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The Influence of Prehistoric Man on Vegetation.

By

Johs. Iversen.

With 3 Plates.

Med dansk Sammendrag:
Det forhistoriske Menneskes Indflydelse paa Vegetationen.

I Kommission hos

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FR. BAGGES KGL. HOFBOGTRYKKERI
KØBENHAVN

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Preface.

The present paper is a verbatim copy of the original manuscript used in a lecture, which was given at the University of Cambridge 14th Oct. 1946. The views expressed in the context are in all essentials the same as in a more detailed paper published in 1941, but the basis of my interpretations is considerably wider. Four of the diagrams given here are quite new, they are worked out with the definite object of throwing more light on some aspects of the influence of Neolithic man on vegetation. The diagram from Sækkedammen shows an especially early settlement of short duration (Atlantic time). The peculiar circumstances prevailing in the infertile Jutland heath plains, is illustrated in a diagram from Tinglev Sø. Finally there is a diagram from a district, which differs greatly, both as regards vegetation and Neolithic culture, namely Mogetorp mosse in Södermanland in the Swedish Midlands, known from STEN FLORINS archaeological and geological investigations of the Mogetorp-Vråculture. Also the presentation and discussion of the material diverges from that in my former paper, and so with some reluctance I have followed a request, that I should publish the lecture and the pollen diagrams.

I acknowledge the assistance rendered by Dr. TAGE NILSSON and Dr. STEN FLORIN, who have kindly provided me with samples from Sækkedammen and Mogetorp respectively. I am also indebted to Mr. A. ANDERSEN, M. Sc., and to Mr. H. KROG, M. Sc., who have worked out the diagrams fig. 6 (A. A.) and fig 5 and 8 (H. K.).

The Influence of Prehistoric Man on Vegetation.

In the Atlantic period, Denmark was covered by continuous woodland, interrupted only by lakes and svamps. There would scarcely be any natural glades of any size and stability; in that favourable climate the trees would be close together and luxuriant. The only places where the forest would be of a more open character were on the less fertile heaths of West Jutland; pollen diagrams from there are characterized by relatively large numbers of grass and ling pollen, though there too they represent only a small percentage of the total of tree pollen.

The comparatively dark character of the Danish forest implied that conditions of living in it were unfavourable for animals, which means man too. The Mesolithic hunter and fisher cultures had to subsist under severe conditions, and large parts of the country must have been almost empty of human beings in the Atlantic period. There were still rich settlements, but only at the coast and along the rivers of Jutland.

Primitive Mesolithic man was entirely dependent on nature; he could not interfere much with the vegetation. The development of the woodlands was determined solely by climatic and other natural factors.

This picture undergoes a change with the coming of farmer culture. Man now proceeds to attack the forest, whereby he transforms his own living conditions. The event also signifies a turning point in vegetation development. A new factor comes into play, the factor which in the course of some millenia changes the continuous forest into an open cultivation landscape, where the very last vestiges of the primeval forest have disappeared.

The archaeological investigations well supported by botanical and zoological contributions have shown us quite a lot about the doings of the first tillers of land in the country. In particular, the excavations of Neolithic settlements in recent years have thrown much new light over the life of the Stone Age farmer, his houses, his domestic animals and his cultivated plants.

Here I shall however not dwell upon these important investigations, but I shall try to show how we can gain an insight into prehistoric man's influence on the vegetation by following another route, that is, by the help of pollen analysis.

In advance, we should presume it to be possible to find traces of prehistoric agriculture in the pollen diagrams by counting the pollen of cultivated plants and of weeds. As a matter of fact, von Post long ago suggested that the frequencies of cereal pollen might be utilized for registering the successive expansion of the tilled area. However, we had no solid basis for testing the suggestion until Firbas in 1937 pointed out that the pollen of cultivated species could generally by its size and associated characters be distinguished from that of other grasses. In the course of the next few years a number of scientists, headed by Firbas, actually demonstrated cereal-growing by means of pollen analysis[1]). But at the same time it transpired that cereal pollen is always extremely sparse in Stone Age sediments, no doubt due to the fact that cereals of that Age—wheat and barley—are self pollinators which do not release their pollen. Among cereals in general, rye is distinctly a wind-pollinator; it was introduced into Denmark in the Roman Iron Age, an event that becomes immediately noticeable in the pollen diagrams with a great increase in the number of cereal pollen. It is not until this juncture that the pollen curves for cereals acquire full significance as indices of the intensity of agriculture.

The other cultivated plants seem to have left little trace in the prehistoric pollen flora, though spurry (*Spergula arvensis*) pollen is occasionally quite frequent in Iron Age deposits.

Among our weed plants are quite a number of wind-pollinators with a large pollen production, and consequently these will be very prominent in the pollen flora of the culture-influenced areas. On the other hand, they are not all closely connected with civilization, having lived in the country long before agriculture came. Figure 1 will illustrate this point.

The diagrams express the pollen frequencies of goosefoot (*Chenopodiaceae*), mugwort (*Artemisia*), sorrel (*Rumex*) and plantain (*Plantago lanceolata*) in the various periods since the Glacial Age. The Roman numbers I to IX indicate Knud Jessen's nine pollen-

[1]) In Amerika E. S. Deevey (American Antiquity Vol. 10, No. 2, 1944) has succeeded in finding fossil pollen af maize (*Zea*).

diagram zones from Early Dryas period (Zone I) to the Sub-Atlantic period (Zone IX). I would point out that in this case I have quite exceptionally placed the border between Zone VII and Zone VIII in the oldfashioned conventional place, where the pollen curve for the Mixed Oak Forest begins to fall, as this characteristic feature of the pollen diagrams marks the beginning of the Neolithic epoch,

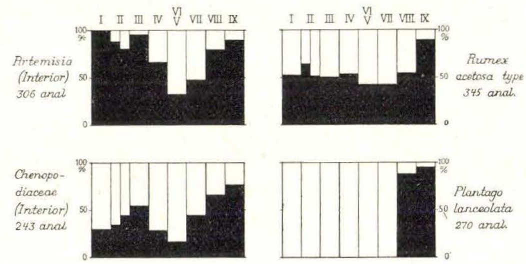

Fig. 1. Pollen frequencies of *Artemisia*, *Rumex* (*R. acetosa* + *R. acetosella*), *Chenopodiaceae* and *Plantago lanceolata* in the various periods since the Glacial Age (cf. the above). The diagrams express the percentage proportion of analyses with and analyses without pollen of the plant concerned.

Fig. 1. Pollenhyppighed af Bynke (*Artemisia*), Syre (*Rumex acetosa* + *R. acetosella*), *Chenopodiaceae* og Lancetbl. Vejbred (*Plantago lanceolata*) i de forskellige perioder efter istiden. KNUD JESSEN's zonesystem: I—III senglacial, IV præboreal, V—(VI) boreal, VII atlantisk, VIII subboreal og IX subatlantisk tid. Diagrammerne udtrykker forholdet mellem analyser med og analyser uden pollen af vedkommende planteart.

as we shall see. The diagrams express the percentage proportion of analyses with and analyses without pollen of the plant concerned. For example, the diagram for *Artemisia* shows that nearly all analyses from Late-Glacial time (I–III) contained *Artemisia* pollen, whereas it was not found in most analyses from the Boreal (Zone V–VI) and the Atlantic (Zone VII) periods. In Neolithic and later times *Artemisia* was again found in most analyses. The pollen of *Chenopodiaceae* exhibits a similar frequency distribution. In both cases the influence of civilization becomes evident. I should add here that the diagrams include analyses from the interior only, as *Artemisia* and *Chenopodiaceae* are common beach plants and therefore in shore deposits they should be treated with great caution as indications of culture influence.

The sorrel (*Rumex*) diagram differs from the others in that the great increase in pollen frequency does not set in until the Sub-Atlantic Zone.

Of course, it is quite evident that all these plants were growing before agriculture came, which to some extent limits their value as indicators of cultivation. This is especially true of *Chenopodiaceae*, which seems to have had a predilection for Mesolithic settlements. The same applies to the nettle (*Urtica dioeca*). On the other hand, the pollen of sorrel (*Rumex acetosella* + *R. acetosa*) occurs in large numbers in conjunction with agriculture only; in Sub-Atlantic time the sorrel pollen percentage is often surprisingly high in analyses from sandy areas, and there can be no doubt that this is pollen mainly from sheep's sorrel (*Rumex acetosella*).

Turning now to the diagram for plantain (*Plantago lanceolata*) we are struck at once by an entirely different appearance. With the exception of one single problematic pollen grain, the species has never been found below the zone border between VII and VIII, but it appears in 270 analyses above that horizon, which practically means them all, and which meant thousands of plantain pollen grains. We are compelled to assume that the plantain invaded the country at the time corresponding to the border between Zones VII and VIII. This handsomely confirms GUNNAR ANDERSSON's opinion which he expressed in his well-known book on the history of the Swedish flora. G. ANDERSSON asserted that *Plantago lanceolata* must have come to Sweden with civilization, although it is now so widespread everywhere that is seems to be native.

The greater plantain (*Plantago major*) seems to have immigrated with the early farmer culture too, though its pollen occurs with low frequency only. The same applies to the pollen of other weeds, for example those of *Polygonum* species, so that first and foremost it is the curve of *Plantago lanceolata* which in Danish pollen diagrams registers the commencement and changing intensity of farmer culture in the Stone and Bronze Ages.

I shall now adduce some evidence in support of this thesis. During the past few years the Neolithic culture in Denmark has been very thoroughly investigated. From early days it has been the custom to distinguish between two quite different Neolithic culture circles, the Megalithic culture and the Single Grave culture. It has long been agreed that the Single Grave culture came to Denmark with an invasion at a time when the Megalithic culture had already spread over most of the country and was in full bloom.

Our oldest agriculture belongs to this first part of the Neolithic culture, the part that is older than the immigration of the Single Grave people. Archaeologically this early part of the Neolithic period including the Dolmen period is unfortunately not sufficiently known, and pending investigation will certainly throw much new light on these problems in the near future[1]). As far as we know at present, we must assume that the plantain immigrated to Denmark during the beginning of the Dolmen period, so that the first pollen of plantain in a Danish pollen diagram actually marks the beginning of the farming culture in that particular region.

I shall now give an outline of the development of the pollen flora in the post-glacial warmth period in Denmark. The lowest part of the diagram fig. 2 belongs to the end of the Boreal period, the uppermost analyses to the beginning of the Sub-Atlantic period. Accordingly, the remainder represent the Atlantic and the Sub-Boreal period. The most characteristic pollen-floristic event within that long period is certainly a well-marked minimum in the Mixed Oak Forest curve, followed immediately by a high hazel maximum. We find this in many Danish diagrams, and the strange thing is, that the immigration and spread of the plantain is closely related to this event. Now, what does that mean?

The most obvious explanation would of course seem to be that this striking minimum in the Mixed Oak Forest curves expresses a transitory climatic depression. This indeed was my first assumption, but on going into matters thoroughly I came across a number of facts that are incompatible with this interpretation. In the first place, the detailed course of the curves agrees but badly with the theory. What happens is that parts of the high forest, here a lime forest, there an oak forest, suddenly perish, and this is followed by a typical forest regeneration. The birch, a pioneer tree, is the first to appear, but it is soon shaded out again. The hazel holds out longer, but finally it too is forced back by the regenerating high forest. It is not at all obvious that a forest destruction and

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[1]) Meanwhile an important paper of C. J. Becker has appeared (Mosefundne Lerkar fra Yngre Stenalder. Aarbog f. Nord. Oldkund. og Hist. 1947. København 1948). According to Becker the dolmens in Denmark belong to the last stage only of the Early Funnel Beaker culture, and thus they should be regarded as separate from the West-European Megalithic civilization. The term Megalithic culture used in the present paper does not agree with this interpretation, and ought perhaps to be replaced by the term Funnel-Beaker culture.

forest regeneration such as this should be brought about by a climatic depression. One would have anticipated a different course of events. For instance, it is incomprehensible why the hazel should be encouraged whereas the pine as a rule suffers from the assumed depression of climate.

In the second place, it is reasonable to suppose that a climatic depression would kill the specially warmth demanding wood plants first and foremost. But this does not happen at all; indeed, the mistletoe, which requires much more warmth than the oak and lime, was common in the critical period[1]).

However, may be the most striking evidence against a climatic interpretation of this phase is the circumstance I have already mentioned, that everywhere there is a close connection between the regular changes of the tree-pollen curves and the pollen curves for plantain and other weeds and for cereals. The first plantain pollen is always contemporaneous with the falling curve for the Mixed Oak Forest, and in all our diagrams the plantain reaches a maximum at the same time as the Mixed Oak Forest is at the minimum. It seems incredible that the first colonization of the farmer culture should be so synchronous at all the bogs that have been examined in the various parts of the country. This evident paradox disappears only if the similarity between the curves for tree pollen and culture pollen is due to their having changed for the same reason, which in this case must be: the forest clearance and land tilling of the first Danish farmer culture. I shal try to demonstrate that on the basis of this interpretation we are able to present a plausible explanation of the various curves associated with this curious phase of the diagrams, which for the sake of simplicity and in conformity with my theory I shall call the "land-occupation phase".

In Icelandic and Greenland bogs the pioneer settlement by the Norwegians is registered by a characteristic charcoal layer, the existence of which is due to the fact that on their arrival the Vikings burned off the shrub vegetation, whereafter herbs and grasses covered the burnt off area. Forest clearance by the Stone Age farmer must also have proceeded mainly by fire, and one might think, with a bit of luck, traces of it might be found.

We seems to have done so in Ordrup Mose, where there is a layer

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[1]) Of greatest interest in this respect is J. Troels-Smith's finding Grape pollen (*Vitis silvestris*) exactly contemporary with the minimum in the Mixed Oak Forest (according to a lecture by J. Troels-Smith in the Danish Geological Society).

of washed-down charcoal, quite a thin layer at the bottom of a very well-developed land occupation phase. In this very charcoal-layer we see an abrupt and exceptionally steep decline in the number of tree pollen per slide, a number which otherwise is fairly constant through several metres of fiord mud. In reality, by placing the pollen analyses close together over the assumed forest-fire-layer we can follow step by step the regeneration of the forest.

The analysis immediately above the charcoal-layer is still abnormally poor in tree pollen, whereas herbaceous pollen has a high relative maximum. Here too we find the first pollen grains of the plantain and several cereal pollen, showing that the forest clearance was connected with agriculture. In the following analysis the absolute pollen frequency of all trees increases rapidly: the regeneration of the forest has begun. However, the pollen frequency of birch, alder and hazel increases much more rapidly than that of the other trees, and this is the main cause of the steep fall of the Mixed Oak Forest curve in the tree pollen diagram.

The tree that pro'ited most from the clearance fire—apart from the hazel—was the birch. In all diagrams that are not complicated by macroscopic supply of pollen, birch reaches a higher pollen frequency in the occupation phase than at any time since the birch-pine period. This is very significant, for in modern times too birch is the principal pioneer tree after a forest fire. Its eminent dispersal and early maturity are important factors contributing to this, but not the only ones. In regions, where the soil is fertile, the birch does not appear after ordinary timber clearances not involving the use of fire. The explanation must be the fact that birch seeds germinate only when the soil is in a suitable condition; conditions for its germination are exceptionally favourable in ashy soil. The birch maximum in the occupation phase on rich soil—as in Ordrup Mose—is very weighty circumstantial evidence that the forest actually was cleared by fire. Allready long ago Gudmund Hatt has advanced the thesis that Danish farming in the Stone Age might have had the character of a rotation fire clearance.

We have several instances showing that the occupation phase appears as such a brief "episode" in the pollen diagram that, as in Ordrup Mose, it may be regarded as an expression of the succession after a local occupation with a settlement of short duration. In deposits in large lakes and fiords the curves often describe a smoother course, which evidently means that they are not conditioned by a single occupation fire, but are rather the reflection of a more gradual change in the forest picture of the surrounding country as a consequence of a whole series of forest clearances, made one by one as the farmer people possessed themselves of new areas.

In principle the same thing has been found in all parts of the country colonized by the Megalithic people. Everywhere we observe the same striking connection between the transitory decline of the high forest and the flourishing of a culture-conditioned pollen flora previously unknown. I think it will be rather difficult to deny that these are the traces of the Stone Age farmer's forest clearances.

However, as soon as we make an effort at arriving at a more detailed picture of what really happened, we find ourselves face to face with serious difficulties. While working on the material one cannot help forming a certain idea of what took place, but there are abundant chances of making mistakes. For this reason I shall not go into details, but shall merely exemplify one or two things which I consider are sufficiently evident. Wherever the occupation phase is of a local character, its violence and brevity are remarkable. This suggests that the colonization of a locality was a collective undertaking and that the people did not stay there long. A considerable number of people settled in an area and founded a settlement on a suitable spot. But first of all they had to clear the forest in order to provide feed for the cattle and open soil for the grain field. The primitive forest was quite unsuitable for grazing, being poor in grass and low bushes, but immensely rich in dead wood. Colonization was therefore initiated with a forest clearance by axe and fire, and thereafter rapidly shooting trees, bushes and herbs would be ideal food for the cattle which moved about loose. When the regenerated forest had again become so dense that a new clearance would be necessary, there seems to have been a general preference for moving to a new spot; no doubt the primitive forest with all its dead, inflammable wood was easier to set on fire than the secondary fresh vegetation. According to Dengler such a primitive form of farming is at present found in the most inaccessible districts of SE-Europe, on the outskirts of the primeval forests, e. g. in the Rouménian Carpathians, in Bosnia and other places.

This view has recently been supported archaeologically. On the subject of the Megalithic settlement of Troldebjerg, which he excavated, Johs. Winther writes: "On the whole I had the feeling that the settlement had been erected according to something so modern as a town plan. While still living at another place, they cleared the forest at Troldebjerg." Furthermore, WINTHER reckons that the settlement of Troldebjerg had a life of only a hundred years or so, and the same with regard to Blandebjerg and Lindø, two other thoroughly examined Megalithic settlements on Langeland. This agrees well with the periods one arrives at by estimating the length of the occupation phase in the pollen diagrams, when the occupation is of a local character.

The occupation phase in the infertile heath areas of Jutland seems to be faintly developed only. In particular, it is remarkable that the birch maximum is indistinct, notwithstanding the fact that on soil like this the birch is the pioneer tree in every forest regeneration. In accordance with this the characteristic rise of the culture flora is also very slightly developed. From all this we must draw the conclusion that in this part of Jutland the forest clearances evidenced by the occupation phase were slight in comparison to other parts of the country. This being so, it is extremely interesting to see that in large parts of the Jutland heath areas the Megalithic culture scarcely ever found foothold. Here again the conformity between the archaeological and the pollen-analytical observations is remarkable.

Now it is obvious that my interpretation of the Mixed Oak Forest curve minimum has its obscure points. Let us discuss the most important of them.

It must indeed cause some surprise that a primitive farmer culture was in a position to exert such an influence on the development of the Danish vegetation as that indicated by the diagrams. But two factors help to explain that difficulty.

In the first place it must be remembered that the occupation phase is a local affair which need not be—and in fact was not—synchronous in the various diagrams. In actual fact the colonization was very unstable; the communities often moved. The result of all this was that unusually large areas were affected—though temporarily—by man's interference. It may be added that if the minimum on the Mixed Oak Forest curve were ascribed to natural factors, then we should really be up against the difficulty of explaining the high Early-Neolithic culture-pollen maxima, which then would necessarily be synchronous all over the country.

In the second place, it must be emphasised that the tree-pollen diagrams give rather an exaggerated picture of man's attacks on the forest. The fact is that birch, alder and hazel produce much more pollen than the trees of the Mixed Oak Forest, the oak, lime, elm and ash. Consequently, a clearance followed by regeneration will cause a disproportionate oscillation in a pollen diagram, because the new scrub forest of birch, alder and hazel produces several times as much pollen as the same area of the primitive forest. If the opposite had been the case, the curve for the Mixed Oak Forest would have been very slightly affected by the regeneration stages.

In order to put matters in their proper proportions I have drawn some special diagrams in which the absolute pollen values for birch, alder, pine and hazel have been divided by 4 before the percentages have been calculated[1]). This can only mean an improvement over the old diagrams, inasmuch as the pollen production of these trees according to the investigations of POHL and others seems to be more than four times as great as that of the Mixed Oak Forest. Next, contrary to usual procedure I have included the hazel in the pollen total on which the percentages are based. In principle this is the more correct, because in actual fact the hazel competes on an equal footing with the other trees, and in some cases it is their superior owing to its greater ability to tolerate and give shade (e. g. in relation to birch and pine).

The diagrams as they look after making the correction are given in fig. 3–8[2]). I think there can be no doubt that they provide a better picture of the actual composition of the forest and of the extent of the clearance. The pollen percentages of cereals, plantains, *Artemisia*, sorrel and grasses are shown in silhouette in order to make a clear picture of the connection between the changes in the tree-pollen and the herbaceous-pollen flora.

The diagram fig. 3 is from Korup Lake (North Jutland), it is a section of the diagram already shown (fig. 2). The Mixed Oak Forest curve now lies high above all other curves, even when at the minimum. The same applies to the diagram from Søborg Lake in North Zealand (fig. 4). The diagram from Sækkedam in Zealand (fig. 5) is remarkable by the fact, that the occupation phase is unusually brief and distinctly local in its whole character; it comprises only 20 cm of a post-glacial profile of 8 or 9 metres[3]). The occupation

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[1]) cf. JOHS. IVERSEN. Discussion at the meeting: Nordisk kvartärgeologisk möte. 1945. Geol. Fören. Förhdl. Bd. 69. p. 241—242. Stockholm. 1947.

[2]) Of course these diagrams are not fitted for correlation purposes with classical treepollen diagrams; normally the latter therefore should always be given in addition.

[3]) cf. TAGE NILSSON, Geol. Fören. Förh. Bd. 57. Pl. VII, 18.

phases in these two diagrams are, obviously, not contemporaneous, the first one must be placed above, the second one below the zone border VII–VIII, which is plotted at a decline of elm and ivy, a decline that was undoubtedly conditioned climatically[1]).

In all these diagrams we can distinguish between three principal stages. The 1' stage is characterized by the sudden rise of the herbaceous pollen, whereas culture pollen (pollen of weeds etc) has made its appearance, though it is scarce as yet. This stage would correspond to the actual clearing of the forest and is quite brief. As this relative increase applies almost equally to all herbaceous groups, we may perhaps conclude that it is as much conditioned by a decline of treepollen than by any real increase of herbaceous plant pollen.

In the 2' stage we have a maximum of culture pollen. The tree vegetation is first characterized by the pioneer tree, the birch, but very soon the hazel predominates. We have a hazel scrub with birch and much grass and plantain on lighter spots. It will be noticed that the minimum point of the Mixed Oak Forest curve coincides exactly with the culture pollen maximum.

In the 3' stage the culture pollen curve falls steeply, the birch disappears and the high forest gradually regains the ascendancy. The hazel curve remains high for some time, and, as the hazel only flowers very little when it grows as underwood, we must still reckon with pure hazel scrub without high trees. It is a well known fact, one that VAUPEL first pointed out, that the trees of the high forest have difficulty in coming up in the darkness of a hazel scrub. We must assume that the settlement has been left at the beginning of this stage, and that the hazel immediately occupied the open spots.

This very characteristic development is found in all our diagrams with a pronounced minimum in the Mixed Oak Forest curve: the first brief stage with the rapid rise of herbs and grasses, the second stage with grassy scrub and farming, and finally the third stage when settlement with its cereals and weeds ceases, the birch disappears, but the high forest makes only slow progress in gaining over the hazel.

Finally we have a diagram (fig. 6) from Tinglev Lake in a South Jutland heathy region with very little Megalithic culture. The minimum on the Mixed Oak Forest curve is very indistinct, the birch

[1]) It is evident that the curves of elm and ivy must be affected heavily by the clearance, but at Sækkedammen their curves bent to the right as soon as the Mixed Oak Forest regenerates, just before the climaticaly conditioned decline is starting.

maximum is absent altogether. Nevertheless we see that the minimum point on the Mixed Oak Forest curve coincides with the only low maximum on the plantain curve, but the other curves of herbs do not reflect any forest clearing.

And to conclude, I can show a diagram from a different region altogether, from Mogetorp in Middle Sweden, where the Swedish archaeologist STEN FLORIN has excavated an Early Neolithic settlement. Natural conditions are quite different there, and the same applies to the archaeological features.

The diagram (fig. 7) shows a distinct forest clearance phase: the local lime-elm forest perished, but the regeneration takes a course that is somewhat different from that in Denmark, as might be expected. The beginning is pretty much the same: immediately after the clearance we observe a sudden rise in the pollen of the herbaceous plants, especially the grasses and *Pteridium* (cfr. p. 20). Then follows the birch maximum, but now much more pronounced, whereas the hazel does not rise at all, on the contrary. Pollen of cereals and *Plantago major* bear witness of cultivation, but we miss the best indicator, *Plantago lanceolata*; in its place we find a maximum of *Melampyrum*. Another feature that differs from conditions in Denmark is that the pine takes its place as a step in the succession between the birch stage and the final oak-lime climax forest.

Turning now to the other great Neolithic culture circle in Denmark, the Single Grave culture, which corresponds to the English Beaker culture, we shall find that its influence on the tree-pollen flora differs still more. In diagrams from the heaths of Jutland, where the Single Grave culture dominates, a little above the indistinct minimum of the Mixed Oak Forest curve there is a marked rise for grasses and plantain, but the characteristic succession that indicates a clearance fire is missing. As a consequence we may assume that the farming culture of the Single Grave was people of another character than that of the Megalithic people, and indeed that assumption agrees with the opinion of the archaeologists. THERKEL MATHIASSEN has shown recently that the Single Grave people did not live together in closed settlements like the Megalithic people, but were scattered over a wider area; and in his treatise on the Jutland Single Grave culture P. V. GLOB speaks of a nomadizing equestrian people who lived by animal husbandry and at first would hardly know agriculture at all. They kept to the relatively open and grassy landscape of West Jutland, where the forest was not so dense that it needed clearing by fire. It is another matter that in the long run cattle grazing might well become a danger to the forest on that poor soil.

However that may have been, it is a fact that the typical occupation phase is to be found in conjunction with the Megalithic culture only. It may seem strange that the great deforestations of the Iron Age are not so clearly indicated in the tree-pollen diagrams, but in reality it is not so difficult to explain. What is registered in tree-pollen diagrams is, as we have seen, not the clearance itself, but the subsequent regeneration with its various stages. As soon as farming becomes so intensive that the forest is held down permanently in the cleared area, the clearance in a homogeneous woodland can no longer be indicated clearly in the tree-pollen diagrams[1]). This is not saying that the influence of civilization on the tree-pollen flora is less than before; but it has been deprived of its simple and perspicuous character. Clearance will now chiefly be registered by the quantity of herbaceous pollen, especially culture pollen, increasing in proportion to the quantity of tree pollen.

It is in this manner first and foremost that man's next great attack on the Danish vegetation is manifested. It begins in the early phase of the Iron Age, and it is much more radical than before. It is only now that the great forest destruction begins and leads to the open culture landscape. In the poor sandy regions of Jutland the ling immigrates into deserted, formerly tilled areas and the first extensive heaths appear.

However, I shal not go further into this stage of man's influence on the development of Danish vegetation. I have confined myself to what actually were agriculture's pioneer days, the phase of which we know least. Thus it will be understood that in many ways the outline shown bears the stamp of incompleteness. It is to be hoped that future research will throw light upon much that is obscure today.

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[1]) If the pollen of herbaceous plants is included in the pollen total, all treepollen curves show distinct decline, after clearance, in diagram, — not only the Mixed Oak Forest curves, as is the case after clearances in Early Neolithic time.

Postscript.

In an interesting paper which has just been published TAGE NILSSON[1]) maintains that the Sub-Boreal minimum in the curve of the Mixed Oak Forest is determined by climatic conditions, while he acknowledges that the contemporary maximum of *Plantago* etc. must be due to Neolithic farming.

Against my interpretation TAGE NILSSON advances five arguments, which below I shall comment on one by one. Three of these (numbered 1, 2 and 4) only apply to the special conditions found in the section in Ordrup Mose and I shall deal with these first.

Re 1 and 2. The stratum of charcoal found in the above mentioned section TAGE NILSSON regards as presumably derived by flowing out of material from the Mesolithic settlement Bloksbjerg, e. g. during particularly highwater level. The great decline of the density of tree-pollen in this stratum is explained as caused by presumed changes of the sedimentation conditions in the last phase of the marine stage of Ordrup Mose.

I admit that TAGE NILSSON may be right in his interpretation of the charcoal-layer in Ordrup Mose even if the exact concurrence of this thin stratum with the passing decline of the absolute treepollen frequency, the start of the "land occupation phase" and the first appearance of *Plantago lanceolata* is not explained by TAGE NILSSON's conception. A conclusive solution of the question demands thorough stratigraphic-pollenanalytic investigations, which can now scarcely be undertaken, as the adjacent area of Ordrup Mose is occupied by villas and gardens. On the other hand a thorough investigation of the herb pollen of the sample just above the charcoal layer would be instructive. Unfortionately the analysis of this sample is imperfect, as most of the material was used up on an earlier occasion (diatom analysis etc.), so that the number of treepollen counted was 260 only. Instead of a further discussion of the old analyses, I shall bring a fresh diagram from the deepest spot in the bog, where conditions are less characterised by local influences than was the case in the section formerly taken nearer the margin. The new more detailed diagram has been analyzed at D.G.U. by H. KROG, M. Sc.

[1]) cf. list of literature p. 23.

A comparison between the classical treepollen diagram (not shown here) and the corresponding older diagram (published in my earlier paper) indicates indisputably that the stratum of charcoal in the former section corresponds to the analyses 5 and 6 in the fresh one (cf. fig. 8, which has been prepared on the same principles as those shown in fig. 3–7). An indistinct minimum of the absolute frequency of tree-pollen in these two analyses followed by a constant increase is consistent with this connection. At the same level the relative frequency of herbs increases abruptly and the first pollengrain of *Plantago lanceolata* appears. Simultaneously the curves for *Pteridium*[1]) and for entomogame *Compositae* rises sharply to maximum. WARMING[2]) points out that *Pteridium* does not take the slightest harm from fires, as its rhizoms are deep in the ground, and LINKOLA[3]) says that in the Carelian *Pteridium* may assume the characters of a burdensome weed after clearance fire. Now TAGE NILSSON's objection to my interpretation of the layer poor in pollen is based on the fact, that the pollenfrequence of herbaceous plants in spite of the sharp *relative* rise (from 4.6 per cent to 14.6 per cent, taken in relation to the total of treepollen) showed a decline in *absolute* frequency (number per sq. cm of slide). He says: "If the forest vegetation had been substituted by herbaceous plants, it is more likely that the reverse had taken place". TAGE NILSSON's objection is comprehensible, but clearly it does not apply, when the pioneervegetation—apart from the emerging trees and bushes—constitutes of entomogame herbs and *Pteridium*[4]).

Re 4. TAGE NILSSON assumes that the pollen grains of Cerealiatype in the charcoal layer and the following marine gyttja belong to *Elymus*. As *Elymus* and cereal pollen normally cannot be distinguished, the possibility definitely cannot be ignored, as indeed I have stressed. However such certain indications of agriculture as *Plantago lanceolata* and *Pl. major* have been found in these analyses in both profiles, likewise it must be taken for granted, that the *Cerealia*-curve a little higher up (in the freshwater marl) cannot result from the typical coast area plant *Elymus*[5]). The question whether also the lowest big pollen grains of grass belong to *Cerealia* or *Elymus* in these circumstances seems of secondary importance.

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[1]) It was J. TROELS-SMITH who first discovered the great importance of *Pteridium* in the land occupation phase in Danish diagrams, and kindly pointed out this fact to me.

[2]) WARMING, E. 1912: Fra det brændte Himmelbjerg. Botanisk Tidsskr. Bd. 33. København. p. 107, 109.

[3]) LINKOLA, K. 1921: Studien über den Einfluss der Kultur auf die Flora in den Gegenden nördlich vom Ladogasee II. Acta Soc. Fauna et Flora Fennica 45, 2. p. 166 a. o.

[4]) *Pteridium* was not counted in the old investigation of Ordrup Mose. In the analyses immediatedly following the charcoal layer two pollen of *Tubulifloræ* were noted.

[5]) A few *Cerealia*-pollen grains in the lake marl must according to their morphological features (extremely coarse pores) be classed as wheat pollen.

Re 3. In the assessment of the "land occupation phase" as an entety the interpretation of the particular conditions in Ordrup Mose cannot be regarded as decisive. On the other hand the interpretation of the relative interdependence between the herb pollen curves and the tree pollen curves, as it is found in all diagrams centring about the minimum of the Mixed Oak Forest, is definite. Tage Nilsson writes about this matter: "If Iversen's conception of a clearance fire is correct, large parts of the country would have been laid bare and free from forest simultaneously at a given point of time. Such an event must be expected to have influenced the NAP-curve considerably more than what is really the case." Tage Nilsson argues from this, that the "land occupation phase" is simultaneous everywhere, which according to my interpretations it definitely is not. Further Tage Nilsson ignores that it is implicit in my interpretation, that the Neolithic culture contrary to the following was a destinctive forest culture[1])—as a matter of fact the new open forest must have produced much more treepollen than the same area before clearing (cf. p. 15). Thus there is no reason to expect any heavy raise of the NAP-curves. Tage Nilsson's argumentation may virtually be turned against his own interpretation. He maintains, that the minimum point of the Mixed Oak Forest curve is exactly synchronous in all diagrams and he acknowledges that the *Plantago* maximum is conditioned by agriculture. As these two points coincide in all detailed diagrams that have been published hitherto, one must conclude from Tage Nilsson's interpretation, that the Early Neolithic settlements have existed and culminated exactly simultaneously all over the country (cf. the diagrams fig. 3–8).

Re 5. Tage Nilsson states in argumentation against my interpretation, that the decline of the Mixed Oak Forest affects the elm and lime much more seriously than the oak.—This fact seems rather easy to explain from my point of view. Oak fruits are of the greatest importance as food for the cattle, especially swine, and it is wellknown, that old oaks for this reason have been protected throughout historical times. As swine have been of considerable importance in Late Stone Age, there has been good reason that also the Neolithic farmer in forest clearing to some extend protected the old oaks at the expense of the "sterile" trees lime, ash and elm, which besides due to their softer wood are easier to clear.

Finally Tage Nilsson mentions that the land occupation phase is as well represented in Scanian as in Danish diagrams, though the Neolithic culture is weaker in Scania, especially in the central parts. I cannot assess the archaeological conditions, but I shall only point out, that the three diagrams stressed by Tage Nilsson have been worked out on the basis of *peat* samples (not gyttja) and so à priory are unsuited to throw light on this problem; I cannot in these diagrams find any reliable land occupation phase. In Denmark there seems to be a complete consistency in the density of the Early Neolithic finds, the degree of the *Plantago-*

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[1]) This is consistent with the conception Graham Clark (Antiquity vol. XXI, pp. 122–36, Sept. 1947) has formed on an archæological-zoological basis.

maximum, and the degree of the decline in the Mixed Oak Forest curve. In the fig. 3–8 the *Plantago* curve virtually seems to be a replica of the minimum of the Mixed Oak Forest curve. The new diagram produced by TAGE NILSSON from Stevningen in Funen is completely consistent with this picture, sparse Neolithic settlement, low *Plantago* maximum and indistinct land occupation phase.

TAGE NILSSON visualizes a direct connection between the Scanian, Danish and German treepollen diagrams even to the point of details ("Leitniveaus sekundärer Grössenordnung"). The necessary basis is, that all these slight fluctations in the pollencurves are the direct result of climatic variations. I am rather sceptical as to this matter, in most cases a climatic interpretation is not obvious, and TAGE NILSSON does not make much of this point, not with regard to the Mixed Oak Forest minimum either. I think that further progress must be through a clear ecological understanding of the pollen diagrams, built on thorough detailed investigations and taking fully into account also other factors besides climatic and human agency.

I should like to express my appreciation of TAGE NILSSON's argumentation against me. A further discussion is however best postponed until the combined pollenanalytical and archaeological investigations by J. TROELS-SMITH are published, surely they will cast much new light on the whole complex question.

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Sammendrag.

Agerbrugets skiftende form og omfang i den forhistoriske tid registreres af pollenkurverne for kulturplanter og ugræs. Kornsorternes pollen kan til en vis grad adskilles fra de andre græssers ved deres størrelse (FIRBAS), dog er de fleste kornsorter selvbestøvere og spreder næsten intet pollen; kun rug danner en undtagelse, og da den først indføres midt i jernalderen, får kornpollenkurven først betydning på dette sene tidspunkt. Det er derfor især de vindbestøvende ugræsplanter, der registrerer agerbrugskulturen. Vigtigst af disse er Lancetbladet Vejbred (*Plantago lanceolata*), som åbenbart er bragt til Danmark med de første bønder (sml. figur 1), og som gennem hele Stenalderen er det hyppigste af alle »kulturpollen«. Også Stor Vejbred (*Plantago major*) synes at indvandre med agerbruget, men dens pollen optræder altid sparsomt. Rødknæ (*Rumex acetosella*) overtager i jernalderen ofte *Plantago*'s rolle som den stærkeste pollenleverant blandt ukrudtsplanterne; i alle tilfælde gælder dette i sandede egne. Syre (*Rumex acetosa* + *R. acetosella*) findes dog i landet også før agerbruget (sml. fig. 1), omend altid med ringe pollenhyppighed. Chenopodiaceer, Bynke (*Artemisia*) og Nælde (*Urtica*) er mindre pålidelige som indikatorer for agerbrugskulturen, idet de også er knyttet til bopladser fra ældre stenalder og iøvrigt er almindelige ved kysten (*Chenopodiaceer* og *Artemisia*) eller på våd nitratrig skovbund (*Urtica*).

Den første bondekultur i landet har været en skovkultur. Vel er der tydelige vidnesbyrd om skovrydninger, men skoven er straks regenereret igen, og kvæget har hentet sin føde i den derved opståede lysere kratskov. Da Birk og Hassel, der har været fremherskende i denne nye skov, er meget stærkere pollenproducenter end urskovens træarter (Eg, Lind, Ask og Elm), giver regenerationsfaserne efter rydningerne et noget overdrevet udtryk i pollendiagrammerne. For at bøde på denne skævhed er pollentallene for de særlig stærkt og regelmæssigt støvende træarter (Birk, El, Hassel, Fyr) divideret med 4 før procentberegningerne. Imod sædvane er Hasselens (reducerede) pollental medtaget i den sum, der danner grundlaget for alle procentberegninger. Denne fremgangsmåde er principielt rigtigere end den gængse, da Hasselen konkurrerer på lige fod med mange træsorter og f. eks. er den overlegne overfor lystræerne Birk, Fyr o. a., hvis opvækst kvæles i hasselkrattets skygge.

De således korrigerede diagrammer (fig. 3—8) giver uden tvivl et rigtigere billede af de lokale vegetationssuccessioner, der er fremkaldt af den første bondekulturs rydninger i urskoven. Man kan adskille 3 stadier i denne neolitiske »Landnamsfase«. I det første stadium, der antages at svare til selve skovrydningerne, stiger urtepollenprocenten stærkt, og de første kulturpollen (*Plantago lanceolata, Pl. major*, korn) optræder, omend i ringe mængde. I det næste stadium er skoven regenereret, men præges af lystræer (Hassel, Birk, El, lidt Pil og Asp). Samtidig opnår pollen af ugræs (især *Plantago lanceolata*) og græsser et maksimum. I det tredje stadium (der formentlig betegner bebyggelsens ophør) indtræder en stærk tilbagegang i hyppighed for de urteagtige planters pollen, specielt for ugræspollen, medens Birk trænges tilbage af egeblandingsskovens træer. Også Hasselen må snart vige, men viser i nogle diagrammer (fig. 5,8) en forbigående opblomstring lige efter at bebyggelsen er ophørt.

Minimet i egeblandingsskovens kurve er blevet tydet som udslag af en klimatisk depression. Mod en sådan tolkning taler først og fremmest det nøje sammenhæng mellem ændringerne i skovbilledet og de utvivlsomt kulturbetingede ændringer i urtepollenfloraen. Man lægger således mærke til, at minimet i egeblandingsskovens kurve og maksimet i vejbred-kurven falder sammen i alle diagrammer. Det er også betegnende, at man i diagrammer med et svagt minimum i egeblandingsskovens kurve også kun finder et ubetydeligt *Plantago*-maksimum (f. eks. i diagrammet fra Tinglev-hedesletten). Det kan endvidere anføres, at den neolitiske landnamsfase efter alt at dømme ikke er synkron. I diagrammet fra Korup sø (fig. 3) ligger den et godt stykke efter det utvivlsomt klimatisk betingede fald i kurverne for Elm (*Ulmus*) og Vedbend (*Hedera*), som betegner grænsen mellem atlantisk og subboreal tid. I Sækkedam-diagrammet (fig. 5) må landnamsfasen derimod henføres til atlantisk tid; Elm og Vedbend er almindelige, da rydningen sætter ind, og de bliver det igen, da egeblandingsskoven regenererer. Først derefter kommer det endelige, klimatisk betingede fald.

Fig. 7 viser en skovrydningsfase fra en mose i Södermanland i Mellemsverige, som ligger ved randen af den af Sten Florin opdagede tidlig neolitiske Mogetorp-boplads. Diagrammet, der er stærkt lokalpræget, viser på flere punkter overensstemmelse med den neolitiske landnamsfase i danske diagrammer, dog mangler det vigtigste ukrudt *Plantago lanceolata*.

Igennem hele sten- og bronzealderen har menneskets indvirkning på skoven indskrænket sig til en omformning af skoven omkring de bebyggede steder.

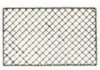
Først i jernalderen stiger urtepollenkurverne så stærkt, at man kan regne med nogen virkelig skovødelæggelse i de tættere beboede egne af landet. I træpollendiagrammet viser det sig især deri, at de karakteristiske regenerationsfaser udebliver. Tilsyneladende er ændringerne i skoven mindre end forhen, men dette er rent illusorisk og skyldes, at det åbne lands pollen ikke er medtaget i den pollensum, som ligger til grund for træpollenprocenterne. Medtager man de urteagtige planters pollen, viser det sig, at alle træpollenkurver har en faldende tendens efter en skovrydning, ikke — som ved de neolitiske skovrydninger — alene egeblandingsskovens.

PLATE I

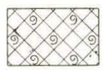
Plate I.

Calculation total: treepollen (AP) excl. *Corylus* (a 'classical' treepollen diagram). Fig. 2. Korup Sø. Survey Diagram (cf. IVERSEN 1941).

The silhouette curves represent the pollen frequencies of *Hedera* and *Plantago* in relation to the tree-pollen total. The bracketed part of the diagram (÷ the lowest analysis) is reproduced as a separate diagram in fig. 3.



Freshwater Gyttja
Ferskvandsgytje



Saltwater Gyttja
Saltvandsgytje

Phragmites Peat
Phragmites-Tørv

Fag.: *Fagus*, beech Cp.: *Carpinus*, hornbeam. AP: Sum of tree-pollen. x: $< 1/4\,\%$.
Signatures cf. plate III.

Tavle I.

Beregningssum: Træpollen (AP) excl. Hassel (et »klassisk« træpollendiagram).

Silhuetkurverne angiver Vedbends (*Hedera*) og Vejbreds (*Plantago lanceolata* + *Plt. major*) pollenhyppighed udtrykt som pro mille af træpollensummen. Det indklamrede stykke af diagrammet (÷ nederste analyse) gengives som specialdiagram i fig. 3.

Fag.: *Fagus*, Bøg. Cp.: *Carpinus*, Avn. AP: Træpollensum. x: $< 1/4\,\%$.

Signaturer cfr. Tavle III.

KORUP SÖ. Oversigtsdiagram

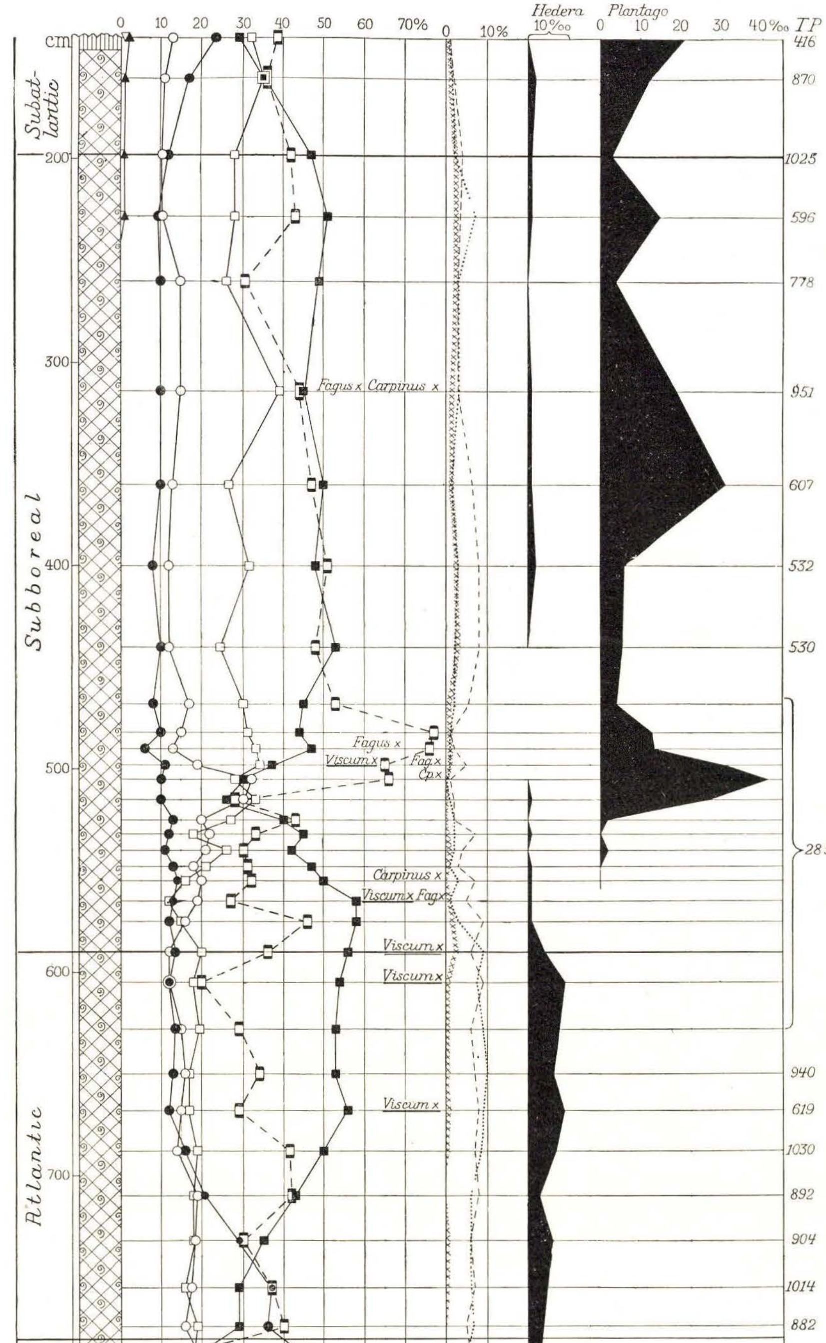


Fig. 2.

PLATE II

Plate II.

Calculation total: Treepollen incl. *Corylus*. Pollencount of *Betula*, *Alnus*, *Pinus* and *Corylus* divided by 4 before calculation of percentages. The pollen curves for trees bent to the right, while the pollen curves for herbaceous plants bent to the left. NB. two different scales are used, i. e. in the pollen curves for trees, and secondly for herbaceous plants and *Hedera*.
1, 2, 3 (a, b): the three stages of the "land occupation phase".

Fig. 3. Korup Sø. Section Diagram (cf. Plate I).
The silhouette curve to the extreme right: *Hedera* (ivy). The "classical" diagram (total: AP excl. *Corylus*) is published in IVERSEN (l. c. 1941 pl. III, p. 58, 63). A large settlement ("Barkær") from a late phase of Early Neolithic time is excavated by P. V. GLOB at the margin of Korup Sø, and corresponds undoubtedly to the "land occupation phase".

Fig. 4. Søborg Sø. Section Diagram.
The silhouette curve to the extreme right: *Hedera*. The classical diagram (total: AP excl. *Corylus*) is published by IVERSEN (l. c. 1941 pl. IV); here also *Fagus* traces a. o.

Fig. 5. Sækkedam. Section Diagram.
A diagram including the whole late pleistocene is published by TAGE NILSSON (l. c. p. 16, p. 466 a. planche VII: 18). A settlement from Early Neolithic time (a thinbutted axe of greenstone, a thinbutted polished flint axe, a stone pavement laid by man a. o.) has been traced along the margin of the former lake[1]), and corresponds undoubtedly to the "land occupation phase".
AP + Coryl.: number of treepollen (incl. hazel) on which the treepollen curves are drawn.
(AP): number of trepollen on which the other curves are drawn. *Fagus* traces in analyses Nr. 6, 8, 9, 11, 12, 13, 14, 15.

Tavle II.

Beregningssum: Træpollen incl. Hassel. Pollentallene for Birk, El, Fyr og Hassel er divideret med 4 før procentberegningerne. Pollenkurverne for træer vender mod højre, for urteagtige planter mod venstre. Bemærk den afvigende skala for træernes pollenkurver på den ene og de urteagtige planters (og *Hedera's*) pollenkurver på den anden side.
1, 2, 3 (a, b): de tre stadier i »Landnamsfasen«.

Fig. 3. Korup Sø. Diagramudsnit (cfr. Tavle I).
Silhuetkurven yderst til højre: Vedbend (*Hedera*).
Et »klassisk« diagram (beregningsbasis: Træpollensum excl. Hassel) er publiceret i et tidligere arbejde (l. c. 1941 pl. III, s. 58, 63). En by (»Barkær«) fra en sen fase af den tidlige del af yngre stenalder, som er udgravet af P. V. GLOB ved randen af Korup Sø, svarer utvivlsomt til landnamsfasen.

Fig. 4. Søborg Sø. Diagramudsnit.
Silhuetkurven yderst til højre: Vedbend (*Hedera*).
Et »klassisk« diagram (beregningsbasis: Træpollensum excl. hassel) er publiceret i et tidligere arbejde (l. c. 1941 pl. IV).

Fig. 5. Sækkedam. Diagramudsnit.
Et diagram omspændende den hele postglaciale og senglaciale periode er publiceret af TAGE NILSSON (l. c. 1935, s. 466 og tavle VII: 18). Bebyggelse fra tidlig yngre stenalder (tyndnakkede økser, stenbrolægning o. a.) er sporet langs randen af den tidligere sø[1]) og svarer utvivlsomt til landnamsfasen.

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[1]) KNUD JESSEN 1920: Moseundersøgelser i det nordøstlige Sjælland. Danm. Geol. Unders. II. R. Nr. 34 p. 36.

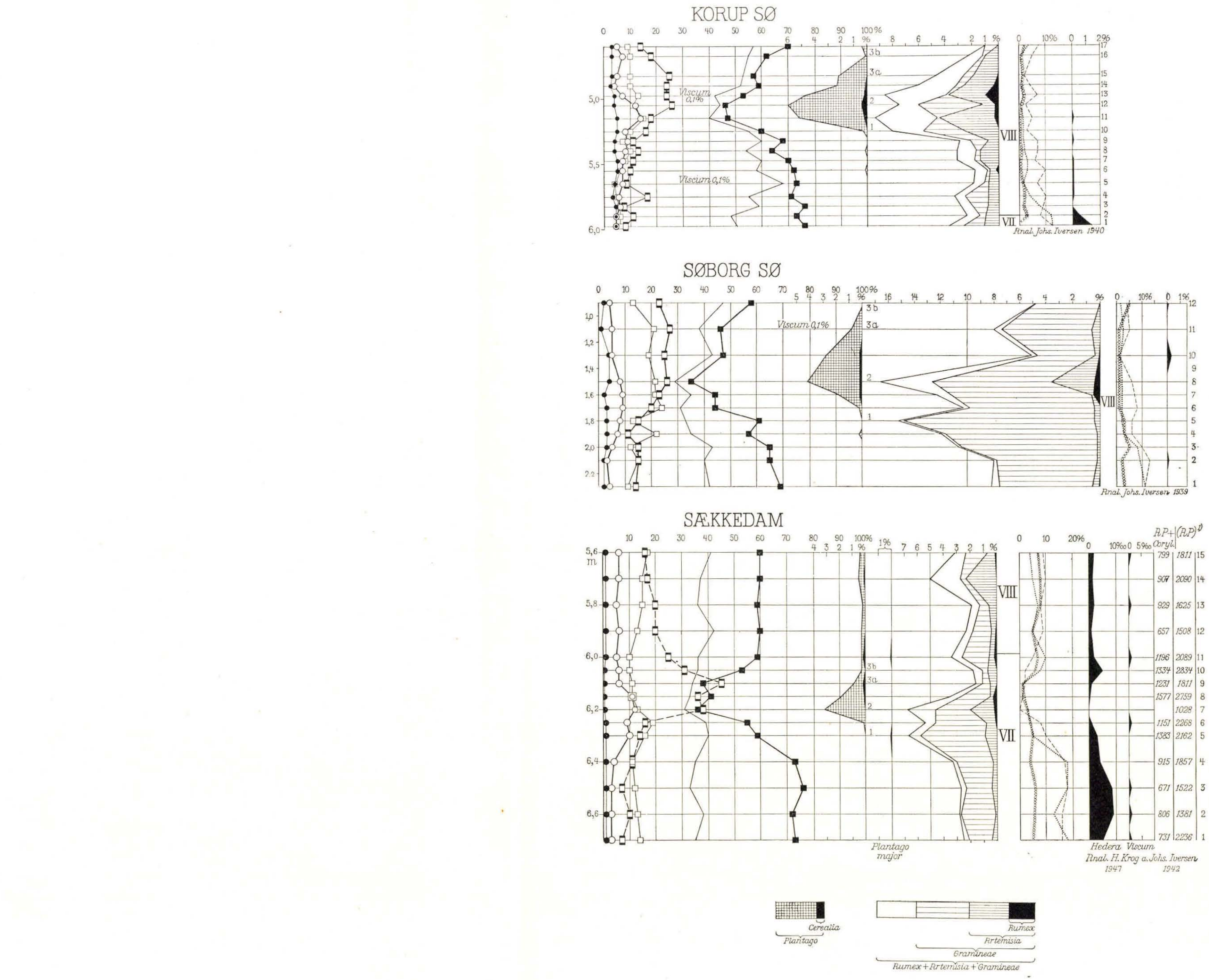
KORUP SØ
Viscum 0,1%
Viscum 0,1%
Anal. Johs. Iversen 1940
SØBORG SØ
Viscum 0,1%
Anal. Johs. Iversen 1939
SÆKKEDAM
Plantago major
Hedera
Viscum
Anal. H. Krog a. Johs. Iversen
1947
1942
Cerealia
Plantago
Rumex
Artemisia
Gramineae
Rumex + Artemisia + Gramineae

Fig. 3—5.

PLATE III

Plate III.

Calculation total: treepollen incl. *Corylus*. Pollencount of *Betula*, *Alnus*, *Pinus* and *Corylus* divided by 4 before calculation of percentages. The pollen curves for trees bent to the right, while the pollen curves for herbaceous plants bent to the left. NB. two different scales are used, i. e. in the pollen curves for trees, and secondly for herbaceous plants, *Hedera*, *Populus*, *Salix*, *Fagus* and *Picea*.
AP: number of treepollen (excl. hazel).
AP + Coryl.: number of treepollen (incl. hazel).

Fig. 6. Tinglev Sø, South Jutland (heath plain).

Cf. Plate II. The silhouette curve to the extreme right: *Hedera*.
Calluna in analyses 1–8 respectively: 0,7 %, 1,4 %, 0,8 %, 1,7 %, 1,2 %, 1,6 %, 0,7 %, 1,7 %. This confirms the conception of H. JONASSEN a. o. that the great plains of Jutland not always were covered with a continuous heath.
Fagus traces in analyses: Nrs. 5, 6.
Sediment: Lake Marl.

Fig. 7. Øvre Mogetorpmossen. Sect.

A diagram from Mogetorpmossen is published by STEN FLORIN[1]). A settlement from Early Neolithic time is situated very near to the little bog[1]). Presumably the clearing corresponds to this settlement. According to the high *Ulmus*-percentage before the clearing phase, it must be presumed that the settlement is from the end of the Atlantic time. Nr. 2, *Secale*-type (1 pollen grain; contemnation?). Nr. 1 *Fagus* 0,1 %, *Nuphar*. Nr. 2, *Nymphæa*. Nr. 3, *Lycopodium annotinum*. Nr. 4 *Myriophyllum*, *Botrychium lunaria*. Nr. 6 *Drosera rotundifolia*. Nr. 8 *Butomus umbellatus*, *Lycopodium clavatum*. Nr. 3–7 *Filipendula ulmaria* a. o.

Sediment: until Nr. 4 Lake Dy (gelmud), Nr. 5–8 Sphagnum Peat. AP: number of treepollen (excl. hazel). The treepollen curves are based on fewer pollengrains counted (about 500 pollengrains).

Fig. 8. Ordrup Mose.

A classical diagram from another section in Ordrup Mose is published by IVERSEN (l. c. 1941 pl. 1).

The analized part of the section comprises the uppermost part only of a 13 m thick gyttja layer—*Ruppia* pollen common in analyses Nrs 1–8, absent in Nrs. 9–20.

In the diagram the usual three stages in the land occupation phase are found, due to the density of the samples and the rapid sedimentation the figure is however more detailed.

- 1a. Maximum of *Pteridium* and entomogame *Compositae*; *Plantago lanceolata* and *Pl. major* appear.
- 1b. The curves of the pioneer trees *Salix*, *Populus* and *Betula* rise, the relative pollen frequency of herbaceous plants is (after a maximum in 1a) pressed down.
- 2. *Corylus* rises, minimum of Mixed Oak Forest. *Plantago lanceolata* and *Artemisia* at maximum. *Pteridium*, *Salix* and *Populus* in decline.
- 3a. New rise of *Corylus* curve, all other curves are falling.
- 3b. *Corylus* curve descending steeply, the Mixed Oak Forest regenerates.

The two peaks of the pollencurves covering herbaceous plants are found also in other diagrams (cf. fig. 3,4), and also the sharp maximum of hazel at the end of the settlement, which causes a new relative minimum of the Mixed Oak Forest is indicated in other diagrams (e. g. Sækkedam fig. 4).

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[1]) STEN FLORIN: Geol. Fören. Förhdl. Bd. 66. p. 572. Fig. 10.

Tavle III.

Beregningssum: Træpollen incl. Hassel. Pollentallene for Birk, El, Fyr og Hassel er divideret med 4 før procentberegningerne. Pollenkurverne for træer vender mod højre, for urteagtige planter mod venstre. Bemærk den afvigende skala for signaturkurkurverne og for silhuetkurverne.

Fig. 6. Tinglev Sø, Sønderjylland.

Sml. tavle II. Silhuetkurven yderst til højre: Vedbend (*Hedera*). Lyng (*Calluna*) i analyserne 1–8: 0,7 %, 1,4 %, 0,8 %, 1,7 %, 1,2 %, 1,6 %, 0,7 %, 1,7 %. Dette bekræfter den af H. Jonassen o. a. hævdede opfattelse, at de jyske hedesletter har været mere eller mindre skovdækkede i stenalderen.
Spor af Bøg i nogle analyser.

Fig. 7. Øvre Mogetorpmossen.

Et diagram fra Mogetorp mose er publiceret af Sten Florin[1]). Nær ved den lille mose har Sten Florin udgravet Mogetorp-bopladsen fra en tidlig fase af yngre stenalder[1]). Sandsynligvis svarer rydningen til denne bebyggelse, der da formentlig må tidsfæstes til slutningen af atlantisk Tid, — at dømme efter den høje *Ulmus*-procent før rydningsfasen. Forskellige pollenfund anføres ovenfor i den engelske figurforklaring.
Sediment: nr. 1—4 sødy, nr. 5—8 sphagnumtørv.
AP: Antal træpollen (excl. Hassel). Træpollenkurverne er bygget på et mindre pollental (ca. 500 pollenkorn).

Fig. 8. Ordrup Mose.

Sammenlign det efter de klassiske principper opstillede diagram fra Ordrup Mose i Iversen (l. c. Tavle 1).

Den analyserede del af profilet omfatter kun den øverste lille del af et 13 m tykt gytjelag.

I diagrammet genfindes de sædvanlige tre stadier i landnamsfasen, grundet på pollenprøvernes tæthed og aflejringens hastige sedimentation er billedet dog mere detailleret.

1a. Maksimum af *Pteridium* og entomogame *Compositae*.
De første spor af *Plantago lanceolata* og *Plt. major*.
1b. Kurverne for pionertræerne Pil (*Salix*), Asp (*Populus*) og Birk stiger, den relative pollenhyppighed af urteagtige planter trykkes ned (efter maksimum i 1a).
2. Hasselkurve stiger. Minimum for egeblandingsskovens kurve. Maksimum for *Plantago lanceolata* og *Artemisia*. *Pteridium*, Pil og Asp i nedgang.
3a. Ny stærk stigning i hasselkurven, alle andre kurver faldende.
3b. Hasselkurven falder, egeblandingsskoven regenererer.

De to toppe for de urteagtige planter genfindes også i andre diagrammer (sml. fig. 3,4) og ligeledes det skarpe maksimum af Hassel ved bebyggelsens slutning, som bevirker et nyt relativt minimum i egeblandingsskovens kurve, er antydet i andre diagrammer (sml. fig. 4).

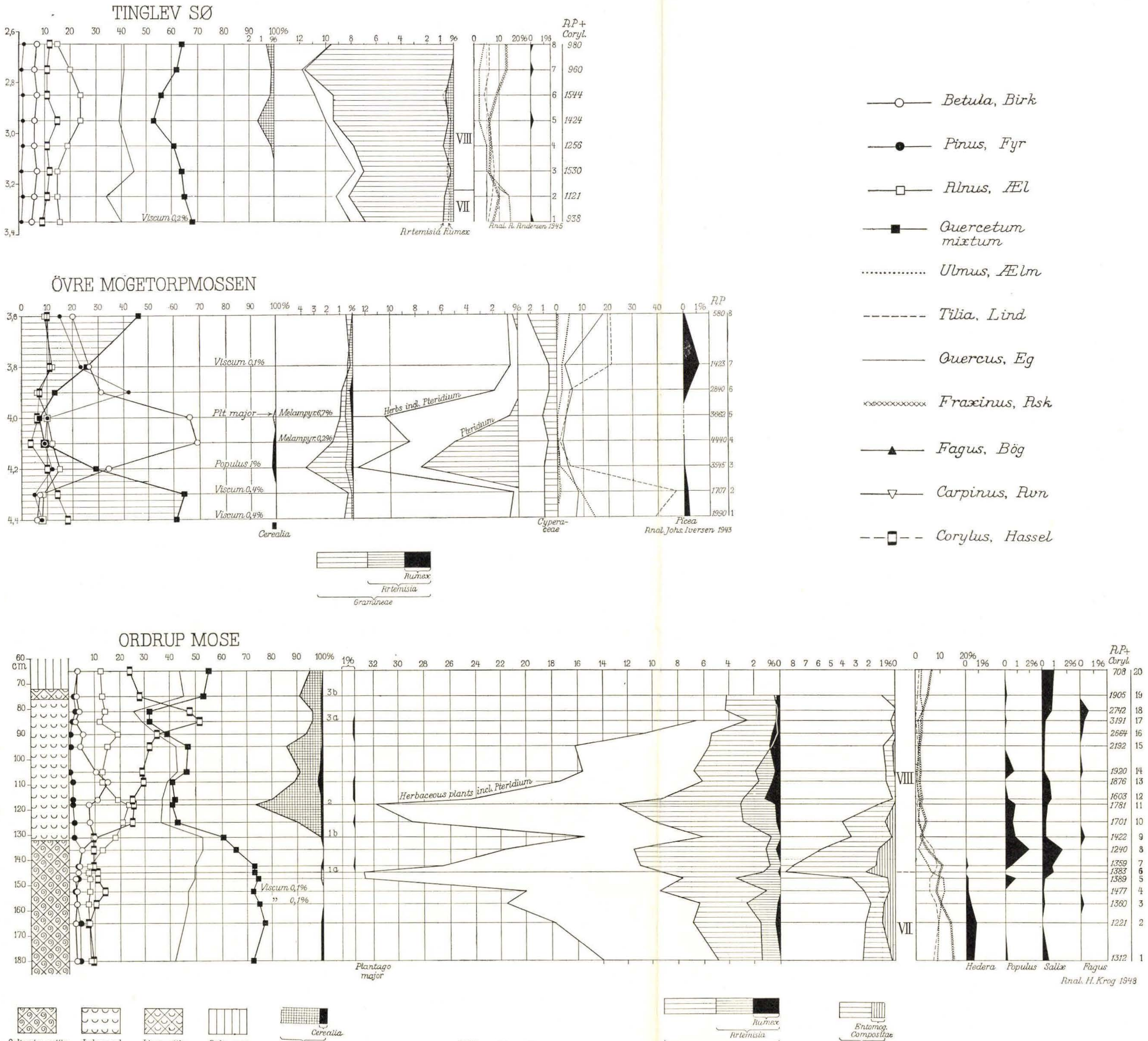

Fig. 6—8.