

shown in the illustrations cited, Regel's fig. 12 of the Asiatic plant showing the characteristically toothed scale, Boott's figs. *c*, *g* and *h* and Mackenzie's figure of the American correctly representing entire scales. The anthers of the Asiatic *C. macrocephala*, as shown by 4 staminate inflorescences before me, are 4.5–6 mm. long; in the American *C. anthericoides*, as shown by Boott's illustration and by several sheets of specimens, only 2–3.3 mm. long. The achene of the Asiatic *C. macrocephala* tapers to the base, that of the American is strongly rounded at both ends, as clearly shown in Boott's figs. *ff*.

Altogether, the specific distinctness of the plants of the two sides of the North Pacific is apparent. Geographically they parallel numerous other cases and it is at least worth noting that true *Carex macrocephala*, now establishing itself on the Atlantic coast of North America comes from the same region as the other sea-shore species, *Artemisia Stelleriana* Besser, which has rapidly fixed itself upon our coastal dunes and beaches. It is also not without interest that the coarse Sand Reed or Psamma of Atlantic America, *Ammophila breviligulata* Fernald¹ should have proved to be specifically quite unlike the European *A. arenaria* (L.) Link; but that the European, rather than the Atlantic American, plant should have made itself at home on the Pacific coast of North America.

(To be continued.)

DYNAMIC FORCES IN THE FLORA OF QUEBEC.²—In this interesting address, delivered by Frère Marie-Victorin, as retiring president of the Société Canadienne d'Histoire Naturelle, we have the Quebec Flora viewed as something dynamic, mobile, feeling the surge of life, and the constant impulse to change. The apparent stability of the flora during a period of years, or even a century, cannot hide the fact that all is changing. "Plant associations are living mosaics where slowly, parallel to the physical evolution of the ecologic factors, and often outside of it, substitutions take place. The equilibrium which impresses us by its apparent stability is only an equilibrium of the whole, and not the equilibrium of the parts; it is only a resultant, a product which remains apparently the same during very long periods at least, but the factors of which are subject to perpetual changes of order and importance."

The influences which affect the flora of a region may be classified more or less arbitrarily as intrinsic, those which arise from the possibilities inherent in the plant life itself, and extrinsic, those which arise from

¹ Fernald, RHODORA, xxii. 71 (1920).

² *Le Dynamisme dans la Flore du Québec*, par Frère Marie-Victorin. 89 pages, 42 figures, 1929. \$1.00. Contributions du Laboratoire de Botanique de L'Université de Montréal, No. 13.

modifications in the external or ecologic conditions under which the plants live.

The forces of evolution have first claim as intrinsic factors. The emphasis in evolutionary studies has been on lines of descent; here it is necessary to take a broader view of the subject, to consider the development of the whole flora. "The view which the flora of our country offers us, and the lessons which may be drawn by studying it attentively, can only strengthen this conviction that vegetable life continues a development begun long since, that it brings forth still more or less rapidly new specific or varietal entities, and that the possibilities of development are by no means exhausted by the actual development of the species and the normal development of the individual."

As examples of *discontinuous* evolution, Brother Victorin cites two species of *Senecio* which show veritable mutations, *S. pauperculus* with its forma *verecundus* Fernald and *S. Pseudo-Arnica* and its variation which is here elevated to specific rank as *S. Rollandii*. Both of these are found in abundance, for Brother Victorin usually has "des milliers" of plants before he is willing to venture a new description.

As the next instance of *discontinuous* evolution he cites the involved group *Crataegus*, fifty species of which, several endemic, are known from Quebec. "For the thorns are not forest species; their expansion demands dry places and abundant light. In prehistoric times all Quebec was covered with thick forests, and open places other than marshes and peat-bogs were decidedly rare. The thorns could only establish themselves with difficulty in little isolated groups along the watercourses. It is thus that we see them today at the limits of their distribution, at their vanguard, on the shores of Lake St. John, at Temiscaming and at Anticosti. It seems then that the great development of the genus in America is the immediate result of the break in ecologic equilibrium caused by deforestation. Not that the new environment thus created at once formed new entities in molding them to its conditions. That is an *a priori* concept that everything today forces us to abandon. It seems indeed rather that the species, because of a dynamic force which we still fail to understand, and under the stimulus of environment, produced by chance, in all directions, mutations which have in themselves no connection with either environment or utility."

An excellent map shows the different routes by which the species of *Crataegus* entered Quebec, and distributed themselves in the Province.

Evolution, apparently *continuous*, has produced many floral changes. Conspicuous among these is the differentiation between the gymnosperms of the Cordilleran region and those of eastern America, brought about at the end of the Cretaceous period, when an inland sea occupied the central part of our continent, and continued later by the wide belt of prairies which in the Tertiary took the place of the sea. Accordingly the western pines, fir and larch are parallel to our eastern species, but not identical with them.

Another change was brought about during early Tertiary (période nummulitique) when the North Atlantic land bridge between America and Europe gradually disappeared. Species which we now think of as distinctly American, like *Liriodendron tulipifera*, *Fraxinus americana*, *Tsuga canadensis*, *Sassafras officinale*, and even *Brasenia Schreberi* and *Dulichium arundinaceum*, had flourished in Europe during the early

Tertiary, but now became extinct there. Other plants which persisted gradually became different from their parallel species in America, till *Juniperus communis* is perhaps the only tree left which is approximately the same on both continents. "But the present flora of the Gulf of St. Lawrence contains a small but rather important little flora, the Alpine, Scandinavian or Baltic affinities of which are most startling. Certain elements like *Scirpus alpinus*, *Carex salina*, var. *kattegatensis*, *Polygonum acadiense*, *Carex vesicaria*, var. *Grahami*, have remained unchanged, while others like *Carex Hostiana*, var. *laurentiana*, of Newfoundland and Anticosti, have diverged more or less from the primitive type."

There followed the glacial period with its violent changes, and the milder interglacial epochs. In Quebec the *Ginkgo biloba* became extinct, and also several maples, among them *Acer pleistocenium*, closely parallel with *Acer platanoides* of Europe. During the last interglacial epoch the northern part of our continent seems to have been covered with a flora closely related to the Cordilleran flora of today. Scattered mountain peaks in the Shickshocks of Gaspé and other limited areas in Quebec, as well as much of the mountainous part of western Newfoundland escaped the general glaciation, either as nunataks rising above the level of the ice-sheet, or as lobal areas between diverging branches of the glacier. Numerous Cordilleran species survived in these places, and with the departure of the ice-sheet these spots became centers of endemism. The explorations of Fernald and his associates, as well as those of Brother Victorin and his Quebec botanical friends have made these known to science. Among the endemics which remained near their place of origin may be cited *Myriophyllum magdalenense* of the Magdalen Islands, *Antennaria eucosma* of Newfoundland, *Arnica Griscomi* of the Shickshocks, and *Draba pycnosperma* of Percé.

Other species have left the places where they survived, and spread. Among these may be mentioned *Botrychium minganense*, *Gentiana nesophila* and *Orobanche terrae-novae*. *Streptopus oreopolus* is of special interest, as it has been found on the White Mts., and recently by G. L. Stebbins, on Mt. Katahdin.

Another group of plants which show the dynamic forces still active in the Quebec flora are the estuarine plants investigated by Fassett,¹ especially *Bidens hyperborea* and its numerous variants.

So far the essay has dealt with constructive forces in the flora. "It seems also probable that under the continual influence of external conditions, certain species can retrograde and disappear through degeneration, although the facts are less easy to verify." Several types of the epibiotic Cordilleran group show a very clear retrogressive tendency. In this way may be explained, in reference to their type such variations as *Erigeron lonchophyllus*, var. *laurentiana*, *Draba luteola*, var. *minganensis*, and *Cypripedium passerinum*, var. *minganense*, recent discoveries of Brother Victorin in his summer explorations,² as well as other isolated species. "A law of death seems to weight down this Cordilleran group of plants, a law which reduces it to burying itself in protected ravines to escape the final destruction which awaits it. Which is the real cause here, intrinsic insufficiency or external pressure?"

¹ Fassett, N. C., *Bidens hyperborea* and its varieties. RHODORA xxvii, 166-171, 1925.

² Deux Epibioties remarquables de la Minganie, par Frère Marie-Victorin. Contributions du Laboratoire de Botanique de l'Université de Montréal. No. 12, 1928.

The intrinsic forces of evolution modify the flora profoundly in time, by modifying the elements of which it is composed. The extrinsic factors work much more quickly, not on the individual plant, but on the expansion of species and their grouping in time and place. Changes of climate and physiographic conditions are of first importance. Thus the mild climate which surrounded the Champlain sea even before all the glaciers had completely melted, may explain the northern extensions of such plants as *Lycopodium tristachyum* and *Solidago puberula* and the genus *Crataegus*.

There is some reason to think that the continental side of the strait of Belle Isle may once have been wooded heavily, though there are different explanations for the presence of large stumps at Blanc Sablon. At any rate there are found in this region, mixed with a strictly boreal flora, such plants as *Botrychium virginianum*, *Milium effusum*, *Carex Deweyana*, *Streptopus amplexifolius*, *Viola Selkirkii* and *Solidago macrophylla*, a group which only needs the spruce forest to be perfectly at home several degrees further south in the St. Lawrence valley, or in the Green Mts. of Vermont. In like manner there is some question as to whether the spruce forest which covers the north shore of Anticosti is not a case of the survival of the *existent*. There is much doubt whether under present climatic conditions such a forest could reestablish itself in that locality again. Local chilling of the sort which may be indicated here and at Blanc Sablon is, however, probably due to changing currents or something of the sort, and is an episode of no general importance, compared with the great climatic changes known to have occurred in the earth's history.

Human life has also had a tremendous extrinsic influence on our flora, for when man had once begun to domesticate plants, he had to wrest the soil from other species to make room for them. "When the shelter of the cave and the skin tent ceased to be sufficient for him, man with his stone axe attacked the tree, and opened the forest. Then began the deforestation of the planet, the contest of a spiritual factor against the agelong forces of nature. A most violent action of itself, deforestation released a whole series of dynamic reactions among the floras of the world." Important among these is the beneficent change of climate, which has already abated the rigors of such new sections as Abitibi and the region of Lake St. John.

Fire also broke loose as an agent for clearing the land. When left to itself the burnt land by a series of plant successions gradually tends back toward primitive conditions. But where the land is permanently cleared, European plants, mostly annuals, which have crossed the Atlantic with man, become quickly acclimated, "sometimes (as around the city of Quebec) nearly displacing the indigenous plants, and becoming veritable scourges." Other waifs have followed the railways and other routes of travel, some, an increasing number, coming from the west, and at least one, *Galinsoga*, from tropical America.

There have indeed been many changes since the old-time botanists first visited Quebec. "What would the spring be without the resplendent flowering of the dandelions; what would our summer fields be without the starry daisies, the caerulean touch of the chicory, and without the blood-tinged vividness of the orange hawkweed? And how different now are the shores of the St. Lawrence between Montreal and Three Rivers, with the rich mantle which the purple loosestrife gives to the

low islands, and the *Butomus* to the river flats!" This latter is a new-comer which in less than forty years has taken possession. "It is a fine example of the overturn which can be brought about in a flora by a single species, when it is well equipped and leaves its horde of enemies behind as it enters a new territory—a fine illustration of dynamic violence in time and space."

"From this rapid survey, some conclusions stand out, it seems, rather clearly.

"The intrinsic influences, forces of evolution or elimination which have dynamic influence on floras in general, and on the flora of Quebec in particular, are a function of the nature of organic beings, and will continue to work out slowly but relentlessly in the direction of development, or in the direction of retrogression.

"The extrinsic influences, which have to do especially with the intelligent activity of man, and his means of action on nature, are essentially more rapid and brutal. They tend to blend and blur the floras, to lead them to a state of equilibrium quite different from the natural equilibrium. By destroying barriers, by suppressing distances, by setting in motion agents of transportation which upset the agelong balance of the elements of the biosphere, they tend to establish on the planet a certain uniformity which would be a state of equilibrium analogous to that toward which the forces of erosion tend. But these extrinsic forces would gradually lose their intensity in case of the destruction of our civilization and a return to barbarism; they would cease to act with the disappearance of the human race. The old balance ought then to reestablish itself, in considerable measure. The hordes of plants long held in check by human toil, the plants of prey long treated as enemies, would advance over our fields, would rise to the assault of our cities and towns, would cover the ruins of them with thick masses of vegetation, while above the ashes of the human edifice, in an atmosphere become more pure, above an earth once more silent, would shine again, liberated, wild, yet magnificent, the torch of life."—CLARENCE H. KNOWLTON, Hingham, Massachusetts.

A *CALLITRICHE* NEW TO MASSACHUSETTS.—*Callitriche deflexa* A. Br., var. *Austini* (Engelm.) Hegelm. is one of the most obscure flowering plants. Prostrate upon the ground, little branched, with leaves "2-4 mm. long," it looks like nothing at all, or at most like sterile basal shoots which may later grow to be something. This probably accounts for its having been so long overlooked on one of the most frequented trails on Mt. Toby. Here it was first collected by the writer on 27 July 1927. It was seen again in 1928, but not collected again until 10 July 1929, as its rarity was not at first suspected. The identification has been kindly verified by Mr. C. A. Weatherby of the Gray Herbarium, who states that it appears to be the first collection of this species in Massachusetts. The Manual records its range as far north as Connecticut, only. This station is



Knowlton, Clarence Hinckley. 1930. "Dynamic Forces in the Flora of Quebec." *Rhodora* 32, 11–15.

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