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An outline of the history of the Irish vegetation

By Knud Jessen, Copenhagen

Following an appeal from Dr. W. Lüdi to give a short view of the history of the Irish vegetation on the basis of my paper, «Studies in late quaternary deposits and flora-history of Ireland» (Proc. Royal Irish Academy 52 B 6 1949) I have tried in the following to do so in grateful memory of the very interesting days of the 9th I.P.E. through Ireland in the summer 1949.

The Late-glacial time with its Zones I, II and III may be defined as the period in which the last general ice-cover (of the General Midland Glaciation) withdrew from Southern Ireland and exposed the lowlands of this country and, according to G. F. Mitchell, probably those of Southern Scotland as well. The sections of the late-glacial lake-deposits make it evident that the surface of the lowland in Ireland in Zones I and III, The Older and the Younger *Salix herbacea* period respectively, to a great extent was subject to solifluction. The plant remains in Zone I are rather few, but it must be suggested that an open tundra vegetation has been prevailing. In Zone II, the Alleröd-period, however, Ireland appeared as an oceanic sector of the sub-arctic Birch-region with scattered copses of *Betula pubescens* and, according to the NAP-curve of the pollen diagrams, stretches of open country which especially in the west were covered with heaths rich in *Empetrum nigrum* s.str. Other more or less oceanic species than *Empetrum* from this zone are the comparatively southern *Littorella uniflora* and *Eleocharis multicaulis*. In Zone III the birch-copses became reduced and a tundra vegetation and sub-arctic heaths spread again. Remarkable plants from these vegetations are *Salix herbacea*, *Betula nana*, *Dryas octopetala*, *Oxyria digyna*, *Thalictrum alpinum* and *Arenaria ciliata*, further a *Saxifraga* referred to *S. hypnoides* and *Arabis* cfr. *petraea*. *Betula nana* does not belong to the present flora of Ireland, and *Arenaria ciliata* is known from Ben Bulbin only, on the steep slopes of which it is supposed to be a glacial survivor. In Zones II and III

it is known from Ballybetagh on the northern slopes of the Wicklow mountains together with a rather rich Alpine flora, whereas at the present day the alpine plants on these mountains are very limited in number and confined to a few localities. The cause why this flora nearly totally has disappeared here may be due to the fact that most of the Wicklow mountains in post-glacial times have been covered by blanket-bogs also above the post-glacial timber-line. On the whole in Ireland alpine plants especially live on cliffs and steep slopes in the mountains where peat can not form.

While the NAP-curve of the pollen diagrams reaches high values in the late-glacial zones in mud from Zone IV, the Post-glacial Birch period or the Pre-boreal time, it decreases usually to low values indicating that now the wood—principally of birch and aspen—took possession of the country, just as was the case everywhere in northwestern Europe as a consequence of the fini-glacial climatic improvement. Of other Zone IV plants than *Populus tremula* which were new to the flora list may be mentioned *Calluna vulgaris* and *Ceratophyllum demersum*.

In Boreal time, which comprises the Hazel-Birch period (Zone V) and the Hazel-Pine period (Zone VI), the lowland and the lower mountains were covered with woods. The earliest macroscopical traces of pine (*Pinus silvestris*) derive from Zone V in which the pine-curve starts to rise, while in Zone IV as well as in Zone II it usually lies very low, and in these zones as in Zone III the pine-pollen is supposed to be due to wind transport from a distance or to be of secondary origin. In Zone V further appear the hazel, *Naias marina* (now extinct in Ireland), *N. flexilis*, *Cladium Mariscus*, *Rhynchospora alba* as well as *Erica Tetralix* and *E. cinerea*, and from Zone VI we have the first true records of oak (*Quercus*) and elm (*Ulmus*) and of *Crataegus* cf. *monogyna*, *Cornus sanguinea*, *Hedera Helix*, *Taxus baccata*, *Viburnum Opulus* and from near the top of the zone *Ilex Aquifolium*; further in a bog near Roundstone are found leaves of the type of *Erica Mackaii*, which is one of the Lusitanian species.

The most striking feature in the development of the vegetation of the boreal period in Ireland as well as in the other parts of northwestern Europe is the hazel-maximum which occurred in the lower part of Zone VI and attained extraordinarily high va-

lues in the northern part of the country with fertile soil. As a suggested reaction of some climatic factor probably it is approximately contemporaneous within the region mentioned.

Because the hazel (*Corylus Avellana*) only flowers a little when growing in woods the great boreal hazel-maximum suggests the existence of extensive hazel-shrubs. In the deep shadow of such the growing up of the forest trees will be hampered, and they did not spread definitively in Boreal time before the hazel decreased in frequency. Then the pine increased as did the oak and the elm. The last mentioned of these trees on eutrophic soil in the north often exceeded the oak in pollen-frequency in this zone and reached its often considerable post-glacial maximum earlier than the pine, which culminated in frequency a little earlier toward the southwest on oligotrophic soil than in the north; in the oligotrophic southwest the elm always has been without any greater significance.

The oldest dated traces of man in Ireland, the mesolithic Toome Bay culture, found in connection with a peat layer at the northern shore of Lough Neagh may go back to about the time of the boreal hazel-maximum.

At the beginning of Atlantic time, the Alder-Oak-Pine period (Sub-zone VIIa), *Alnus rotundifolia* (= *A. glutinosa* Gaertn.) quickly spread through the country, and also *Ilex* and *Hedera* became more common in this period. The woods still contained a certain amount of pine in company with oak and elm which in the pollen diagrams from the northern part of the country in places still may exceed the oak. Pollen of *Eriocaulon septangulare* has been recorded in mud from this sub-zone near Roundstone together with leaves of the above mentioned three *Erica*-species making it certain that this American plant must be indigenous in Ireland. From this period also derive the oldest records of *Ajuga reptans* and *Carex Pseudo-Cyperus*.

While the peat-formation of the pre-boreal and boreal zones exclusively belongs to the topogenous type or to the oceanic soligenous types in Atlantic time the raised-bogs and the blanket-bogs began to develop forming a well decayed peat. From this derive the earliest records in the country of a number of oligotrophic bog-species, i. a. *Eriophorum vaginatum*, *Scirpus caespitosus*, *Molinia coerulea* and *Oxycoccus quadripetalus*. The raised-

bogs especially developed in the North and in the Centre, and the blanket-bogs did so in the West and on the mountains, the two types together at last covering enormous areas of the country.

The climate was oceanic, and it appears to have been rather more moist in Atlantic than in Boreal time according to the fact that the relative frequency of layers of wood-peat found in the bogs was lower in the atlantic than in the boreal part of the sections. The transgression of the sea reached its maximum in north-eastern Ireland at the end of the period, and mesolithic cultures are found in the raised beaches. The suggestion that the temperature was relativ warm may be supported by the molluscan fauna in the raised beaches and by the wider distribution of *Ilex* and *Hedera*.

In Sub-boreal time or the Alder-Oak period (Sub-zone VIIb) the pollen frequencies of elm and pine became rather low, and the pine ultimately almost completely disappeared from the woods while the oak increased and often reached its post-glacial maximum. Alder and often hazel increased in frequency from the bottom of the sub-zone, and *Hedera* and *Ilex* reached their highest post-glacial pollenfrequency. Wood of *Fraxinus excelsior* is recorded from this sub-zone, but the tree undoubtedly is older in the country just as *Sorbus Aucuparia* must have immigrated earlier than in Atlantic time from which seeds of it have been noted.

The woods still covered also the lower mountains, and in the Wicklow mountains the timber-line lay at about 600 metres above the sea level, but in this period the first decline of the forest area has been noted locally in the west. The occurrence of pollen of *Plantago lanceolata* suggests that now the development of pastures had started. Many finds of implements of Neolithic and especially of Early- and Middle-Bronze age types have been localized in this sub-zone, from the beginning of which the farming started in Ireland with the growing of Small Spelt, Emmer and Naked Barley; impressions of grains of these culture plants have been found in Irish Neolithic and Bronze age pottery.

Macroscopic remains as well as pollen of *Myrica Gale* are recorded in the peat from the beginning of this sub-zone, in which the formation of highly humified ombrogenous peat and wood-peat is common. Toward the end of the period pine and birch often

migrated out on the bogs, and the peat formation in the raised bogs at last nearly came to a standstill. The climate was comparatively dry, and it is suggested that the summer temperature rose to its post-glacial maximum.

The following Alder-Birch-Oak period (Zone VIII) corresponds to the Sub-atlantic time which includes the historical times. The chief characteristics of the vegetation were the rapid growth of the ombrogenous bogs causing the formation of thick layers of fresh sphagnum-peat in the raised-bogs, the general increase in deforestation recorded by the rise of the NAP-curve, and the rise of the relative frequency of the birch. A general recurrence surface in the raised-bogs (supposed to be contemporaneous with Ry III in the Swedish and Danish bogs) separates Sub-zone VIIb from Zone VIII indicating a marked change from a relative dry to a more moist climate, and probably in this period the winds were stronger and the summer temperature lower. As results of this climatic change is understood the decline of the pollen-frequency of *Hedera* and *Ilex* and the fall of the oak-curve especially at the beginning of the zone. Later in this traces of two younger recurrence surfaces have been stated suggesting minor oscillations in climate.

This disappearance of the trees, which gradually meant a radical change of the appearance of the country, was accelerated by the grazing of cattle, the tilling of fields and the cutting of timber, but the nature of the climate which was less favourable for the tree-growth and particularly for the establishment of young trees probably was the fundamental reason why the trees gradually almost totally vanished, thus that in the first decennaries of this century less than two per cent of the area of the country were wooded.

A number of Late Bronze age bog-finds are recorded from the lower part of the zone. Later in this again a certain transgression of the sea is evident.

The much discussed question of the survival of the Irish flora during the last general glaciation should be seen in the light of the present knowledge of the late-glacial conditions of the country. In Zones I and III solifluction was an ordinary phenomenon in most part of the country, and in Zone III vegetation to a great extent had the character of tundra or sub-arctic heath. Ireland at

that time was lying north of the polar timber-line, and probably rather far to the north of it, because many of the species which immigrated into Ireland in the boreal period did so in almost the same order and, so far it can be seen, not earlier than they immigrated into Denmark, from which country the distances to the glacial refuges in central Europe were considerable.

Thus it may be suggested that during the last general glaciation of Ireland conditions prevailed in the ice-free southern part of the country and on the supposed refuges off the present shore to the south and to the west somewhat similar to those which characterized the greater part of the country in late-glacial times, when the ice-border withdrew to Scotland.

Provided the situation was as here suggested the glacial refuges in Ireland accommodated an alpine or oceanic arctic-subarctic and boreal flora, in which the birch may have formed thickets here and there, and in so far the state of affairs would not be unlike what we find to-day in South-west Greenland and in Iceland. But as a consequence of the lower geographical latitude, which meant more insolation than in those regions, there were conditions favourable to a richer flora of water and swamp plants and of photophile but rather thermo-indifferent dry-soil species, now missing in the arctic and sub-arctic regions, but known from the late-glacial flora of previously glaciated areas in Europe including Ireland, where they were represented by *Helianthemum* sp. (recorded by Mitchell), *Rumex crispus* and *Artemisia* sp.

As to the American element of vascular plants in the Irish flora the present distribution of most of these species (especially that of *Sisyrinchium angustifolium*) speaks in favour of the view that they may have been able to survive in Ireland during the last glaciation on favourable places as probably it also may have been the case with most of the Lusitanian species. However, it will be difficult to imagine a phanerophyte like *Arbutus Unedo* living north of the polar timber-line, and on the whole it is suggested that i. a. most of the woodland plants did reach the country only after the late-glacial period.