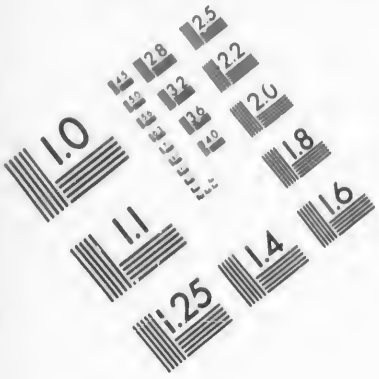

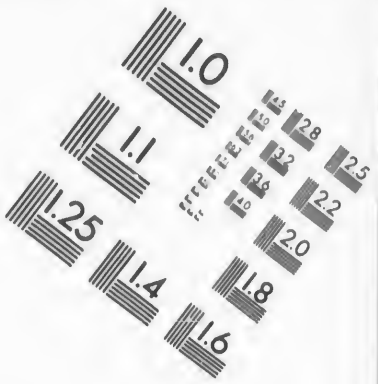

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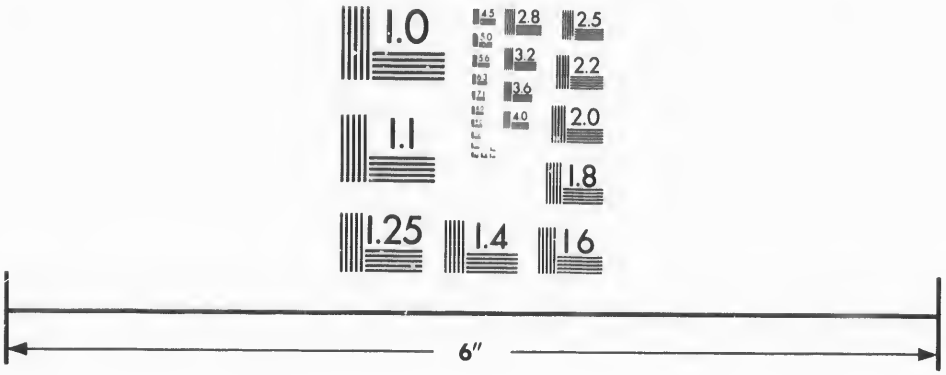

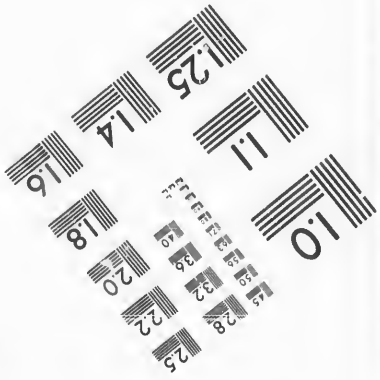

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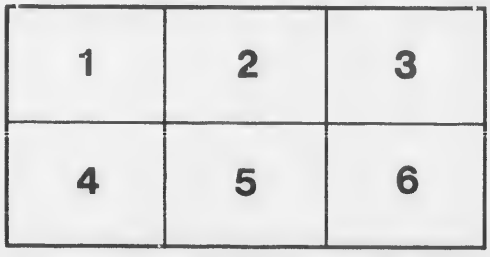

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(Reprinted from The Canadian Record of Science, Vol. III., No. 1, 1888.)

The Distribution and Physical, and Past-Geological Relations of British North American Plants.

By A. T. Drummond.

(*Conclusion.*)

In illustrating the groups into which the flora of the Dominion may thus be divided, lengthy lists of plants will be avoided. Sufficient examples will be given under each division to show the distinctiveness of the group. It has, however, to be borne in mind that new facts in distribution are always coming to light. The explorations of the country between Lake Superior and the Pacific Coast are, comparatively speaking, recent and limited, and in coming years, with fuller knowledge of the range of each species there, it will be possible to speak with more confidence of, and to group more accurately, the flora of the western half of the continent. At present, in the case of too many species, we have only general locations given, covering a wide stretch of country.

CANADIAN GROUP.

There are no temperate plants in Canada of wide range from Atlantic to Pacific, which are exclusively Canadian, but there are many species of which it may be predicated that their maximum distribution is in this country rather than in the United States. The species which are common to Europe and America, and range to the Pacific, being chiefly northern temperate plants, have, as a rule, the mass of the individuals of each species in Canada. Exclusive of these, however, the following are illustrations of the group:—

Viola blanda, Willd.	Alnus viridis, D. C.
Lathyrus ochroleucus, Hook.	Vicia Americana, Muhl.
Potentilla arguta, Pursh.	Geum triflorum, Pursh.
Rubus triflorus, Rich.	Rosa blanda, Ait.
R. strigosus, Mq.	Cornus stolonifera, Mx.
Cornus Canadensis, L.	Chiogenes hispidula, T. & G.
Nardosmia palmata, Hook.	Menyanthes trifoliata, L.
Kalmia glauca, Ait.	Shepherdia Canadensis, Nutt.
Apocynum androsæmifolium, L.	Betula papyracea, Mx.
Corylus rostrata, Ait.	Smilacina trifolia Desf.

The question naturally suggests itself—Why are many species of wide range, reaching from one side of the continent to the other, whilst many others are circumscribed in area? It is quite clear that the size and weight of the seed, and the appendages which it may have in the shape of wings or silky plumes, to aid in its dissemination, the high winds, the crops, feathers and feet of birds, the different relations of land and water and temperature in past ages—all have been important factors in the extension of the range of plants. But there is another conclusion, the drawing of which analogy warrants. Every plant may be said to have an area where the number of its species and the condition of its growth are at the maximum. Outside of this area, the individuals are found in diminishing numbers until their progress, varying in different directions, finally ceases on every side. The growth, again, of each individual

plant, has its birth in the swelling seed, its maturity when it expands its flower, and its death when, after ripening its seeds, it withers and decays. Similarly, each species has had its beginning, in past ages, in the development and permanency of a well defined variety formed from an already existing species. This new species, thus formed, would, in the course of downward geological time, reach its highest stage of existence as a species,—its period of most active growth and of largest area of distribution, when its ability, under further new conditions, to give rise to further new species, is greatest. Finally, such species has, in after geological time, its period of decline, when the activity of its individuals is gradually lessened and its area of distribution diminished, until extinction comes, leaving to the palæobotanist the duty of revealing its story when he discovers the remains in the clay nodule or the hardened rock. Applying this idea, the older existing species, which are at their maximum of activity, would, with the greater opportunities which in time they had had, have naturally a wider range, under the same set of circumstances, than those which were of more recent creation. Others, again, of the older species, would have passed their maximum of energy and, even though wide of range, would, in each passing century, become more rare. The species of newer creation would, on the other hand, be gradually extending their range wherever circumstances of climate and situation admitted, but, from the shorter lapse of time, would have a more limited range than the older species. Thus, for illustration, *Viola Selkirkii*, Pursh, being common to Europe and America, is probably one of the older species, but being now rare on this continent, may presently be on the decline; *Viola blanda*, Willd., which is a frequent species of wide range, is doubtless about its maximum of energy; whilst *Viola hastata*, Mx., which is uncommon, may be either a recently formed species, or an older species on the decline.

The same idea can be equally well applied in the case of animals.

Forest Group.

The species of this group are, with few exceptions, shrubs and herbaceous plants. That in the far west so many of these plants avoid the open prairies, is an illustration of what might be termed a companionship which nature has arranged between many of the smaller forms of plant life and their towering congeners, the trees, and which brings to light the dependence of the former and the protecting influence of the latter. Amidst the great bluffs of trees which margin the prairie, the general temperature is modified, the play of the sun's rays on the ground is less continuous, the ground itself is more moist, and the high, drying winds of the prairies are greatly diminished in force. Whilst such smaller representatives of plant life find within the line of forests or bluffs such congenial conditions, they afford, as they die, some return to the trees by growing with the trunks and leaves of the trees in enriching the soil by their decay.

The group is illustrated by the following:—

Nuphar luteum, Smith.
Corydalis aurea, Willd.
Claytonia Virginica, L.
Acer spicatum, Lam.
Rhamnus alnifolius, L'Her.
Potentilla tridentata, Sol.
Ribes prostratum, L'Her.
Cicuta bulbifera, L.
Diervilla trifida, Mœnch.
Lonicera ciliata, Muhl.
Viburnum ladum, L.
Erigeron bellidifolium, Muhl.
Diplopappus umbellatus, Hook.
Gaylussacia resinosa, T. & G.
Vaccinium macrocarpon, Ait.
Epigæa repens, L.
Polygonum cilinode, Mx.
Populus tremuloides, Mx.
Abies balsamea, Marsh.
Larix Americana, Mx.

Maritime Group.

As I, several years ago, endeavoured to explain, the species of this group, which are presently found along the shores of the Great Lakes, and of saline ground farther westward, are evidently the remnants of a larger maritime flora which margined the coast in glacial or post-glacial times when the sea made great inroads over Eastern Canada. Their existence in their present positions far inland, may be an argument for the saltness of the great interior seas of these

times, but this does not necessarily follow in the absence of other more direct evidence. The very fact of their flourishing now on the fresh-water lake coasts shows how—no doubt after a severe struggle—they have, but in greatly diminished numbers, adapted themselves to the new conditions in which in the one case the saline element, and in the other, the moist atmosphere of the sea shore, were wanting. We can conceive how, in these distant times, when the sea had receded and when the struggle with changed circumstances had ended in the survival of some, these survivors could, in the usual course, find their way from the former sea shore to the inland seas, and spread themselves around their borders. Some further evidence is needed of the fresh or saline condition of these inland seas of glacial and post-glacial times. In the meantime, it is to be observed that the largest number of the inland maritime plants are found around Lake Ontario and smaller sheets of water east and south of it.

The maritime plants occurring on the coasts of the Great Lakes include the following:—

Ranunculus cymbalaria, Pursh.
Cakile Americana, Nutt.
Hudsonia ericoides, L.
H. tomentosa, Nutt.
Spergularia media, Presl.
Hibiscus Moscheutos, L.
Lathyrus maritimus, Bigel.
Atriplex hastata, L.
Salicornia herbacea, L.
Polygonum aviculare, L.
Var. littorale, Link.
P. articulatum, L.
Rumex maritimus, L.
Euphorbia polygonifolia, L.
Myrica cerifera, L.
Naias major, All.
Ruppia maritima, L.
Triglochin maritimum, L.
T. palustre, L.
Juncus Gerardi, Lois.
Sciopus maritimus, L.
Calamagrostis arenaria, Roth.
Leptochloa fascicularis, Gray.
Spartina stricta, Roth.
Var. alterniflora, Gray.
Hordeum jubatum, L.

These inland maritime plants can be regarded as one of our older floras, dating back to at least the times of the Leda clays.

EASTERN COAST GROUP.

The following species may be taken as illustrative of this group in Canada. Where they occur in the United States, they have, with two exceptions, a similar range there:—

Hudsonia ericoides, L.
Potentilla nemoralis, Nest.
Rosa nitida, Willd.
Lythrum salicaria, L.
Aster radula. Ait.
A. Novi-Belgii, L.
A. tardiflorus, L
Dipplopappus linarifolius, Hook.
Solidago speciosa, Nutt.
Gnaphalium sylvaticum, L.
Gaylussacia dumosa, T. & G.
Calluna vulgaris, Salisb.
Kalmia latifolia, L., if localities confirmed.
Rhodora Canadensis, L.
Betula alba var. populifolia, Spach.
Corema Conradii, Torr.
Solidago puberula, Nutt.

Some of the special influences which limit the range of the species of this group, are not difficult to conjecture. The Appalachian chain of mountains has no doubt acted as a barrier to the westward progress of many plants, as it has to the eastern extension of many others. The more equable temperature, the moister atmosphere and the prevailing fogs, so pronounced on the immediate coast, especially of Nova Scotia, New Brunswick, Newfoundland and the St. Lawrence estuary, must exercise some influence inland as well, though this influence necessarily diminishes as the distance from the coast increases. A marked illustration of this influence will be referred to in the case of the British Columbia plants.

The most remarkable feature, however, in the eastern coast distribution, is the absence of such a large number of the familiar trees, shrubs and herbaceous plants of the Upper St. Lawrence valley. It is quite probable that the same local causes which favour the distribution of the species of this eastern coast group, may be prejudicial to the extension towards the coast, of many of these more inland plants now absent. Causes which affect even human life differently in different individuals, may equally well, even in a greater degree, we can readily suppose, have different effects on the plants of different species. It has always appeared to me probable that the dense fogs of the Nova Scotia coast may have something to do with the absence of such a northern and widely ranging tree as the white cedar, *Thuja occidentalis*, L.; and a similar cause, and the moister atmosphere generally, may have also some influence in limiting the range in both New Brunswick and

Nova Scotia of the white oak and butternut. A more immediate cause for the absence of Ontario and Eastern Quebec plants is, however, the lower temperature arising from the Labrador current, which, by a branch through the Straits of Belle Isle, extends its influence up the St. Lawrence on both sides towards Quebec, whilst its main stream, after washing the eastern coasts of Newfoundland, spreads along the Nova Scotia and New Brunswick coasts in its course south westward. Of the effect of this cold current on plant life on the immediate coast, there is no question.

ERIE GROUP.

The area in Canada in which this group of plants is distributed, is practically limited to that part of Ontario lying between Lake Erie and a line drawn from the eastern end of Lake Ontario to the mouth of the St. Clair River. This area is in the latitude of Southern Michigan and of Central and Southern New York State, and forms the most southern portion of Canada. It has, further, its climate modified by the proximity of the three lakes, Huron, Erie and Ontario. These facts sufficiently account for the middle temperate nature of the flora which, in its relations to Canada, has here been termed the Erie group.

The south-western peninsula of Ontario is also marked by the great variety in species of its trees, and by, in the past, their remarkable growth. It is possible to find on a single farm of two hundred acres, more than half of the species of trees which occur in Ontario. The peninsula is now well denuded of its large trees, but fifty or more years ago its splendid forests were the admiration of travellers. Near where the present city of London stands, were white pines six feet in diameter and one hundred and sixty feet in height, and magnificent button-woods averaging about eighteen feet in girth and sending upwards straight stems to a height of even thirty feet before branching. Farther north, these button-woods were sometimes found of nearly twelve feet in diameter. Oaks in the district watered by the River Thames, varied from ten to fifteen feet in circumference, and had often forty-five to fifty feet of clear, straight

stems. The stately elms were in great abundance and of remarkable size, attaining occasionally even twenty-five feet in circumference, whilst the tulip trees around Niagara were not only of considerable height, but were not unfrequently ten to twelve feet through.

The following plants are characteristic of this group:—

Liriodendron tulipifera, L.	Aster Shortii, Boot.
Asimina triloba, Dunal.	Solidago Riddellii, Frank.
Nelumbium luteum, Willd.	Coreopsis tripteris, L.
Corydalis flavula, Raf.	Gerardia flava, L.
Euonymus Americanus, L.	Hydrophyllum appendiculatum, Mx.
Polygala lucaroata, L.	Phlox subulata, L.
Agrimonia parviflora, Ait.	Sassafras officinale, Nees.
Cornus florida, L.	Morus rubra, L.
Nyssa multiflora, Wang.	Castanea vesca, L.

St. Lawrence Group.

It is a remarkable fact, pointed out by me some years ago, that a considerable number of the forest trees of Ontario in their range westward, come to an abrupt termination in Canada in the district lying between Lake Superior and the Lake of the Woods, whilst others are hardly seen west of the Sault St. Marie. In Ontario, there are sixty-nine species of forest trees, of which thirty-five are known either on the north or the south shores of Lake Superior. Of these thirty-five, only fourteen cross into the prairie region in central and southern Manitoba. Similar circumstances are apparent in an even greater degree among the shrubs and herbaceous plants. In Canada, many of these seem to be limited in their westward course by the outlet of Lake Superior, though in the United States they range more or less along the southern shores of that lake. The reason of this limit in Canada is readily understood when the rocky, hilly nature of the country around the northern coasts of Lake Superior and the boreal character of the climate there are considered.

The rough nature of the country immediately to the westward of Lake Superior—being successions for over three hundred miles of rocky hills, swamps, and large and

small lakes with their connecting rivers—has had, no doubt, its influence in limiting the distribution of many species there. As the prairie is approached, the drier atmosphere, the lighter rainfall, the more prevalent winds and the lower temperature must also have their effect on westward range. It has, however, always appeared to me that the gradual widening, by forest and prairie fires, of the prairie area in a direction easterly from the Red River, has been a leading cause in checking the farther westward extension of the eastern trees, shrubs and herbaceous plants presently confined to the country to the east of the Lake of the Woods. There is much reason to believe that the forest area may have at one time extended westward beyond its present limits in this district, even on what is now treeless prairie, but that fires—no doubt almost entirely since the advent of man there—have, by their annual depredations, extended the [illegible] gradually eastward, carrying with them the destruction not only of the trees, but of the numerous smaller plants which are dependent on or influenced by the vicinity of forest areas. Whether the whole prairies have been at one time covered with forest, may be open to question, but, as I have already shown in this journal, there is a strong probability that to forest fires, constantly recurring, may be attributed the gradual enlargement of the prairie area and the formation of new prairies within forest areas. Another visit to the Northwest Territories the past summer, has only confirmed this opinion. It may be objected that were this the case, the stumps and roots of trees should be found on the surface of the prairie. That they have not been more frequently observed is probably due to the rapid decay—one authority gives four years—of the stumps of the poplar, the almost universal tree of the prairies and the immediately surrounding forests.

The brief list hereunder given, enumerates species which range from the Maritime Provinces or Lower St. Lawrence to Lake Superior on either side, or immediately west of it. It is merely in its relations in Canada that the name St. Lawrence is applied to the group.

Acer Pennsylvanicum, L.
Acer saccharinum, Wang.
A. rubrum, L.
Waldsteinia fragrarioides, Tratt.
Dalibarda repens, L.
Rubus villosus, Ait.
Aralia racemosa, L.
Viburnum lantanoides, Mx.
Cephalanthus occidentalis, L.
Fraxinus sambucifolia, Lam.
Quercus rubra, L.
Q. alba, L.
Fagus ferruginea, Ait.
Betula lutea, Mx.
Pinus strobus, L.
P. resinosa, Ait.
Abies Canadensis, Mx.
Arisæma triphyllum, Torr.

Boreal Group.

The localities and their surroundings where the species of this group are found, sufficiently account for their presence now there. In regard to some which occur around the Lake Superior coasts, we can attribute their first migration thither to the same succession of circumstances which gave rise to the small colony of sub-arctic plants more or less associated with them there, and to which allusion will be made when referring to the sub-arctic group.

Illustrations of this group are:—

Anemone parviflora, Mx.
Sagina nodosa, Mey.
Oxytropis campestris, D. C.
Hedysarum boreale, Nutt.
Parnassia palustris, L.
Cornus suecica, L.
Viburnum pauciflorum, Py
Aster graminifolius, Psh.
Tanacetum Huronense, Nutt.
Artemisia borealis, Pallas.
Arnica Chamissonis, Less.
Lobelia Dortmanna, L.
Pinguicula vulgaris, L.
Rhinanthus Crista-galli, L.
Polygonum viviparum, L.
Pinus Banksiana, L.

Ontario Group.

The species referable to this group, and some of which are confined to Ontario, have, in general, in the United States, a range from Western New England to Wisconsin—a stretch of country in breadth about similar to that of Ontario. They occur chiefly west of the Appalachian chain, and do not appear to cross from the forest lands of Wisconsin into the prairie country of Minnesota and Dakota. Their northward and northeastward range in Canada is probably limited by the colder climate.

The following species sufficiently indicate the group :—

Viola rostrata, Pursh.	Conopholis Americana, Wall.
Ceanothus ovalis, Bigel.	Pentstemon pubescens, Sol.
Staphyllea trifolia, L.	Lophanthus nepetoides, Benth.
Desmodium cuspidatum, T. & G.	Gentiana alba, Muhl.
Lespedeza hirta, Ell.	Asclepias phytolaccoides, Pursh.
Aster ericoides, L.	Montelia tamarascina, Gr.
Lobelia syphilitica, L.	Phytolacca decandra, L.
Vaccinium stamineum, L.	Quercus castanea. Muhl.

A number of representatives of this group, including such plants as *Coreopsis verticillata*, L., *C. lanceolata*. L., *Cacalia tuberosa*, Nutt., *Calamintha Nuttallia*, Benth., and *Scutelaria versicolor*, Nutt., are limited to the vicinity of Lakes Huron and Erie, some extending even to Lake Superior. In the United States, their range is similarly confined to Wisconsin, Illinois, Pennsylvania and southward. It is difficult to give a reason for this. The suggestion which I have already made that, in geological time each species has had its initial, its maximum and its final stage of existence as a species, will, however, I think, explain numerous eccentricities in range everywhere. Whilst many plants, at the present time, are at their maximum stages of activity in individual growth and in reproduction, and have now their maximum breadth of distribution, some are merely in the early or initial stages of this activity, and at the initial points of their ultimate area of range, whilst others must be on the decline when activity in reproducing the species is lessening and the area of distribution is being circumscribed. The range of each species is thus vastly affected. When the stage of decline has been reached, climatal and other causes which would in the ordinary course limit range, would have greater effects on the species than upon others which were in the progressive stage of activity or had reached the maximum.

In these modern times, cultivation itself is having a limiting effect on the distribution of plants as well as animals. The yearly extension of the cultivation of the soil, the demands of commerce, the enlargement of towns and cities, and forest and prairie fires, all contribute annually to this result.

Prairie Group.

The plants peculiar to the prairies are of relatively recent creation—perhaps the most modern group of species existing in America. The prairies, as I have elsewhere stated in this journal, are of comparatively recent origin, and, in some sections, are still in process of formation, and only since this formation of these prairies can we conceive it possible that plants to specially give them an individuality, were called into existence. The variation which gave rise to them was, no doubt, brought about by the very nature of the surroundings—the drier atmosphere, the lighter rainfall, the greater exposure to the sun's rays, the stronger winds, the different and more uniform soil, and the absence of any marked physical surroundings. That many of the flowers there have a wide range is readily understood from the facilities they have for diffusion. The vast expanse of generally treeless, level or relatively level plain, exposed to the uninterrupted play of winds, and the generally uniform soil over great stretches of country, afford an opportunity not elsewhere possible for the diffusion and propagation of seeds. The large representation of the Compositæ—a comparatively modern order—and the vast abundance of the individuals of certain species of this order, are noticeable.

Of the influence of soils on vegetation, both in their chemical and mechanical combinations, there is no question, but this influence in Ontario and Quebec is chiefly observable when considering local floras. Gravel ridges or a stretch of sand will be found frequented or deserted, as the case may be, by certain plants, but the causes which in distant times produced these ridges or this sand operated with similar results here and there over vast sections. Other causes as well, acting simultaneously, or afterwards, mixed and distributed the surface soils everywhere in such a manner that it is difficult to indicate very broad areas of the country from Lake Superior eastward, where special soils, uniformily the same, are alone to be found to the exclusion of their occurrence elsewhere. Other influences acting over greater areas have, therefore, to be songht in study-

ing distribution. There are, however, illustrations of special, more or less uniform soils in the great deposits of black vegetable mould forming these newer Manitoba prairies, and possibly also in the drift deposits of the Missouri Coteau and other such localities, and these may be, in connection, however, with associated influences, found to have some effects on the distribution of species in these sections.

It is unnecessary to individualize this well-known group by a list of species.

Western Prairie Group.

Some species associated in range with true western prairie plants, appear to extend to the foothills of the Rockies, and even in individual cases climb the Rockies themselves. More information is needed with regard to the limits of this group. The following, however, in our present knowledge of their range, illustrate it:—

Cleome integrifolia, T. & G.
Arenaria congesta, Cham.
Malvastrum coccineum, Gray.
Linum rigidum, Psh.
Paronychia sessiliflora, Nutt.
Rhus trilobata, Nutt.
Lupinus Kingii, Watson.
Astragalus kentrophyta, Gray.
Potentilla fastigiata, Nutt.
Heuchera parviflora, Nutt.
Œnothera cæspitosa, Nutt.
Œnothera triloba, Nutt.
Centunculus minimus, L.
Plantago pusilla, Nutt.
Heliotropium curassavicum, L.
Polygonum imbricatum, Nutt.

Western Central Group.

The distribution of the members of this group from the Pacific Coast or the interior of British Columbia eastward towards or into Manitoba, is peculiar, but will be probably found to follow to some extent, the lines of mean temperature. The few species which occur in the Northern United States east of the Mississippi, have a general northwestward range. As more is known of the flora of the Saskatchewan and Peace River countries, the northern limits of distribution of many of the species of this group will, I think, be found to nearly parallel, as some do now, the trends of

mean temperature as they, in a northwestward direction, cross the continent. Others again may find the dry prairies east of the Rockies and the dry interior plateaus of British Columbia equally congenial. Much more information is, however, yet needed.

The plants hereunder, are examples of the group:—

Myosurus aristatus, Benth.
Vesicaria Ludoviciana, D. C.
Silene Menziesii, Hook.
Astragalus aboriginum, Rich.
Potentilla Hippiana, Lehm.
Crataegus Douglasii, Lindl
Œnothera albicaulis, Nutt.
Sedum stenopetalum, Pursh.
Grindelia squarrosa, Dunal.
Chrysopsis villosa, Nutt.
Helianthus annuus, L.
Artemisia fracmeuloides, Psh.
Troximon glaucum, Nutt.
Androsace occidentalis, Pursh.
Comandra pallida, D. C.
Euphorbia serpyllifolia, Pas.

Rocky Mountain Group.

Further enquiry into the range, as well eastward of the mountains, as in British Columbia, of the species presently referable to this group, is needed before the group can be definitely determined. Some of the plants specially referable to it can be classed as boreal, and are known, to the northward, to fringe outward beyond the mountains into the Mackenzie River district, and even towards the coast. There are also some alpine plants, entirely confined in Canada to the Rocky Mountains, and there are others—arctic species—which, whilst they have a considerable range along the arctic coasts between Hudson Bay and Alaska, seem to use the mountains as a ridge along the higher summits of which they extend into latitudes far to the southward.

The following plants presently exemplify the group, in so far as their range is presently known:—

Clematis Douglasii, Hook.
Aquilegia flavescens, Wats.
Lychnis elata, Watson.
Astragalus glabriuscula, Gr.
Oxytropis viscida, Nutt.
Rosa Fendleri, Crepin.
Parnassia fimbriata, Kœnig.
Bupleurum ranunculoides, L.
Cymopterus terebrinthus, T. & G.
Musenium tenuifolium, Nutt.
Brickellia grandiflora, Nutt.
Erigeron bellidiastrum, Nutt.
Cnicus eriocephalus, Gray.
C. foliosus, Gray.
C. Hookerianus, Gray.
Populus angustifolia, James.

British Columbia Flora.

Excluding the sedges and grasses, there are over four hundred species of phænogamous plants in British Columbia, which are not known east of the Rocky Mountains. This number will be considerably increased along both the northern and southern boundaries. The knowledge, however, of this distribution, within the province, of these species is as yet limited, and at this stage it seems better not to draw conclusions too hastily. It may be said generally, that there are species which are well distributed over the province, except probably in the most northern sections, and these may be termed the British Columbia Group. To those confined to the declivities, the valleys and foothills of the Rocky Mountains, and sometimes crossing to the Selkirks, reference has already been made under the term Rocky Mountain Group. Towards the Alaska boundary will yet be found further representatives, not only of the Alaska flora, but of the Asiatic flora as well. There may thus be, in time, sufficient material for an Alaskan or an Asiatic Group. At and towards the southern boundary of the province, are numbers of species familiar in Colorado, Nevada, California, Oregon, or Washington Territory, and whose range across the border into British Columbia is very circumscribed. These, as their centre of distribution is probably in or near Oregon, may be termed the Oregonian Group. Perhaps, however, the most remarkable, as well as the largest flora in British Columbia, is what may be fitly called the Western Coast Group. The greater rainfall, and the general proximity to the coast and to the numerous very deep inlets which indent the coast, are the influences which appear to more or less control the disposition of this flora, and to affect its range also in Washington Territory and Oregon west of the Sierras.

Dr. G. M. Dawson has given considerable attention to the flora of British Columbia and particularly to the distribution of the trees there, and what are here intended by the Western Coast and Oregonian Groups coincide in general terms with areas of his there.

I purpose at an early day, illustrating these British Columbia groups more fully.

Sub-arctic Group.

The Labrador current, which, laden with icebergs, descends from Baffin's Bay, and in a broad stream of three hundred miles, skirts the Labrador coast, sends an off-shoot of its waters through the Straits of Belle Isle, and past Anticosti, up the northern side of the estuary of the St. Lawrence. Meeting, as it proceeds upward, the warmer fresh waters of the river coming from the Great Lakes above, this branch current is diverted to the south coast of the estuary, where it appears as a stream, cold, but somewhat warmer than on the north side, and, proceeding onwards, finally leaves the coast at Gaspe. The effect of this cold current on the vegetation of the shores, is seen in the occurrence of a few arctic and many sub-arctic plants at the Straits of Belle Isle and on Anticosti and the Mingan Islands, and occasional sub-arctic species as far up on the north shore as Tadousac and Murray Bay. Even on the Island of Orleans, near Quebec, there are some boreal forms. The flora of the south shore of the estuary shows the milder character of the current there, whilst that of the Bay of Chaleur appears to prove its comparative absence in that locality.

On the jutting headlands of Lake Superior, and along the bays of its northern coasts, there are both sub-arctic and boreal plants, which appear to form an isolated group there. It is not difficult to account for their continuance in these localities. Northern species delight in a low, equable temperature and a moist atmosphere, and whether this is obtainable on alpine summits or on sea or ocean coasts, there they find a congenial home. The high northern shores of Lake Superior supply these conditions. To account, however, for their original presence there, it is necessary to go back to glacial or post-glacial times, when, with a somewhat colder climate, and with the area of the Great Lakes forming the bed of an inland sea, some sub-arctic and boreal plants found a natural highway along the coasts of this

sea. With lofty mountains to the immediate northward in glacial times, these plants were probably, then, not uncommon. As the waters receded and formed the present lakes, and the climate became as it now is, these northern plants were driven to localities like the headlands of Lake Superior, where conditions were favourable to their continuance. In all other localities they would disappear. Even on Lake Superior, the struggle with changed conditions must have resulted in the extinction there of many of the more northern forms.

The following are some representatives of this group and of the boreal group presently occurring around Lake Superior :—

Draba incana, L.
Viola palustris, L.
Parnassia parviflora, D. C.
Hedysarum boreale, Nutt.
Dryas Drummondii Hook.
Rubus arcticus, L.
R. Chamæmorus, L.
Erigeron acre, L.
Solidago thyrsoidea, Mayer.
Solidago virga-aurea, L.
v. alpina, Big.
Arnica mollis, Hook.
Vaccinium uliginosum, L.
V. cæspitosum, Mx.
Castilleia pallida, Hun.
Euphrasia officinalis, L.
Empetrum nigrum, L.
Tofieldia palustris, Huds.

Arctic Group.

The species of this group include many that are common to Scandinavia, Lapland and the higher Alps, and to our arctic coasts. Whilst numerous arctic plants find their way southward on the higher summits of the Rocky Mountains, on the Pacific side of the continent, and along the Labrador coasts, even up to Anticosti and the Mingan Islands on the Atlantic side, the home of this large group is in the great stretch of country, continental and insular, from the high northern coasts of Labrador, and Greenland to Alaska.

It is unnecessary to illustrate the group.

Relations of the Laramie Flora.

Since the last number of this journal was published, I have had an opportunity of seeing, in the publications of

the Geological Survey of the United States, Lester F. Ward's recent monographs on the flora of the Laramie group, and Sir William Dawson has shown me a proof of his paper on the same subject in the forthcoming transactions of the Royal Society of Canada. Whilst Ward still remains somewhat credulous about the age of the Laramie rocks, Sir William confidently refers them to the Lower Eocene, and concludes also that the Greenland flora usually referred to the Miocene is of later Cretaceous and early Eocene age, though he suggests the question whether this early flora of Greenland, and the floras of the Mackenzie River and North Western States—localities so far apart—may not have been successive within a long epoch in which climatic changes were gradually progressing. Ward's tables indicating the distribution of the Laramie flora not only geographically, but also through geologic time, are interesting to the student of distribution of existing plant life. They show—if the identification be correct—that four, and it may be five, of our living species, viz.: *Viburnum pubescens*, Pursh, *Corylus rostrata*, Ait, *C. Americana*, Watt, *Onoclea sensibilis*, L., and probably *Ginkgo biloba*, L., now of Japan and China, date their origin as far back as at least Eocene times, whilst many of the most familiar genera among the trees and shrubs of the present day were equally well, and in some cases more largely represented in this past period, though appearing for the first time then or in the middle Cretaceous. The tables also bring to light another circumstance of great interest in connection with the discussion, in an earlier part of this paper, on the identity, at the present day, between so many plants in Europe and America. Eleven species—all now extinct—were common to the Eocene of Europe and the Laramie of the United States, whilst two others—also extinct—were common to the European Eocene and to the Greenland beds, considered by Sir William Dawson as later Cretaceous and early Eocene. There is thus some evidence that in the later Cretaceous and Eocene times, not only was the climate in sub-arctic America sufficiently mild to admit there of genera which are, now at least, of a middle or possibly even southern tem-

perate type, but that the relations of land and water were such as to allow migration between Europe and America. Is it unreasonable to suppose that the land then sufficiently elevated above the sea to connect the old world with the new, may have been in a similar position in Pliocene or Post-Pliocene times, and have afforded the facilities then needed for the intermingling of the flora still existing at the present day on the two continents?

Pre-Glacial Drift Plants.

It is interesting to find that in the pre-glacial drift which is thought to be either Pliocene or Pleistocene, and which is spread over a considerable portion of the Middle and Southern States, palæobotanists believe they have recognized three of the existing trees of these States—*Magnolia glauca*, L., *Liquidambar styraciflua*, L., and *Quercus imbricaria*, Mx. These species do not range as far as Canada.

Age of the Canadian Flora.

The relative ages of the species which comprise the Canadian flora form matters rather of speculation, and yet, from the foregoing pages, it will be seen that there are some data on which to found opinions. The conclusions may be thus summarized:—The species of whose presence in the Eocene there is fossil evidence, are the oldest known representatives of the existing flora. Next to these in age, as species, are the plants common to Europe and America, for they were apparently already well distributed at the time of the deposition of the Leda clays. It is probable that many of the Arctic species, which are now limited to America, are equally old, but, just as many plants now have but limited ranges, they had not in these older times found their way beyond the American continent. The American species, not also European in range, but which are denizens of Japan, may be contemporaneous with these Americo-European species, or even earlier in origin. Two of the plants now common to Japan and America date back to the Laramie times. The plants confined in range to British

Columbia, form probably, a later flora brought into existence after the first upheaval of the great parallel chains of mountains there. Following on all of these older floras, but possibly contemporaneous in age with some of them, are the sub-arctic species now on the headlands of Lake Superior and the maritime plants presently on the shores of all of the Great Lakes. The most recent creations are without doubt those species—well represented by composite—which frequent more especially the newer prairies of Manitoba.

It is not difficult to see that the development of life on the earth from its dawn to the present time has been largely influenced by the vast changes which have proceeded gradually but constantly throughout geologic time. In the Laramie age, which was a prolonged period, the great central plains of North America parallel to and east of the Rocky Mountains, and throughout much of the length of the continent, formed a vast, perhaps relatively, shallow inland fresh water sea; during and after the glacial times, whilst an equally great inland, ice-laden sea again prevailed over the northern central parts of the same continent, the southern portions were dry land. In later cretaceous and Eocene times, the climate of the sub-arctic regions was, relatively speaking, warm; in glacial times and since, it has been so cold as to give a meaning of its own to the name arctic. During the tertiary times, the great dividing ridges forming the Rocky Mountains, were finally raised to their present elevations; whilst, as glacial times were passing away, the then much higher elevations and mountain ranges, which gave rise to the eastern glaciers of this period, were gradually lowered in elevation to what they appear at the present day. And these vast physical and climatic changes in tertiary and post-tertiary times are but an illustration of what has been going on from age to age from the very dawn of life upon the earth. What vast destruction of animals and plants each change must have occasioned! What a struggle for existence must have taken place among those which were left! What adaptation to new conditions in which the survivors constantly

found themselves, must have resulted! What changes in these animals and plants themselves must have been gradually brought about by altered habits and altered food, and by the process of selection which new surroundings would result in! It is not difficult to conceive how new varieties and species would from time to time follow, and how new genera would be created.

[NOTE.—Amid the great mass of material which it has been necessary to bring together in preparing this paper, it is difficult to single out special collectors without referring to all, but I think it right to acknowledge the assistance in regard to our far western flora which Dr. G. M. Dawson and Mr. Macoun's publications haven given me, particularly by indicating in nearly every case the precise localities of occurrence.]—A. T. D.