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ART. XXXIX.—*Characteristics of the North American Flora: an Address to the Botanists of the British Association for the Advancement of Science at Montreal; read to the Biological Section, August 29; by ASA GRAY.*

WHEN the British Association, with much painstaking, honors and gratifies the cultivators of science on this side of the ocean by meeting on American soil, it is but seemly that a corresponding member for the third of a century should endeavor to manifest his interest in the occasion and to render some service, if he can, to his fellow-naturalists in Section D. I would attempt to do so by pointing out, in a general way, some of the characteristic features of the vegetation of the country which they have come to visit,—a country of “magnificent distances,” but of which some vistas may be had by those who can use the facilities which are offered for enjoying them. Even to those who cannot command the time for distant excursions, and to some who may know little or nothing of botany, the sketch which I offer may not be altogether uninteresting. But I naturally address myself to the botanists of the Association, to those who, having crossed the wide Atlantic, are now invited to proceed westward over an almost equal breadth of land; some, indeed, have already journeyed to the Pacific coast, and have returned; and not a few, it is hoped, may accept the invitation to Philadelphia, where a warm welcome awaits them—warmth of hospitality, rather than of summer temperature, let us hope; but Philadelphia is proverbial

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for both. There opportunities may be afforded for a passing acquaintance with the botany of the Atlantic border of the United States, in company with the botanists of the American Association, who are expected to muster in full force.

What may be asked of me, then, is to portray certain outlines of the vegetation of the United States and the Canadian Dominion, as contrasted with that of Europe; perhaps also to touch upon the causes or anterior conditions to which much of the actual differences between the two floras may be ascribed. For, indeed, however interesting or curious the facts of the case may be in themselves, they become far more instructive when we attain to some clear conception of the dependent relation of the present vegetation to a preceding state of things, out of which it has come.

As to the Atlantic border on which we stand, probably the first impression made upon the botanist or other observer coming from Great Britain to New England or Canadian shores, will be the similarity of what he here finds with what he left behind. Among the trees the White Birch and the Chestnut will be identified, if not as exactly the same, yet with only slight differences—differences which may be said to be no more essential or profound than those in accent and intonation between the British speech and that of the "Americans." The differences between the Beeches and Larches of the two countries are a little more accentuated; and still more those of the Hornbeams, Elms, and the nearest resembling Oaks. And so of several other trees. Only as you proceed westward and southward will the differences overpower the similarities, which still are met with.

In the fields and along open roadsides the likeness seems to be greater. But much of this likeness is the unconscious work of man, rather than of Nature, the reason of which is not far to seek. This was a region of forest, upon which the aborigines, although they here and there opened patches of land for cultivation, had made no permanent encroachment. Not very much of the herbaceous or other low undergrowth of this forest could bear exposure to the fervid summer's sun; and the change was too abrupt for adaptive modification. The plains and prairies of the great Mississippi Valley were then too remote for their vegetation to compete for the vacancy which was made here when forest was changed to grain-fields and then to meadow and pasture. And so the vacancy came to be filled in a notable measure by agrestial plants from Europe, the seeds of which came in seed-grain, in the coats and fleece and in the imported fodder of cattle and sheep, and in the various but not always apparent ways in which agricultural and commercial people unwittingly convey the plants and ani-

imals of one country to another. So, while an agricultural people displaced the aborigines which the forest sheltered and nourished, the herbs, purposely or accidentally brought with them, took possession of the clearings, and prevailed more or less over the native and rightful heirs to the soil,—not enough to supplant them, indeed, but enough to impart a certain adventitious Old World aspect to the fields and other open grounds, as well as to the precincts of habitations. In spring-time you would have seen the fields of this district yellow with European Buttercups and Dandelions, then whitened with the Ox-eye Daisy, and at midsummer brightened by the cærulean blue of Chicory. I can hardly name any native herbs which *in the fields and at the season* can vie with these intruders in floral show. The common Barberry of the Old World is an early denizen of New England. The tall Mullein, of a wholly alien race, shoots up in every pasture and new clearing, accompanied by the common Thistle, while another imported Thistle, called in the States “the Canada Thistle,” has become a veritable nuisance, at which much legislation has been leveled in vain.

According to tradition the wayside Plantain was called by the American Indian “White-Man’s foot,” from its springing up wherever that foot had been planted. But there is some reason for suspecting that the Indian’s ancestors brought it to this continent. Moreover there is another reason for surmising that this long-accepted tradition is factitious. For there was already in the country a native Plantain, so like *Plantago major* that the botanists have only of late distinguished it. (I acknowledge my share in the oversight.) Possibly, although the botanists were at fault, the aborigines may have known the difference. The cows are said to know it. For a brother botanist of long experience tells me that, where the two grow together, cows freely feed upon the undoubtedly native species, and leave the naturalized one untouched.

It has been maintained that the ruderal and agrestial Old World plants and weeds of cultivation displace the indigenous ones of newly-settled countries in virtue of a strength which they have developed through survival in the struggle of ages, under the severe competition incident to their former migrations. And it does seem that most of the pertinacious weeds of the Old World which have been given to us may not be indigenous even to Europe, at least to Western Europe, but belong to campestrine or unwooded regions farther east; and that, following the movements of pastoral and agricultural people, they may have played somewhat the same part in the once forest-clad Western Europe that they have been playing here. But it is unnecessary to build much upon the possibly falla-

cious idea of increased strength gained by competition. Opportunity may count for more than exceptional vigor; and the cases in which foreign plants have shown such superiority are mainly those in which a forest-destroying people have brought upon newly-bared soil the seeds of an open-ground vegetation.

The one marked exception that I know of, the case of recent and abundant influx of this class of Old-World plants into a naturally treeless region, supports the same conclusion. Our associate, Mr. John Ball, has recently called attention to it. The pampas of Southeastern South America beyond the Rio Colorado, lying between the same parallels of latitude in the South as Montreal and Philadelphia in the North, and with climate and probably soils fit to sustain a varied vegetation, and even a fair proportion of forest, are not only treeless, but excessively poor in their herbaceous flora. The district has had no trees since its comparatively recent elevation from the sea. As Mr. Darwin long ago intimated: "Trees are absent not because they cannot grow and thrive, but because the only country from which they could have been derived—tropical and sub-tropical South America—could not supply species to suit the soil and climate." And as to the herbaceous and frutescent species, to continue the extract from Mr. Ball's instructive paper recently published in the Linnean Society's Journal, "in a district raised from the sea during the latest geological period, and bounded on the west by a great mountain range mainly clothed with an alpine flora requiring the protection of snow in winter, and on the north by a warm-temperate region whose flora is mainly of modified sub-tropical origin—the only plants that could occupy the newly-formed region were the comparatively few which, though developed under very different conditions, were sufficiently tolerant of change to adapt themselves to the new environment. The flora is poor, not because the land cannot support a richer one, but because the only regions from which a large population could be derived are inhabited by races unfit for emigration."

Singularly enough, this deficiency of herbaceous plants is being supplied from Europe, and the incomers are spreading with great rapidity; for lack of other forest material even apple-trees are running wild and forming extensive groves. Men and cattle are, as usual, the agents of dissemination. But colonizing plants are filling, in this instance, a vacancy which was left by nature, while ours was made by man. We may agree with Mr. Ball in the opinion that the rapidity with which the intrusive plants have spread in this part of South America "is to be accounted for, less by any special fitness of the immigrant species, than by the fact that the ground is to a great extent unoccupied."

The principle applies here also; and in general, that it is opportunity rather than specially acquired vigor that has given Old-World weeds an advantage may be inferred from the behavior of our weeds indigenous to the country, the plants of the unwooded districts—prairies or savannas west and south,—which, now that the way is open, are coming in one by one into these eastern parts, extending their area continually, and holding their ground quite as pertinaciously as the immigrant denizens. Almost every year gives new examples of the immigration of campestrine western plants into the Eastern States. They are well up to the spirit of the age; they travel by rail-way. The seeds are transported, some in the coats of cattle and sheep on the way to market, others in the food which supports them on the journey, and many in a way which you might not suspect, until you consider that these great roads run east and west, that the prevalent winds are from the west, that a freight-train left unguarded was not long ago blown on for more than one hundred miles before it could be stopped, not altogether on down grades, and that the bared and mostly unkempt borders of these railways form capital seed-beds and nursery grounds for such plants.

Returning now from this side-issue, let me advert to another and, I judge, a very pleasant experience which the botanist and the cultivator may have on first visiting the American shores. At almost every step he comes upon old acquaintances, upon shrubs and trees and flowering herbs, mostly peculiar to this country, but with which he is familiar in the grounds and gardens of his home. Great Britain is especially hospitable to American trees and shrubs. There those both of the eastern and western sides of our continent flourish side by side. Here they almost wholly refuse such association. But the most familiar and longest-established representatives of our flora (certain western annuals excepted) were drawn from the Atlantic coast. Among them are the Virginia Creeper or *Ampelopsis*, almost as commonly grown in Europe as here, and which, I think, displays its autumnal crimson as brightly there as along the borders of its native woods where you will everywhere meet with it; the Red and Sugar Maples, which give the notable autumnal glow to our northern woods, but rarely make much show in Europe, perhaps for lack of sharp contrast between summer and autumn; the ornamental *Ericaceous* shrubs, *Kalmias*, *Azaleas*, *Rhododendrons*, and the like, specially called American plants in England, although all the *Rhododendrons* of the finer sort are half Asiatic, the hardy American species having been crossed and recrossed with more elegant but tender Indian species.

As to flowering herbs, somewhat of the delight with which

an American first gathers wild Primroses and Cowslips and Foxgloves and Daisies in Europe, may be enjoyed by the European botanist when he comes upon our Trilliums and Sanguinaria, Cypripediums and Dodecatheon, our species of Phlox, Coreopsis, etc., so familiar in his gardens; or, when, crossing the continent, he comes upon large tracts of ground yellow with *Eschscholtzia* or blue with *Nemophilas*. But with a sentimental difference; in that Primroses, Daisies, and Heaths, like nightingales and larks, are inwrought into our common literature and poetry, whereas our native flowers and birds, if not altogether unsung, have attained at the most to only local celebrity.

Turning now from similarities, and from that which interchange has made familiar, to that which is different or peculiar, I suppose that an observant botanist upon a survey of the Atlantic border of North America (which naturally first and mainly attracts our attention) would be impressed by the comparative wealth of this flora in trees and shrubs. Not so much so in the Canadian Dominion, at least in its eastern part; but even here the difference will be striking enough on comparing Canada with Great Britain.

The Coniferæ, native to the British Islands, are one Pine, one Juniper, and a Yew; those of Canada proper are four or five Pines, four Firs, a Larch, an *Arbor-Vitæ*, three Junipers, and a Yew,—fourteen or fifteen to three. Of Amentaceous trees and shrubs, Great Britain counts one Oak (in two marked forms), a Beech, a Hazel, a Hornbeam, two Birches, an Alder, a *Myrica*, eighteen Willows, and two Poplars,—twenty-eight species in nine genera, and under four natural orders. In Canada there are at least eight Oaks, a Chestnut, a Beech, two Hazels, two Hornbeams of distinct genera, six Birches, two Alders, about fourteen Willows and five Poplars, also a Plane tree, two Walnuts and four Hickories; say forty-eight species, in thirteen genera, and belonging to seven natural orders. The comparison may not be altogether fair; for the British flora is exceptionally poor, even for islands so situated. But if we extend it to Scandinavia, so as to have a continental and an equivalent area, the native Coniferæ would be augmented only by one Fir, the Amentaceæ by several more Willows, a Poplar, and one or two more Birches;—no additional orders nor genera.

If we take in the Atlantic United States, east of the Mississippi, and compare this area with Europe, we should find the species and the types increasing as we proceed southward, but about the same numerical proportion would hold.

But, more interesting than this numerical preponderance—which is practically confined to the trees and shrubs—will be the extra-European types, which, intermixed with familiar old-

world forms, give peculiar features to the North American flora,—features discernible in Canada, but more and more prominent as we proceed southward. Still confining our survey to the Atlantic district, that is, without crossing the Mississippi, the following are among the notable points:

1. Leguminous Trees of peculiar types. Europe abounds in leguminous shrubs or under-shrubs, mostly of the Genisteous tribe, which is wanting in all North America, but has no leguminous tree of more pretense than the *Cercis* and *Laburnum*. Our Atlantic forest is distinguished by a *Cercis* of its own, three species of *Locust*, two of them fine trees, and two Honey Locusts, the beautiful *Cladrastis*, and the stately *Gymnocladus*. Only the *Cercis* has any European relationship. For relatives of the others we must look to the Chino-Japanese region.

2. The great development of the *Ericaceæ* (taking the order in its widest sense), along with the absence of the *Ericaceous* tribe, that is, of the Heaths themselves. We possess on this side of the Mississippi 30 genera and not far from 90 species. All Europe has only 17 genera and barely 50 species. We have most of the actual European species, excepting their *Rhododendrons* and their Heaths,—and even the latter are represented by some scattered patches of *Calluna*, of which it may be still doubtful whether they are chance introductions or sparse and scanty survivals; and besides we have a wealth of peculiar genera and species. Among them the most notable in an ornamental point of view are the *Rhododendrons*, *Azaleas*, *Kalmias*, *Andromedas* and *Clethras*; in botanical interest, the endemic *Monotropeæ*, of which there is only one species in Europe, but seven genera in North America, all but one absolutely peculiar; and in edible as well as botanical interest, the unexampled development and diversification of the genus *Vaccinium* (along with the allied American type, *Gaylussacia*) will attract attention. It is interesting to note the rapid falling away of *Ericaceæ* westward in the valley of the Mississippi as the forest thins out.

3. The wealth of this flora in *Compositæ* is a most obvious feature; one especially prominent at this season of the year, when the open grounds are becoming golden with *Solidago*, and the earlier of the autumnal *Asters* are beginning to blossom. The *Compositæ* form the largest order of *Phænogamous* plants in all temperate floras of the northern hemisphere, are well up to the average in Europe, but are nowhere so numerous as in North America, where they form an eighth part of the whole. But the contrast between the *Compositæ* of Europe and Atlantic North America is striking. Europe runs to Thistles, to *Inuloideæ*, to *Anthemideæ*, and to *Cichoriaceæ*. It has very few *Asters* and only two *Solidagoes*, no *Sunflowers* and hardly anything of that tribe. Our Atlantic flora surpasses all

the world in *Asters* and *Solidagoes*, as also in *Sunflowers* and their various allies, is rich in *Eupatoriaceæ*, of which Europe has extremely few, and is well supplied with *Vernoniaceæ* and *Helenioideæ* of which she has none; but is scanty in all the groups that predominate in Europe. I may remark that if our larger and most troublesome genera, such as *Solidago* and *Aster*, were treated in our systematic works even in the way that Nyman has treated *Hieracium* in Europe, the species of these two genera (now numbering 78 and 124 respectively) would be at least doubled.

4. Perhaps the most interesting contrast between the flora of Europe and that of the eastern border of North America is in the number of generic and even ordinal types here met with which are wholly absent from Europe. Possibly we may distinguish these into two sets of differing history. One will represent a tropical element, more or less transformed, which has probably acquired or been able to hold its position so far north in virtue of our high summer temperature. (In this whole survey the peninsula of Florida is left out of view, regarding its botany as essentially Bahaman and Cuban, with a certain admixture of northern elements.) To the first type I refer such trees and shrubs as *Asimina*, sole representative of the *Anonaceæ* out of the tropics, and reaching even to lat. 42°; *Chrysobalanus*, representing a tropical suborder; *Pinckneya* representing as far north as Georgia the *Cinchoneous* tribe; the *Baccharis* of our coast, reaching even to New England; *Cyrilla* and *Cliftonia*, the former actually West Indian; *Bumelia*, representing the tropical order *Sapotaceæ*; *Bignonia* and *Tecoma* of the *Bignoniaceæ*; *Forestiera* in *Oleaceæ*; *Persea* of the *Laurineæ*; and finally the *Cactaceæ*. Among the herbaceous plants of this set, I will allude only to some of peculiar orders. Among them I reckon *Sarracenia* (of which the only extra-North American representative is tropical-American, the *Melastomaceæ*, represented by *Rhexia*; *Passiflora* (our species being herbaceous), a few representatives of *Loasaceæ* and *Turneraceæ*, also of *Hydrophyllaceæ*; our two genera of *Burmanniaceæ*; three genera of *Hæmodoraceæ*; *Tillandsia* in *Bromeliaceæ*; two genera of *Pontederiaceæ*; two of *Commelynnaceæ*; the outlying *Mayaca* and *Xyris*, and three genera of *Eriocaulonaceæ*. I do not forget that one of our species of *Eriocaulon* occurs on the west coast of Ireland and in Skye, wonderfully out of place, though on this side of the Atlantic it reaches Newfoundland. It may be a survival in the Old World; but it is more probably of chance introduction.

The other set of extra-European types, characteristic of the Atlantic North American flora, is very notable. According to a view which I have much and for a long while insisted on, it

may be said to represent a certain portion of the once rather uniform flora of the arctic and less boreal zone, from the late Tertiary down to the incoming of the Glacial period, and which, brought down to our lower latitudes by the gradual refrigeration, has been preserved here in eastern North America and in the corresponding parts of Asia, but was lost to Europe. I need not recapitulate the evidence upon which this now generally accepted doctrine was founded; and to enumerate the plants which testify in its favor would amount to an enumeration of the greater part of the genera or subordinate groups of plants which distinguish our Atlantic flora from that of Europe. The evidence, in brief, is that the plants in question, or their moderately differentiated representatives, still co-exist in the flora of eastern North America and that of the Chino-Japanese region, the climates and conditions of which are very similar; and that the fossilized representatives of many of them have been brought to light in the late tertiary deposits of the arctic zone wherever explored. In mentioning some of the plants of this category I include the Magnolias, although there are no nearly identical species, but there is a seemingly identical *Liriodendron* in China; and the *Schizandras* and *Illiciums* are divided between the two floras; and I put into the list *Menispermum*, of which the only other species is eastern Siberian, and is hardly distinguishable from ours. When you call to mind the series of wholly extra-European types which are identically or approximately represented in the eastern North American and in the eastern Asiatic temperate floras, such as *Trautvetteria* and *Hydrastis* in *Ranunculaceæ*; *Caulophyllum*, *Diphyllia*, *Jeffersonia* and *Podophyllum* in *Berberideæ*; *Brasenia* and *Nelumbium* in *Nymphæaceæ*; *Stylophorum* in *Papaveraceæ*; *Stuartia* and *Gordonia* in *Ternstromiaceæ*; the equivalent species of *Xanthoxylum*, the equivalent and identical species of *Vitis*, and of the poisonous species of *Rhus* (one, if not both, of which you may meet with in every botanical excursion, and which it will be safer not to handle); the Horse-chestnuts, here called Buckeyes; the Negundo, a peculiar offshoot of the Maple tribe; when you consider that almost every one of the peculiar Leguminous trees mentioned as characteristic of our flora is represented by a species in China or Manchuria or Japan, and so of some herbaceous Leguminosæ; when you remember that the peculiar small order of which *Calycanthus* is the principal type has its other representative in the same region; that the species of *Philadelphus*, of *Hydrangea*, of *Itea*, *Astilbe*, *Hamamelis*, *Diervilla*, *Triosteum*, *Mitchella* which carpets the ground under evergreen woods, *Chiogenes*, creeping over the shaded bogs; *Epigæa*, choicest woodland flower of early spring; *Elliottia*; *Shortia* (the curious history

of which I need not rehearse); *Styrax* of cognate species; *Nyssa*, the Asiatic representatives of which affect a warmer region; *Gelsemium*, which under the name of *Jessamine* is the vernal pride of the Southern Atlantic States; *Pyrularia* and *Buckleya*, peculiar *Santalaceous* shrubs; *Sassafras* and *Benzoin*s of the *Laurel* family; *Planera* and *Maclura*; *Pachysandra* of the *Box* tribe; the great development of the *Juglandaceæ* (of which the sole representative in Europe probably was brought by man into southeastern Europe in pre-historic times); our *Hemlock-Spruces*, *Arbor-vitæ*, *Chamæcyparis*, *Taxodium* and *Torreya*, with their East Asian counterparts, the *Roxburghiaceæ*, represented by *Croomia*—and I might much further extend and particularize the enumeration—you will have enough to make it clear that the peculiarities of the one flora are the peculiarities of the other, and that the two are in striking contrast with the flora of Europe.

This contrast is susceptible of explanation. I have ventured to regard the two antipodal floras thus compared as the favored heirs of the ante-glacial high northern flora, or rather as the heirs who have retained most of their inheritance. For, inasmuch as the present arctic flora is essentially the same round the world, and the Tertiary fossil plants entombed in the strata beneath are also largely identical in all the longitudes, we may well infer that the ancestors of the present northern temperate plants were as widely distributed throughout their northern home. In their enforced migration southward geographical configuration and climatic differences would begin to operate. Perhaps the way into Europe was less open than into the lower latitudes of America and eastern Asia, although there is reason to think that Greenland was joined to Scandinavia. However that be, we know that Europe was fairly well furnished with many of the vegetable types that are now absent, possibly with most of them. Those that have been recognized are mainly trees and shrubs, which somehow take most readily to fossilization, but the herbaceous vegetation probably accompanied the arboreal. At any rate, Europe then possessed *Torreya*s and *Ginkgos*, *Taxodium* and *Glyptostrobus*, *Libocedrus*, *Pines* of our five-leaved type, as well as the analogues of other American forms, several species of *Juglans* answering to the American forms, and the now peculiarly American genus *Carya*, *Oaks* of the American types, *Myrica*s of the two American types, one or two *Planer*-trees, species of *Populus* answering to our *Cotton-woods* and our *Balsam-poplar*, a *Sassafras* and the analogues of our *Persea* and *Benzoin*, a *Catalpa*, *Magnolias* and a *Liriodendron*, *Maples* answering to ours, and also a *Negundo*, and such peculiarly American *Leguminous* genera as the *Locust*, *Honey Locust*, and *Gymnocladus*. To

understand how Europe came to lose these elements of her flora, and Atlantic North America to retain them, we must recall the poverty of Europe in native forest trees, to which I have already alluded. A few years ago, in an article on this subject, I drew up a sketch of the relative richness of Europe, Atlantic North America, Pacific North America and the eastern side of temperate Asia in genera and species of forest trees.* In that sketch, as I am now convinced, the European forest-elements were somewhat under-rated. I allowed only 33 genera and 85 species, while to our Atlantic American forest were assigned 66 genera and 155 species. I find from Nyman's *Conspectus* that there are trees on the southern and eastern borders of Europe which I had omitted, that there are good species which I had reckoned as synonyms, and some that may rise to arboreal height which I had counted as shrubs. But on the other hand and for the present purpose it may be rejoined that the list contained several trees, of as many genera, which were probably carried from Asia into Europe by the hand of man. On Nyman's authority I may put into this category *Cercis Siliquastrum*, *Ceratonia Siliqua*, *Diospyros Lotus*, *Styrax officinalis*, the Olive, and even the Walnut, the Chestnut, and the Cypress. However this may be, it seems clear that the native forest flora of Europe is exceptionally poor, and that it has lost many species and types which once belonged to it. We must suppose that the herbaceous flora has suffered in the same way. I have endeavored to show how this has naturally come about. I cannot state it more concisely than in the terms which I used six years ago.

"I conceive that three things have conspired to this loss of American, or as we might say, of normal types sustained by Europe. First, Europe, extending but little south of lat. 40°, is all within the limits of severe glacial action. Second, its mountains trend east and west, from the Pyrenees to the Carpathians and the Caucasus beyond: they had glaciers of their own, which must have begun their work and poured down the northward flanks while the plains were still covered with forest on the retreat from the great ice forces coming from the north. Attacked both on front and rear, much of the forest must have perished then and there.

"Third, across the line of retreat of whatever trees may have flanked the mountain ranges, or were stationed south of them, stretched the Mediterranean, an impassible barrier. . . Escape by the east, and rehabilitation from that quarter until a very late period, was apparently prevented by the prolongation of the Mediterranean to the Caspian, and probably thence to the Siberian Ocean. If we accept the supposition of Norden-

* This Journal, III, xvi, 85.

skiöld that, anterior to the Glacial period, Europe was 'bounded on the south by an ocean extending from the Atlantic over the present deserts of Sahara and Central Asia to the Pacific,' all chance of these American types having escaped from and reëntered Europe from the south and east seems excluded. Europe may thus be conceived to have been for a time somewhat in the condition in which Greenland is now. . . . Greenland may be referred to as a country which, having undergone extreme glaciation, bears the marks of it in the extreme poverty of its flora, and in the absence of the plants to which its southern portion, extending six degrees below the arctic circle, might be entitled. It ought to have trees and it might support them. But since their destruction by glaciation no way has been open for their return. Europe fared much better, but has suffered in its degree in a similar way."*

Turning to this country for a contrast, we find the continent on the eastern side unbroken and open from the arctic circle to the tropic, and the mountains running north and south. The vegetation when pressed on the north by on-coming refrigeration had only to move its southern border southward to enjoy its normal climate over a favorable region of great extent; and, upon the recession of glaciation to the present limit, or in the oscillations which intervened, there was no physical impediment to the adjustment. Then, too, the more southern latitude of this country gave great advantage over Europe. The line of terminal moraines, which marks the limit of glaciation rarely passes the parallel of 40° or 39°. Nor have any violent changes occurred here, as they have on the Pacific side of the continent, within the period under question. So, while Europe was suffering hardship, the lines of our Atlantic American flora were cast in pleasant places, and the goodly heritage remains essentially unimpaired.

The transverse direction and the massiveness of the mountains of Europe, while they have in part determined the comparative poverty of its forest-vegetation, have preserved there a rich and widely distributed alpine flora. That of Atlantic North America is insignificant. It consists of a few arctic plants, left scattered upon narrow and scattered mountain-tops, or in cool ravines of moderate elevation; the maximum altitude is only about 6,000 feet in lat. 44°, on the White Mountains of New Hampshire, where no winter snow outlasts midsummer. The best alpine stations are within easy reach of Montreal. But as almost every species is common to Europe, and the mountains are not magnificent, they offer no great attraction to a European botanist.

Farther south, the Appalachian Mountains are higher, be-

* This Journal, l. c., 194.

tween lat. 36° and 34° rising considerably above 6,000 feet; they have botanical attractions of their own, but they have no alpine plants. A few subalpine species linger on the cool shores of Lake Superior, at a comparatively low level. Perhaps as many are found nearly at the level of the sea on Anticosti, in the Gulf of St. Lawrence, abnormally cooled by the Labrador current.

The chain of great fresh-water lakes, which are discharged by the brimming St. Lawrence, seems to have little effect upon our botany, beyond the bringing down of a few northwestern species. But you may note with interest that they harbor sundry maritime species, mementoes of the former saltiness of these interior seas. *Cakile Americana*, much like the European Sea Rocket, *Hudsonia tomentosa* (a peculiar Cistaceous genus imitating a Heath), *Lathyrus maritimus*, and *Ammophila arenaria* are the principal. *Salicornia*, *Glaux*, *Scirpus maritimus*, *Ranunculus Cymbalaria*, and some others may be associated with them. But these are widely diffused over the saline soil which characterizes the plains beyond our wooded region.

I have thought that some general considerations like these might have more interest for the biological section at large than any particular indications of our most interesting plants, and of how and where the botanist might find them. Those who in these busy days can find time to herborize will be in the excellent hands of the Canadian botanists. At Philadelphia their brethren of "the States" will be assembled to meet their visitors, and the Philadelphians will escort them to their classic ground, the Pine Barrens of New Jersey. To have an idea of this peculiar phytogeographical district, you may suppose a long wedge of the Carolina coast to be thrust up northward quite to New York harbor, bringing into a comparatively cool climate many of the interesting low-country plants of the South, which, at this season, you would not care to seek in their sultry proper home. Years ago, when Pursh and Leconte and Torrey used to visit it, and in my own younger days, it was wholly primitive and unspoiled. Now, when the shore is lined with huge summer hotels, the Pitch Pines carried off for firewood, the bogs converted into cranberry-grounds, and much of the light sandy or gravelly soil planted with vineyards or converted into melon and sweet-potato patches, I fear it may have lost some of its botanical attractions. But large tracts are still nearly in a state of nature. *Drosera filiformis*, so unlike any European species, and the beautiful *Sabbatias*, the yellow Fringed Orchises, *Lachnanthes* and *Lophiola*, the larger *Xyris*es and *Eriocaulons*, the curious grass *Amphicarpum* with cleistogamous flowers at the root, the showy species of *Chrysopsis*, and many others, must still abound. And every botanist

will wish to collect *Schizæa pusilla*, rarest, most local, and among the smallest of Ferns.

If only the season would allow it, there is a more southern station of special interest,—Wilmington, on the coast of North Carolina. Carnivorous plants have, of late years, excited the greatest interest, both popular and scientific, and here, of all places, carnivorous plants seem to have their most varied development. For this is the only and the very local home of *Dionæa*; here grow almost all the North American species of *Drosera*; here or near by are most of the species of *Sarracenia*, of the bladder-bearing *Utricularias*,—one of which the President of our Section has detected in fish-catching,—and also the largest species of *Pinguicula*.

But at this season a more enjoyable excursion may be made to the southern portion of the Alleghany or Appalachian Mountains, which separate the waters of the Atlantic side from those of the Mississippi. These mountains are now easily reached from Philadelphia. In Pennsylvania, where they consist of parallel ridges without peaks or crests, and are of no great height, they are less interesting botanically than in Virginia; but it is in North Carolina and the adjacent borders of Tennessee that they rise to their highest altitude, and take on more picturesque forms. On their sides the Atlantic forest, especially its deciduous-leaved portion, is still to be seen to greatest advantage, nearly in pristine condition, and composed of a greater variety of genera and species than in any other temperate region, excepting Japan. And in their shade are the greatest variety and abundance of shrubs, and a good share of the most peculiar herbaceous genera. This is the special home of our *Rhododendrons*, *Azaleas*, and *Kalmias*; at least here they flourish in greatest number and in most luxuriant growth. *Rhododendron maximum* (which is found in a scattered way even as far north as the vicinity of Montreal) and *Kalmia latifolia* (both called Laurels) even become forest trees in some places; more commonly they are shrubs, forming dense thickets on steep mountain-sides, through which the traveler can make his way only by following old bear-paths, or by keeping strictly on the dividing crests of the leading ridges.

Only on the summits do we find *Rhododendron Catawbiense*, parent of so many handsome forms in English grounds, and on the higher wooded slopes the yellow and the flame-colored *Azalea calendulacea*: on the lower, the pink *A. nudiflora* and more showy *A. arborescens*, along with the common and widespread *A. viscosa*. The latter part of June is the proper time to explore this region, and, if only one portion can be visited, Roan Mountain should be preferred.

On these mountain tops we meet with a curious anomaly in

geographical distribution. With rarest exceptions, plants which are common to this country and to Europe extend well northward. But on these summits from southern Virginia to Carolina, yet nowhere else, we find—undoubtedly indigenous and undoubtedly identical with the European species—the Lily-of-the-Valley!

I have given so much of my time to the botany of the Atlantic border that I can barely touch upon that of the western regions.

Between the wooded country of the Atlantic side of the continent and that of the Pacific side lies a vast extent of plains which are essentially woodless, except where they are traversed by mountain-chains. The prairies of the Atlantic States bordering the Mississippi and of the Winnipeg country shade off into the drier and gradually more saline plains, which, with an even and gradual rise, attain an elevation of 5,000 feet or more where they abut against the Rocky Mountains. Until these are reached (over a space from the Alleghanies westward of about twenty degrees of longitude) the plains are unbroken. To a moderate distance beyond the Mississippi the country must have been in the main naturally wooded. There is rainfall enough for forest on these actual prairies. Trees grow fairly well when planted; they are coming up spontaneously under present opportunities; and there is reason for thinking that all the prairies east of the Mississippi, and of the Missouri up to Minnesota, have been either greatly extended or were even made treeless under Indian occupation and annual burnings. These prairies are flowery with a good number of characteristic plants, many of them evidently derived from the plains farther west. At this season, the predominant vegetation is of Compositæ, especially of Asters and Solidagoes, and of Sunflowers, Silphiums, and other Helianthoid Compositæ.

The drier and barer plains beyond, clothed with the short Buffalo-Grasses, probably never bore trees in their present state, except as now some Cottonwoods (i. e. Poplars) on the margins of the long rivers which traverse them in their course from the Rocky Mountains to the Mississippi. Westward, the plains grow more and more saline; and Wormwoods and Chenopodiaceæ of various sorts form the dominant vegetation, some of them *sui generis* or at least peculiar to the country, others identical or congeneric with those of the steppes of northern Asia. Along with this common campestrine vegetation, there is a large infusion of peculiar American types, which I suppose came from the southward, and to which I will again refer.

Then come the Rocky Mountains, traversing the whole continent from north to south; their flanks wooded, but not richly so,—chiefly with Pines and Firs of very few species, and with

a single ubiquitous Poplar, their higher crests bearing a well-developed alpine flora. This is the arctic flora prolonged southward upon the mountains of sufficient elevation, with a certain admixture in the lower latitudes of types pertaining to the lower vicinity.

There are almost 200 alpine Phænogamous species now known on the Rocky Mountains; fully three-quarters of which are arctic, including Alaskan and Greenlandian; and about half of them are known in Europe. Several others are North Asian but not European. Even in that northern portion of the Rocky Mountains which the Association is invited to visit, several alpine species novel to European botany may be met with; and farther south the peculiar forms increase. On the other hand, it is interesting to note how many Old-World species extend their range southward even to lat. 36° or 35° .

I have not seen the Rocky Mountains in the Dominion; but I apprehend that the aspect and character of the forest is Canadian, is mainly coniferous, and composed of very few species. Oaks and other cupuliferous trees, which give character to the Atlantic forest, are entirely wanting, until the southern confines of the region are reached in Colorado and New Mexico, and there they are few and small. In these southern parts there is a lesser amount of forest, but a much greater diversity of genera and species; of which the most notable are the Pines of the Mexican plateau type.

The Rocky Mountains and the Coast Ranges on the Pacific side so nearly approach in British America that their forests merge, and the eastern types are gradually replaced by the more peculiar western. But in the United States a broad, arid and treeless, and even truly desert region is interposed. This has its greatest breadth and is best known where it is traversed by the Central Pacific Railroad. It is an immense plain between the Rocky Mountains and the Sierra Nevada, largely a basin with no outlet to the sea, covered with Sage-brush (i. e. peculiar species of *Artemisia*) and other subsaline vegetation, all of grayish hue; traversed, mostly north and south, by chains of mountains, which seem to be more bare than the plains, but which hold in their recesses a considerable amount of forest and of other vegetation, mostly of Rocky Mountain types.

Desolate and desert as this region appears, it is far from uninteresting to the botanist; but I must not stop to show how. Yet even the ardent botanist feels a sense of relief and exultation when, as he reaches the Sierra Nevada, he passes abruptly into perhaps the noblest coniferous forest in the world,—a forest which stretches along this range and its northern continuation, and along the less elevated ranges which border the Pacific coast, from the southern part of California to Alaska.

So much has been said about this forest, about the two gigantic trees which have made it famous, and its Pines and Firs which are hardly less wonderful, and which in Oregon and British Columbia, descending into the plains, yield far more timber to the acre than can be found anywhere else, and I have myself discoursed upon the subject so largely on former occasions, that I may cut short all discourse upon the Pacific coast flora and the questions it brings up.

I note only these points. Although this flora is richer than that of the Atlantic in Coniferæ (having almost twice as many species), richer indeed than any other except that of Eastern Asia, it is very meagre in deciduous trees. It has a fair number of Oaks, indeed, and it has a Flowering Dogwood, even more showy than that which brightens our eastern woodlands in spring. But, altogether it possesses only one-quarter of the number of species of deciduous trees that the Atlantic forest has; it is even much poorer than Europe in this respect. It is destitute not only of the characteristic trees of the Atlantic side, such as *Liriodendron*, *Magnolia*, *Asimina*, *Nyssa*, *Catalpa*, *Sassafras*, *Carya*, and the arboreal *Leguminosæ* (*Cercis* excepted), but it also wants most of the genera which are common throughout all the other northern-temperate floras, having no Lindens, Elms, Mulberries, *Celtis*, Beech, Chestnut, Hornbeam, and few and small Ashes and Maples. The shrubby and herbaceous vegetation, although rich and varied, is largely peculiar, especially at the south. At the north we find a fair number of species identical with the eastern; but it is interesting to remark that this region, interposed between the N. E. Asiatic and the N. E. American and with coast approximate to the former, has few of those peculiar genera which, as I have insisted, witness to a most remarkable connection between two floras so widely sundered geographically. Some of these types, indeed, occur in the intermediate region, rendering the general absence the more noteworthy. And certain peculiar types are represented in single identical species on the coasts of Oregon and Japan, etc., (such as *Lysichiton*, *Fatsia*, *Glehnia*); yet there is less community between these floras than might be expected from their geographical proximity at the north. Of course the high northern flora is not here in view.

Now if, as I have maintained, the eastern side of North America and the eastern side of Northern Asia are the favored heirs of the old boreal flora, and if I have plausibly explained how Europe lost so much of its portion of a common inheritance, it only remains to consider how the western side of North America lost so much more. For that the missing types once existed there, as well as in Europe, has already been in-

licated in the few fossil explorations that have been made. They have brought to light Magnolias, Elms, Beeches, Chestnut, a Liquidambar, etc. And living witnesses remain in the two Sequoias of California, whose ancestors, along with Taxodium, which is similarly preserved on the Atlantic side, appear to have formed no small part of the Miocene flora of the arctic regions.

Several causes may have conspired in the destruction;—climatic differences between the two sides of the continent, such as must early have been established (and we know that a difference no greater than the present would be effective); geographical configuration, probably confining the migration to and fro to a long and narrow tract, little wider, perhaps, than that to which it is now restricted; the tremendous outpouring of lava and volcanic ashes just anterior to the Glacial period, by which a large part of the region was thickly covered; and, at length competition from the Mexican plateau vegetation,—a vegetation beyond the reach of general glacial movement from the north, and climatically well adapted to the southwestern portion of the United States.

It is now becoming obvious that the Mexican plateau vegetation is the proximate source of most of the peculiar elements of the Californian flora, as also of the southern Rocky Mountain region and of the Great Basin between; and that these plants from the south have competed with those from the north on the eastward plains and prairies. It is from this source that are derived not only our *Cactææ* but our *Mimoseæ*, our *Daleas* and *Petalostemons*, our numerous and varied *Onagraceæ*, our *Loasaceæ*, a large part of our *Compositæ*, especially the *Eupatoriaceæ*, *Helianthoideæ*, *Helenioideæ*, and *Mutisiaceæ*, which are so characteristic of the country, the *Asclepiadeæ*, the very numerous *Polemoniaceæ*, *Hydrophyllaceæ*, *Eriogoneæ*, and the like.

I had formerly recognized this element in our North American flora; but I have only recently come to apprehend its full significance. With increasing knowledge we may in a good measure discriminate between the descendants of the ancient northern flora, and those which come from the highlands of the southwest.