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SOME RADIO-CARBON DATES FROM THE RAISED BOG NEAR EMMEN (NETHERLANDS)

(pl. xxx; figs. 27-28)

During the last few years a fair amount of palynological research has been carried out on peat deposits from the south-eastern part of the province of Drenthe. In this connection a radio-carbon dating of some palynological levels which can also be observed in diagrams from other regions appeared to be desirable. For this purpose a peat monolith was collected in the raised bog east of the town of Emmen (Fig. 27). This raised bog forms part of the extensive bog found on both sides of the German-Dutch border, which for the greater part has vanished in consequence of intensive peat-digging.

The ^{14}C -measurements were carried out by Professor Hl. de Vries (Physical Laboratory, State-University, Groningen). The physical investigation was made possible by a grant from the Netherlands Organization for Pure Research (Z.W.O.). Most pollen counts were made by Miss G. Kempkes.

The english text has been improved by Dr. R. G. West (Cambridge).

On the spot where the peat monolith mentioned above was collected the following profile was recorded:

0- 7 cm	fresh <i>Sphagnum imbricatum</i> peat
7- 18 cm	fresh to moderately humified <i>Sphagnum papillosum</i> peat
18- 22 cm	fresh <i>Sphagnum imbricatum</i> peat
22- 32 cm	fresh to moderately humified <i>Sphagnum papillosum</i> peat with <i>Eriophorum</i>
32- 39 cm	fresh to moderately humified <i>Eriophorum</i> peat
39- 44 cm	fresh <i>Sphagnum papillosum</i> peat
44-185 cm	highly humified <i>Sphagnum</i> peat with <i>Calluna</i> and <i>Eriophorum</i>
185-252 cm	wood peat
252-299 cm	fen peat
299-306 cm	<i>gyttja</i>
306-314 cm	detritus <i>gyttja</i>
314-330 cm	<i>Hypnum</i> peat
330- cm	sand

The diagram prepared from the peat monolith is represented on Pl. XXX. For practical reasons this diagram is not published completely. In general only the

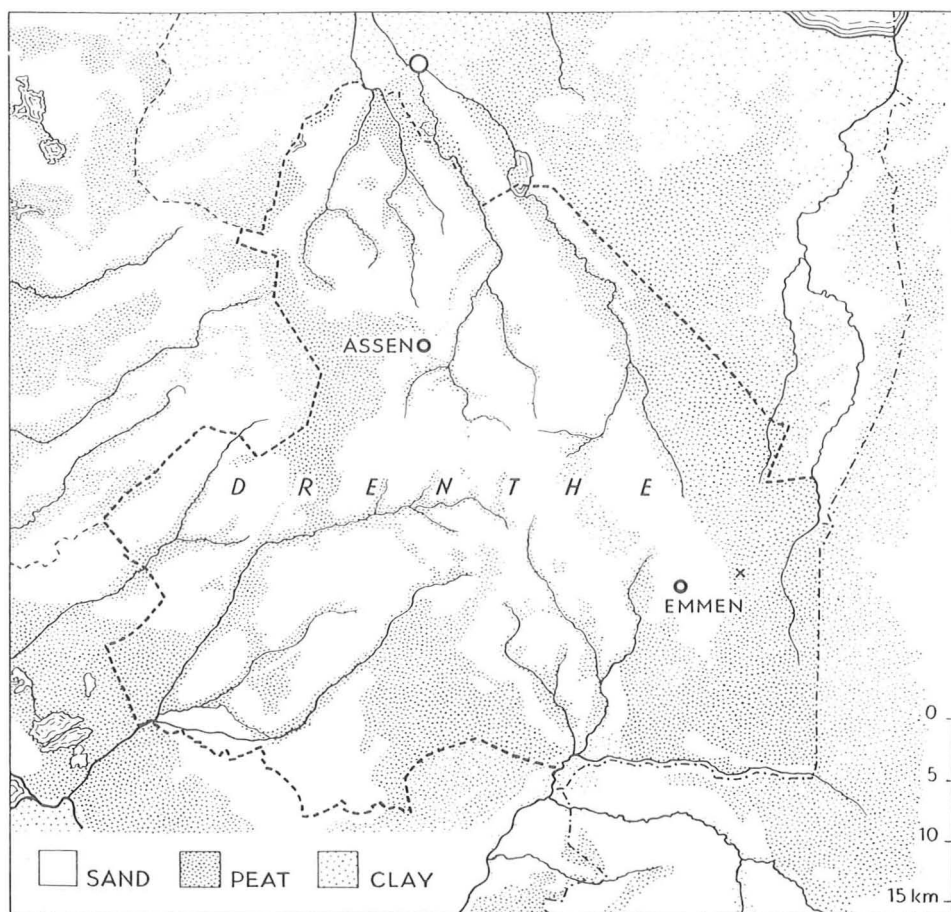


Fig. 27

curves for the trees and the herbs which are of importance for the interpretation of the diagram are represented. As afterwards some doubt arose on a number of "Cerealia", a curve for cereals is omitted. The distance between the successive spectra is 5 cm, and in the upper part of the diagram 2,5 cm. With the exception of the 9 samples at the bottom a number of 750-1000 tree pollen was generally counted in each sample, *Corylus* being included in the Σ AP.

The diagram of Pl. XXX agrees well with the diagrams already published from this region (cf. Van Zeist, 1955). For that reason this diagram will not be discussed at length.

The lower part of the profile, beneath a depth of 299 cm, was deposited during late-glacial time. In consequence of local circumstances the relation between tree and herbaceous pollen cannot be compared with that in corresponding deposits in small basins. It is probable that practically the whole late-

glacial part of this profile was deposited during the Allerød time. Both the lowermost samples perhaps still belong to the Lower Dryas time (relatively high percentages for *Artemisia* and Compositae, much *Selaginella* in the lowest sample but one). In the Allerød part of the diagram a birch phase and a pine-birch phase can be distinguished. At a depth of 299 cm, between the top of the *gyttja* and the base of the fen peat, there must be a stratigraphical hiatus in consequence of which the whole Upper Dryas time and a part of the Preboreal are lacking.

As in this profile the Late-glacial was developed incompletely and, moreover, because the interpretation of this part of the diagram remains somewhat hypothetical, no samples from this period were submitted for radio-carbon dating.

The Preboreal/Boreal border is placed at the first increase of *Corylus*. For this border an age of 6675 ± 180 B.C. (GRO 481) was found. According to Firbas (1949) it is not certain whether the so-called Rha time which lasted from 6800 to 6500 B.C. has to be included in the Boreal. The radio-carbon dating mentioned above cannot give an answer to this question.

In north-western Europe generally the Boreal/Atlantic border is placed at the level where the rising *Alnus* curve intersects the falling *Pinus* curve. In most cases where the distance between the successive spectra is fairly great, this intersection coincides with the strong increase of *Alnus*. This is not so in the diagram published here. For the sake of clarity the end of the Boreal and the beginning of the Atlantic are re-drawn in Fig. 28. This diagram only shows the curves for *Pinus*, *Quercus*, *Corylus* and *Alnus*. *Betula* is excluded from the Σ AP, as otherwise in this part of the diagram the course of the curves for the

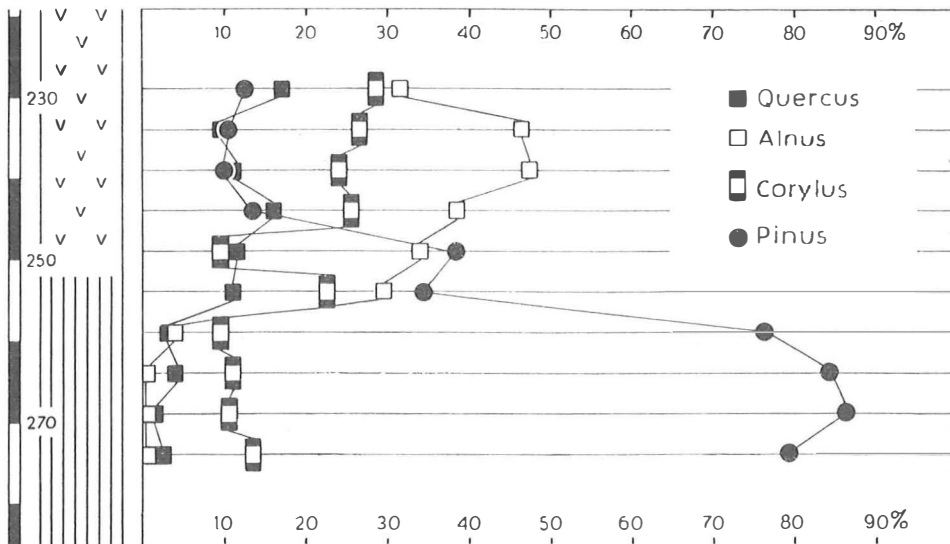


Fig. 28

other trees is too much influenced by the locally high *Betula* percentages. In the diagram of Fig. 28 it is clearly shown that the strong increase of *Alnus* takes place between 259 and 254 cm, whereas the intersection of the lines for *Pinus* and *Alnus* takes place at a depth of 248 cm. In other diagrams from this raised bog the same phenomenon can be observed. For that reason it would deserve recommendation to place in principle the Boreal/Atlantic border at the marked increase of *Alnus*, as Jessen (1949) and Mitchell (1951) did in their Irish diagrams.

For the big increase of *Alnus* an age of 5790 ± 135 B.C. (GRO 667) was obtained. This is somewhat older than the dating of about 5500 B.C. generally accepted up to now for the Boreal/Atlantic border. As the dating of 5790 ± 135 B.C. means that there is 70 per cent chance that the age of this sample lies between 5655 and 5925 B.C., there remains a real possibility that the actual age of this sample is still somewhat younger than 5655 B.C.

The ^{14}C -measurement of a sample between 249 and 254 cm gave an age of 5130 ± 210 B.C. (GRO 429). This sample was measured because originally the Boreal/Atlantic border was placed between 249 and 254 cm, supposing that this part of the diagram would more or less agree with the intersection of the lines for *Pinus* and *Alnus* seen in many other diagrams. As the distance between this sample and the preceding one amounts to only 5 cm, the difference in age obtained by radio-carbon dating is rather great. This perhaps could be an indication in favour of the possibility put forward in the preceding paragraph.

The Atlantic/Subboreal border is placed at the level where the curve for *Ulmus* shows a considerable decline. This decrease of *Ulmus* which can be observed in the diagrams from Ireland to Denmark is generally used as a zone border. From about the same level *Fagus* appears in very low percentages (0.1–0.4 per cent) in the diagrams from south-eastern Drenthe, and the first pollen grains of *Plantago lanceolata* are also found, indicating the presence of Neolithic farmers (cf. Iversen 1941, 1949). It must be mentioned that in one of the diagrams from this raised bog published formerly (Van Zeist, 1955, Fig. 4) the Atlantic/Subboreal border has to be placed at a depth of 205 cm, and not at a depth of 160 cm as indicated in that diagram. At the time the relatively high value for *Ulmus* at a depth of 170 cm gave occasion to this incorrect interpretation.

The dating of 3010 ± 135 B.C. (GRO 431) agrees well with other radio-carbon dates from this level (cf. De Vries & Waterbolk, in the press). An archaeologically important implication is that in the Emmen region Neolithic people immigrated at about 3000 B.C. This is earlier than generally supposed up to now.

The humic acid extract from this sample gave an age of 3165 ± 190 B.C. (GRO 432). This proves that no humic acid had been infiltrated from upper

lying layers, for otherwise the age obtained for the humic acid extract had to be significantly younger than 3010 B.C. Finally from this sample the hydrochloric acid soluble substance was measured: 2875 ± 400 B.C. (GRO 487).

In the Emmen region there is plenty of archaeological evidence. The *hunebedden* people were the first settlers. Bell Beaker immigrants (of the early western "pan-European" group) arrived at a later date. Late descendants of the Corded Beaker people came from northern and western Drenthe at a still later date as is shown by hybrid forms (cf. Van der Waals & Glasbergen, 1955).

The next sample measured lies just at the beginning of a conspicuous increase of *Plantago lanceolata*. From palynological investigations of Neolithic burial monuments—tumuli and *hunebeds*—it could be established that in contrast to those from *hunebeds* the samples from tumuli are characterized by high percentages for *Plantago lanceolata* and other herbs (cf. Waterbolk, 1954). On the ground of those results it is obvious to suppose that the increase of plantain at a depth of about 115 cm is an indication for the arrival of a tumulus people. The rather scarce pollen grains of *Plantago* below a depth of 120 cm must be ascribed to the activity of the *hunebedden* people.

For the sample at the beginning of the increase of *Plantago* an age of 2230 ± 140 B.C. (GRO 428) was found. ^{14}C -dates suggest a dating of about 2200 B.C. for the earliest Beaker immigrants on the Veluwe belonging to the central German Corded Ware group. An offshoot is found in western Drenthe.

At a depth of 62 cm *Fagus* reaches a value of about 1 per cent. This level corresponds with the beginning of the continuous *Fagus* curve in those diagrams at which 100–200 tree pollen were counted in each sample. On the evidence of the position of archaeological objects in raised bogs it could be established that in north-western Europe the beginning of the 1 per cent *Fagus* curve corresponds approximately with the transition from the Neolithic to the Bronze Age. In the sample dated at 1395 ± 140 B.C. (GRO 424) *Fagus* just shows a value of 1 per cent, so that according to this result the transition from the Neolithic to the Bronze Age must have taken place shortly before 1400 B.C. This is in good agreement with the dating of about 1500 B.C. for this transition arrived at on archaeological grounds.

In the diagrams from north-western Germany and the Netherlands a last *Corylus* maximum is very often present just previous to the final decline of the curve to a value of 10–15 per cent. It is not unlikely that this last *Corylus* maximum (C_4 of Overbeck & Schneider, 1938) is a synchronous phenomenon. For this *Corylus* maximum an age of 1140 ± 150 B.C. (GRO 426) was found.

Although just above the last *Corylus* maximum generally the values for *Fagus* are somewhat higher than beneath C_4 , the first important increase of *Fagus* starts at a depth of 21 cm. In this diagram the Subboreal/Subatlantic border

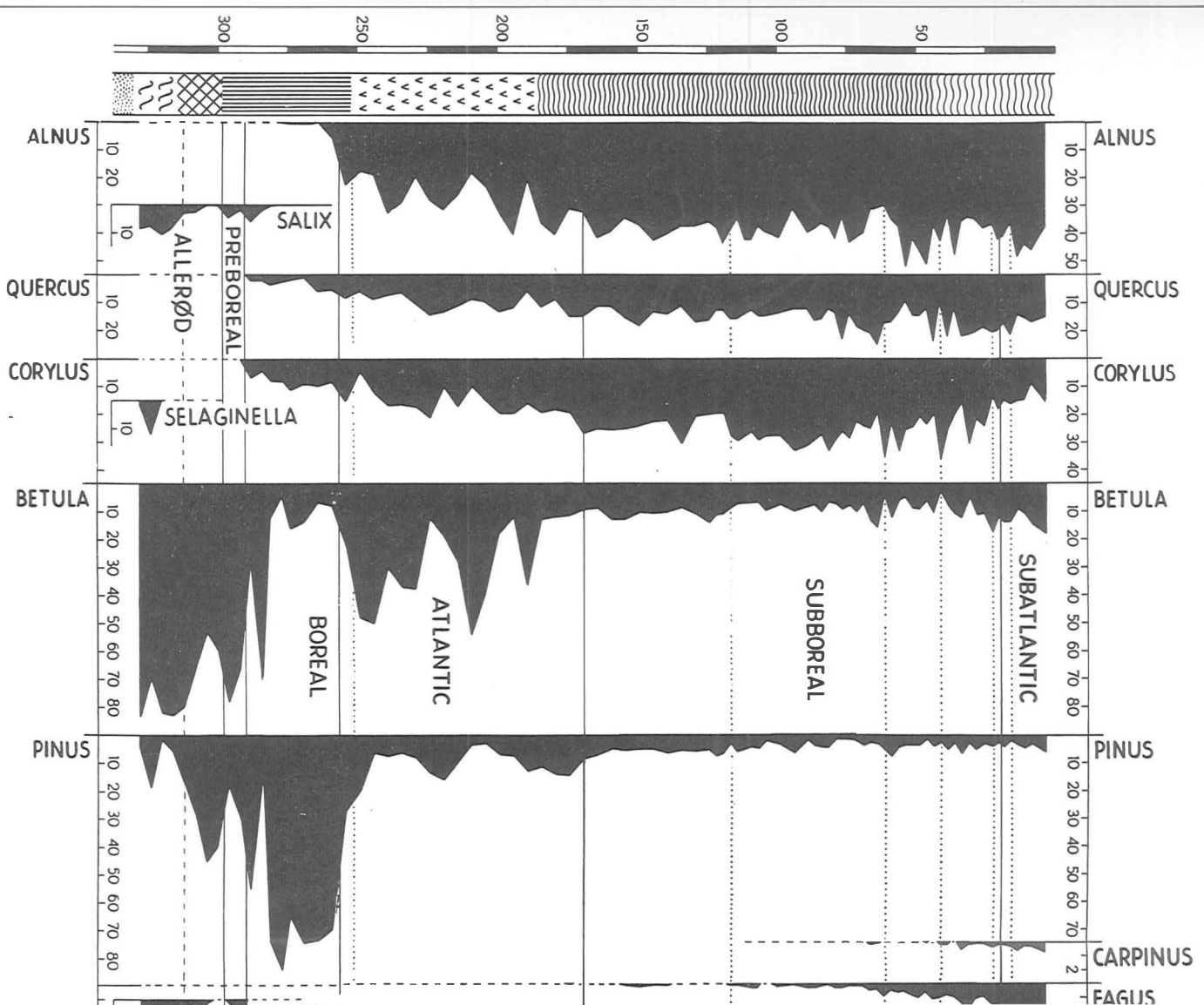
is placed at the beginning of this increase of *Fagus*.¹ A sample just below and one just above this zone border gave an age of respectively 915 ± 140 B.C. (GRO 480) and 645 ± 140 B.C. (GRO 479) on account of which the Subboreal/Subatlantic transition can be dated at about 800 B.C.

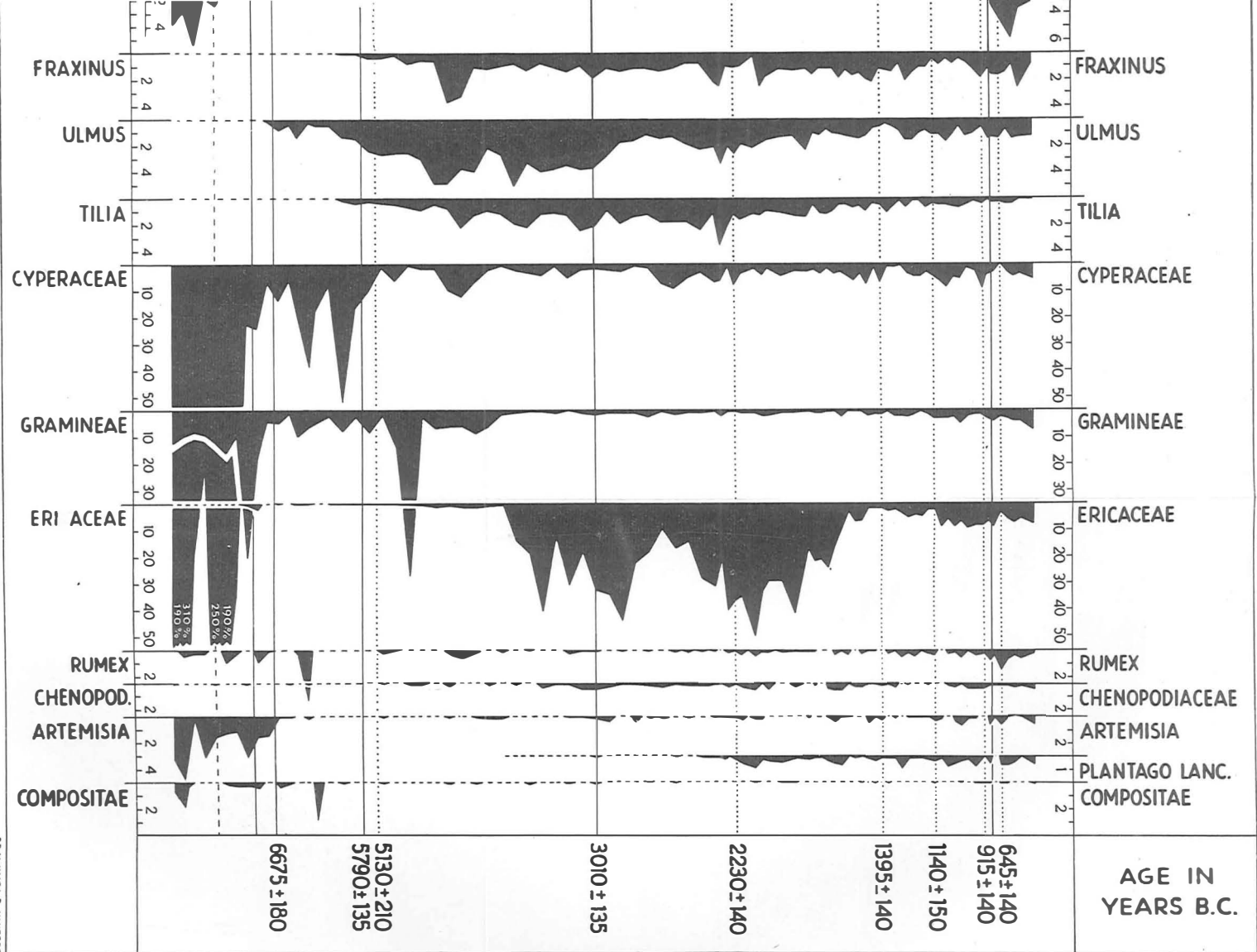
In consequence of buckwheat cultures the upper part of the peat has vanished, so that practically the whole Subatlantic period is lacking here.

¹ This zone border is placed here in concert with Mr. W. H. Zagwijn, Geological Survey, Haarlem (Netherlands).

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EMMEN (PROVINCE OF DRENTHE)





DRAWING: B. KUITERT

PLATE XXX