Zeitschrift: Veröffentlichungen des Geobotanischen Institutes Rübel in Zürich
Herausgeber: Geobotanisches Institut Rübel (Zürich)
Band: 34 (1958)

Artikel: Some radio-carbon dates in the postglacial vegetation history of the northern Netherlands
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DOI: https://doi.org/10.5169/seals-308102

Some radio-carbon dates in the postglacial vegetation history of the northern Netherlands

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About a century ago the greater part of south-eastern Drenthe (Fig. 1) was covered by raised bog. However, as a consequence of intensive peat-digging only a comparatively small part of these peat deposits have been left.

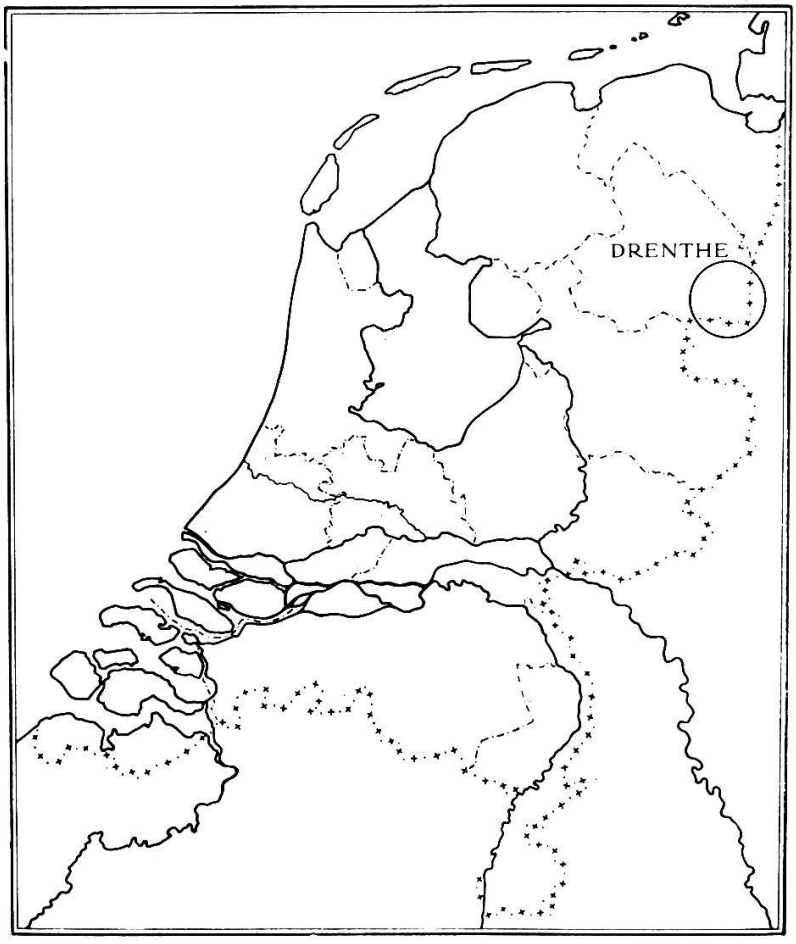

Fig. 1

During the last few years a fair amount of palynological research has been carried out in this area. In this connection the radio-carbon dating of some palynological levels of more than local importance appeared to be desirable. The ^{14}C-measurements were carried out by professor H. de Vries (Physical Laboratory, State University, Groningen).

As the results have been published elsewhere (Van Zeist 1955, 1956), they will not be discussed here in detail.

Fig. 2 shows a diagram from the Emmen region with the radio-carbon dates inserted on the right. The Preboreal/Boreal border is here placed at the increase of *Corylus*. For this border an age of about 6700 B. C. was obtained.

As there is some difference of opinion on the Boreal/Atlantic border we have submitted a sample from the middle point of the increase in *Alnus* and one from the intersection of the lines for *Alnus* and *Pinus*. Although the distance between both samples is less than 10 cm, the difference in age is rather great.

The level at which the curve for *Ulmus* begins to fall was dated at about 3000 B. C. At a depth of 120 cm *Plantago lanceolata* shows a conspicuous rise. On the ground of palynological investigations of burial monuments we are inclined to ascribe this increase of plantain to the invasion of a tumulus-burying people (beakers with protuding foot, cf. Van der Waals and Glasbergen 1955). In contrast with the settled farmers of the funnel beaker culture, these new immigrants were nomads, clearing large parts of the forest in order to get suitable grazing land for their cattle. The dating of about 2200 B. C. for the increase of plantain agrees well with the results of radio-carbon measurements from burial monuments of the tumulus people.

At a depth of about 60 cm *Fagus* reaches somewhat higher percentages. This level corresponds with the beginning of the continuous *Fagus*-curve in most diagrams from north-western Germany. On the evidence of the position of archaeological objects in raised bogs it could be established that in north-western Europe the first increase of *Fagus* corresponds approximately with the transition from the Neolithic to the Bronze Age. The sample dated at 1400 B. C. lies just above the increase of *Fagus*, 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.

The beginning of a more considerable increase of *Fagus*, constituting the Subboreal/Subatlantic border, could be dated at about 800 B. C.

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

From another site in the same raised bog, where less peat has vanished, the upper part of the peat profile was sampled. The most characteristic features of the diagram from this profile (Fig. 3) are the gradual decline of *Tilia* and the rise of *Fagus* and particularly of *Car-*

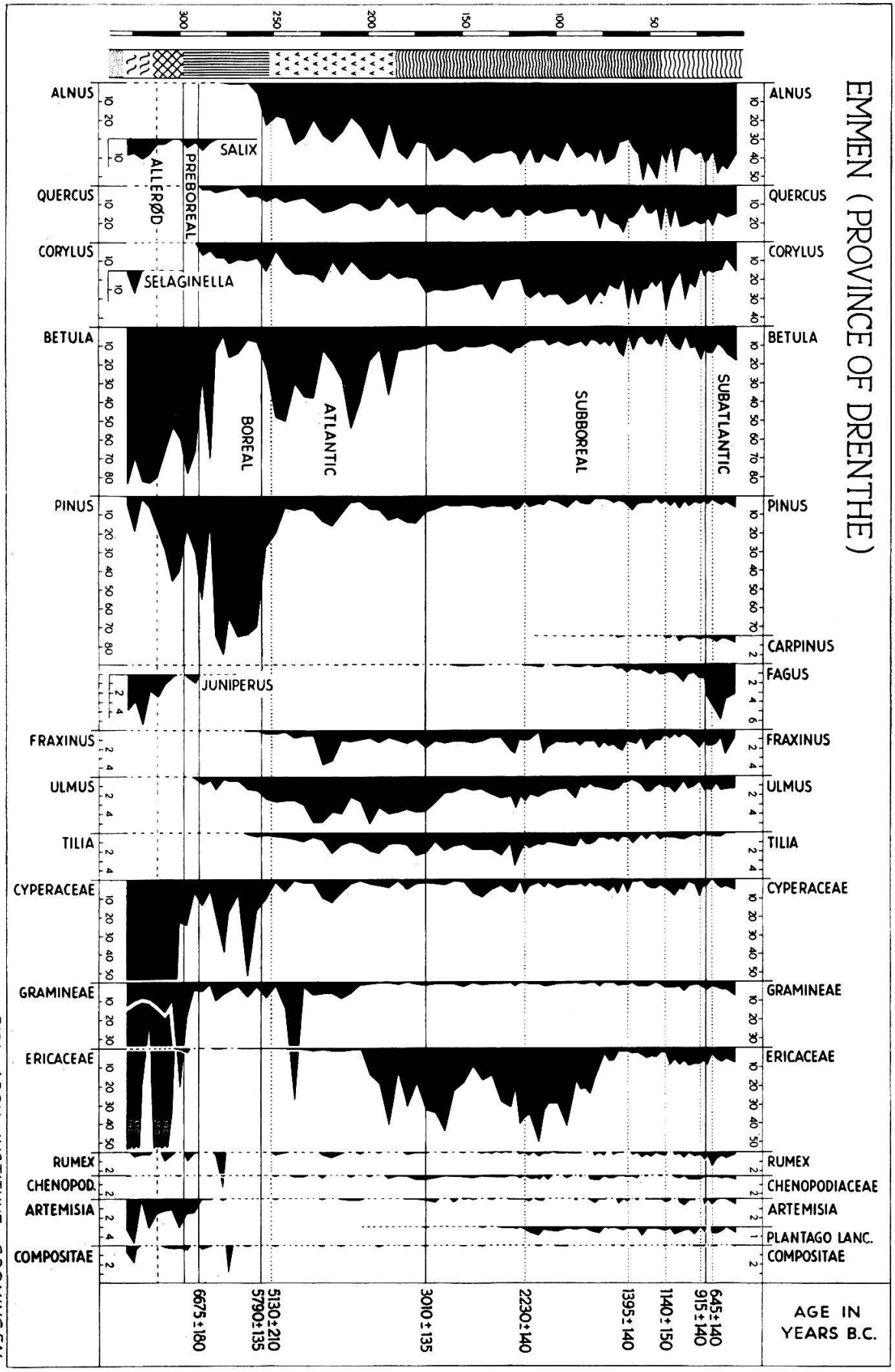
EMMEN (PROVINCE OF DRENTHE)
ALNUS
QUERCUS
CORYLUS
BETULA
PINUS
CARPINUS
FAGUS
FRAXINUS
ULMUS
TILIA
CYPERACEAE
GRAMINEAE
ERICACEAE
RUMEX
CHENOPOD.
CHENOPODIACEAE
ARTEMISIA
PLANTAGO LANC.
COMPOSITAE
SALIX
SELAGINELLA
JUNIPERUS
ALLERØD
PREBOREAL
BOREAL
ATLANTIC
SUBBOREAL
SUBATLANTIC
6675 ± 180
5790 ± 135
5130 ± 210
3010 ± 135
2230 ± 140
1395 ± 140
1140 ± 150
915 ± 140
645 ± 140
AGE IN YEARS B.C.
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Fig. 2

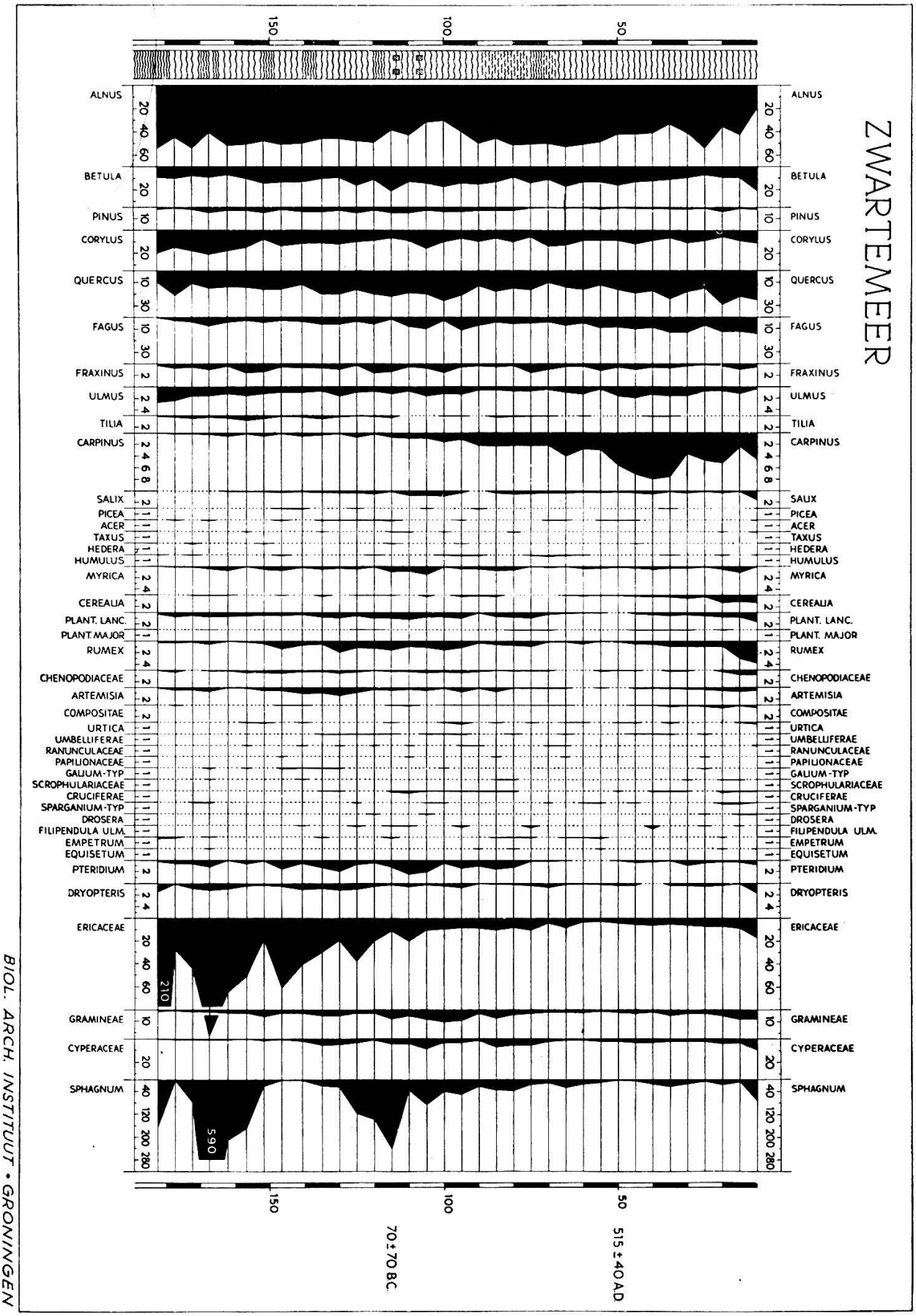
ZWARTEMEER
ALNUS
BETULA
PINUS
CORYLUS
QUERCUS
FAGUS
FRAXINUS
ULMUS
TILIA
CARPINUS
SALIX
PICEA
ACER
TAXUS
HEDERA
HUMULUS
MYRICA
CEREALIA
PLANT. LANC.
PLANT. MAJOR
RUMEX
CHENOPODIACEAE
ARTEMISIA
COMPOSITAE
URTICA
UMBELLIFERAE
RANUNCULACEAE
PAPILIONACEAE
GALIUM-TYP
SCROPHULARIACEAE
CRUCIFERAE
SPARGANIUM-TYP
DROSERA
FILIPENDULA ULM.
EMPETRUM
EQUISETUM
PTERIDIUM
DRYOPTERIS
ERICACEAE
GRAMINEAE
CYPERACEAE
SPHAGNUM
210
590
150
100
50
70 ± 70 B.C.
515 ± 40 A.D.
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Fig. 3

pinus. The first increase of *Carpinus* could be dated at about 70 B. C., whereas at about 500 A. D. this tree must have been very common in this region.

In connection with these radio-carbon dates some facts which may be of interest for the discussion of the post-glacial climate will be mentioned here briefly.

At the end of the Atlantic time *Fagus* arrived in the northern Netherlands. Then, for a long time, this tree was present here in small numbers. Evidently, conditions for an increase of *Fagus* were not favourable until the level where this tree attains a value of about 1 per cent.

There is reason to suppose that in the Netherlands it was an increase in precipitation which favoured the beech. From about the level where *Fagus* shows an increase the formation of *Sphagnum cuspidatum* peat started in various places in the raised bog of south-eastern Drenthe. The formation of this type of peat must have been the effect of an increase of rainfall, on account of which pools were formed on the surface of the bog. In these pools the hydrophilous *Sphagnum cuspidatum* could develop. The fact that the *Sphagnum cuspidatum* peat is highly fissile suggests that the pools dried up during the summer.

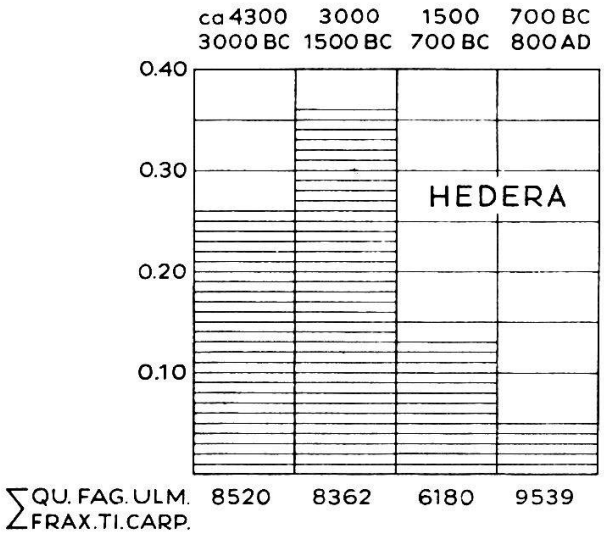

Fig. 4

The further increase of *Fagus* is preceded by another indication of a changing climate. Just before the rise of the *Fagus* curve the conditions for the formation of fresh *Sphagnum imbricatum* peat became favourable in this region. From that time on, the general humidity must have increased in such a way that in the large raised bogs the surface became sufficiently moist to establish conditions favourable for the growth of *Sphagnum imbricatum*.

Finally the behaviour of *Hedera* in this part of the Netherlands will be mentioned. The decline of *Ulmus* is not accompanied here by a similar fall of *Hedera* (cf. IVERSEN 1941, 1944). It is not until the first increase of *Fagus* that the *Hedera* values become considerably lower than in the preceding periods. This is shown in Fig. 4, in which the average frequency of *Hedera* is expressed as a percentage of a tree pollen sum of *Quercus, Tilia, Ulmus, Fraxinus, Fagus* and *Carpinus.* It is clear that there is a marked fall of *Hedera* after about 1500 B. C. On the ground of what has been said before it is highly improbable that this decrease of *Hedera* is to be ascribed to a more continental climate.

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