

A MILESTONE IN BOTANICAL CARTOGRAPHY.¹ — Geobotanical investigations in general and studies on the distribution of taxa in particular were instrumental in forming one of the main pillars on which the theory of evolution rests. Likewise, this approach has greatly affected the development of taxonomic botany during the past one hundred years. It has also strongly influenced the understanding of the need for extensive collections and large herbaria wherever taxonomical and geobotanical studies are to be performed. It has been said that over-confidence in some of the hypotheses, advanced by this important school of thought has sometimes resulted in unnecessary splitting of species because of some geographical distinctiveness; a typical case may seem to be the thick volume XII of the magnificent Flora SSSR with its 849 species of *Astragalus*. There are also instances when too strong adherence to an originally fruitful hypothesis has counteracted further research on details seemingly offsetting these ideas. As a whole, however, the geobotanical approach to taxonomy and evolution has been one of the most prolific ones in botany in the past and it will certainly continue to be so for a long time to come.

In studying the distribution of species and their past history, different approaches have been tried. They have developed from the very schematical descriptions of areas given by Linnaeus and his predecessors, through the more elaborate outlines of Willdenow, Wahlenberg, and von Humboldt, to the more or less detailed maps of present-day publications. The distribution maps seem to have originated with DeCandolle, who used a few such outlines in his "Géographie botanique raisonnée" in 1855. They were, however, developed further by the influential Austrian school of geobotany, and then notably by its greatest representatives, Kerner von Marilaun and his son-in-law, Richard Wettstein. In later years, Scandinavian followers of this school improved considerably the methods of mapping and stressed the necessity of greater exactitude. As a direct result of this, the so-called dot-maps, on which small dots represent every collection or locality, have been employed in Scandinavian geobotanical and taxonomical works for many years. This scientific art has recently reached fulfillment in the well-known "Atlas of the distribution of vascular plants in N.W. Europe," worked out and published by Professor Eric Hultén of Stockholm in 1950. That Atlas gives exact maps of the known distribution in Fennoscandia (in its wider sense) of almost all the species occurring within the area. It is based on records in literature and on detailed studies in the main herbaria in these countries, which certainly are better known botanically than any other comparable area in the world.

¹ ERIC HULTEN: The Amphi-Atlantic Plants and Their Phytogeographical Connections. Kungliga Vetenskapsakademiens Handlingar. Fjarde Serien. Band 7. Nr. 1. Stockholm 1958. pp. 1-340.

In addition, more schematical maps show the general distribution of the species, but these are in no way detailed and are sometimes incorrect; they were never intended to be more than approximative.

Although Professor Hultén knows more about the distribution of the higher plants in the entire northern hemisphere than does anybody else, his interest has been focused on certain problems of past dispersals involving plants of Scandinavia and of the Beringian region. His studies on the flora of the latter area effected his coining of the now universally accepted theory of equiformal progressive areas, which may perhaps be regarded as an outgrowth of the age and area hypothesis. He was able to demonstrate, in 1937, that this theory could explain most distribution areas of plants on the continents, and also that it could give distinct indications as to the place of origin, or rather place of survival, of the different species. At that time, Professor Hultén tried to press this hypothesis to explain the distribution of all plants in the boreal zone, and especially those confined to a limited area in northwestern Europe and to a larger area in eastern North America. These are the truly amphi-Atlantic plants in the restricted meaning of the term, but Professor Hultén stressed that they could only be properly studied in connection with plants having larger areas, or what others have named bis-Atlantic distribution. Scandinavian botanists had long regarded the strictly amphi-Atlantic distribution as an indicator of a former trans-Atlantic land connection, but Professor Hultén maintained that if they were seen from his wider point of view these areas could more appropriately be explained as being remnants only of a formerly circumpolar area. Despite several indications to the contrary, recently reviewed in a good article by Dr. Eilif Dahl in the Norwegian journal *Blyttia*, Professor Hultén has vindicated this point of view in several articles and also in his Atlas, but the lack of adequate maps of the total extent of the species under discussion has made it almost impossible to consider the entire problem on a fully scientific basis.

In a recent book on "The amphi-Atlantic plants and their phyto-geographical connections," Professor Hultén has published a group of 279 maps of species which apparently are selected with the above-mentioned explanation in mind. These are the most accurate maps of general distribution ever published of so many species at the same time, and their reproduction and exactness are such that most remarks on them must be regarded as vague comments only. When all the boreal flora has been so mapped with the same care as given to these maps for Europe, this method of indirect inquiry into the history and dispersal of the boreal species will be exhausted and the hypotheses based on them will then have to be tested by aid of other and more exact approaches.

In the new book, Professor Hultén starts with a very readable and concise introduction, stating in a nutshell the present knowledge of the distribution of boreal plants in general and of his opinions as to the explanation of their areas in particular. This fascinating chapter is followed by information about the material on which the maps are based, and also about the plants included and excluded. In this connection it must be said that comparing the reasons given for the exclusion of some species, and the maps given of some others to which the same principles could have been applied, indicates that the selection has been somewhat arbitrary, but this cannot be avoided as long as all the species are not mappable. And the reader must keep in mind that there is a distinct tendency behind the selection, as stated in the introductory chapter. The bulk of the book consists of a short text about the individual species, on the left hand page, and detailed maps of two species or taxa, in dark-brown and greyish blue, on the right hand page. The book concludes with a list of references, a comprehensive, though far from complete, bibliography, and an index.

A detailed description of the maps is not possible; they have to be seen and studied to be fully appreciated. There is no doubt that future geobotanists will long draw upon the wealth of information here collected, and the book is likely to influence plant geographers in such a way as no other recent publication can do. American readers will probably be able to find a lot of "mistakes" or "omissions" in the areas of many species, whereas European botanists will have less opportunity to add to the information collected by the author. The reason for this discrepancy between the American and European parts of the distributions mapped is evidently caused by the fact that our present knowledge of the American flora is considerably more restricted than that of the European plants. Not only can this be seen by comparing the vast number of flora lists and treatments (both past and present) of small regions in Europe with the low number of such articles printed in America (and the difficulties in getting such treatments printed here), but it is perhaps best seen by comparing the number of specimens in European and American herbaria. European herbaria contain over 77 million specimens, whereas the herbaria in the United States and Canada, an area twice as large as Europe, contain only about 32 million specimens. Still more relevant to the present study is the fact that less than 2 million specimens of herbarium plants are available in Canada as a whole, and vast regions here are almost devoid of collections. Therefore, criticism of the maps for possible mistakes in this very essential part of the area should be made with this in mind, at the same time as caution in the hypothesizing is required just for the North American parts of the areas.

A rather common misunderstanding may seem to have affected the

author when he tries to explain the fact that considerably more species have been introduced into North America from Europe than the reverse way. He regards this as connected with the much greater disturbances by cultivation in the New World. Certainly, some weeds may have got an unexpectedly wide distribution in a short period because of this fact, whereas ecological and climatical conditions may counteract this to a certain extent. In order to get weeds established, however, even the most favourable conditions for dispersal within the country are of no significance if seeds are not carried over the ocean, and the main reason for the difference in number of introduced species must be the fact that considerably more seeds were transported westward than eastward. All the settlers brought with them effects of different kinds and seeds from their homelands, including many weeds. In addition, the fishing vessels carried fish only towards Europe but ballast westwards, and this ballast was very often soil which was carried ashore in the new country. The whole problem of introduction of plants and animals has recently been excellently studied in a book by a compatriot of Professor Hultén, namely in "The faunal connection between Europe and North America" by Professor C. H. Lindroth, the eminent entomologist. In that book the elimination of introduced species, before discussing possible dispersal routes of other plants or animals, is done more thoroughly than plant geographers have ever done with their material. Professor Hultén has excluded most introduced species, and he has mapped some others to show areas of no significance to the geobotanical problems aimed at. But although there is no doubt that the author has been very critical and correct in his selection in most cases, others are occasionally somewhat irrelevant, since only palynological studies can demonstrate with certainty the age of some of these plants in the flora. It is hardly very logical to regard a species as introduced in North America solely because it is introduced in New Zealand, but it is to be hoped that this kind of reasoning has not been employed on other species than *Juncus subnodulosus*.

Naturally, the species concept of Professor Hultén is based on that of the classical geobotanical school, but it may sometimes seem to be unnecessarily wide and other times it is unduly narrow. Because of his careful differentiation of what he believes are intraspecific races, this does not matter, since taxa which others may regard as species are usually shown with different signs. In a few cases, however, the usual caution has broken down, with worthless maps as a result. Examples of such inadequate maps are, e.g., those of *Molinia coerulea* and *Myrica Gale*. It does not matter that the map of *Eriocaulon septangulare* shows no distinctions between the endemic British species and the American *E. pellucidum* with which it has long been misidentified, but the map of what the author calls *Sisyrinchium montanum* is a complete mess,

including a mixture of *S. albidum*, *S. Bermudianum*, *S. montanum* s.str., and a still undescribed endemic species from Ireland. This last mixture is, perhaps, the very best demonstration of the fact that the morphological-geobotanical method, though excellent, is by no means sufficient for exact studies of this kind, since it cannot always prevent evolutionary heterogeneity being included into a single taxon.

Professor Hultén should be excused for ignoring recent biosystematic data which in fact would have added considerable strength to the arguments the maps are intended for, though not always in support of his own ideas. Also, unfamiliarity with cytogenetics alone is responsible for his attempts to use terms and explanations from this branch of botany to enhance his views on some species: his "cytogenetical" explanations of *Antennaria Porsildii*, *Draba fladnizensis* and *D. lactea*, and a few other groups are not supported by available cytogenetical evidence. Only in a very few cases does this affect the maps slightly, and the data in the maps are much more important than the good or bad judgments we may pass upon them now or later.

It is pity that all new combinations proposed, on pp. 16, 38, 52, 74, 96, 106, 146, 174, 204, 246, 262, 294, and perhaps elsewhere, are illegitimate since the author does not follow the old-fashioned rule for references to the basionyms in the text, as required by the International Code. It is to be hoped that at least some of these combinations will be legitimized elsewhere.

There are a few printing errors, none of them essential. The dot in Iceland for *Luzula pallescens* ought to be erased, and some mix-up has caused a dot on the same island for *Carex Hartmani* — the same dot is correctly placed for *Carex adelostoma* based on the same original information. Löve 1951 on p. 96 should be Löve & Löve, and Rousseau on p. 152 is probably an error for Rouleau. The specific epithet of *Carex macloviana* is everywhere capitalized by mistake. And several of the references mentioned in the text are not met with in the bibliography, which, nevertheless, is rather comprehensive and invaluable as a source for further literature on boreal geobotany.

In conclusion it must be said that this most recent one of the many outstanding contributions to boreal geobotany by Professor Hultén is a worthy addition to his long list of books and the most valuable map collection ever published. It is the very best basis available for discussions on the amphi-Atlantic plants. However, the problem of the origin of these areas cannot be properly discussed before maps are available of all the boreal and arctic flora, a task nobody can fulfill better than Professor Hultén himself. Even when such maps are available for the entire flora of the northern zone, they will have to be complemented by detailed evolutionary studies of each species and by extensive palynological investigations before all doubts are removed.

Although the present maps by no means can be regarded the final step towards the solution of this delicate and important geobotanical problem, they are undoubtedly a very important step in the correct direction. In this connection it does not matter if the explanation these maps are intended to support will prove to be right or wrong, since the main object of the compiler is, after all, not to vindicate his own old opinions but to get the correct explanation of the facts expressed in the peculiar areas of the relatively few species of plants with true amphi-Atlantic distribution.

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