C. Darwin
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INTRODUCTORY ESSAY

TO

THE FLORA OF NEW ZEALAND*.

On commencing the Flora of New Zealand I addressed a few remarks to my readers at the Antipodes, in which I represented the advantages of the study of Botany, if only for the utilitarian purpose of acquiring the names of many little known and useful plants that contribute so much to their comfort and enjoyment. In the absence of such aids as are attainable in countries where a knowledge of botany is more generally diffused, the necessary examination and study required to name plants properly by their natural characters is considerable; but by going through the process for himself, the beginner rapidly acquires a knowledge of the structure and anatomy of Natural Orders, Genera, and Species, which will enable him to prosecute the study of their affinities, geographical distribution, and variation, so as greatly to extend the very limited knowledge we possess of these difficult branches of the science. He will discover that an elementary acquaintance with the Natural Orders and Species of plants is not so readily acquired as in many divisions of the animal kingdom, where it is deduced from a consideration of external characters of form, clothing, and colour, or from modifications of conspicuous organs: he must commence with the knife and the microscope, tracing the development of important organs, however minute; and if he desire to obtain that knowledge of the affinities of plants which alone will enable him to prosecute other branches of the science, he can only do so by first making himself thoroughly acquainted with their comparative anatomy.

In the hope of being able to offer some remarks that may facilitate the labours of those who would pursue the higher branches of this science, I shall preface the observations I have to offer on the affinities and distribution of the New Zealand Flora, with some general theoretical views on the origin, variation, and dispersion of species. These are seldom alluded to in such botanical works as are within the reach of the colonist; and, though probably familiar to most of my English readers, I need hardly apologize to the latter for dwelling on them, if they agree with me in considering that it is very necessary for those who set themselves up as systematists, to give their individual impressions upon these important and obscure subjects, the elucidation of which is one great object of their studies. Not only may a naturalist's views be supposed to represent the result of his accumulated experience, but his mode of treating his subject must in many cases be influenced by them, however much he may try to avoid it. For instance, it is natural to suppose that an observer who believes species to be arbitrary divisions of a genus, dependent on the naturalist's choice of characters, will

* Reprinted from the first volume of Dr. Hooker's 'Flora of New Zealand,' published in October, 1853.

adopt widely different conclusions as to their limits and origin, from one who regards them as distinct creations; and he who denies that a plant which grows spontaneously in England and New Zealand can have originated from one common parent, will reason differently on the subject of migration and dispersion from him who holds an opposite view. Now the actual amount of knowledge we possess on such subjects is so very limited, that few experienced naturalists are inclined to pronounce positively upon them, whilst the majority offer no opinion at all. I am very sensible of my own inability to grapple with these great questions, of the extreme caution and judgment required in their treatment, and of the experience necessary to enable an observer to estimate the importance of characters whose value varies with every organ and in every order of plants. I think, however, that there is a mean to be kept between the dogmatism with which a large class of naturalists (generally of very limited experience) decide upon species, and the vagueness which characterizes the writings of others in all that refers to them; this, and the fact that most persons commence botany without any definite idea of what meaning naturalists attach to the term, or of its importance, have also induced me to address some cautions to the student, suggested by those theoretical principles which the study of the New Zealand Flora may help to develope. This I propose to do under three heads or chapters, which will be devoted—1. To the history of New Zealand Botany, showing the labours of my predecessors, the nature and amount of the materials that have been available to myself, and the probable limits of the New Zealand Flora.—2. To the views I have adopted in the descriptive part as to the affinities, limits, origin, variation, distribution, and dispersion of plants generally.—3. To the illustration and development of these views by an analysis of the New Zealand Flora, and its relation to those of other countries.

J. Lubbock Esq. has been kind enough to read the first Chapter

CHAPTER I.

SUMMARY OF THE HISTORY OF THE BOTANY OF NEW ZEALAND.

For the earliest account of the plants of these Islands we are indebted to two of the most illustrious botanists of their age, and to the voyages of the greatest of modern navigators; for the first, and to this day the finest and best illustrated herbarium that has ever been made in the islands by individual exertions is that of Sir Joseph Banks and Dr. Solander, during Captain Cook's first voyage in 1769. Upwards of 360 species of plants were collected during the five months that were devoted to the exploration of these coasts, at various points between the Bay of Islands and Otago, including the shores of Cook's Straits; and the results are admirable, whether we consider the excellence of the specimens, the judgment with which they were selected, the artistic drawings by which they are illustrated, and above all the accurate MS. descriptions and observations that accompany them. That the latter, which include a complete Flora of New Zealand as far as then known, systematically arranged, illustrated by two hundred copper-plate engravings, and all ready for the press, should have been withheld from publication by its illustrious authors, is (considering the circumstances under

which it was prepared) a national loss, and to science a grievous one, since, had it been otherwise, the botany of New Zealand would have been better known fifty years ago than it now is*.

Captain Cook was, on his second voyage, accompanied by three scientific men, all more or less conversant with botany, namely, the two Forsters (father and son), and Dr. Sparrmann, who joined the expedition at the Cape of Good Hope. Queen Charlotte's Sound, in Cook's Straits, and Dusky Bay were the chief points botanized. From the former, as it had been previously explored by Banks and Solander, little novelty was to be expected, and from the latter, which has lately proved so rich in interesting plants, little, comparatively speaking, was brought. About 160 species of flowering plants and Ferns were collected in all, and these were (often inaccurately named) distributed amongst many public and private Museums. I have examined a set in the Paris Museum, another in the Banksian, and a third in my father's†, and in these collections the same plant has sometimes different names; this has given rise to much confusion and synonymy, and false identification of the plants published in the 'Nova Genera Plantarum' and 'Prodromus Floræ Insularum Australium.' The latter work contains descriptions of 150 New Zealand species; these are supposed to have been elaborated by Dr. Sparrmann, and even for the period are very unsatisfactory. Forster's 'Commentatio de Plantis esculentis insularum Oceani Australis' contains better descriptions, and much curious information on the few edible plants of the islands‡. Mr. Anderson, surgeon to Cook's third expedition, undertook the botanical department on that voyage; but though Dusky Bay was visited a second time, nothing of importance was added to its botany. It remained for Mr. Menzies, the surgeon and naturalist of Captain Vancouver's voyage, to discover the cryptogamic riches of New Zealand, and especially those of Dusky Bay. That naturalist devoted himself to the collection of Mosses and Hepaticæ, and this at a time when these objects were scarcely thought worthy of attention, and their structure and functions little known or understood. Most of his collections were placed in Sir William Hooker's hands, and many of them were beautifully illustrated in the 'Musci Exotici.'

For upwards of twenty years after Cook's voyage New Zealand remained unvisited by any naturalist, until Captain Duperrey's expedition in the French surveying corvette the Coquille, in 1822, when he was accompanied by a young officer of great promise, and an ardent collector of plants, the late Admiral D'Urville. This officer revisited New Zealand in 1827, in the same ship (re-named the

* This herbarium and MS. form part of the Banksian collection, and are deposited in the British Museum. I feel that I cannot over-estimate the benefit which I have derived from these materials, and it is much to be regretted that they were not duly consulted by my predecessors. The names by which Dr. Solander designated the species have been in most cases replaced by others, often applied with far less judgment, and his descriptions have never been surpassed for fulness, terseness, and accuracy. The total number of drawings of New Zealand plants is about 212, of which 176 are engraved on copper, but the engravings have never been published; these treasures are accompanied with 24 additional copper-plates from Forster's drawings, of plants which were not found during Cook's first voyage.

† This was presented by the late Mr. Shepherd, of Liverpool, and formed part of what I believe is a very complete collection of Forster's plants. I have to add with regret that the trustees of the institution to which the latter belongs considered it inexpedient to accede to my request that it should be transmitted temporarily to Kew for comparison and publication.

‡ *Solanum aviculare, Coriaria sarmentosa, Convolvulus chrysorhizus* (cult.), *Dioscorea alata* (cult.), *Arum esculentum* (cult.), *A. macrorhizon* (cult.), *Cordyline indivisa, Areca sapida, Apium graveolens, Tetragonia expansa, Lepidium oleraceum, Sonchus oleraceus, Pteris esculenta, Cyathea medullaris, Gleichenia* sp. (*Polypodium dichotomum*), *Leptospermum scoparium, Dacrydium cupressinum.* It is in this work that the *Avicennia tomentosa* is described as *A. resinifera,* with the statement recorded by Crozet of its producing a gum which is eaten by the natives, which no doubt originated in some mistake.

Astrolabe), and accompanied by M. Lesson, a distinguished naturalist. The combined collections of these individuals and two voyages, amounting to 200 species of flowering plants and Ferns, were published by the late Professor A. Richard, in his 'Essai d'une Flore de la Nouvelle-Zélande.' This is a work of considerable merit, in which were included all Forster's plants in the Paris Museum, with extracts from his MSS. that accompany them.

On the establishment of Colonial Gardens and botanists at Sydney, New Zealand became an object of especial interest to the latter, and the Bay of Islands was visited by Mr. Charles Frazer in 1825, by his successor Allan Cunningham in 1826, by Richard Cunningham (brother to the latter) in 1833, and again by Allan in 1838, during which visit this indefatigable collector contracted, through exposure and fatigue, the illness which terminated his life at Sydney in 1839. After his first expedition Allan Cunningham prepared his Prodromus, which was published in detached portions in several botanical periodicals*. In this he enumerated all the previously published species of Forster and A. Richard, but the work is so unsatisfactory and incomplete that were it not for the invaluable herbarium of both Cunninghams, now in Mr. Heward's possession†, I should have found it impossible to have quoted the 'Prodromus' with any degree of confidence.

Amongst the earlier explorers of this period, Dr. Logan, now a resident in the colony, deserves especial mention; his contributions of excellent specimens arriving at a time when New Zealand plants were almost the rarest, and scientifically the most interesting. It is however within the last twelve years, and since New Zealand has attracted the notice of colonists, that the most important accessions to its botany have been made, and it is to correspondents, most of them still alive, and actively engaged in pursuing their investigations, that I am indebted for the materials of these volumes. The Reverend William Colenso, Dr. Andrew Sinclair, R.N., my lamented friend J. T. Bidwill, Esq., Dr. Dieffenbach, M. Raoul, and Dr. Lyall, stand pre-eminent as indefatigable explorers and collectors. Mr. Colenso's researches have extended uninterruptedly over upwards of twelve years, during which he has traversed a great part both of the coast and interior of the Northern Island, and has been the principal contributor to our knowledge of its botany. Dr. Sinclair has also devoted many years to the New Zealand Flora, and has made numerous most interesting discoveries, especially on the east coast, and has transmitted such copious suites of excellent specimens as are most valuable for botanical purposes. Mr. Bidwill and Dr. Dieffenbach were the first explorers of the lofty mountains of the interior: Mr. Bidwill indeed ascended both Tongariro and the Nelson range, and formed collections of the greatest interest and value, accompanied by valuable notes on the elevation at which the plants were gathered, their variations, periods of flowering, and many other important points‡. M. Raoul accompanied the French frigate L'Aube in 1840 and 1841, and again L'Allier in 1842–3, during which voyages he made a very complete botanical exploration of Banks' Peninsula and the Bay of Islands. His admirable collections were deposited in the Jardin des Plantes at Paris, where they were placed at my disposal by M. Raoul, with whom I had the pleasure of examining them in 1845; a complete set was also detached for Sir W. Hooker's Herbarium, and has been of the greatest use to me. A selection from the new species was described by MM. Raoul

* Under the title of 'Floræ Novæ Zelandiæ Præcursor,' in the 'Companion to the Botanical Magazine,' vol. 2, and concluded in the 'Annals of Natural History,' vols. 1, 2, and 3.

† I am indebted to Mr. Heward's liberality for the unreserved use of this extremely valuable collection.

‡ The Nelson Mountains have since been again explored by Dr. Monro, who has added a few remarkable novelties that had escaped Mr. Bidwill's notice, and whose excellent collections are, I hope, an earnest of still further discoveries.

and Decaisne in the 'Annales des Sciences Naturelles*,' and the beautiful 'Choix de Plantes de la Nouvelle-Zélande,' published in 1846, a work accompanied with plates of rare excellence as botanical drawings, and with a careful enumeration† of all known New Zealand plants, compiled from the collections in the Paris Museum, and from M. Richard's and Cunningham's Floras.

In 1847 H.M.St.V. Acheron was commissioned by Captain Stokes, R.N., for the survey of New Zealand, to explore the western and southern coasts; and we are indebted to the exertions of the eminent hydrographer of the navy, Sir Francis Beaufort, for the selection of a naturalist as surgeon to the expedition. My friend Dr. Lyall, in whose company I had formerly botanized in the Bay of Islands during the Antarctic Expedition‡, was selected for the service; and devoting himself, like Mr. Menzies, with indefatigable zeal to the lower Orders especially, he amassed the most beautiful and important collections in these branches of botany, that have ever been formed; besides making considerable discoveries in Phænogamic plants, and collecting many that had previously only been gathered by Banks and Solander and the Forsters.

As far as the discovery of species is concerned, the above enumeration brings me down to the present state of our knowledge of the New Zealand Flora; but it remains for me to observe that within the last three years, indeed since the announcement of this work being forthcoming, I have been favoured with more than a dozen collections from various parts of the island. Of new gleaners in the field, I would especially mention Dr. Monro, Mr. Knight, the Rev. Mr. Taylor, Captain Drury, Mr. Jolliffe, Captain D. Rough, and Lieutenant-Colonel Bolton; all of whom have sent valuable contributions. It is true that these contain little novelty, but they throw light on the distribution of the species, and afford materials for tracing their geographical limits.

From these materials the 'Flora of New Zealand' has been worked up: its probable completeness may be judged of by the fact that the islands have been botanized on by upwards of thirty-five individuals, whose specimens have (with a few unimportant exceptions) all passed under my eye. The Flora of the Northern Island has been tolerably well examined, so far as its flowering plants are concerned; though there remains a good deal to be done on the west coast, especially in the neighbourhood of Mount Egmont. Dr. Lyall alone has collected in the Southern Island, or on the west coast north of Dusky Bay. The Middle Island has been visited by few explorers, its north and east coasts alone having been botanized: the west and the whole mountain range require a careful survey; and considering how many Auckland and Campbell Islands plants are still strangers to New Zealand, it cannot be doubted that much remains to be discovered there. Excepting from the above-mentioned tracts, I do not expect much novelty amongst flowering plants, for the following reasons:—1, there is a remarkable sameness in the flora throughout large tracts§; 2, because out of the 730 flowering plants known, there are scarcely one hundred that have not been gathered by several individuals; 3, because the collections I have lately received, though some of them are extensive, and from scarcely visited localities, yet contain little or no novelty. With Cryptogamia the case is widely different; and it is difficult to estimate the vast number, especially of Mosses, Hepaticæ, and

* Annales des Sciences Naturelles, August, 1844.

† In this enumeration upwards of 500 species of flowering plants are named, but fully one hundred of these are synonyms, introduced species, or erroneous ones of Cunningham and others.

‡ In the above list I have not thought it necessary to allude to the collections made at the Bay of Islands by Dr. Lyall and myself in the Antarctic Expedition: they contained no novelty amongst flowering plants, not known to Mr. Colenso and Dr. Sinclair, with whom I spent many happy days. Amongst Cryptogamic plants I collected much that was then new, but most of the species have since been found elsewhere.

§ In this respect New Zealand contrasts remarkably with Tasmania.

Fungi, that will reward future explorers in what, as far as flowering plants are concerned, are exhausted fields. Upwards of 114 Ferns (including Lycopodia) are already known*, a number which might be swelled by nearly one-half, were all the varieties which have been described as species considered by me as such. I do not anticipate many more novelties in this Order; the species (with few exceptions) having very wide ranges in the islands, and these beautiful plants having always attracted a greater share of attention than others. The foliaceous Cryptogams† (Mosses and Hepaticæ) are by far the most extensive Natural Order of plants (except Fungi) in these islands, as they are of most temperate and especially moist climates. Of Hepaticæ Mr. Mitten enumerates in this work 180, whereas only about 150 are found in all Great Britain; and Mr. Wilson's 'Muscologia of New Zealand' includes 250 species, amongst which are many of the most gigantic, beautiful, and interesting in structure, in the world. I have no doubt that both these Orders will be more than doubled: it requires a practised eye, and some previous knowledge, thoroughly to explore a small district rich in Mosses and Hepaticæ.

In Fungi this flora is still most imperfect, owing to the unattractive appearance of the species to the general observer, and the difficulty of preserving them in a fit state for examination. Mr. Berkeley has undertaken their arrangement, and his are the first observations of any consequence that have ever appeared on the New Zealand species of this curious and most interesting Natural Order, which is by far the largest in the vegetable kingdom. So many of the kinds are minute, and even microscopic, that it is probable that, when properly investigated, there will prove to be upwards of 1000 species in New Zealand.

Much novelty is not to be looked for amongst the foliaceous and larger Lichens, but great additions may be made amongst crustaceous and minute epiphytical species. The New Zealand Algæ, of which Dr. Harvey enumerates nearly 300 species, have from their beauty and singularity long been objects of great interest to the botanist; and by the labours of Menzies, Turner, Bory, Harvey, and Montagne, this Natural Order has been better illustrated than any other. The great amount of novelty contained in the collections of Dr. Lyall, however, received since this work was begun, show that even this department may be greatly increased.

The total number of species brought together in this Flora is nearly 1900, to which upwards of 100 may be added, for the many minute Cryptogamia which I possess, but which are in too imperfect a state for satisfactory determination. This is much more than double the numerical extent of the last enumeration published, that of M. Raoul, who in 1846 enumerates only 920 species, which may be reduced to 770, if the naturalized and erroneous species be eliminated. In 1838 Mr. Cunningham gave 640 species, which should be reduced to 570; in 1832 M. Richard included 350 in his list; Forster's 'Prodromus' has 154; and Banks and Solander's collections amount to 426. This rapid increase of the Flora, which has thus been quintupled in twenty years, is mainly due to the attention which has been devoted to the lower Orders: this may easily be shown; for whereas in all the early enumerations and collections the number of flowering plants exceeds the flowerless, in M. Raoul's Catalogue they are equal, and in the present work the relative proportions are reversed; the Phænogamic plants being to the Cryptogamic as 1 to 1·6; *i. e.* about two to three.

* Banks and Solander described 66 species; Forster enumerates 40; M. A. Richard 57, of which 8 should be expunged; A. Cunningham and M. Raoul 112, from which fully 30 must be deducted, to bring the lists into comparison with my own estimate of 114.

† These were little attended to by the earlier explorers, except Menzies. Banks and Solander collected very few Mosses.

In conclusion, if I may venture to assume a limit to the Flora of New Zealand, from the data at my disposal, and from a comparison of these with those of better investigated countries with which I am familiar, I should regard 4000 as the probable approximation; of which 1000 may be flowering plants. Compared with any other countries in the same latitude, this is a very scanty Flora indeed, especially as regards flowering plants; of which Britain contains, in about the same area, upwards of 1400 species; and in Tasmania, not yet well explored, and only containing one-third of the area, upwards of 1000 have already been discovered. In Cryptogamic plants, on the other hand, these islands are extremely rich; not only proportionately to the Phænogamic, but absolutely so. Great Britain, where these lower Orders have been assiduously studied for fifty years, contains about fifty Ferns, and Tasmania sixty-four.

In the above remarks I have not alluded to the Floras of some outlying islands, all of which have more or less claim to be considered botanically as a part of New Zealand. Of these, the extent of its Flora renders Norfolk Island the most important: it contains many more tropical forms than New Zealand, and is also more closely connected with the Pacific and Australian Floras. Chatham Island* has been visited by Dr. Dieffenbach, who brought thence a very few plants, all identical with or closely allied to New Zealand species. Lord Auckland's Group and Campbell's Island were investigated by myself in the Antarctic Expedition, and also by the French and American Antarctic Expeditions, under Admiral D'Urville and Commodore Wilkes. All the known species have been published in the first volume of the 'Antarctic Flora;' they are almost all identical with or closely allied to New Zealand plants, and amongst them are found a few Antarctic American ones, not hitherto discovered in New Zealand. They include 370 species, of which 100 are flowering plants, and of these again 54 are known natives of New Zealand. As however neither these islands, nor the mountains of the Middle Island of New Zealand, have been explored satisfactorily, it is probable that a much larger proportion of their flora is common to both.

CHAPTER II.

ON THE LIMITS OF SPECIES; THEIR DISPERSION AND VARIATION.

It is no part of my present object to discuss the theoretical views that have been entertained on these obscure subjects: my aim is to draw attention to a few leading questions of great practical importance, which ought not to be overlooked, even if they do not force themselves on the notice of naturalists. In explanation of my meaning I shall assume certain positions†, and adopt them as principles

* A few Chatham Island plants were engraved in Paris many years ago for a magnificent work, 'Voyage de la Venus;' but the letterpress of that publication has never appeared, nor has the Botany of that voyage been completed.

† I need hardly remark that these have no claim to originality; they are merely selected as heads of the subjects upon which I intend to enlarge.

or axioms; and they shall have the advantage of being simple, intelligible, and as little exposed to the charge of being speculative, as any of that nature can be. I shall assume then—

§ 1. That all the individuals of a species (as I attempt to confine the term) have proceeded from one parent (or pair), and that they retain their distinctive (specific) characters.

§ 2. That species vary more than is generally admitted to be the case.

§ 3. That they are also much more widely distributed than is usually supposed.

§ 4. That their distribution has been effected by natural causes; but that these are not necessarily the same as those to which they are now exposed.

§ 1.

Although in this Flora I have proceeded on the assumption that species, however they originated or were created, have been handed down to us as such, and that all the individuals of a unisexual plant have proceeded from one individual, and all of a bisexual from a single pair, I wish it to be distinctly understood that I do not put this forward intending it to be interpreted into an avowal of the adoption of a fixed or unalterable opinion on my part. Whether or not such a theory be consonant with that great mystery, the origin of organic beings, animate and inanimate, is not the point I would here dwell upon; but the fact that it appears to me essential that the systematist should keep some such definite idea constantly before him, to give unity to his design, and to guide him in the more or less arbitrary restriction of the species of a variable genus, to which he is unfortunately often obliged to resort. Except he act upon the idea that for practical purposes at any rate species are constant, he can never hope to give that precision to his characters of organs and functions which is necessary to render his descriptions useful to others; for in groups where the limits of species cannot be traced (or, what amounts to the same thing in the opinion of many, where they do not exist), the object of the systematist is the same as in groups where they are obvious,—to throw their forms into a natural arrangement, and to indicate them by tangible characters, whose value is approximately relative to what prevails in genera where the limitation of species is more apparent.

In the present imperfect state of our knowledge of the botany of any large area, we have not the materials for solving the great questions as to the origin and permanence of species, upon general principles. A careful comparative study of the Floras of temperate North America and Europe, or of any similarly extensive countries, would throw great light on this subject; or a study of the variations of those plants (and they are not a few) which are common to the five great divisions of the globe. But these branches of botany are so neglected, that I am not acquainted with a British* or Continental Flora, which attempts to give a general view of the variation and distribution of the species described in it. I have to some extent attempted this for the New Zealand Flora; but it would have been manifestly impossible to have concluded this work within a reasonable time, had I made a

* In Mr. Hewett Watson's 'Outlines of the Geographical Distribution of British Plants,' and 'Cybele Britannica,' will be found, amongst a mass of valuable information respecting the Flora of the British Isles, the only detailed account of the distribution of species within our own shores, and (in the first-mentioned work) a sketch of their dispersion over the globe as far as was then known. I am given to understand that Mr. Watson is still engaged on the subject, and most sincerely hope that he is so. A more important desideratum to the British Flora cannot be named, nor one that would tend more to give that direction to the studies of our local botanists, which is so grievously wanted: leading them to the investigation of species as members of the vegetable kingdom, and not as inhabitants of the British Isles only.

critical examination of all the forms from all countries, of those New Zealand species which are cosmopolitan; such operations must necessarily be left to my successors, who may receive many of my remarks on the dispersion of the species simply as suggestions.

A want of materials is not, however, my only reason for withholding a decided assent to the view I have enunciated. There are other theories which claim more or less consideration from every unprejudiced naturalist; and there are such theoretical and practical difficulties (and perhaps impossibilities) in the way of our coming to any conclusions as to the limits of the species of many genera, as give colour to the assumption that they have no permanently recognizable limits. A statement of some of these views and difficulties may be the means of throwing much light on this subject; and they are well worthy of the consideration of the New Zealand botanist; for islands situated far from continents, and in the midst of great oceans, offer many favourable points from which to start in such investigations.

1. Very many naturalists consider species as permanently distinct, but demand a plurality of parents to account for their extensive distribution.

2. Another large class do not consider species as permanent at all, and hold that what are called such, are stirpes or races (like those of man, and such of the lower animals as dogs, horses, etc.), subject to change or obliteration, which have been either accidentally produced, or developed according to some theoretical law.

3. A third class believe in a progressive development of all organized nature, from the cell to an ideal type of perfection, towards which man is the last step reached.

4. Others subscribe to various shades of these opinions, or blend them as far as they consistently can; some, taking even a much larger view of the limits of variability consistent with permanence of type than I profess to have adopted, think genera of plants permanent types, and species accidentally produced varieties.

Arguments in favour of these views are not wanting, derived both from the animal and vegetable kingdoms; the chief of which are drawn from a large class of well established facts, upon the bearings of which the most distinguished and candid naturalists are divided in opinion: such are—the great number of genera whose species have baffled all attempts at circumscription by fixed characters,—the facility with which breeds of certain plants and animals may be propagated, and the comparative certainty with which some few varieties are reproduced under favourable circumstances,—the great facility with which many plants hybridize, and the fact of hybrids having proved fertile,—the sudden appearance and unexplained cause of many varieties or sports,—and the difficulty of accounting for the existence of plants and animals in two or more localities, between which they cannot have been transported by natural causes now in operation. These are all questions relating to the diffusion and variation of species, which will be discussed here and in the following section.

Arguments in favour of the single creation, and permanence of species, are all based upon general considerations of the phenomena of distribution. Comparative anatomy, which has thrown such great light upon this branch of study in the sister kingdom, has not done so much for plants; this arises from several causes:—1. The habits of allied plants do not differ so remarkably as those of animals, and there is consequently less modification of their functional organs.—2. The relation of these modifications to the habits and wants of the species, is in the animal kingdom directly appreciable, but in plants no such connection can be traced*.—3. The individual organs of support,

* The structure of woods offers many illustrations of this; very closely allied plants (especially *Leguminosæ*) differing entirely in the nature, arrangement, and development of the vascular and cellular tissues of their trunks.

respiration, and reproduction, are infinitely more variable and susceptible of change and even obliteration in plants, without affecting the life either of the individual or of the species*. The result of these facts is that we have the means in animals of appreciating the extent and value of differences, by combined observations upon structure and functions, upon habits and organization, which we have not in the vegetable kingdom, and which the phenomena of cultivation assure us do not exist to a degree that has, within the limits of our experience, proved available for throwing much light on the subject.

The arguments in favour of the permanence of specific characters in plants are:—

1. The fact that the amount of change produced by external causes does not warrant our assuming the contrary as a general law. Though there are many notorious cases in which cultivation and other causes produce changes of greater apparent value than specific characters generally possess, this happens in comparatively very few families, and only in such as are easily cultivated. In the whole range of the vegetable kingdom it is difficult to produce a change of specific value, however much we may alter conditions; it is much more difficult to prevent an induced variety from reverting to its original state, though we persevere in supplying the original conditions; and it is most difficult of all to reproduce a variety with similar materials and processes†.

2. In tracing widely dispersed species, the permanence with which they retain their characters strikes the most ordinary observer; and this, whether we take such plants as have been dispersed without the aid of man (as *Sonchus oleraceus, Callitriche,* and *Montia*) through all latitudes from England to New Zealand; or such as have within modern times followed the migrations of man (as *Poa annua, Phalaris Canariensis,* Dock, Clover, *Alsine media, Capsella bursa-pastoris,* and a host of others); or such as man transports with him, whether such temperate climate plants as the cerealia, fruits, and flowers of the garden or field, or such tropical forms as *Convolvulus Batatas* and yams, which were introduced into New Zealand by its earliest inhabitants;—all these, in whatever climate to which we may follow them, retain the impress of their kind, unchanged save in a trifling degree.

Though to a great extent these differences accompany a habit of growth (as in the case of erect and scandent *Bauhinias*), there is nothing in the abnormally developed wood of the climbing *Bauhinia* that would lead a skilled physiologist ignorant of the fact to say that it was better adapted to a climbing than to an erect plant; the function is experimentally known to be indicated by the structure, but the structure is not seen to be adapted to the function. This is not so in the sister kingdom, for we confidently pronounce an animal to be a climber, because we see that its organs are adapted to the performance of that function; here the habit is not only indicated by the structure, but the latter is explained by the function which it enables the animal to fulfil.

* To take an extreme case of this;—many plants are known, in a wild and cultivated state, which propagate abundantly by roots or division, where they do not do so by seed. *Anacharis Alsinastrum* is a conspicuous example: it is a unisexual water-plant, of which one sex alone was introduced from North America into England, where it has within a few years so spread by division as to be a serious impediment to inland navigation. The Horse-radish is another example, it being, I believe, never known to seed or even to bear perfect flowers. A still more remarkable case has been pointed out to me by Mr. Brown, in the *Acorus Calamus*, a plant spread (not by cultivation) over the whole north temperate hemisphere, which bears hermaphrodite flowers, but very rarely seeds.

† I am quite aware that this argument will be met by many instances of change produced in our garden plants: but, after all, the skill of the gardener is successfully exerted in but few cases upon the whole: out of more than twenty thousand species cultivated at one time or another in the Royal Gardens of Kew, how few there are which do not come up, not only true to their species, but even to the race or variety from which they spring; yet it would be difficult to suggest a more complete change than that from the Alps or Polar regions to Surrey, or from the free air of the tropics to the thoroughly artificial conditions of our hothouses. Plants do not accommodate themselves to these changes: either they have passive powers of resisting their effects to a greater or less degree, or they succumb to them.

3. With comparatively few exceptions, plants are confined within well-marked limits, which, though often very wide, are sometimes as much the reverse; while the instances are rare of sporadic species, as such are called which are found in small numbers in widely sundered localities. These facts seem incompatible on the one hand with the theory of species spreading from many centres, and on the other with their varying indefinitely; for were it otherwise, sporadic distribution would be the rule, insular floras would not necessarily be peculiar, and similar climates would have similar, if not identical species, which is not the case.

4. A multitude of allied species of plants grow close together without any interchange of specific character; and there are instances of exceedingly closely allied plants keeping company under many modifications of climate, soil, and elevation, yet never losing their distinctive marks.

5. The individuals that inhabit the circumference of the area occupied by a species, are not found passing into other species, but ceasing more or less abruptly; their limits may meet or overlap those of one or more very similar species, when the individuals associate, but do not amalgamate.

6. One negative argument in favour of distribution from one centre only, is, that taking the broadest view of the dispersion of species, we find that the more extensive families* are more or less widely distributed, very much in proportion to the facilities they present for dispersion. Thus the most minute-spored Cryptogams† are the most widely dispersed of all organized nature; plants that resist the influence of climate best, range furthest; water-plants are more cosmopolite than land-plants, and inhabitants of salt, more than those of fresh water: the more equable and uniform is the climate of a tract of land, the more uniformly and widely will its plants be distributed.

7. The species of the lowest Orders are not only the most widely diffused, but their specific characters are not modified by the greatest changes of climate, however much their stature and luxuriance may vary. Fungi offer a remarkable instance of this: their microscopic spores are wafted in myriads through the air; the life of the individuals is often of very short duration, and many of them being as sensitive as insects to temperature and humidity, they are ephemeral in all senses; sometimes appearing only once in the same spot, and remaining but a few days, never to reappear within the observer's experience. The specific characters of many reside in the diameter, form, colour, and arrangement of their most minute organs, whose analysis demands a refinement of microscopic skill; yet the most accomplished and profound botanist in this Natural Order (who has favoured me with the descriptions of the New Zealand Fungi) fails to find the most trifling character by which to separate many New Zealand species from European.

8. The fact, now universally conceded by all intelligent horticulturists, that no plant has been acclimated in England within the experience of man, is a very suggestive one, though not conclusive; for it may be answered, that plants which cannot survive a sudden change, might a slow and progressive one. On the other hand, plants have powers of enduring change when self-propagated that they have not in our gardens; thus I find a great difference in the hardiness of individual species of several Himalayan plants‡, depending upon the altitude at which they were gathered. In these

* This rule does not extend to the Natural Orders themselves. The *Compositæ*, whose facilities for dispersion are proverbial, are amongst the most local; and the same may be said of *Leguminosæ* and *Solaneæ*, whose seeds retain their vitality in a remarkable degree: a few of their species are remarkably cosmopolite, but the greater number have generally narrow ranges.

† The fact (first communicated to me by the Rev. M. J. Berkeley) of the spores of Fungi having been found by Professor Ehrenberg mingled with the atmospheric dust that has fallen on ships far out at sea, is one of the most decisive proofs of this.

‡ Thus some of the seedling Pines whose parents grew at 12,000 feet appear hardy, whilst those of the same

cases the species is the same, and the parent individuals were not even varieties of one another, except so far as regards hardiness; in other words, the specific character remains unaltered in spite of the change of constitution, just as the climate of one part of the globe disagrees with the human race of another, and is even fatal to it.

Such are a few of the leading phenomena or facts that appear to me to give the greatest weight to the opinion that individuals of a species are all derived from one parent: for such arguments as the New Zealand Flora furnishes, I must refer my readers to the following chapter. I would again remind the student that the hasty adoption of any of these theories is not advisable: plants should be largely collected, and studied both in the living and dried states, and the result of their dissection noted, without reference to any speculations, which are too apt to lead the inquirer away from the rigorous investigation of details, from which alone truth can be elicited. When however the opportunity or necessity arises for combining results, and presenting them in that systematic form which can alone render them available for the purposes of science, it becomes necessary for the generalizer to proceed upon some determinate principle; and I cannot conclude this part of the subject better than by adopting the words of the most able of Transatlantic botanists, who is no less sound as a generalizer than profound in his knowledge of details:—"All classification and system in Natural History rests upon the fundamental idea of the original creation of certain forms, which have naturally been perpetuated unchanged, or with such changes only as we may conceive or prove to have arisen from varying physical influences, accidental circumstances, or from cultivation*."

§ 2.

Species vary in a state of nature more than is usually supposed.

The views entertained as to the limitation of species appear to be quite arbitrary: no general principles have been discovered for the guidance of the systematist; and those that are adopted vary in kind and in value with every natural group. It is not therefore surprising that two naturalists, taking opposite views of the value of characters, should so treat a variable genus that their conclusions as to the limits of its species should be wholly irreconcilable. Some naturalists consider every minute character, if only tolerably constant or even prevalent, as of specific value; they consider two or more doubtful species to be distinct till they are proved to be one; they limit the ranges of distribution, and regard plants from widely severed localities as almost necessarily distinct; they do not allow for the effects of local peculiarities in temperature, humidity, soil, or exposure, except they can absolutely trace the cause to the effect; and they hence attach great importance to habit, stature, colour, hairiness, period of flowering, etc. These views, whether acknowledged or not, are practically carried out in many of the local floras of Europe, and by some of the most acute and observant botanists of the day; and it is difficult to over-estimate the amount of synonymy and confusion which they have introduced into the nomenclature of some of the commonest and most variable of plants. In such hands the New Zealand genera *Coprosma, Celmisia, Epilobium,* etc., may be indefinitely extended. The principles I have adopted are opposed to these: I have based my conclusions

species from 10,000 are tender. The common scarlet *Rhododendron* of Nepal and the North-west Himalaya is tender, but seedlings of the same species from Sikkim, whose parents grew at a greater elevation, have proved perfectly hardy.

* Botanical Text-book, p. 303, by Professor Asa Gray, of Cambridge University, U.S.

on this subject upon a very extensive examination of living plants in all latitudes, with my attention particularly directed to the influence of external causes, not only on the general phenomena of vegetation, but also upon individuals. Added to this, I have paid a great deal of attention to variable plants, both of tropical and temperate climates, and studied them in a living state, both wild and cultivated, and also in the herbarium. The result of my observations is, that differences of habit, colour, hairiness, and outline of leaves, and minute characters drawn from other organs than those of reproduction, are generally fallacious as specific marks, being attributable to external causes, and easily obliterated under cultivation. It has hence been my plan to group the individuals of a genus which I assume after careful examination to contain many species whose limits I cannot define, that the species shall have the same relative value as those have of allied genera whose specific characters are evident. I doing so I believe I have followed the practice of every systematist of large experience and acknowledged judgment since the days of Linnæus, as Bentham, Brown, the De Candolles, Decaisne, Asa Gray, Jussieu, Lindley, and the Richards; names which include not only the most learned systematists, but the most profound anatomists and physiologists. I am far from supposing that the same materials of a difficult group would receive precisely similar treatment at the hands of each of these eminent men; but their results would so closely approximate as to be in harmony with each other, and available for scientific purposes: with all, the tendency would be to regard dubious species as varieties, to take enlarged views of the range and variation of species, and to weigh characters not only *per se*, but with reference to those which prevail in the Order to which the species under consideration belong.

In working up incomplete floras especially, I believe it to be of the utmost importance to adopt such a course, and to resist steadily the temptation to multiply names, for it is practically very difficult to expunge a species founded on an error of judgment or observation*. There is further an inherent tendency in every one occupied with specialities to exaggerate the value of his materials and labours, whence it happens, that botanists engaged exclusively upon local floras are at issue with those of more extended experience, the former considering as species what the latter call varieties, and what the latter suspect to be an introduced plant the former are prone to consider a native. There is much to be said on both sides of such questions: the local botanist looks closer, perceives sooner, and often appreciates better, inconspicuous organs and characters, which are overlooked or too hastily dismissed by the botanist occupied with those higher branches of the science, which demand a wider range of observation and broader views of specialities; and there is no doubt but that the truth can only be arrived at through their joint labours; for a good observer is one thing, and the knowledge and experience required to make use of facts for purposes of generalization, another: minute differences however, when long dwelt upon, become magnified and assume undue value, and the general botanist must always receive with distrust the conclusions deduced from a few species of a large genus, or from a few specimens of a widely distributed plant.

I have been led to dwell at length upon this point, because I feel sure the New Zealand student will at first find it difficult to agree with me in many cases, as for instance on so protean a Fern as *Lomaria procera*, whose varieties (to an inexperienced eye) are more dissimilar than are other species of the same genus. In this (and in many similar cases) he must bear in mind that I have examined

* The state of the British flora proves not only this, but further, that one such error leads to many more of the like kind: students are led to over-estimate inconstant characters, to take a narrow view of the importance and end of botany, and to throw away time upon profitless discussions about the difference between infinitely variable forms of plants, of whose identity really learned botanists have no doubt whatever.

many hundred specimens of the plant, gathered in all parts of the south temperate hemisphere, and have found, after a most laborious comparison, that I could not define its characters with sufficient comprehensiveness from a study of its New Zealand phases alone, nor understand the latter without examining those of Australia, South Africa, and South America. The resident may find two varieties of this and of many other plants, retaining their distinctive characters within his own range of observation (for that varieties often do so, and for a very uncertain period, both when wild and also in gardens, is notorious), and he may perhaps have to travel far beyond his own island to find the link I have found, in the chain of forms that unites the most dissimilar states of *Lomaria procera;* but he can no more argue thence for the specific difference of these, than he can for a specific difference between the aboriginal of New Zealand and himself, because he may not find intermediate forms of his race on the spot. We do not know why varieties should in many cases thus retain their individuality over great areas, and lose them in others; but the fact that they do so proves that no deductions drawn from local observations on widely distributed plants can be considered conclusive. To the amateur these questions are perhaps of very trifling importance, but they are of great moment to the naturalist who regards accurately-defined floras as the means for investigating the great phenomena of vegetation; he has to seek truth amid errors of observation and judgment, and the resulting chaos of synonymy which has been accumulated by thoughtless aspirants to the questionable honour of being the first to name a species*.

There are many causes which render it extremely difficult to determine the limits of species, and in some genera the obstacles appear to increase, the more the materials for studying them multiply, and the more we follow our analysis of them into detail; hence the botanist is often led on to an indefinite multiplication of species (with increased difficulty of determining those already established), or to a reduction of all to a few, or to one variable species. My own impression is, that the progress of botany points to the conclusion that in many genera we must ultimately adopt much larger views of the variation of species than heretofore, and that the number of supposed kinds of plants is (as I shall indicate elsewhere) greatly over-estimated; if it be not so, we must either admit that species are not definable, or that there are hidden characters throughout all classes of the vegetable kingdom, of which the botanist has no cognizance, and towards the acquirement of which, if they are ever to be revealed, all efforts in the direction in which we have been advancing appear to be vain. Could systematists as a body be accused of carrying out their investigations in an unphilosophical manner or spirit, or without due attention to all the modes of testing the validity of characters, afforded by the study of living and dried plants, by direct observation, and by experiment, there might be hopes of such a revelation; but such hopes are inconsistent with the great advances that have been made in systematic botany, which, having all tended to a more perfect knowledge of the affinities of plants, we are assured have been the effect of progress in the right direction.

Of the genera to which I here allude as variable, there are many in New Zealand†; some of

* The time however is happily past when it was considered an honour to be the namer of a plant; the botanist who has the true interests of science at heart, not only feels that the thrusting of an uncalled-for synonym into the nomenclature of science is an exposure of his own ignorance and deserves censure, but that a wider range of knowledge and a greater depth of study are required, to prove those dissimilar forms to be identical, which any superficial observer can separate by words and a name.

† M. Bory de St. Vincent has observed (Voyage dans les Quatre principales Iles des Mers d'Afrique) with reference to insular floras, that their species are generally variable, an hypothesis scarcely compatible with the fact that the proportion of species to genera in islands is always small, because the proportion of imported plants, which is considerable in an island, is made up of species of different genera, having no affinity with one another, and

these are mundane, that is, found in all or most temperate or tropical climates, as *Ranunculus, Clematis, Senecio,* and many Grasses and Ferns; and we cannot yet tell whether the difficulties are greater with them than with the more local or endemic genera, as *Coprosma, Celmisia, Alseuosmia,* and *Dracophyllum.* Of the mundane genera again, some are chiefly composed of species which are local (as is the case with the three first mentioned), while of others the species themselves are widely distributed, as those of *Potamogeton, Lemna,* and many Ferns.

The fact of a plant having a wide range implies its being exposed to climatic differences that often induce change, and the consequent propagation of forms or races that cannot be recognized as members of one species, without full series of specimens from many localities. If we allow a sufficient time, it is quite reasonable to suppose that geological or other natural causes (producing a change of climate) may isolate by sea or desert, or by the intrusion of stronger plants that monopolize the soil, the outlying abnormal states of a species that was once uniformly spread over an area. To connect those dissevered members is often a work of great difficulty, for individuals of such races frequently retain their character even when they have been under cultivation for many years.

Hybridization has been supposed by many to be an important element in confusing and masking species*. Nature, however, seems effectually to have guarded against its extensive operation and its effects in a natural state, and as a general rule the genera most easily hybridized in gardens, are not those in which the species present the greatest difficulties. With regard to the facility with which hybrids are produced, the prevalent ideas on the subject are extremely erroneous. Gärtner, the most recent and careful experimenter, who appears to have pursued his inquiries in a truly philosophical spirit, says that 10,000 experiments upon 700 species produced only 250 true hybrids†. It would have been most interesting had he added how many of these produced seeds, and how many of the latter were fertile, and for how many generations they were propagated. The most satisfactory proof we can adduce, of hybridization being powerless as an agent in producing species (however much it may combine them), are the facts that no hybrid has ever afforded a character foreign to that of its parents, and that hybrids are generally constitutionally weak, and almost invariably barren. Unisexual‡ trees must offer many facilities for the natural production of hybrids, which, nevertheless, have never been proved to occur, nor are such trees more variable than hermaphrodite ones.

nothing in common but their facility for transportation. From the above-mentioned hypothesis it would hence result that whilst the differences of one degree (specific) are small and inconstant, those of a higher degree (generic) are great and trenchant. To a certain extent, however, these facts are not incompatible, for we can imagine a flora wholly composed of a few genera as well marked (generically) as *Coprosma* and *Alseuosmia,* whose species may yet be as undefinable; or again, species may be well marked, yet variable in characters which would in no one's opinion be of specific value.

* Hybridization as an agent in confusing species is a very favourite argument with those who are fond of founding species on inconstant characters; when shown a specimen combining two such spurious species, they at once pronounce it a hybrid—a very simple way of getting rid of a difficulty. In Ferns, the most variable of all plants, hybrids were once generally admitted to exist, but the observations of Suminski have led to the discovery of their sexual organs, whose arrangement and structure seem to preclude the possibility of such a phenomenon.

† See his observations on muling, Hort. Soc. Journ. vol. v. and vi. 1850–1851.

‡ Unisexual plants are very interesting in many points of view, and in none more than in the varying development of the sexes according to circumstances. Observations on this subject are very much wanted: it has been stated to depend on local circumstances whether the seeds of a bisexual plant shall come up male or female; and the fact of both kinds of flowers, or even of hermaphrodite flowers, often occurring on a plant that usually perfects one sex only (as in the monœcious Hop-plant described by Mr. Masters in Gard. Chron. 1847), shows that we may even speculate on the possibility of diœcious plants having sprung originally from a single parent, whose off-

These considerations lead us to others still more elusive of the naturalist's grasp. The reference of all varieties to a species, and of its individuals to a single parent, argues the existence at some epoch of a type or form around which all varieties may be grouped. It has been observed that two or more created or induced types or species may resemble one another so closely, that, amid the multitude of varieties of each, the naturalist shall seek in vain for that which best demonstrates the species. No one can deny the possibility of such creations, nor perhaps their probability, when he considers the infinite varieties of climates, how insensibly they pass into one another, and how nicely the functions of some plants appear to be adapted to certain modifications of these, and to no others. Had, moreover, every climate its own species, and were there any difficulty in propagating the majority of the plants of one climate in a very different one, such creations would appear to be indispensable: but the facts of botanical geography assure us, that it is by far the smaller half of the vegetable kingdom that is confined to narrow geographical or climatic areas, and that very few plants indeed are absolutely local; whilst the operations of the gardener and agriculturist prove, that a vast proportion of the plants of the two temperate zones are capable of growing in any moderate climate. I do not think that those who argue for narrow limits to the distribution and variation of species, can have considered a garden in a philosophical spirit, or have weighed such facts as that there have been cultivated, within the last seventy years, in the open air of England (at Kew) upwards of twenty thousand species of plants from all quarters of the globe, and this within a space that, had it been left to nature, would not have contained two hundred indigenous species! The fact that an overwhelming proportion of these have come up true to their parent, and have continued so under every possible disadvantage of transportation and transplantation, of altered seasons, and amount and distribution of temperature and humidity, of unsuitable soil and exposure, and of the multitude of errors in management which unavoidable ignorance of their natural locality and habit engenders. Such appears to me the most forcible argument in favour of the power of plants to retain their original characters under altered circumstances.

To return however to the idea of a type, I must remind the New Zealand reader that the word is often used in a vague and unphilosophical manner: in the too frequent sense of the term it denotes that individual of a species which was first cultivated, described, figured, or collected, or that form which is most abundant in the neighbourhood of the writer; whereas all the individuals thus referred to may represent anomalous or exceptional states of the true type. The fact is, that we have no clue whatever to the originally created typical form of any plant, consistent with the view of its origin in a single parent, and its powers of varying. If we take a species of universal distribution, a careful examination of all its variations, and a contrast between these and those of its allies, may lead to the detection of a form, which for various reasons may be assumed as the real or ideal standard; for we have no reason to suppose that the whole globe is so altered that the circumstances under which the assumed type originally appeared do not now exist anywhere. But with local plants the case is different; they may have originated where they are now found, but it is more consistent with geological truths to assume that many did not, and that, however slight the induced changes have been, and however powerless to obliterate specific character, they may still mask the original form.

Practically, then, the type is a phantom; what was once the typical state may no longer be the

spring by altered circumstances have become unisexual, and, what is of more practical importance, upon the possibility of the chance transport of one sex of a diœcious plant proving sufficient to effect the propagation of the species.

common one, or that which now fulfils the office the species did at an earlier epoch*. For practical purposes we must assume the most common form to be the most typical, for it is that which is best known. In doing this, however, there is extreme difficulty in combating local prejudices; the general botanist cannot give a higher place in the great scheme of Nature to a natural object on account of its beauty, rarity, or local associations, any more than he can call a doubtful plant a native because it looks well in his flora or herbarium; but there are local observers who cannot be brought to see things in such a light, and who take the exclusion of plants accidentally introduced into the flora of their neighbourhood, and the reduction of supposed local types to varieties of better known and wider spread plants, as little short of an insult to their understandings, and a slight upon the natural history of their village or island, and suppose that because the systematist cannot see with their eyes he therefore takes a less true interest in what he observes.

§ 3.

Species are more widely diffused than is usually supposed.

This is a point upon which my own views differ materially from those of many of my fellow botanists, and which, if borne out by facts, leads to a widely different estimate of the number and variety of the members of the vegetable kingdom than that which is at present entertained. As with the affinities and variation of species, so is it with their distribution: an extensive knowledge of the subject is only to be obtained by actual observation over large areas, and many of them, or by the study and comparison of the contents of many museums. It has been my singular good fortune to have visited many regions of the globe, and to have entered into some details upon the dispersion of living species, which has always been a favourite pursuit of mine. I have further had the advantage of collating my results with the largest and best-named botanical collections in the world, and have received a greater amount of assistance from my fellow naturalists than has fallen to the lot of most: facts which in ordinary cases are the result of long study and much consultation have been placed at my disposal rather than worked out by myself†. A very extended examination of these materials has only tended to confirm the view which originated in my personal experience, viz. that the esti-

* Thus the few remaining native Cedars of Lebanon may be abnormal states of the tree which was once spread over the whole of the Lebanon, for there are now growing in England varieties of it that have no existence in a wild state. Some of these closely resemble the Cedars of the Atlas and of the Himalayas (*Deodar*), and the absence of any valid botanical differences between these three forms tends to prove that all, though generally supposed to be different species, are one. The characters by which these Cedars are distinguished reside in habit, colour, and length of leaf, and are in process of change and obliteration under cultivation; if we find, then, these plants to be varieties of one which is dispersed from the Atlas Mountains to Northern India, which of the three can we assume as the type, but that which retains its characters over the greatest area, viz. the Cedar (*Deodar*) of the Himalaya? whether or not that was the originally created state, or whether the species was created there or in the Atlas or in Lebanon, or in some intermediate area whence it is now banished. It will be difficult to disconnect the idea of the common Cedar from that of the type of its race, but the systematist may have to do so. What thus happens with large trees may likewise occur with smaller plants. I have given the most conspicuous illustration with which I am familiar, but in the eyes of a naturalist it is not in the least more significant than one drawn from the study of the varieties and distribution of a Moss or Grass.

† It is impossible to over-estimate the importance of a well-studied and named herbarium for such purposes, a simple inspection of many species often giving their geographical range, and in the numerous cases in which widely distributed genera have been worked up by competent authorities, the results are obtained with great accuracy.

mate of the number of species known to botanists is a greatly exaggerated one*, and the prevalent ideas regarding their distribution no less contracted.

Many more plants are common to most countries than is supposed; I have found 60 New Zealand flowering plants and 9 Ferns to be European ones, besides inhabiting various intermediate countries; and amongst the lower Orders we find a greatly increased proportion of species common to all countries: thus of Mosses alone 50 are found in New Zealand and Europe†; of Hepaticæ 13; of Algæ 45 are also natives of European seas; of Fungi nearly 60; and of Lichens 100.

So long ago as 1814 Mr. Brown‡ drew attention to the importance of such considerations, and gave a list of 150 European plants common to Australia. The identity of many of these has repeatedly been called in question, but almost invariably erroneously, added to which more modern collectors have greatly increased the list.

The too prevalent idea that the plants of newly discovered, isolated, or little visited localities must necessarily be new, has been a fertile source of the undue multiplication of species. There are very many cases of naturalists having been so impressed with this idea, that they have not thought it worth while to consult either books or herbaria before describing the plants from such spots. The New Zealand Flora presents several instances of this; two conspicuous ones occur in the genus *Oxalis*; one, *O. corniculata*, is amongst the most widely diffused and variable plants in the world; of its varieties no less than seven or eight species have been made, most of them supposed to be peculiar to New Zealand; not only is *O. corniculata* hence excluded from the flora, but in the descriptions of these its varieties, no allusion is made to that plant§. In the case of the other species the error is more excusable, and may be still open to question‖; it is that of *O. Magellanica*, originally discovered in Fuegia, and imperfectly described by Forster, whose very indifferent specimens of it are in the

* According to the loose estimate of compilers, 100,000 is the commonly received number of known plants: from a multiplicity of data I can come to no other conclusion but that half that number is much nearer the truth. This may well be conceived, when it is notorious that nineteen species have been made of the common Potato, and many more of *Solanum nigrum* alone. *Pteris aquilina* has given rise to numerous book species, *Vernonia cinerea* of India to fifteen at least. Many of the commonest European plants have several names in Europe, others in India, and still others in America, besides a host of garden names for themselves, their hybrids and varieties, all of which are catalogued as species in the ordinary works of reference whence such estimates are compiled.

† In fact the distribution of some Cryptogams is so wide, that I have visited a spot in a high southern latitude, nearly all whose plants are not only identical with those of Great Britain, but inhabit many intermediate temperate and tropical countries. Cockburn Island, in lat. 64° 12′ S. and long. 64° 49′ W., nearly fulfils this condition; I thereon collected nineteen plants, of which three-fourths are natives of England.

‡ Appendix to Flinders's Voyage, vol. ii. p. 592.

§ I have stated very confidently in the body of this work that eight of Cunningham's and Richard's species of this genus are all referable to one. This view will probably not meet the approbation of the local botanists, who will point to the constancy with which some of the states retain their characters under varied conditions. I value such facts very highly, and attach great weight to them, and did these varieties occur only in New Zealand I should perhaps have withheld so strong an opinion on the subject; but such is not the case. *O. corniculata* varies as much in numerous other parts of the world; and admitting, as every one must, that varieties are known to retain their characters with more or less constancy for certain periods, some other evidence is necessary to shake the opinion of the botanist who grounds his views on an examination of the plant from all quarters of the globe.

‖ As no identification is proved till all the organs of the plants to be compared have been studied, there is yet a possibility of these three species proving distinct, but I do not at all expect it; the only difference I can find is a greater obliquity and emargination of the petals of the New Zealand species, but that character varies so much both in this plant and in others of the genus that it loses all specific value.

British Museum. When re-found in New Zealand it was described as new, and called *O. cataractæ*, and when found a third time in Tasmania, was called by still a third name, *O. lactea*. In this case a more important fact was smothered than that of the distribution of *O. corniculata*, namely, that of a very peculiar plant of the south temperate zone being common to these three widely sundered localities.

Many similar instances might be added, for there are several New Zealand plants (as *Pteris aquilina*) that have a different name in almost every country in the world, and, partly from changes in nomenclature, partly from the reduction of species, I have found myself obliged to quote 1500 names for the 720 New Zealand flowering-plants described, and I believe I might have doubled the number had my limits not obliged me to reduce the synonymy as much as possible; in many cases too much, I fear, for the requirements of working botanists in Europe.

§ 4.

The distribution of species has been effected by natural causes, but these are not necessarily the same as those to which they are now exposed.

Of all the branches of Botany there is none whose elucidation demands so much preparatory study, or so extensive an acquaintance with plants and their affinities, as that of their geographical distribution. Nothing is easier than to explain away all obscure phenomena of dispersion by several speculations on the origin of species, so plausible that the superficial naturalist may accept any of them; and to test their soundness demands a comprehensive knowledge of facts, which moreover run great risk of distortion in the hands of those who do not know the value of the evidence they afford. I have endeavoured to enumerate the principal facts that appear to militate against the probability of the same species having originated in more places (or centres) than one; but in so doing I have only partially met the strongest argument of all in favour of a plurality of centres, viz. the difficulty of otherwise accounting for the presence in two widely sundered localities of rare local species, whose seeds cannot have been transported from one to the other by natural causes now in operation. To take an instance: how does it happen that *Edwardsia grandiflora* inhabits both New Zealand and South America? or *Oxalis Magellanica* both these localities and Tasmania? The idea of transportation by aerial or oceanic currents cannot be entertained, as the seeds of neither could stand exposure to the salt water, and they are too heavy to be borne in the air. Were these the only plants common to these widely-sundered localities, the possibility of some exceptional mode of transport might be admitted by those disinclined to receive the doctrine of double centres; but the elucidation of the New Zealand Flora has brought up many similar instances equally difficult to account for, and has developed innumerable collateral phenomena of equal importance, though not of so evident appreciation. These, which all bear upon the same point, may be arranged as follows:—

1. Seventy-seven plants are common to the three great south temperate masses of land, Tasmania, New Zealand, and South America.

2. Comparatively few of these are universally distributed species, the greater part being peculiar to the south temperate zone.

3. There are upwards of 100 genera, subgenera, or other well-marked groups of plants entirely or nearly confined to New Zealand, Australia, and extra-tropical South America. These are represented by one or more species in two or more of these countries, and they thus effect a botanical relationship or affinity between them all, which every botanist appreciates.

4. These three peculiarities are shared by all the islands in the south temperate zone (including even Tristan d'Acunha, though placed so close to Africa), between which islands the transportation of seeds is even more unlikely than between the larger masses of land.

5. The plants of the Antarctic islands, which are equally natives of New Zealand, Tasmania, and Australia, are almost invariably found only on the lofty mountains of these countries.

Now as not only individual species, but groups of these, whether orders, genera, or their subdivisions, are to a great degree distributed within certain limits or areas, it follows that the flora of every island or archipelago presents peculiarities of its own. Though an insular climate may favour the relative abundance of individuals, and even species of certain Natural Orders, there is nothing in the climate, or in any other attribute of insularity, which indicates the nature of the peculiarity of endemic species. The islands of each ocean contain certain botanically allied forms in common, which are more or less abundant in them, and rarely or never found on the neighbouring continents; thus there are curious genera peculiar to the North Atlantic islands, others to the North Pacific islands, others to those of the South Pacific, and others again to the Malayan Archipelago; just as there are still others peculiar to the Antarctic islands, and many to New Zealand, Fuegia, and Tasmania.

Each group of islands hence forms a botanical region, more or less definable by its plants as well as by its oceanic boundaries; precisely as a continuous area like Australia or South Africa does. There is however this difference, that whereas the Natural Orders that give a botanical character to a continuous area of a continent or to a large island (as the *Proteaceæ* in South Africa or in New Holland, and *Coprosma* in New Zealand) are numerous in species and often uniformly spread,—in clusters of small islands, distant from continents, they are few in species, and the individuals are scattered, appearing as if the vestiges of a flora which belonged to another epoch, and which is passing away: this is perhaps a fanciful idea, but one which I believe to contain the germ of truth; for no Botanist can reflect upon the destruction of peculiar species on small islands (such as is now going on in St. Helena amongst others), without feeling that, as each disappears, a gap remains, which may never be botanically refilled; that not only are those links breaking by which he connects the present flora with the past, but also those by which he binds the different members of the vegetable kingdom one to another. It is not true in every sense that all existing nature appears to the naturalist as an harmonious whole; each species combines by its own peculiarities two or more others more closely, and reveals their affinities more clearly, than any other does; just as the flora of an intermediate spot of land connects those of two adjacent areas better than any other locality does. It is often by one or a very few species that two large Natural Orders are seen to be related; just as by a few Chilian plants the whole flora of New Zealand is connected with that of South America. The destruction of a species must hence create an hiatus in our systems, and I believe that it is mainly through such losses that natural orders, genera, and species become isolated, that is, peculiar, in a naturalist's eyes.

To return to the distribution of existing species, I cannot think that those who, arguing for unlimited powers of migration in plants, think existing means ample for ubiquitous dispersion, sufficiently appreciate the difficulties in the way of the necessary transport. During my voyages amongst the Antarctic islands, I was led, by the constant recurrence of familiar plants in the most inaccessible spots, to reflect much on the subject of their possible transport; and the conviction was soon forced upon me, that, putting aside the almost insuperable obstacles to trans-oceanic migration between such islands as Fuegia and Kerguelen's Land, for instance (which have plants in common, not found else-

where), there were such peculiarities in the plants so circumstanced, as rendered many of them the least likely of all to have availed themselves of what possible chances of transport there may have been. As species they were either not so abundant in individuals, or not prolific enough to have been the first to offer themselves for chance transport, or their seeds presented no facilities for migration*, or were singularly perishable from feeble vitality, soft or brittle integuments, the presence of oil that soon became rancid, or from having a fleshy albumen that quickly decayed†. Added to the fact that of all the plants in the respective floras of the Antarctic islands, those common to any two of them were the most unlikely of all to emigrate, and that there were plenty of species possessing unusual facilities, which had not availed themselves of them, there was another important point, namely, the little chance there was of the seeds growing at all, after transport. Though thousands of seeds are annually shed in those bleak regions, few indeed vegetate, and of these fewer still arrive at maturity. There is no annual plant in Kerguelen's Land, and seedlings are extremely rare there; the seeds, if not eaten by birds, either rot on the ground or are washed away; and the conclusion is evident, that if such mortality attends them in their own island, the chances must be small indeed for a solitary individual, after being transported perhaps thousands of miles, to some spot where the available soil is pre-occupied.

Beyond the bare fact of the difficulty of accounting by any other means for the presence of the same species in two of the islands, there appeared nothing in the botany of the Antarctic regions to support or even to favour the assumption of a double creation, and I hence dismissed it as a mere speculation which, till it gained some support on philosophical principles, could only be regarded as shelving a difficulty; whilst the unstable doctrine that would account for the creation of each species on each island by progressive development on the spot, was contradicted by every fact.

It was with these conclusions before me, that I was led to speculate on the possibility of the plants of the Southern Ocean being the remains of a flora that had once spread over a larger and more continuous tract of land than now exists in that ocean; and that the peculiar Antarctic genera and species may be the vestiges of a flora characterized by the predominance of plants which are now scattered throughout the southern islands. An allusion to these speculations was made in the 'Flora Antarctica' (pp. 210 and 368), where some circumstances connected with the distribution of the Antarctic islands were dwelt upon, and their resemblance to the summits of a submerged mountain chain was pointed out; but beyond the facts that the general features of the flora favoured such a view, that the difficulties in the way of transport appeared to admit of no other solution, and that there are no limits assignable to the age of the species that would make their creation posterior to such a series of geological changes as should remove the intervening land, there was nothing in the shape of evidence by which my speculation could be supported. I am indebted to the invaluable labours of Lyell and Darwin‡, for the facts that could alone have given countenance to such an hypothesis; the one showing that the necessary time and elevations and depressions of land

* Thus of the *Compositæ*, common to Lord Auckland's Group, Fuegia, and Kerguelen's Land, none have any pappus (or seed-down) at all! Of the many species *with* pappus, none are common to two of these islands!

† Of the seeds sent to England from the Antarctic regions, or transported by myself between the several islands, almost all perished during transmission.

‡ See Darwin's 'Journal of a Naturalist,' and 'Essays on Volcanic Islands and Coral Islands.' The proofs of the coasts of Chili and Patagonia having been raised continuously, for several hundred miles, to elevations varying between 400 and 1300 feet, since the period of the creation of existing shells, will be found in the first-named of these admirable works, which should be in the hands of every New Zealand Naturalist, if only from its containing

need not be denied; and the other, that such risings and sinkings are in active progress over large portions of the continents and islands of the southern hemisphere. It is to the works of Lyell* that I must refer for all the necessary data as to the influence of climate in directing the migration of plants and animals, and for the evidence of the changes of climate being dependent on geological change. In the 'Principles of Geology' these laws are proved to be of universal application, and amply illustrated by their being applied to the elucidation of difficult problems in geographical distribution. It follows from what is there shown, that a change in the relative positions of sea and land has occurred to such an extent since the creation of still existing species, that we have no right to assume that the plants and animals of two given areas, however isolated by ocean, may not have migrated over pre-existing land between them. This was illustrated by an examination of the natural history of Sicily (where land-shells, still existing in Italy, and which could not have crossed the Straits of Messina, are found imbedded on the flanks of Etna high above the sea-level), regarding which Sir Charles Lyell states that most of the plants and animals of that island are older than the mountains, plains, and rivers they now inhabit†.

It was reserved for Professor Edward Forbes, one of the most accomplished naturalists of his day, to extend and enlarge these views, and to illustrate by their means the natural history of an extensive area; which he did by applying a profound knowledge of geology and natural history to the materials he had collected during his arduous surveys of many of the shores of Europe and the Mediterranean. The result has been the enunciation of a theory, from which it follows that the greater part, if not all, of the animals and plants of the British Islands have immigrated at different periods, under very different climatic conditions; and that all have survived immense changes in the configuration of the land and seas of Northern Europe. The arguments which support this theory are based upon evidence derived from Zoology and Geology‡, and they receive additional observations on his own islands. The fact of this accomplished Naturalist and Geologist having preceded me in the investigation of the Natural History of the Southern Ocean, has materially influenced and greatly furthered my progress; and I feel it the more necessary to mention this here, because Mr. Darwin not only directed my earliest studies in the subjects of the distribution and variation of species, but has discussed with me all the arguments, and drawn my attention to many of the facts which I have endeavoured to illustrate in this Essay. I know of no other way in which I can acknowledge the extent of my obligation to him, than by adding that I should never have taken up the subject in its present form, but for the advantages I have derived from his friendship and encouragement.

* To Sir Charles Lyell's works, indeed, I am indebted for the enunciation of those principles that are essential to the progress of every naturalist and geologist; those, I mean, that affect the creation and extinction, dispersion and subsequent isolation of organic beings; and though botanists still differ in opinion as to the views he entertains on the most speculative of subjects (the origin and permanence of species), there is, I think, but one as to the soundness and originality of his observations on all that relates to the strict dependence of organic beings on physical conditions in the state of the earth's surface. I feel that I cannot over-estimate the labours of this great philosopher, when I reflect that without them the science of geographical distribution would have been with me little beyond a tabulation of important facts; and that I am indebted to them, not only for having given a direction to my studies in this department, but for an example of admirable reasoning on the facts he has collected regarding the distribution of plants and animals. I have no hesitation in recommending the 'Principles of Geology' to the New Zealand student of Nature, as the most important work he can study.

† See the Principles of Geology, ed. 9. p. 702, and Address to the Geological Society of London by the President (Leonard Horner, Esq.), in 1847, p. 66.

‡ For the contents of the Essay itself, I must refer to the Records of the Geological Survey of Great Britain, vol. i. p. 336. This is the most original and able essay that has ever appeared on this subject, and though I cannot

tional weight from the fact that the distribution of British plants is in accordance with its principal features*.

The geographical distribution of British plants has been the subject of the most rigorous investigation by one of our ablest British botanists, Mr. H. C. Watson, who first drew attention to the various botanical elements of which the flora is composed, and grouped the species into botanical provinces. These provinces were intended for "showing the areas of plants, as facts in nature independent of all theoretical explanations and reasons." (Cybele Britannica, vol. i. p. 18.) An inspection of them shows the relations borne by the plants of England to those of certain parts of Europe and of the Arctic regions; and Professor Forbes, applying a modification of these botanical provinces to the illustration of his views of the original introduction of plants into the British Islands, proceeds to show that their migration took place at different periods, contemporary of course with the connection by land of each botanical region of Britain with that part of the continent which presents a similar association of plants.

To extend a theoretical application of these views to the New Zealand Flora, it is necessary to assume that there was at one time a land communication by which the Chilian plants were interchanged; that at the same or another epoch the Australian, at a third the Antarctic, and at a fourth the Pacific floras were added to the assemblage. It is not necessary to suppose that for this interchange there was a continuous connection between any two of these localities, for an intermediate land, peopled with some or all of the plants common to both, may have existed between New Zealand and Chili when neither of these countries was as yet above water†. To account, however, for the Antarctic plants on the lofty mountains, a new set of influences is demanded; no land connection between these islands and New Zealand could have effected this, for the climate of the intermediate area must necessarily have prevented it. But changes of relation between sea and land induce changes of climate, and the presence of a large continent connecting the Antarctic islands would, under certain circumstances, render New Zealand as cold as Britain was during the glacial epoch. Sir C. Lyell first demonstrated this, and showed what such conditions should be; and by consulting the 'Principles of Geology,' my reader will understand how such a climate would reign in the latitude of New Zealand, as that its flora should consist of what are now Antarctic forms of vegetation. The

subscribe to all its botanical details, I consider that the mode of reasoning adopted is sound, and of universal application. What I dissent from most strongly is, the origin of the gulf-weed, the peopling of Scotch mountains by iceberg transport of seeds, and the too great stress laid upon the west Irish flora, whose peculiarities appear to me to be considerably over-estimated.

* It may be well to state to the New Zealand student, that there are no reasons to suppose that Botany can ever be expected to give that direct proof of plants having survived geological changes of climate, sea, and land, which animals do; the cause is evident, for the bones of quadrupeds, shells of mollusca, and hard parts of many animals, afford an abundant means of specific identification, and such are preserved when the animals perish. In plants the case is widely different: their perishable organs of reproduction, which alone are available for systematic purposes, are seldom imbedded, even when other parts of the plants are.

† This disappearance of old land, and the migration of its flora and fauna to new, may be illustrated to a certain extent by the delta of any New Zealand river. A mud-bank on one shore, covered with mangroves, advances across the channel, the mangroves growing on the new land as it forms. The current changes, and the end of the bank (with its mangroves) is cut off, and becomes an island: another change of the river channel fills up that between the islet and the opposite shore, to which it hence becomes a peninsula, peopled by mangroves, whose parents grew on the opposite bank. Here, be it remarked, no subsidence is required, such as must have operated in the assumed isolation of New Zealand.

retirement of the plants to the summit of the New Zealand mountains*, would be the necessary consequence of the amelioration of climate that followed the isolation of New Zealand, and the replacement of the Antarctic continent by the present ocean.

The climate throughout the south temperate zone is so equable, and the isothermal lines are so parallel to those of latitude, that it is not easy for the New Zealand naturalist to realize the altered circumstances that would render the plains of his island suitable for the growth of plants that now inhabit its mountains only†; but if he glance at the map of the isothermal lines of the northern hemisphere, he will see how varied are the climates of regions in the same latitude; that London, with a mean temperature of 51°, is in the same latitude as Hudson's Bay, where the mean temperature is 30°, and the soil ever frozen: and he will further be able to understand by a little reflection, how a change in the relative positions of sea and land would, by isolating Labrador, raise its temperature 10°–15°, causing the destruction of all the native plants that did not retire to its mountain-tops, and favouring the immigration of the species of a more genial climate.

The first inference from such an hypothesis is that the Alpine plants of New Zealand, having survived the greatest changes, are its most ancient colonists; and it is a most important one in many respects, but especially when considered with reference to the mountain floras of the Pacific and southern hemisphere generally. These may be classed under three heads‡:—

1. Those that contain identical or representative species of the Antarctic Flora, and none that are peculiarly Arctic; as the Tasmanian and New Zealand Alps§.

2. Those that contain, besides these, peculiarities of the Northern and Arctic Floras‖; as the South American Alps.

3. Those that contain the peculiarities of neither; as the mountains of South Africa and the Pacific Islands.

* With regard to the British mountains, Professor Forbes imagines that they were islets in the glacial ocean, and received their plants by transportation of seeds with soil, on ice from the Arctic regions. This appears to me to want support, and there is much in the distribution of Arctic plants especially, wholly opposed to the idea of ice transport being an active agent in dispersion. A lowering of 10° of mean temperature would render the greater part of Britain suitable to the growth of Arctic plants; it would give it the climate of Labrador, situated in the same latitude on the opposite side of the Atlantic. Britain is the warmest spot in its latitude, and a very slight geological change would lower its mean temperature many degrees.

† The New Zealand naturalist has probably a very simple means of determining for himself whether his island has been subject to a geologically recent amelioration of climate; to do which, let him examine the fiord-like bays of the west coast of the Middle Island, for evidence of the glaciers which there exist in the mountains having formerly descended lower than they now do. Glaciers to this day descend to the level of the sea in South Chili, at the latitude of Dusky Bay; and if they have done so in the latter locality, they will have left memorials, in the shape of boulders, moraines, and scratched and polished rocks.

‡ I need scarcely remind my reader that in thus sketching the characteristics of these Alpine floras, I make no allusion to exceptions that do not alter the main features. I am far from asserting that there are no peculiar Arctic or Antarctic forms in the Pacific Islands, nor any peculiarly Arctic ones in Tasmania and New Zealand: but if, on the one hand, future discoveries of such shall weaken the points of difference between these three mountain regions, on the other they might be very much strengthened by adducing the number of Arctic species common to the South American Alps, but not found in the others.

§ These Antarctic forms are very numerous; familiar ones are *Acæna, Drapetes, Donatia, Gunnera, Oreomyrrhis, Lagenophora, Forstera, Ourisia, Fagus, Callixene, Astelia, Gaimardia, Alepyrum, Oreobolus, Carpha, Uncinia.*

‖ *Berberis, Sisymbrium, Thlaspi, Arabis, Draba, Sagina, Lychnis, Cerastium, Fragaria, Lathyrus, Vicia, Hippuris, Chrysosplenium, Ribes, Saxifraga, Valeriana, Aster, Hieracium, Stachys, Primula, Anagallis, Pinguicula, Statice, Empetrum, Phleum, Elymus, Hordeum.*

We thus observe that the want of an Arctic or Antarctic Flora at all in the Pacific islands, and the presence of an Arctic one in the American Alps, are the prominent features; and I shall confine my remarks upon these to the fact that, with regard to the isolated islands of the Pacific, they are situated in too warm a latitude to have had their temperature cooled by changes in the relative position of land and ocean, so as to have harboured an Antarctic vegetation. With regard to the South American Alps, there is direct land communication along the Andes from Arctic to Antarctic regions; by which not only may the strictly Arctic genera and species have migrated to Cape Horn, but by which many Antarctic ones may have advanced northward to the equator*.

There is still another point in connection with the subject of the relative antiquity of plants, and in adducing it I must again refer to the 'Principles of Geology,' where it is said, "As a general rule, species common to many distant provinces, or those now found to inhabit many distant parts of the globe, are to be regarded as the most ancient . . . . their wide diffusion shows that they have had a long time to spread themselves, and have been able to survive many important changes in Physical Geography†." If this be true, it follows that, consistently with the theory of the antiquity of the Alpine flora of New Zealand, we should find amongst the plants common to New Zealand and the Antarctic islands, some of the most cosmopolitan; and we do so in *Montia fontana, Callitriche verna, Cardamine hirsuta, Epilobium tetragonum,* and many others.

On the other hand, it must be recollected that there are other causes besides antiquity and facility for migration, that determine the distribution of plants; these are their power, mentioned above, of invading and effecting a settlement in a country preoccupied with its own species, and their adaptability to various climates: with regard to the first of these points, it is of more importance than is generally assumed, and I have alluded to its effects under *Sonchus,* in the body of this work. As regards climates, the plants mentioned above seem wonderfully indifferent to its effects‡.

Again, even though we may safely pronounce most species of ubiquitous plants to have outlived many geological changes, we may not reverse the position, and assume local species to be amongst the most recently created; for whether (as has been conjectured) species, like individuals, die out in the course of time, following some inscrutable law whose operations we have not yet traced, or whether (as in some instances we know to be the case) they are destroyed by natural causes (geological or others), they must in either case become scarce and local while they are in process of disappearance.

In the above speculative review of some of the causes which appear to affect the life and range of species in the vegetable kingdom, I have not touched upon one point, namely, that which concerns the original introduction of existing species of plants upon the earth. I have assumed that they have existed for ages in the forms they now retain, that assumption agreeing, in my opinion, with the facts elicited by a survey of all the phenomena they present, and, according to the most eminent zoolo-

* Why these Antarctic forms have not extended into North America, as the Arctic ones have into South America, is a curious problem, and the only hypothesis that suggests itself is derived from the fact that though the Panama Andes are not now sufficiently lofty for the transit of either, there is nothing to contradict the supposition that they may have had sufficient altitude at a former period, and that one which preceded the advance of the Antarctic species to so high a northern latitude.

† Principles of Geology, ed. 9. p. 702.

‡ Mr. Watson (Cybele Britannica) gives the range of *Callitriche* in Britain alone as including mean temperatures of 40° to 52°, and as ascending from the level of the sea to nearly 2000 feet in the East Highlands of Scotland. *Montia,* according to the same authority, enjoys a range of 36° to 52°, and ascends to 3300 feet; *Epilobium,* a temperature of 40° to 51°, and ascends to 2000 feet; *Cardamine,* a temperature of 37° to 52°, and ascends to 3000 feet.

gists, with those laws that govern animal life also; but there is nothing in what is assumed above, in favour of the antiquity of species and their wide distribution, that is inconsistent with any theory of their origin that the speculator may adopt. My object has not so much been to ascertain what may, or may not, have been the original condition of species, as to show that, granting more scope for variation than is generally allowed, still there are no unassailable grounds for concluding that they now vary so as to obliterate specific character; in other words, I have endeavoured to show that they are, for all practical purposes of progress in botanical science, to be regarded as permanently distinct creations, which have survived great geological changes, and which will either die out, or be destroyed, with their distinctive marks unchanged. We have direct evidence of the impoverishment of the flora of the globe, in the extinction of many most peculiar insular species within the last century; but whether the balance of nature is kept up by the consequent increase of the remainder in individuals, or by the sudden creation of new ones, does not appear, nor have we any means of knowing: if the expression of an opinion be insisted on, I should be induced to follow the example of an eminent astronomer, who, when the question was put to him, as to whether the planets are inhabited, replied that the earth was so, and left his querist to argue from analogy. So with regard to species, we know that they perish suddenly or gradually, without varying into other forms to take their place as species, from which established premiss the speculator may draw his own conclusions.

And now that I have brought these desultory observations to a close, I cannot review them without fearing that I may incur the charges of, on the one hand, attempting to promote a spirit of theoretical inquiry amongst those naturalists of the distant colony whom I would fain instruct; and on the other, of giving way to it myself, and occupying the time of my readers with what is with too many the foundation of fruitless controversy. In answer to the first I would say, that the speculations which I have endeavoured to combat are becoming widely spread amongst superficial observers, and are quoted every day as objections to the devotion of time and labour to a systematic inquiry into any branch of Natural History. The very many aspirants to a knowledge of science whom I have had the pleasure of knowing in the Colonies, though well educated in the ordinary acceptation of the term, have never been trained to habits of observation, or of reasoning upon what they read in the book of nature, nor have they been grounded in the elements of natural science; they are hence prone to rely for information on these speculative subjects (which they seek with avidity) upon a class of works that are, with very few exceptions, by authors who have no practical acquaintance with the sciences they write about, or with the facts they so often distort. I have further had a more practical object in view—the offering of theoretical reasons for inculcating caution on the future botanists of New Zealand; I have endeavoured to make it clear to those who may read these remarks, that systematic botany is a far more difficult and important object than is generally supposed; that the progress the student will make himself, and hence that the science will make in his country, is not to be measured by the number of new species he may find, but by his manner of treating the old, and his desire to regard all as parts of the vegetable kingdom, and not of the New Zealand Flora only; and that there is no surer sign of his not appreciating the aim and scope of the science he cultivates, than a craving to load it with names, and to take contracted views of species, their variation and distribution.

To those who may accuse me of giving way to hasty generalization or loose speculation on the antiquity and dispersion of plants over parts of the Southern Hemisphere, I may answer, that no speculation is idle or fruitless, that is not opposed to truth or to probability, and which, whilst it

co-ordinates a body of well established facts, does so without violence to nature, and with a due regard to the possible results of future discoveries. I may add, that after twelve years' devotion to the laborious accumulation and arrangement of facts in the field and closet, untrammelled by any theories to combat or vindicate, I have thought that I might bring forward the conclusions to which my studies have led me, with less chance of incurring such a reproach, than those would, who, with far better abilities and judgment, have not had my experience and opportunities.

CHAPTER III.

§ 1. ON THE PHYSIOGNOMY AND AFFINITIES OF THE NEW ZEALAND FLORA.

In the following remarks, the flowering plants alone of New Zealand are referred to, except when it is otherwise stated: my object being primarily to show the relation between the botany of New Zealand and that of the south temperate continents, I have, for several reasons, considered that the introduction of the Ferns even was not expedient:—1. Because they include only one family of *Cryptogamia*, and that the only one towards a knowledge of whose number and distribution in New Zealand we have even approximately accurate data.—2. Because the diffusion of their minute spores is so ubiquitous*, and their growth is so dependent on one climatic element, viz. humidity, that their geographic distribution does not harmonize with that of flowering plants in general.

The traveller from whatever country, on arriving in New Zealand, finds himself surrounded by a vegetation that is almost wholly new to him; with little that is at first sight striking, except the Tree-fern and *Cordyline* of the northern parts, and nothing familiar, except possibly the Mangrove; and as he extends his investigations into the Flora, with the exception of *Pomaderris* and *Leptospermum*, he finds few forms that remind him of other countries. Of the numerous Pines, very few recall by habit and appearance the idea attached either to trees of this family in the northern hemisphere, or to the *Callitris* of New Holland, or to the *Araucariæ* of that country and Norfolk Island; while of the families that on examination indicate the only close affinity between the New Zealand Flora and that of any other country, (the *Myrtaceæ*, *Epacrideæ*, and *Proteaceæ*,) few resemble in general aspect

* A most remarkable exemplification of this is found in the occurrence of *Lycopodium cernuum* (a most universally distributed Fern in all warm climates) in the Azores, where it grows only around some hot springs. Within the last few months it has been also collected in St. Paul's Island (lat. 38° south), by the naturalists of Captain Denham's Expedition to the Pacific Islands: there, too, only where the ground is much heated by springs. These facts are most remarkable, for the *Lycopodium cernuum* does not inhabit Madeira or any spot in the Azores, except the vicinity of the hot springs, and St. Paul's Island is also far beyond its natural isothermal in that longitude of the southern hemisphere; and it is to be remarked, that in neither island is the *Lycopodium* accompanied by any other tropical plant, which would indicate the aerial transport of larger objects than the microscopic spores of *Lycopodia*, which are raised in clouds from large surfaces covered with the gregarious species.

their allies in Australia. A paucity of Grasses, an absence of *Leguminosæ,* an abundance of bushes and Ferns, and a want of annual plants, are the prevalent features in the open country, whilst the forests abound in *Cryptogamia,* and in phænogamic plants with obscure green flowers, and very often of obscure and little-known Natural Orders*.

Considerably more than two hundred of the New Zealand species have either unisexual or polygamous flowers, or are otherwise incomplete in their reproductive organs, even when their floral envelopes are more or less developed. The number of Natural Orders† is large in proportion to the genera; being as 92 to 282, that is, about one to three: while the genera are to the species as 282 to 730, each genus having on the average only two and a half species; whence it follows that there are, on the average, but eight species to each Natural Order.

Considering these circumstances, and the additional one, that very many of the Natural Orders cannot be recognized by the flower alone, by fruit alone, or by habit or foliage, it may, I think, safely be said that the New Zealand Flora is, for its extent, much the most difficult on the globe to a beginner. Indeed, the mere fact that the student must know a Natural Order for every eight species he has to investigate, offers as direct a means of proving this by comparison as any datum could do, for the probable proportion of species of plants on the globe to the known Natural Orders, exceeds three hundred and fifty to one; in Tasmania the proportions are eleven to one, and in Great Britain they average fourteen to one.

It is, therefore, not surprising that the vegetation of New Zealand should be wanting in any conspicuous or prevailing feature, which is the case to so great a degree that, excluding Ferns, I do not think any two botanists would, without investigation, characterize any part of the islands as the region of any particular order, genus, or species. The *Coniferæ,* when known, prove to be perhaps the most universally prevalent natural family; but the majority of their species, not being social, but growing intermixed with other trees, give no character to the landscape. The vast number of trees, the paucity of herbaceous plants, and the almost total absence of annuals, are the most remarkable features of the Flora; for of flowering trees, including shrubs above twenty feet high, there are upwards of 113‡, or nearly one-sixth of the Flora, besides 156 shrubs and plants with woody stems. Of the largest Natural Orders, so far as regards the number of species, the individuals are often so few, that the botanist would form a very erroneous estimate of the numerical force of such in the whole island from an examination of some of its parts only: thus the Orders most numerous in species are, *Compositæ,* 90; *Cyperaceæ,* 66; *Gramineæ,* 53; *Scrophularineæ,* 40; *Orchideæ,* 39; *Rubiaceæ,* 26; and *Epacrideæ* and *Umbelliferæ,* each 23; none of which can be said to form prevalent features in the landscape, though none are rare.

In the neighbouring island of Tasmania, where the same Orders predominate to a great extent, the case is widely different: there the Grasses everywhere form a prominent feature; the *Cyperaceæ,*

* My first day's collections about the Bay of Islands included *Corynocarpus, Alseuosmia, Melicytus, Drimys, Aristotelia, Coriaria, Gunnera, Carpodetus, Griselinia, Corokia, Geniostoma, Laurelia, Hedycarya, Freycinetia, Rhipogonum,* and *Astelia;* all belonging to small, obscure, or little-known Natural Orders, many long considered of dubious affinity: besides a host of obscure genera of little-known families.

† It is to be observed, that I have adopted as few Natural Orders as possible; fewer, I think, than I should have done in a work on general botany; but I was anxious to diminish as much as possible the labours of the beginner. Had I adopted all the Orders that have been proposed, there would be upwards of a hundred of flowering plants in New Zealand.

‡ In England there are not more than 35 native trees, out of a flora of upwards of 1400 species.

from their size, strength, and cutting foliage, arrest the traveller's progress through the forest; *Orchideæ* of many kinds carpet the ground in spring with beautiful blossoms; the heaths are gay with *Epacrideæ*; herbs, trees, and shrubs of *Compositæ* meet the eye in every direction; whilst the *Myrtaceæ* and *Leguminosæ* are characteristics both of the arboreous and shrubby vegetation. The difference is so marked, that I retain the most vivid recollection of the physiognomy of the Tasmanian mountains and valleys, but a very indifferent one of the New Zealand forest, where all is, comparatively speaking, blended into one green mass, relieved at the Bay of Islands by the symmetrical crown of the Tree-fern, the pale green fountain of foliage of the *Dacrydium cupressinum*, and the poplar-like *Knightia* overtopping all. It is true that there is more variety in the latter country than is expressed by this selection of a few individuals, and a little reflection recalls a vast number of noble, and some beautiful botanical objects, but with the exception of groves of the Kaikatea Pine (*Podocarpus dacrydioides*) on the swampy river banks, the *Pomaderris* and *Leptospermum* on the open hill-sides, and *Dammara* on their crests, there is little to arrest the botanist's first glance; and nothing in the massing or grouping of the species of any Natural Order renders that Order an important element in the general landscape, or gives individuality to any of its parts, by flowers and gaiety, or by foliage and gloom. The same features prevail even so far south as Lord Auckland's Group, where *Dracophyllum, Coprosma, Metrosideros, Panax*, and a shrubby *Veronica* unite to form an evergreen mantle: and I suspect, from the accounts I have heard and read, that they are repeated on the damp cool coasts of Chili, to the north of the region of the sombre Beech-forests which clothe the Fuegian islands.

A. *Plants peculiar to New Zealand.*

In analysing the Phænogamic Flora of New Zealand, the first important result is the large amount of absolutely peculiar or endemic plants, of which there are 26 genera and 507 species, or more than two-thirds of the whole. Of these, the greater proportion are Exogens, as was to be expected, from the Grasses, *Cyperaceæ*, and water-plants being more widely diffused than any other families.

The Petaloid Endogens, on the other hand, are remarkably local, especially the *Orchideæ*, of which only two species, out of thirty-nine, are found elsewhere (in Tasmania). This, however, is so invariably the case with *Orchideæ*, that the proportion of species in the globe to other Natural Orders is perhaps greatly underrated. Nearly all the New Zealand genera of Orchids are natives of Australia, and most of them are otherwise peculiar to that continent; the ubiquitous *Spiranthes* is the most marked exception, as Australia contains the only widely distributed species in that vast Natural Order, namely, *S. rosea*, which however is replaced in New Zealand by *S. Novæ-Zelandiæ*.

The next peculiar Order is *Coniferæ*, whose twelve species are all endemic*: it is very widely spread, and many of its species in the northern hemisphere have wide though strictly defined ranges. In this respect the southern species differ from the northern, for they are local; thus several occupy very limited areas indeed in Tasmania and elsewhere, of which the Huon and Norfolk Island Pines are remarkable instances: *Dammara australis* is confined to the northern half of the northern island of New Zealand, and other species only grow on a few lofty mountains. Of the New Zealand genera, two are peculiar to it, Australia, and the Malay Archipelago (*Dacrydium* and *Phyllocladus*);

* Except perhaps *Phyllocladus*, one species of which is very closely allied to the Tasmanian *P. aspleniifolia*.

Dammara is common to New Zealand, the Moluccas, and New Caledonia; *Podocarpus* is found in many parts of the world from Japan to the Straits of Magellan, from India to Tasmania and South Africa; but *Thuja* is absent from Australia, though found in most countries inhabited by *Podocarpus*, and in rather high northern latitudes of western North America. Several of the *Coniferæ* of New Zealand are alpine, as are others in many parts of the world. The absence of the whole Order in the Atlantic, in the smaller, remote, Antarctic and Pacific Islands, is one of the most curious features in its distribution and in their botany, for *Coniferæ* ascend the loftiest mountains of New Zealand and Tasmania.

Scrophularineæ includes many of the endemic species, thirty-three out of the forty being so. Of these, one of the two *Calceolarias* is very closely allied to a Chilian species; these and the *Mimuli*, a shrubby *Veronica*, and *Ourisia* further intimately connect the Flora with that of South America, as do other species of *Veronica*, *Mimulus*, *Ourisia*, and *Euphrasia* with that of Tasmania.

The *Epacrideæ* all belong to Australian genera, and two are species of that continent and of Tasmania.

Of *Compositæ* upwards of seventy-four are endemic, an enormous proportion, considering how fugitive their seeds are, and that the genera are almost without exception Australian. *Araliaceæ* are all peculiar, as are the greater number of *Umbelliferæ*, and all the *Myrtaceæ*, with one exception (a New Holland species), and all but four of the *Ranunculaceæ*.

A close botanical relationship to other countries may thus be traced in most of the endemic genera and species. The exceptional genera are *Ixerba*, which belongs to a Madagascar family (*Brexiaceæ*); *Corynocarpus*, which I have reduced to *Terebinthaceæ*; *Carpodetus*, also of disputed affinity, which I place in *Escalloniæ*, and which is one of the few extra South American species of that Order, which is considered by some to be a tribe of *Saxifrageæ*; *Griselinia* and *Corokia*, which I think both belong to *Corneæ*, and which are also more nearly allied to some South American plants than to any others; *Alseuosmia* has no near known affinity; *Phormium*, which appears "sui generis," is elsewhere found only in Norfolk Island; *Nesodaphne*, one of the two genera of *Laurineæ*, is allied to a South American genus.

B. *Plants common to New Zealand and other Countries.*

The remaining third of the New Zealand Flora may be divided into five groups, for illustrating the relations of the plants to those of other countries,—viz.,

1. 193 species, or nearly one-fourth of the whole, are Australian.
2. 89 species, or nearly one-eighth of the whole, are South American.
3. 77 species, or nearly one-tenth of the whole, are common to both the above.
4. 60 species, or nearly one-twelfth of the whole, are European.
5. 50 species, or nearly one-sixteenth of the whole, are Antarctic Islands', Fuegian, etc.

1. *Those of Australian affinity.*—The decided preponderance of Australian forms is not confined to this large number of absolutely identical species; I have shown it to prevail in the genera containing peculiar species also. There are no Natural Orders in New Zealand which are not also found in Australia and Tasmania, except *Coriariæ*, *Escalloniæ*, *Brexiaceæ*, and *Chloranthaceæ*. Upwards of 240 of the 282 New Zealand genera are Australian, and of these more than fifty are all but confined to these two countries. New Zealand, however, does not appear wholly as a satellite of Australia in all the genera common to both, for of several there are but few species in

Australia, which hence shares the peculiarities of New Zealand, rather than New Zealand those of Australia: this is the case with *Pittosporum, Coprosma, Olearia, Celmisia, Forstera, Gaultheria, Dracophyllum, Veronica, Fagus, Dacrydium,* and *Uncinia;* of which there are comparatively few species in Australia and Tasmania: on the other hand, *Stackhousieæ, Pomaderris, Leptospermum, Exocarpus, Persoonia, Epacris, Leucopogon, Goodenia,* and a few other large Australian genera, are very scantily represented in New Zealand.

If the number of plants common to Australia and New Zealand is great, and quite unaccountable for by transport, the absence of certain very extensive groups of the former country is still more incompatible with the theory of extensive migration by oceanic or aerial currents. This absence is most conspicuous in the case of *Eucalypti,* and almost every other genus of *Myrtaceæ;* of the whole immense genus of *Acacia,* and of its numerous Australian congeners, with the single exception of *Clianthus,* of which there are but two known species, one in Australia, and the other in New Zealand and Norfolk Island.

The rarity of *Proteaceæ, Rutaceæ,* and *Stylideæ,* and the absence of *Casuarina* and *Callitris,* of any *Goodeniæ* but *G. littoralis* (equally found in South America), of *Tremandreæ, Dilleniaceæ,* and of various genera of *Monocotyledones,* admit of no explanation, consistent with migration over water having introduced more than a very few of the plants common to these tracts of land. Considering that *Eucalypti* form the most prevalent forest feature over the greater part of South and East Australia, rivalled by the *Leguminosæ* alone, and that both these Orders (the latter especially) are admirably adapted constitutionally for transport, and that the species are not particularly local or scarce, and grow well wherever sown, the fact of their absence from New Zealand cannot be too strongly pressed on the attention of the botanical geographer, for it is the main cause of the difference between the floras of these two great masses of land being much greater than that between any two equally large contiguous ones on the face of the globe. If no theory of transport will account for these facts, still less will any of variation; for of the three genera of *Leguminosæ* which do inhabit New Zealand, none favour such a theory; one, *Clianthus,* I have just mentioned; the second, *Edwardsia,* consists of one tree, identical with a Juan Fernandez and Chilian one, and unknown in New Holland; and the third genus (*Carmichælia*) is quite peculiar, and consists of a few species feebly allied to some New Holland plants, but exceedingly different in structure from any of that extensive Natural Order.

2. *Species of South American affinity.*—The South American species in New Zealand amount to 89, or one-eighth: of these some are absolutely peculiar to the two countries, as *Myosurus aristatus,* two species of *Coriaria, Edwardsia grandiflora, Haloragis alata, Hydrocotyle Americana,* and *Veronica elliptica.* Of these the *Edwardsia* is by far the most striking case, from the size of the tree: it appears to have a much wider range in New Zealand than in Chili, and supposing it to have been transported between these countries, it is difficult to say which was the parent one; its affinities would, however, incline us to consider it amongst the aborigines of the former. It is by representative genera and species that the affinity of the New Zealand and South American floras is best shown, and this most conspicuously by *Fuchsia* and *Calceolaria,* two most remarkable genera, confined to these two countries, but by far the most abundant to the west of the Andes. Here again the amount of affinity is differently displayed by each; of the Calceolarias one is so closely allied to an American species, that I doubt the propriety of keeping them separate, while the other appears a very distinct species; the Fuchsias are both extremely peculiar, one of them being the only species that has no petals. Altogether there are 76 genera common to New Zealand and South America,

and 17 of these are not found in Australia or elsewhere in the Old World. It is curious that none of the latter belong to those peculiarly Arctic and north temperate genera mentioned in the note to p. xxiv, except *Caltha*, to a southern form of which, however, the New Zealand species belongs.

3. *Plants common to New Zealand, Australia, and South America.*—Of the 77 plants common to these three countries, which include one-tenth of the flora of New Zealand, the majority are Grasses, 10; *Cyperaceæ*, 7; moisture-loving Monocotyledons, 9; *Monochlamydeæ*, 8; *Umbelliferæ* and *Compositæ* each 4; and fully 50 of the whole number are also found in Europe, and do not indicate any peculiar affinity between these three southern masses of land: of those that are not European, some are Antarctic plants found in mountainous districts of Australia and Tasmania, as *Oxalis Magellanica*. Of genera and species which, from their near affinity with one another, and marked distinction from any others, may be said to be represented in all three countries, the majority are Antarctic, and will be noticed under the fifth head.

4. *European plants in New Zealand.*—These, amounting to 60, or about one-twelfth of the whole flora, are in many respects the most interesting, and to their identification (which I consider approximate only) I have given a great deal of care. Many I consider still open to inquiry, which may reduce their supposed numbers; but on the other hand I am sure that future discoveries will add to them. To some extent these are distributed according to well-defined laws, which do accord with facilities for migration by transport, thus:—*a*. 17 are sea-shore plants, or inhabitants of salt marshes, as *Ruppia, Zannichellia, Atriplex,* and their allies; *Dodonæa, Arenaria rubra,* and *Calystegia Soldanella,* also affect coasts;—*b*. 16 are fresh-water plants, or natives of very marshy spots, for whose transport, however, it appears to me as difficult to account as if they were land-plants;—*c*. 5 are *Compositæ,* of which four have pappus; a facility for aerial transport, which loses its significance and weight from the fact that the species of *Compositæ* (which of all Orders is the largest and most universal) are the most local. The fact of these five being found in so very many parts of the globe, and being the only ones that are so, is extremely remarkable, for it points to oceanic transport as the means of their diffusion: though the probabilities are against their all having thus accidentally met in that most isolated area which they all inhabit;—*d*. 19 of the species are *Glumaceæ,* including seven Grasses and three aquatic *Cyperaceæ* (which latter have also been included under *b*).

This large proportion of the lower Orders of Phænogamic plants is in accordance with a general law of geographic distribution, but not the more intelligible on that account, for I cannot recognize in their structure or physiology any peculiarities that render them fitted for such diffusion*. And I may add, that after a most careful microscopic study of the structure of the seeds of all the plants common to Europe and New Zealand, I have come to the conclusion that, as a body, they present no such facility for trans-oceanic or aerial transport, as would account for their having migrated further than the majority of other plants. To this may be added the fact that the Orders to which they belong, are not those whose seeds after transport are found to vegetate most surely or freely in gardens.

Many of the European species occurring in New Zealand are also Australian, Tasmanian, and Antarctic; some of the more remarkable exceptions are,—of plants not hitherto found in South America, *Hierochloe borealis, Alopecurus geniculatus,* some *Carices,* and other Monocotyledons. Of plants not found in Australia, *Agrostis canina* and *Taraxacum officinale.* Of those not found either in Australia or South America, *Carex stellulata* and *Pyrenaica,* and *Sparganium natans.*

* For some details upon the adaptation of various seeds to oceanic and aerial transport, see my Essay on the Geographic Distribution of the Plants in the Galapagos Archipelago.—Transactions of the Linnean Society, vol. xx.

It should also be mentioned here, that some very widely diffused European and Australian plants are absent from New Zealand, as *Lythrum Salicaria, Alchemilla arvensis, Portulaca oleracea, Hydrocotyle vulgaris, Zapania nodiflora, Verbena officinalis, Prunella vulgaris, Samolus Valerandi, Vallisneria spiralis, Potamogeton perfoliatus* and *crispus, Alisma Plantago, Caulinia oceanica, Juncus maritimus* and *effusus, Carex cæspitosa, Cladium Mariscus, Isolepis fluitans, Cyperus rotundus, Glyceria fluitans,* and *Arundo Phragmites.*

5. *Antarctic* plants in New Zealand.*—Of these Antarctic plants, about 50 inhabit the mountains and southern extreme of New Zealand; a number which (as I have stated at p. 15) will probably be greatly increased by future discoveries. They may be geographically grouped as follows:—*a.* Those of general distribution, being common also to Europe, as *Callitriche, Montia, Cardamine hirsuta, Potentilla anserina, Epilobium tetragonum, Myriophyllum, Calystegia Soldanella* and *C. Sepium, Limosella,* many *Monochlamydeæ,* and more *Monocotyledones.*—*b.* Those found also in Tasmania†, and chiefly on its mountains, but not elsewhere; as *Oxalis Magellanica, Acæna,* some *Epilobia, Colobanthus, Scleranthus, Tillæa, Apium, Coprosma, Leptinella, Hierochloe antarctica,* etc.

The botanical affinity between extra-tropical South America, the Antarctic islands, New Zealand, and Tasmania, is, however, much better indicated by the peculiar genera, by groups of those, or by individual species which, as it were, represent one another in two or more of these localities, and which give a peculiar botanical character to the flora of southern latitudes beyond latitude 35°.

Of these genera, there are 50 which afford botanical characters in common, and give as decided a proof of close affinity in vegetation, as do the 50 identical species above mentioned. The most conspicuous of these genera common to all the above-named localities are, *Colobanthus, Drosera, Acæna, Gunnera, Oreomyrrhis, Leptinella, Lagenophora, Forstera, Pratia, Gaultheria, Gentiana, Euphrasia, Plantago, Drapetes, Fagus, Astelia, Juncus, Carpha, Chætospora, Oreobolus, Uncinia, Carex,* and many Grasses, especially *Hierochloe, Alopecurus, Trisetum, Deyeuxia,* etc.

In the following list 228 species are thus contrasted: in most of these cases the parallelism is very striking, but a few are open to future investigation. In sketching out the grand features of so large an area, I must demand some indulgence from those of my readers who may have the opportunity of going into the details of the evidence I here adduce. The subject is one that cannot be fully worked out without far more materials than have hitherto been collected. I could easily have trebled the list were there any object in doing so, by adducing instances of feebler representation‡ than I have thought it worth while to introduce. When the floras of the mountains of South Chili, New Zealand, Southern Tasmania, the Australian Alps, the Crozets, Prince Edward's Islands, Amsterdam Island, St. Paul's Island, and M'Quarrie Island, shall have been properly explored, the great problem of Representation and Distribution in the South Temperate and Antarctic zone will be solved.

* For the limitation of the term Antarctic, I must refer to the Introduction to the second part of the 'Flora Antarctica,' p. 210, and shall only mention here that its flora includes that of Fuegia, the Falklands, with different islands east and south of them, Tristan d'Acunha, St. Paul's, Amsterdam and Kerguelen's Land, Lord Auckland's, Campbell's, and other islands south and east of New Zealand.

† Tasmania contains some Antarctic genera and species not hitherto found in New Zealand, which will be specially alluded to in the Tasmanian Flora, as *Pernettya, Eucryphia,* etc.

‡ I need hardly remark, that in the following list all the instances selected are of Botanical affinity; to the exclusion of cases of mere analogical resemblance between plants that are not botanically closely allied.

Comparative table of plants which may be considered as representing one another (more or less remarkably) in two or all the three south temperate masses of land, viz. New Zealand (including Auckland and Campbell's Island), Australia (including Tasmania), and extra-tropical South America (including the Falkland Islands).

NEW ZEALAND, ETC.	AUSTRALIA AND TASMANIA.	TEMPERATE AND COLD S. AMERICA.
Ranunculus *subscaposus*, H.f.	Ranunculus *lappaceus*, Sm.	Ranunculus *Chilensis*, DC.
Caltha *Novæ-Zelandiæ*, H.f.		Caltha *sagittata*, Cav.
Drimys *axillaris*, Forst.	Tasmannia *aromatica*, Br.	Drimys *Winteri*, Forst.
Lepidium *oleraceum*, Forst.	Lepidium *Piscidium*, Forst.	
Drosera *stenopetala*, H.f.	Drosera *Arcturi*, Hook.	Drosera *uniflora*, Willd.
	Eucryphia *Billardieri*, Spach.	Eucryphia *cordifolia*, Cav.
Hymenanthera *crassifolia*, H.f.	Hymenanthera *angustifolia*, Br.	
Colobanthus *Billardieri*, Fenzl.	Colobanthus *Billardieri*, Fenzl.	Colobanthus *crassifolius*, H.f.
Linum *monogynum*, Forst.	Linum *marginatum*, A. C.	
Aristotelia *racemosa*, H.f.	Friesia *peduncularis*, DC.	Aristotelia *Macqui*, Hérit.
Plagianthus *sidoides*, Hook.	Plagianthus *urticinus*, A. C.	
Discaria *Australis*, Hook.	Discaria *Australis*, Hook.	Colletia *discolor*, Hook.
Stackhousia *minima*, H.f.	Stackhousia *flava*, H.f.	
Geum *Magellanicum*, Com.	Geum *urbanum*, L. ?	Geum *Magellanicum*, Com.
Rubus *Australis*, Forst.	Rubus *Gunnianus*, Hook.	Rubus *geoides*, Sm.
Acæna *sanguisorbæ*, Vahl.	Acæna *sanguisorbæ*, Vahl.	Acæna *lævigata*, Ait.
Fuchsia *excorticata*, Linn. fil.		Fuchsia *coccinea*, Ait.
Gunnera *monoica*, Raoul.	Gunnera *cordifolia*, H.f.	Gunnera *Magellanica*, Lam.
Metrosideros *florida*, Sm.	Metrosideros *corifolia*, Vent.	Metrosideros *stipularis*, H.f.
Myrtus *pedunculata*, H.f.		Myrtus *Nummularia*, Poir.
Eugenia *Maire*, A. Cunn.		Eugenia *Darwinii*, H.f.
Carpodetus *serratus*, Forst.		Escallonia *serrata*, Sm.
Weinmannia *sylvicola*, B. et S.	Tetracarpæa *Tasmanica*, H.f.	
Donatia *Novæ-Zelandiæ*, H.f.		Donatia *fascicularis*, Forst.
Pozoa *trifoliolata*, Hf.	Pozopsis *cordifolia*, Hook.	Azorella *Ranunculus*, D'Urv.
Oreomyrrhis *Colensoi*, H.f.	Oreomyrrhis *sessiliflora*, H.f.	Oreomyrrhis *Andicola*, Endl.
Panax *simplex*, Forst.	Panax *Gunnii*, H.f.	Panax *nov. sp.*
Olearia *operina*, H.f.	Olearia *phlogopappa*, DC.	Chiliotrichum *amelloides*, Cass.
Celmisia *gracilenta*, H.f.	Celmisia *asteliæfolia*, A.C.	
Lagenophora *Forsteri*, DC.	Lagenophora *montana*, H.f.	Lagenophora *Commersonii*, Cass.
Eurybiopsis *Australis*, H.f.	Eurybiopsis *scabrida*, H.f.	
Brachycome *radicata*, H.f.	Brachycome *scapiformis*, DC.	
Craspedia *fimbriata*, DC.	Craspedia *Richea*, Cass.	
Trineuron *pusillum*, H.f.	Scleroleima *Forsteroides*, H.f.	Abrotanella *emarginata*, Cass.
Cassinia *Vauvilliersii*, H.f.	Cassinia *cuneifolia*, A.C.	
Ozothamnus *glomeratus*, H.f.	Swammerdammia *Antennaria*, DC.	
Leptinella *dioica*, H.f.	Leptinella *intricata*, H.f.	Leptinella *scariosa*, Cass.
Raoulia *Australis*, H.f.	Raoulia *Tasmanica*, H.f.	
Microseris *Forsteri*, H.f.	Microseris *Forsteri*, H.f.	Microseris *pygmæa*, DC.
Forstera *clavigera*, H.f.	Forstera *bellidifolia*, Hook.	Forstera *muscifolia*, Willd.

NEW ZEALAND, ETC.	AUSTRALIA AND TASMANIA.	TEMPERATE AND COLD S. AMERICA.
Pratia *angulata*, H.f.	Pratia? *irrigua*, H.f.	Pratia *repens*, Gaud.
	Pernettya *Tasmanica*, H.f.	Pernettya *pumila*, Hook.
Gaultheria *antipoda*, Forst.	Gaultheria *hispida*, Br.	Gaultheria *microphylla*, H.f.
	Prionotes *cerinthoides*, Br.	Lebetanthus *mucronatus*, Endl.
Dracophyllum *squarrosum*, H.f.	Dracophyllum *Milligani*, Hook.	
Olea *Cunninghamii*, H.f.	Notelea *ligustrina*, Vent.	
Gentiana *montana*, Forst.	Gentiana *montana*, Forst.	Gentiana *Magellanica*, Gaud.
Parsonsia *heterophylla*, A. C.	Lyonsia *straminea*, Br.	
Myosotis *capitata*, H.f.	Myosotis *australis*, Br.	Myosotis *albiflora*, B. et S.
Solanum *aviculare*, Forst.	Solanum *aviculare*, Forst.	Solanum *tuberosum*, L.
Veronica *elongata*, Benth.	Veronica *calycina*, Br.	
Calceolaria *Sinclairi*, Hook.	7 — 3	Calceolaria *punctata*, Vahl.
Mimulus *repens*, Br.	Mimulus *repens*, Br.	Mimulus *luteus*, L.
Ourisia *macrophylla*, Hook.	Ourisia *integrifolia*, Br.	Ourisia *Magellanica*, Comm.
Euphrasia *cuneata*, Forst.	Euphrasia *collina*, Br.	Euphrasia *Antarctica*, Benth.
Gratiola *sexdentata*, A. C.	Gratiola *latifolia*, Br.	Gratiola *Peruviana*, L.
Scutellaria *humilis*, Br.	Scutellaria *humilis*, Br.	Scutellaria *nummulariæfolia*, H.f.
Myoporum *lætum*, Forst.	Myoporum *insulare*, Br.	
Plantago *carnosa*, Br.	Plantago *carnosa*, Br.	Plantago *barbata*, Forst.
Rumex *flexuosus*, B. et S.	Rumex *fimbriatus*, Br.	Rumex *cuneifolius*, Camp.
Laurelia *Novæ-Zelandiæ*, A. C.	Atherosperma *moschata*, Lab.	Laurelia *aromatica*, Juss.
Knightia *excelsa*, Br.	Telopea *truncata*, Br.	Embothrium *coccineum*, Forst.
	Lomatia *tinctoria*, Br.	Lomatia *ferruginea*, Br.
Drapetes *Lyallii**, H.f.	Drapetes *Tasmanica*, H.f.	Drapetes *muscosa*, Lam.
Pimelia *arenaria*, Cunn.	Pimelia *sericea*, Br.	
Exocarpus *Bidwillii*, H.f.	Exocarpus *humifusa*, Br.	
Australina *Novæ-Zelandiæ*, H.f.	Australina *Tasmanica*, H.f.	
	Fagus *Gunnii*, H.f.	Fagus *Antarctica*, Forst.
Fagus *Menziesii*, H.f.	Fagus *Cunninghamii*, Hook.	Fagus *betuloides*, Mirb.
Phyllocladus *trichomanoides*, Don.	Phyllocladus *aspleniifolia*, Rich.	
Athrotaxis *cupressinus*, Don.	Thuja *Doniana*, Hook.	Thuja *tetragona*, Hook.
Dacrydium *Colensoi*, Hook.	Dacrydium *Franklinii*, H.f.	
Rhipogonum *scandens*, Forst.	Rhipogonum *album*, Br.	
Herpolirion *Novæ-Zelandiæ*, H.f.	Herpolirion *Tasmaniæ*, H.f.	
Libertia *ixioides*, Spreng.	Renealmia *paniculata*, Br.	
Callixene *parviflora*, H.f.	Drymophila *cyanocarpa*, Br.	Callixene *marginata*, Com.
Rostkovia *gracilis*, H.f.	8 — 4	Rostkovia *grandiflora*, H.f.
Astelia *linearis*, H.f.	Astelia *alpina*, Br.	Astelia *pumila*, Br.
Alepyrum *pallidum*, H.f.	Alepyrum *Pumilio*, Br.	
Gaimardia *setacea*, H.f.	9 — 5	Gaimardia *Australis*, Gaud.
Oreobolus *pectinatus*, H.f.	Oreobolus *Pumilio*, Br.	Oreobolus *obtusangulus*, Gaud.
Carpha *alpina*, Br.	Carpha *alpina*, Br.	Carpha *schœnoides*, B. et S.
Sarcochilus *adversus*, H.f.	Sarcochilus *falcatus*, Br.	

* The specific name of this species has been, by some mistake, replaced by that of *muscosa* in the body of this work, p. 223; the latter is the original South American species of the genus.

NEW ZEALAND, ETC.	AUSTRALIA AND TASMANIA.	TEMPERATE AND COLD S. AMERICA.
Prasophyllum *Colensoi*, H.f.	Prasophyllum *Australe*, Br.	
Spiranthes *Novæ-Zelandiæ*, H.f.	Spiranthes *Australis*, Br.	
Orthoceras *Solandri*, Lindl.	Orthoceras *strictum*, Br.	
Thelymitra *Forsteri*, Sw.	Thelymitra *ixioides*, Sw.	
Microtis *porrifolia*, Spr.	Microtis *parviflora*, Br.	
Acianthus *Sinclairii*, H.f.	Acianthus *fornicatus*, Br.	
Cyrtostylis *oblonga*, H.f.	Cyrtostylis *reniformis*, Br.	
Adenochilus *gracilis*, H.f.	Eriochilus *autumnalis*, Br.	
Caladenia *minor*, H.f.	Caladenia *carnea*, Br.	
Pterostylis *graminea*, H.f.	Pterostylis *longifolia*, Br.	
Nematoceras *macrantha*, H.f.	Corysanthes *fimbriata*, Br.	
Gastrodia *Cunninghamii*, H.f.	Gastrodia *sesamoides*, Br.	
Cheiloglottis *cornuta*, H.f.	Cheiloglottis *diphylla*, Br.	

Enough is here given to show that many of the peculiarities of each of the three great areas of land in the southern latitudes are representative ones, effecting a botanical relationship as strong as that which prevails throughout the lands within the Arctic and Northern Temperate zones, and which is not to be accounted for by any theory of transport or variation, but which is agreeable to the hypothesis of all being members of a once more extensive flora, which has been broken up by geological and climatic causes.

I have alluded to Pacific Island peculiarities in the New Zealand Flora; these are few, but very well marked by some otherwise local genera, as *Coprosma, Astelia, Exocarpus, Dammara, Geniostoma, Cyathodes, Santalum, Elatostemma, Ascarina, Cordyline,* and others, of which *Ascarina* is the most remarkable, as the genus has hitherto been found nowhere but in New Zealand and the Sandwich Islands. Until the New Caledonian and Hebridean vegetation especially is known, however, we cannot follow out this affinity, as I do not doubt that their rich floras will connect the Botany of the Pacific, Australian, New Zealand, and Malay Islands in a very remarkable manner, and exhibit affinities of the utmost importance.

There has lately indeed been discovered a most remarkable and unique instance of representation by close botanical affinity between very distant spots, viz. the existence of three of the most peculiar Antarctic, New Zealand, and Tasmanian genera on the lofty mountain of Kini-Balu, in Borneo, situated under the equator, viz. *Drapetes, Phyllocladus,* and *Drimys**.

§ II. ON THE VARIATION OF NEW ZEALAND SPECIES.

The difficulty of reducing the variations of species or of their organs to any system is confessedly very great, and I have not the necessary materials for arranging such data as the New Zealand Flora affords; still there are certain facts which appear of great importance in the consideration of the general character of any flora, but which are almost invariably overlooked, because in the present

* These formed part of a very small collection made by H. Low, Esq., most of which I have described in the 'Icones Plantarum,' vol. x.; they were gathered at about 8000 feet elevation, and consisted of a mixture of Australian, Antarctic, and Indian forms. Amongst the latter, many species of Rhododendron prevailed,—a genus unknown south of the equator in the Old World, and here associated with *Dacrydium*, *Epacrideæ*, and the above-mentioned Antarctic genera, which are almost unknown in the northern hemisphere.

state of our knowledge they are not of practical application. Such are—1. The relative number and extent of genera, the limits to whose species it is difficult to assign, owing to the variableness of their organs.—2. The number of species which materially vary by altering their form and habit during different periods of their growth, and of those whose variations seem independent of age, climate, or condition.

There are many minor considerations that are equally well worthy of study with the above, but which can only be treated of in detail, and studied by local botanists; such as variation in size, stature, colour, and many other particulars which do not produce any generally admitted difficulty in recognizing species.

1. The genera whose species are extremely variable are—

Of very general distribution, 45 :—

Clematis.	Taraxacum.	Gaultheria.	Parietaria.	Pelargonium.
Ranunculus.	Lobelia.	Polygonum.	Dodonæa.	Sonchus.
Linum.	Euphrasia.	Hypericum.	Senecio.	5 gen. Cyperaceæ.
Geranium.	Cardamine.	Apium.	Calystegia.	10 gen. Grasses.
Oxalis.	Rubus.	Olea.	Potamogeton.	
Epilobium.	Wahlenbergia.	Urtica.	Veronica.	
Gnaphalium.	Plantago.	Gentiana.	Luzula.	

Endemic, or of confined geographical distribution, 34 :—

Pittosporum.	Pimelia.	Oreomyrrhis.	*Carmichælia.	Microtis.
Coriaria.	Oreobolus.	Craspedia.	*Tupeia.	Weinmannia.
Cassinia.	*Hoheria.	Trophis.	Ozothamnus.	*Alseuosmia.
Elatostemma.	Leptospermum.	Aristotelia.	Leptocarpus.	Parsonsia.
Pterostylis.	Dracophyllum.	Coprosma.	Elæocarpus.	Calorophus.
*Anisotome.	Prasophyllum.	Ourisia.	Leptinella.	Calceolaria.
Celmisia.	*Phormium.	Thelymitra.	Santalum.	

(*a.*) The first obvious result of this classification is the great number of variable genera, amounting to 79 out of 282, or upwards of one-third; and that the more or less local genera are rather more variable than the widely diffused; for I find in the whole flora that those genera common to all quarters of the globe are to those confined chiefly to Australia and Tasmania as 132 to 150, or nearly one-half of the whole flora: whereas the variable local genera are to the variable widely distributed in the proportion of 34 to 45. As, however, the division into local and peculiar genera is somewhat arbitrary, and that into variable and constant much more so, these conclusions are necessarily vague. Perhaps a more intelligible comparison may be made by examining the absolutely endemic genera. Of these there are 27, or one-tenth of all the genera in the flora, and six only (or one-fifth) of these are very variable; whence it would appear that there is absolutely less tendency to vary, amongst the endemic genera, than amongst those more widely dispersed.

(*b.*) With regard to the widely diffused genera that are variable in New Zealand, most of them are so in all quarters of the globe, but present little uniformity in amount of variation; thus *Rubus*, of which there is only one in New Zealand, and that an extremely variable species, has very few representatives in Australia, and those not particularly variable; very many in

* Those marked with an asterisk are either absolutely peculiar to New Zealand, or found elsewhere in Norfolk Island only, as *Phormium;* or in Lord Auckland's Group, as *Anisotome.*

Europe*, and those highly sportive; and in the Himalaya, the head-quarters of the genus, there are still more species, and those (comparatively speaking) by no means variable. Again, *Clematis, Ranunculus, Epilobium, Apium, Lobelia, Wahlenbergia, Gaultheria, Olea, Gentiana, Calystegia, Euphrasia, Luzula,* and *Poa,* all very cosmopolitan, are as variable in New Zealand as elsewhere, and some of them more so; but as they are not as equally represented in number of species in New Zealand as elsewhere, the results presented by each genus are of very different value. Thus *Lobelia* and *Wahlenbergia,* though very large genera indeed in many parts of the globe where the species are not conspicuously protean, are represented in New Zealand by two widely diffused and exceptionally protean species. *Potamogeton* and *Poa* (with many others) belong to a class equally common in New Zealand and elsewhere, and equally variable everywhere. *Epilobium, Veronica, Senecio,* and others, bear a larger proportion to the New Zealand Flora than to any other Flora of equal area and number of species, and are decidedly as variable in New Zealand as anywhere.

(*c.*) If we turn to the sparingly diffused and endemic genera, the same want of any recognizable relations between extent of geographical distribution, number of species, and their variation, prevails, rendering vain any attempt to characterize them by such general terms as shall convey a more accurate or definite idea, than, that in whatever light we regard them they are all very variable; the absolutely local and well-marked genera, as *Alseuosmia, Hoheria,* and *Carmichælia,* being quite as much as or more so than the others. This leads to the last remark.

(*d.*) Are the New Zealand plants more variable than those of other countries? This it is almost impossible to answer, except by giving the general impressions (and such are but too often fallacious) received during my examinations; and may, I conceive, be better put thus—Have I had comparatively more difficulty in working out New Zealand plants than those of other countries to whose floras I have paid equal attention? I here again find almost insuperable obstacles to a direct answer. If I have met with fewer difficulties in other floras, as in those of Tasmania, Europe, and the Antarctic regions, it may be because my materials were better, and more assistance was available from my predecessors, and not because the species were less variable; again, if I have met with unusual difficulties in the New Zealand Flora, it is certainly in a great measure to be accounted for by the very great natural obstacles in the way of a right understanding of the Natural Orders, genera, and species, some of which I have mentioned at p. xxvii. Upon the whole, I do think that the New Zealand genera are in proportion to their numbers more variable than those of other countries whose botany I have investigated, whether insular or continental; but I do not wish to express this opinion so decidedly as to warrant any conclusion being drawn from it.

In the British Flora I find fully seventy widely distributed genera (out of about 512) containing species as variable proportionally as any in New Zealand, besides many others containing but one or two very sportive species.

In Tasmania and Australia some of the largest genera (as *Eucalyptus*) are the most protean in every point of view, the older individuals of each species not only differing widely from the younger, but also from each other in stature, habit, and botanical characters. In *Acacia,* on the other hand, while the young states of many individual species differ from the old as much as in *Eucalyptus,* the latter are easily limited by constant characters in most important organs. In a third immense endemic Australian genus, *Banksia,* the species are very local, and constant as to form; whilst in a fourth equally large and almost equally local genus of the same order, *Persoonia,* the species vary

* Except, indeed, we admit with many excellent botanists, and perhaps with all our best ones, that the majority of the European species are reducible to a very few.

much. Enough has been adduced to show that this subject is most difficult and obscure, and I may add that it is one in which hasty generalization from first impressions has given rise to much error.

2. Genera whose species alter in form or habit. These are—*Hymenanthera, Pittosporum, Plagianthus, Melicope, Discaria, Edwardsia, Carmichælia, Ackama, Panax, Aralia, Carpodetus, Coprosma, Parsonsia, Olea, Weinmannia, Dammara, Thuja, Podocarpus, Dacrydium, Phyllocladus, Rhipogonum.*

Many of the above vary so remarkably that botanists have been greatly puzzled by the abnormal forms they present: thus a state of *Hymenanthera crassifolia* has been referred to *Goodenia,* one species of *Weinmannia* has been made into two genera, and an *Olea* has been converted into a *Metrosideros.* Some states of *Plagianthus urticinus* and of *Carpodetus serratus* (plants of two very different Natural Orders) are almost undistinguishable, and so are *Hymenanthera crassifolia* and *Pittosporum obcordatum;* so also *Melicytus micranthus, Panax anomala,* and *Melicope simplex,* are often so extremely like one another in foliage as to be confounded when in a dry state. With regard to *Carmichælia, Ackama, Weinmannia,* most of the *Araliaceæ, Coprosma, Parsonsia,* and some of the Pines, the variation is greatest in amount between old and young plants; but with *Discaria, Hymenanthera, Pittosporum,* some species of *Coprosma, Olea,* and many Pines, there seems to be no law, abnormally formed organs appearing on the same branches with normal ones.

From the above list it would appear that variability of this nature is most frequent amongst more or less endemic genera and species, but whether in this respect the New Zealand Flora is more variable than others I have not proved. The Yew, Cedar, Holly, Ivy, and especially Furze and Juniper, perhaps vary in Europe as much as, or more than, the above; but it is difficult to appreciate the amount of variability in a familiar object. On the whole I am inclined to think that the New Zealand Flora is remarkable for the number of plants which vary thus, but that this peculiarity is rendered conspicuous by the prevalence of *Coniferæ* and *Araliaceæ,* which are variable in all parts of the world.

5. Means confined to Southern temperate

Plants common to New Zealand (but not Auckland) and South America but not European

× S	Myosotis antarctica, Hy (not Fuegia)	Chili	Europe	N. America — species in Fiji (Range of genus)
	Elatine Americana, Arn	—	N. Am.	Europe, E. Indies
S	Colobanthus subulatus, Hf. (not)	Fuegia	—	Antarctic genus
	~~Hypericum Japonicum~~			
	Isolepis viscosa, Forst.	—	Tropics, Australia &c	Africa, India
S	Oxalis Magellanica, Forst.	—	Austral, Fuegia	mountains
S	Coriaria ruscifolia, L. (not Fuegian but genus)	—	Chili	Europe, India, Africa, Peru, Mexico
S	—— thymifolia, Humb.		Chili	
S	Edwardsia grandiflora Sol.		Chili	Sandwich Is., Chile, India
?	Geum Magellanicum, Comm.		Fuegia, Austral	Europe, Japan, Chile, India, N. America
× S.	Epilobium pincernum, Forst. (Sim. India, N. Holland, Nepal, Mexico) (not Fuegia)	—	Chili	Northern & Southern genus
S.	Nasturtium alata. Jacq. (not Fuegia)		Chili, Cape of Good Hope, Brazil, Australia &c	
S.	Myriophyllum elatinoides, Gaud		Chili, Fuegia	
·	Scyphos angulatus L.	—	N. & S. Am.	Africa, Sandwich Is.
S.	Tillæa moschata, Hk. (Kerguelen)	— (Auckland)	Fuegia	Europe, N. America, Brazil, Australia
S.	Tetragonia expansa, Sol.	—	Austral, Fuegia,	Peru, Japan
S	Hydrocotyle Americana, L. (not Fuegia)	—	Chili	
	—— asiatica, L.	—	Tropics, austral,	
S.	—— moschata, Forst	—	Chili ?	
S	Apium australe, Bet. Th	—	Chili Fuegia Austral	
	Crantzia lineata, Nutt.	—	N. & S. Am. Austral.	
	Daucus brachiatus, Sieb.	—	do	— Persia, Egypt
	Nertera depressa (Drift) Banks	—	S. Am. Austral.	
S.	Goodenia ovata, Lab (not Fuegia) (not in Australia) (in and the like species)	—	do	do — Any Australian genus
S.	Lobelia anceps, Th. (I see called Lobelia decurrens) (not Fuegia)	—	do	do — A. Indian genus
	Dichondra repens, Forst.	—	do	do — Chiefly N. America; Persia
S.	Veronica elliptica, Forst	(Auckland) —	Chili Fuegia	Peru, India, Wallich, Ind. or N. Holland? Java
S.	Euphrasia antarctica, Benth (Jamaica, Carmichael)	—	Fuegia	
	Avicennia tomentosa, L.	—	~~S. Am.~~, tropics, austral	
S.	Samolus litoralis, Hk (C. Fre. Mountains)	—	Chili, (species peculiar) austral.	Cuba
S.	Triglochin triandrum, Mich.		N. & S. Am	C. Good Hope, Australia, Europe
S.	Juncus planifolius, Hk (Chonos)	—	S. Chili	
	~~Antarcticus~~,			
S	—— scheuzerioides (Kerguelen)	—	Fuegia	
S	Rostkovia Magellanica, Hf. (Auckland)	—	Fuegia	

(Juncus)

~~Carex Magellanica Wahl (Rocky Isl.)~~

S (I think doubtful)

Carex trifida, Cav. Auckland Falkland Chili

Paspalum scrobiculatum, L. Robins.

——— distichum, Burm. Do

Oplismenus annulus, Kth. Do

S Hierochloe redolens, Br. Auckland Fuegia, Auckland.

Simple, N. Zealand (port Hope, Delia)

S — Leptinella plumosa. (by addition)

38 (24 confirmed in my list (either of which I was omitted)

26 will Carex & Leptinella)

I say Leptinella plumosa ought to be added. — Kerguelen Land. Campbell.

Macquarie Is?

Sea Cockle Is?

In the list

Genera not found in Fuegian species	Antarctic genera	Pacific genera
Myosurus (2 sp.)	Colobanthus	Edwardsia
Epilobium (?)	Rostkovia	Sodenia
Deschampsia (?)		Australian genus. (& Chile)

12 of these common to Chile (& not Fuegia) & N. Zealand (6 Auckland Is.)

These do not belong to the Australian Fuegian genera, XX IV. Sub.

Now

Another only Leptinella a sub genus.

(except Colobanthus & perhaps Leptinella) Doubtful in my cases Fuegia!

The species — common belonging not to Antarctic genera, but the representative species belonging to — accord both Antarctic genera, does not seem to have reached all, at least acaulis, where not intermediate representative species has reached far inland. These species have reached all, acaulis, where not acaulis.

Plants in the list do not appear to be those which have arrived at South of Cordillera.

Plants on the ~~Is~~ this part not

Bulbostylis ~~Nesoddia~~

Isolepis cernua (almost cosmopolitan)

S ~~Leptinella plumosa~~

~~Leptinella hectoris allium fuegia only~~

New Zealand Algæ supposed to be common to India & N.Z. but not to be found in intermediate tropical Ocean.

Carpomitra Cabrera Kutz.
Desmarestia ligulata, Lam.
Chorda tomentosa, Lyngb.
Leathesia Berkleyi, Harv.
Ectocarpus siliculosus, Lyngb.
——— granulosus, Ag.
Polysiphonia nigrescens, Grev.
——— pennata, Ag
Asparagopsis Delilei, Mont.
Laurencia virgata, J. Ag.
Champia parvula, Harv.
Melobesia calcarea, Ellis,
Delesseria sarcifolia, Lamour
Nitophyllum uncinatum, J. Ag.
Gigartina pistillata, Lamour
Dumontia filiformis Grev.
Catenella Opuntia, Grev.
Ceramium diaphanum, Roth.
Griffithsia setacea Ag.
Callithamnion plumula, Lyngb.
——— byssoideum, Ag
——— Rothii, Lyngb.
Myriopsis plumosa, Ag.
Cladophora pellucida, Kutz.
——— gracilis, Griff.

25 Right —
May genera

20 gen

New Jersey Inc

X = Europe
F = Fuegia Falkland Is. or Kerguelen
A = Australia

Additions & Corrections (1
from Flora Nov. Zel. 1854.

Auckland & Campbell Inds. 1844.

X Ranunculus pinguis Hf. No Mark New Zealand & these
F n.z. ——— acaulis BTS. n.Zeal. islands, confined to —
X ——— subscaposus Hf.

F.A. Cardamine { hirsuta L. n. Zealand
{ corymbosa Hf. — a var of C. hirsuta L.

X — ——— { depressa Hf.
{ stellata Hf.

n.z. Stellaria decipiens, Hf.
n.z. ——— * media, With.

A Geranium microphyllum, Hf. n.z. var of G. potentilloides, L'Herit.
n.z. Drosera (see Suppl.) — — G. stenopetala, Hf.
F? Sieversia albiflora, Hf. is a Geum, & is S. American?
A. Acaena sanguisorbae Vahl n. Zealand
X — ——— adscendens Vahl —

n.z. Epilobium linnaeoides Hf.
X ——— confertifolium Hf. = E. alpinum ? (see suppl.)
n.z. ——— nerterioides, Hf.

FA Callitriche verna, L. n. Zealand & Kerguelen Land
n.z. Metrosideros lucida, Hf. n. Zealand & Kerguelen Land
FA Montia fontana, L. — n. Zealand & n. Zealand
F Colobanthus subulatus Hf. — n. Zealand, but Hew remarks that it is not of S. Am. origin
X ——— muscoides, Hf.
A ——— Billardieri Fenzl n. Zealand
F Kerguelen Bulliarda moschata, D'Urv. Tillaea moschata, Dc n. Zealand.
X Bozoa veniformis Hf.
X Anisotome latifolia, Hf.
X ——— antipoda, Hf.

n.z. Panax simplex, Forst.
n.z. Aralia polaris, Humb. & Jacq. = N.Z. Stilbocarpa.
n.z. Coprosma { foetidissima, Forst. } varieties in H.N.Z.
——— { affinis, Hf.
— — { cuneata Hf. } probably varieties
— — { myrtillifolia Hf.

\+ Coprosma ciliata, H.f. a doubtful species

n.J ——— vernus, H.f.

FA Nertera depressa, Banks & New Zealand I see & India & Ceylon

× Trineuron spathulatum H.f.

\+ Ceratella vosulata, H.f.

\+ Leptinella lanata H.f.

F & Hayes ——— plumosa H.f. not in New Zealand

× ——— propinqua H.f. perhaps a var. of lanata.

n.J Ozothamnus Vauvilliersii, Hamb. & Jacq = Cassinia H.N.Z.

n.J Helichrysum (prostratum H.) bellidioides, ~~H.f.~~ (see suppl) - Gnaphalium H.N.Z.

FA Gnaphalium luteo-album, L. (see Suppl) - N. Zealand

A —— Erechtites prenanthoides, DC. - (see Suppl) - N. Zealand

n.J Euryebia Lyallii, H.f. (see suppl)

\+ Pleurophyllum speciosum, H.f.

\+ ——— criniferum, H.f.

\+ Celmisia vernicosa, H.f.

n.J Lagenophora petiolata H.f. -- added since

n.J Forstera clavigera H.f.

n.J Pratia arenaria, H.f. = P. angulata H.f.

n.J Androstoma empetrifolia H.f. = Gaultheria H.N.Z.

n.J Dracophyllum longifolium, Dr.

n.J ——— scoparium H.f.

n.J Sutteria divaricata, H.f.

\+ Gentiana concinna, H.f.

× ——— cerina, H.f.

n.J Myosotis capitata, H.f.

n.J ——— antarctica, H.f.

F Veronica elliptica, Forst. - N. Zealand

n.J ——— salicifolia, Forst.? (see Suppl.)

\+ ——— Benthamii, H.f.

n.J ——— odora, H.f. var of V. buxifolia?

\+ Plantago antelandica, H.f.

A ——— carnosa, Dr. - N. Zealand

n.J Rumex cuneifolius, Camp. = probably young R. flexuosus Sol.

n.J Urtica australis H.f.

\+ ——— antelandica H.f.

Auckland & Campbell Isds.

* Chiloglottis cornuta, Hk.f.

2.3 Thelymitra stenopetala Hk.f. — — — var T. Forsteri ?

2.3 — — ? uniflora, Hk.f. (see suppl.) — H. N. Z.

2.3 Caladenia — — — — C. Lyallii ? see H. N. Z.
C.? bifolia Hk.f. & Do

2.3 Acianthus sinclairii, Hk.f. see H. N. Z.

2.3 Acianthus viridaris, Hk.f. = Nematoceras viridaris H. N. Z.
rotundifolia ? H. N. Z.

* Hyperanthus antarcticus Hk.f. (see suppl.)

2.3 Chrysobactron Rossii, Hk.f.

2.3 Astelia linearis, Hk.f.

* Juncus antarcticus, Hk.f. — Not N. Zealand

F — — — scheuzerioides, Gaud.

A F — — — planifolius Br. (see suppl.) — N. Zealand

F Rostkovia Magellanica Hk.f. Not N. Zeal.

* — — — gracilis, Hk.f.

* Luzula crinita, Hk.f.

* Gaimardia ciliata, Hk.f.

2.3 — — — pallida, Hk.f. Alepyrum pallidum H. N. Z.

2.3 Oreobolus pectinatus Hk.f.

* Bolbis aucklandica Hk.f.

F? Carex ternaria, Forst. N. Zealand

F — — — trifida Cav. N. Zealand

A — — — chrepa Br. Not N. Zealand

Uncinia Hookeri, Boott. = U. masculatris Raoul

F A Hierochloe redolens, Br. N. Zealand.

* — — — Brunonis Hk.f.

* Agrostis lepto tachys, Hk.f.

* — — — multicaulis Hk.f.

* — — — subulata, Hk.f.

* — — — aucklandica Hk.f.

F A Trisetum subspicatum Beauv. Not N. Zealand

Bromus antarcticus Hk.f. = Danthonia antarctica Hk.f.

F? Festuca scabrata Hk.f. N. Zealand = Schedonorus littoralis, P.B.

* — — — foliosa Hk.f.

* Poa annua L.

* — — — ramosissima Hk.f.

* — — — brevigluris Hk.f.

Catabrosa Antarctica, Hk.f.

100 species
36 peculiar
16 Fuegian
14. Australian

8 common to Fuegia & Australia

I imagine these are nearly common to New Zealand ~~Australia~~

66
34 — must be common to New Zealand & no where else.
100

× = Peculiar

Kerguelen Lands List of Plants of

× Ranunculus crassipes, Hf. — ~~near Fuegian & P~~

Cabbage × Pringlea antiscorbutica Hf.

× Colobanthus Kerguelensis Hf. — In Flora 2. Amer. species, & 3 Auckland 2 of species

× Acaena affinis, Hf. — too near a Fuegian to sh. Rather an American genus

Callitriche verna, L. — — ubique

Montia fontana, L. — ubique

× Galium Kerguelensis, Hf. (see subst.)

Bulliarda aquatica, D'Urv. — — Fuegia, & N.C. hab. N.Z.

American genus, few sp.

Azorella Selago, Hf. — — Fuegia — an American genus

Galium Antarcticum Hf. — Fuegia — not New Zealand nor Auckland Is.

few species, chiefly American

Leptinella plumosa Hf. Compost — A. & N.C. hab. — S. America. not at Fuegia — not N. Zealand

Limosella aquatica L. — — ubique & N.Z.

Juncus Scheuzerioides, Gaud — — Fuegia — & N. Zealand & Auckland Is.

Agrostis Antarctica, Hf. — Fuegia

Aira Antarctica, Hook. — — Fuegia — not Auckland Is. nor N. Zealand

× Triodia Kerguelensis Hf. — — ~~an error.~~

× Festuca Cookii Hf. — — ~~an error.~~

Auckland, common to Kerguelen I

Montia fontana ubique

Bulliarda aquatica

Leptinella plumosa not N. Zealand

Callitriche verna ubique

Juncus scheuzerioides not N. Zealand

5

— Fuegia. not New Zealand nor Auckland Is.

her lost Tasm. Fl

Costillers plant

3 ubique

7 Fuegian (2 Auckland & Campbell Is. — so 5 strictly Fuegian & 1 endemic too near Fuegian) — of the genera which then belong 1 American viz Azorella

1 Auckland & Campbell Is.

18

of the 7 Endemic 2 Colobanthus & Acaena (Hooker) Antarctic genera, so my has confirm

2 Peculiar

3 Auckland & North

I sh say the century derivation of Fl. del Fuegian

× = Peculiar

Kerguelen Lands

× Ranunculus crassipes, H.f. — ~~near a Fuegian sp.~~

× Pringlea antiscorbutica H.f.

× Colobanthus Kerguelensis H.f. — [illegible] Auckland [illegible], &c.

× Acaena affinis, H.f. — — two near a Fuegian sp.

Callitriche verna, L. — — — ubique

Montia fontana, L. — — ubique

× Galium Kerguelensis, H.f. (see subjoined)

Bulliarda moschata, D'Urv. — — Fuegia, A. & C. Isl. N.Z.

Azorella Selago, H.f. — — — Fuegia

Galium Aucandicum H.f. — — Fuegia

Leptinella plumosa H.f. — — A. & C. Isl. — S. America, Isl. of Fuegia

Limosella aquatica L. — — ubique

Juncus Schenzerinoides, Gaud — — Fuegia

Agrostis Antarctica, H.f. — — Fuegia

Aira Antarctica, Hook. — — Fuegia

× Poa Kerguelensis H.f. — — ~~[illegible]~~

× Festuca Coarctata, H.f. — — ~~[illegible]~~

— — erecta, D'Urv. — — Fuegia.

18 species

Hooker says [illegible]

18 Plants

7 Endemic, 2 very peculiar, one near Fuegian

~~[illegible]~~

3 ubique

7 Fuegian (2 Auckland & Costall Is. & Jerland) = of a [illegible]

so 5 strictly Fuegian

vis [illegible]

[illegible]

14

[illegible]

7 [illegible]

2 [illegible]

[illegible]

Botany of the Antarctic Voyage. "Flora Nova-Zelandiæ"
J. J. D. Hooker. 1853

p. 6. Acaena several species very closely resembling those of Tasmania

p. 41. Pelargonium denticulatum, identical apparently with a Cape species. Apparently rare with Dr Lindley. The other species are of Abyssinia & St Helena

p. 52 The Edwardsia grandiflora, apparently rare in N.Z. Native of Juan Fernandez — another species in Sandwich Isl & S. in India

p. 69 Leptospermum a large genus confined to Australia & N.Z. Island & Malay in, & in Letter in mountains Alg.

p. 73 N.Z. Pittosporum has been made a distinct genus — genus Discaria inhabit Australia

p. 73 genus Colletia confined to S. America.

exept perhaps species

p. 94 Genus Brachichiton seeds with wides "aculeates" with a series of stiff spines bearded at the apex." —

Remarks on Day of Fever

/ 5 & 6

/ 10

/ 65

/ 66

~~[illegible]~~

/ 80

89

102

111

113

114

116

120 – similar cases not noted

128

130

143

154

(No test was here discontinued)

New Jersey Hosp

Tora Tacu the Ilexia seem the Mountain (3
p. 182. Taraxacum officinale, the dandy introduced from Britain & Europe for the pleasant varieties in N. Zealand.

p. 182. Mr Colenso says that the native Leptospermum Scoparium, from the impoverished

p. 187. Celmisia, the affinity with Pacific

p. 186 Pentachondra, closely as Mountain of the isl.
the only N. Z. Ilexia is P. on Mountains of Tasmania. —

p. 172 Pittosporum species confined to Auckland, N. Z. & Norfolk Is. —

p. 177. Geniostoma, a small & isolated genus, a few species inhabiting the Pacific & Mauritius.

187 Coleostemon, the only 2 species not S. American on N. Zealand

p. 218 Lomatia trees a little Chilean genus of which N.
Zealand & S. Chile only species known.

p. 219. Proteaceae (1) Knightia N. Z. genus with 1 species. (2) Persoonia a large Australian genus with 1 N. Z. peculiar species

p. 222 Grafetia only 4 species known; one Fuegian, 2 New Zealand, 1 mountain of Borneo

p. 228 Ascarina only 2 species known, Sandwich Is & N. Z. —

p. 229. Fagus & Ilex seem the mountain (3
Trees – on Cliffs & sides, soon-grown.
p 234. Dacrydium quite good in Cases of Do
p 234. Phyllocladus (quite conifer) relatives of
Podocarpus. Dacrydium & mountains of Borneo
p 238 Lomatia, p on most parts of temperate
world.
p 253 Calligeria genus with 3 spec. 1 on S.
Chile 1 on Fuegia, 1 on N. Zealand. on Alpine woods
p 258. Astelia, a remarkable genus, 1 p on Oahu,
several on N. Zealand, 1 Fuegia. 1 Tasmania
p 261 Genus Areca (Palm) confined to N.S. Norfolk
2. & Malay archipelago
p 267 Gaimardia genus with 3 spec. 1. N.S.
1 Auckland Isn 1. Fuegia with Falkland.
vol 2. p 322. List of naturalised plant,
61 in number. of which about 6 are
cultivated.

Nothing particular in Vol. 2

Plants common to Chile, Nth Fuegia & New Zealand found only in southern Hemisphere

Myosurus aristatus Lay — Nth mountain

Coriaria ruscifolia Lin — Do

——— thymifolia Hunb. — Do but is Kerguelen only stunted state of ruscifolia.)

Edwardsia grandiflora. Chile Juan Fernandez, Nth alpine?

Epilobium pincanum Forst. Nth alpine

Halorragis alata Jacq ~~Nth alpine~~

Hydrocotyle americana Lin Nth alpine

——— moschata Chile?

Goodenia ovata S. amer. Australia {Falk. Islands

Lobelia anceps do do Nth alpine

Samolus littoralis Br. C. Tem Australia (Sea side)

Juncus planifolius Chatham (Nth alpine)

These genera, Hooker says are not particularly wide ranges; the species with restricted ranges. — Nothing particular in that. —

The Casuarina are very scarce in N. Zealand
& make another very case like Eucalyptus.
Olea are a (but distinct species) of
N. Zealand; no Banksia;
Protaceae in
but yet in Tasm. deprived, from
Flinders in P. the — Casuarina
& Banksia, among the partly then
from ancient in Australia —
Olea the then are plant a
mountain of N. Zealand, not P. in intended
the country. of age Tasm. and illicified, in
Thinks nothing known of
Vanpelen Land. —

The species is common in the Antarctic land being generally mountain land, according to analogy, (Mr. Lemesdee,) strongly supports idea of migration from new shetlands Antarctic Pen.

Hooker. Note on N. Zealand Flora Aug 1856
In conversation

W

In Sinclair Th Thylacica (?) is a decidedly
Cape Genus, but distinct species: Th Germinum
(with many Cape species)
he believes is identical with New Zealand
species. — a very peculiar geog. latitude f.
a. Spartina identical with specimens a Th
Paris & Amsterdam. Dr. Hooker in D.
very intermediate in ~~points~~ flora between
Australia & New Zealand. Chatham D.
very little known — New Zealand is characterised
but with some at least distinct species.
Auckland & Campbell he thinks more part
of New Zealand flora than the published,
but numbers of S. New Zealand unknown —
Sir James Ross voyage for soundings & hydr.
Hooker dwelt much peculiarity in Pacific
islands. — Thinks like Lonicera, part of
Indy Flora

Did not answer by
argument the claim —
for the land were
enormous. —

~~Many African forces.~~ —