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POLLEN-ANALYTIC EVIDENCE FOR THE CULTIVATION OF *CANNABIS* IN ENGLAND

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SUMMARY

A detailed pollen diagram from an East Anglian Lake, Old Buckenham Mere, registers vegetational changes from Late Glacial time to the present. When a chronology is projected upon it this allows the reconstruction of the effects of historic and prehistoric man upon local vegetation through the last 5,000 years. Neolithic influence was slight, but in the Late Bronze Age and pre-Roman Iron Age there was progressive forest clearance associated with pasturage. In Anglo-Saxon time arable cultivation extended greatly upon heavier soils. *Secale* (rye) was cultivated from the Roman time and from Early Anglo-Saxon time there is a substantial continuous curve for a pollen grain recognisable as that of *Cannabis sativa* (hemp), upon microscopic criteria newly defined. It was locally cultivated in large amount in Late Saxon and Norman time when the region was heavily populated and in Tudor time cultivation of this crop was enforceable by law.

INTRODUCTION

Consideration of the early history of hemp indicates that it spread from Central Asia into Greece and Italy in classical time, but there is no good evidence for the cultivation of hemp in northwestern Europe before the birth of Christ. There is some insecure evidence that it may have accompanied arable cultivation in the Roman period near Oslo and in northwest England. With the subsequent folk migrations that brought the Anglo-Saxons to England the evidence for cultivation of hemp becomes strong and widespread from Scandinavia to East Anglia and western France. These were people who cleared the lowland oak-forests, cultivated the heavier soils with large ox-team plough and grew rye (*Secale*) as an important crop. It is likely that these people brought the knowledge of hemp with them in their westwards migrations from eastern Europe, as also its teutonic name. As we have seen there is good evidence of cultivation in Viking and Norman

times and in England certainly its growth, legally enforced in Tudor times, has continued until the nineteenth century at least.

RECOGNITION OF CANNABIS POLLEN

Towards the top of several Postglacial pollen diagrams in western Europe there appears a substantial curve for a grain described as "*Humulus*" or "*Humulus-Cannabis*". It was the presence of a curve of this kind in the upper part of a long diagram from Old Buckenham Mere, south Norfolk that led Dr. D. M. Churchill, of the Sub-department of Quaternary Research, Cambridge, to attempt microscopic resolution of the differences between pollen of *Humulus lupulus* and of *Cannabis sativa*. He adduced differentiating characters that may be summarised as follows. Firstly, in optical section the rim of the pore in *Cannabis* is seen to have a hollow internal annulus or void between the ectexine and the endexine: this is absent or much smaller in *Humulus*. Secondly, in the pollen of *Cannabis*, the tectum of the annulus rises very steeply above the general surface and arches over the rim of the pore extending down inside the grain below the general level of the inner wall (endexine). This is particularly noticeable when the tectum breaks free from the endexine inside the pore. Thirdly, in most pollen grains of *Humulus* and in some grains of *Cannabis*, the outline of the pore, when seen in polar view, rises with a very low slope above the general level of the outer wall, in contrast to the steep external slope of the pore in the majority of *Cannabis* grains.

The fossil pollen grains from Old Buckenham Mere corresponded far more closely, upon these criteria, to *Cannabis* than to *Humulus* pollen and indeed it was not possible to find fossil pollen from Old Buckenham Mere which could be unequivocally matched with grains of present day *Humulus*. Thus, although precise identification could not be applied to all the fossil grains, it seems likely that the bulk if not all of them are referable to *Cannabis*.

The pollen diagram (Fig. 1 and 2) appears to present a continuous vegetational record from early zone VII up to the present day. Although there is clear evidence of a hiatus which removed most or all of the deposits of zones V and VI at this borehole, thereafter deposition seems to have been uninterrupted. The open water calcareous muds are unsuitable for radiocarbon age determination. It is however possible to construct a rough time scale by using the date 0 B.C. for the beginning of the curve for *Secale* (400 cm), which is not known before Roman time in Britain. The earliest (Neolithic) forest clearances then fall close to 3000 B.C., and the average rate of formation is about 1000 years for each metre of deposit.

Making use of this conjectural but reasonable time scale, it is now extremely interesting to consider how the anthropogenic influences disclosed by the pollen diagrams correspond with the known prehistoric and historic evidence for the region, particularly with regard to the curve indicative of cultivation of *Cannabis*.

The pollen of *Plantago lanceolata* appears in small amounts in the Neolithic

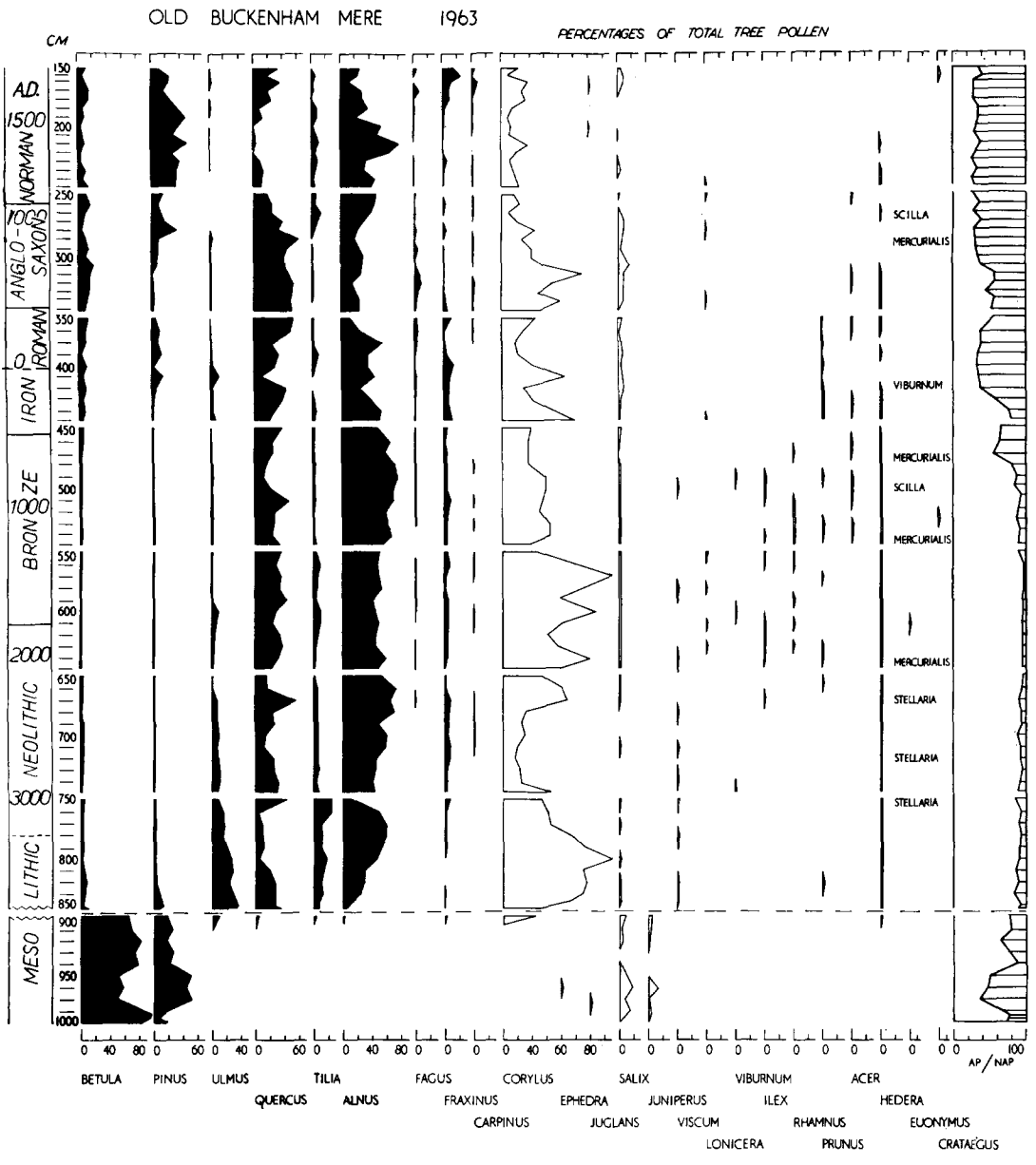

Fig.1. Pollen diagram from borehole 2, Old Buckenham Mere: pollen of trees and shrubs, and associated woodland genera; on the right the ratio of arboreal to non-arboreal pollen; on the left the conjectural time scale. A considerable discontinuity exists at the level 850–900 cm: below this the deposits are Late Glacial.

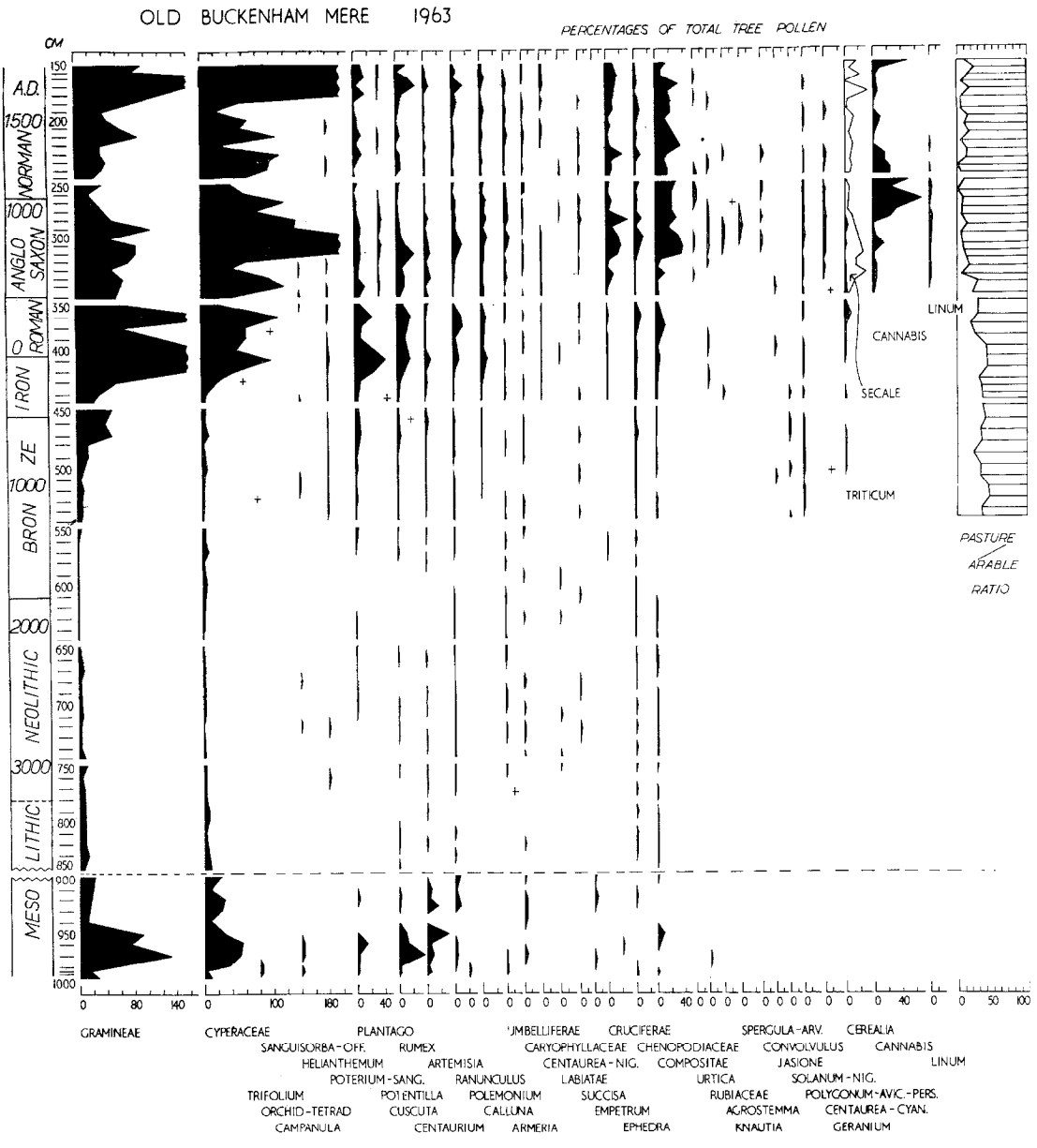

Fig.2. Pollen diagram from borehole 2, Old Buckenham Mere: pollen of herbaceous plants associated with forest clearance, pasture indicators on the left and arable on the right. On the extreme right the ratio of pasture to arable indicator pollen, on the extreme left the conjectural time scale. The increased emphasis on arable cultivation in Anglo-Saxon and Norman time is evident and is clearly correlated with cultivation of *Secale* (rye), *Cannabis* (hemp) and *Linum* (flax).

of our diagram, shews a slight increase in the Middle Bronze Age, more in the Late Bronze Age and reaches a considerable maximum in the pre-Roman and Roman Iron Age, declining afterwards to more or less steady low values in Anglo-Saxon and later times. This pollen type is accompanied and paralleled by curves for *Rumex*, *Artemisia* and *Ranunculus*, so that, taken with the arboreal/non-arboreal pollen ratio, we are presented with a picture of slight and temporary clearances in the Neolithic and Early and Middle Bronze Age, moderate disforestation in the Late Bronze Age and rapidly extended disforestation in the pre-Roman and Roman Iron Age. This latest clearance was very largely associated with pasturage however as might be expected from the fact that this is a region of relatively heavy clay soils: we note that the associated *Centaurea* pollen hereabouts is *C. nigra* and not *C. cyanus*.

This predominantly pastoral phase is followed by one which unmistakeably indicates widespread arable cultivation and, so far as the time scale can be trusted, it began about 400 A.D. the time when settlement of the area by Anglo-Saxon invaders took place. The curves for *Secale*, *Linum* and *Cannabis* are strikingly similar and are accompanied by frequencies of Compositae, Chenopodiaceae and Cruciferae that remain high within what we take to be the Anglo-Saxon and subsequent periods to about 1300 or 1400 A.D. It is notable also that in lower frequencies we have *Spergula arvensis* and *Urtica* in the Anglo-Saxon period, *Convolvulus arvensis*, *Agrostemma githago* and *Centaurea cyanus* in the Saxon and Norman periods, with *Vicia*, *Knautia* and *Valerianella* at the *Cannabis* maximum which, on this time scale, appears to be between 800 and 1200 A.D. These highly characteristic weeds of arable crops, especially such as rye and flax, confirm the indication of an extensive arable cultivation gaining momentum in the Late Saxon and Norman periods, but suffering a considerable set-back at what seems to be about the fourteenth century A.D.

When we attempt to see this against the background of archaeological events we are fortunate in being able to call upon the publications of the late Dr. R. R. Clarke for East Anglia as a whole and for the Norwich area in particular (Clarke, 1960), both embracing the area of Old Buckenham. The following major features of economy and population at successive periods emerge. The Bronze Age inhabitants are regarded as "nomadic pastoralists" without permanent settlement sites; they supplemented stock-raising by hunting and hoe agriculture and to judge from the frequency of hoards, the population increased greatly in the Late Bronze Age. Iron Age "A", "B" and "C" people were immigrant peasant farmers who herded sheep and oxen and who cultivated cereals. Like their predecessors they favoured upland sites and easily worked soils which were tilled with a one-ox plough in small square fields, commonly spoken of as "Celtic" fields. Their populations in upland Norfolk do not seem to have been dense, but here as in other parts of Britain there is indication of spinning and weaving. The Romanisation of Norfolk was tardy and less intense than in other areas of

Britain, possibly because the Early Roman period was marked by the abortive revolt of the Iceni under Bondicca and its subsequent cruel suppression. This evidence agrees with the continued main emphasis upon pastoralism and the slight extension of agriculture evident for the heavy soil area up to the end of the Roman occupation in the middle of the fourth century A.D.

Anglo-Saxon invasions began in the middle of the third century and by A.D. 500 there was substantial occupation in several parts of the region. It is evident that the Anglo-Saxon multiple ox-team allowed the immigrant farmers to clear and cultivate the heavier soils, a fact very sharply reflected in the place names of the region which are overwhelmingly Anglo-Saxon. The Kingdom of East Anglia with its capital at Thetford, 12 miles southwest of Old Buckenham became politically and economically powerful, and despite the passing effects of Danish raids and Danish hegemony "by 1066 A.D., East Anglia was the most densely populated area in England, and by this date Thetford itself boasted no less than twelve churches". Clarke continues that "medieval Norfolk was a rich county, and its wealth was created by the efficient system of agriculture inherited from Late Saxon time and augmented by industrial activities". This picture of forest clearance and arable cultivation, moderate in Early and Middle Saxon time and very extensive in the Later Saxon time, coincides to a quite remarkable degree with what we have read into the pollen evidence.

Ralph Gauder, Earl of Norfolk owned Old Buckenham in the reign of Edward the Confessor but fled the country at the Conquest. Norman occupation established a feudal control of the region without impairment of the rural economy, and about 1150 A.D. were built the Norman Castle and the Augustinian Priory of New Buckenham, in replacement of the pre-existing castle at Old Buckenham, only 1.5 miles away. It is not unreasonable to see the great (and selective) decrease in *Quercus* after 800 A.D. on our interpolated time scale as the consequence of the local building needs during Late Saxon and Norman time, just as the great expansion of arable cultivation and the maximum of *Cannabis* cultivation may reasonably be associated with this period. It is tempting to attribute the pronounced decline which followed (putatively in the fourteenth century) to the ravages of the Black Death which halved the population of many parts of Britain, but other causes were operating in the same sense and Clarke writes that "from the Later Middle Ages unsuccessful farming on marginal lands caused the abandonment of many villages, especially in Breckland" and "the Middle Ages in Norfolk ended in a welter of destruction. Civil strife exploded in Kett's formidable revolt of 1549, there was depression in the woollen industry and disturbance in the countryside with increasing rural depopulation".

Over and above the anthropogenic effects there are a great many more features of interest and importance arising from consideration of the pollen diagrams but these will be left for publication elsewhere. We may summarise by saying that the historical accounts conform extraordinarily well with the deduc-

tions based upon the Old Buckenham Mere pollen diagrams and lend surprising support to the conjectural time scale. In particular they support the proposition that pastoralism was locally prevalent throughout the pre-Roman and Roman Iron Age, that it was not until the arrival of Anglo-Saxon peoples that arable cultivation preponderated in the region, that there was great disforestation and arable cultivation in Late Saxon and Norman time, and that there was pronounced recession of activity around the fourteenth century.

Within the historical context just outlined it would seem that *Cannabis* first appeared in the neighbourhood of Old Buckenham Mere with the establishment of the Anglo-Saxon farmers, and that its cultivation was greatly expanded in Late Saxon and Norman time. From the fourteenth century onwards it seems to have been grown in small amount until comparatively recently for there is a substantial rise in its pollen frequencies at the top of the diagram, possibly referring to the eighteenth or nineteenth centuries.

EUROPEAN POLLEN EVIDENCE (FIG.3)

In 1952, WELTEN describing a pollen diagram from Spiezerbucht on the shore of Lake Thun (560 m) directed attention to the substantial curve for a pollen type that he attributed to *Cannabis*. It was present to the extent of 10–13% of the total pollen along with high frequencies of such indicators of arable cultivation as *Cerealia* and *Centaurea cyanus* as well as *Plantago lanceolata*, and greatly increased total non-arboreal pollen. On the basis of the tree-pollen zonation, of the varve chronology that he had earlier linked with it, and of subsequent general confirmation by radiocarbon dating, Welten was able to date the *Cannabis* pollen curve, rightly claiming this as the first established proof of cultivation of hemp in Switzerland. In low frequency it was present in the folk migration period shortly after Roman times, but the high maxima clearly indicative of cultivation seem to have occurred about 1100–1600 A.D.

HAFSTEN (1956) at two sites Hogstadvann and Bårsrudvann in the inner Oslo Fiord area of Norway reported pollen of *Humulus-Cannabis* type that attained 45% of the non-arboreal pollen, along with all the indicators of arable cultivation including flax. Scattered grains of this type from all the previous pollen zones could well be due to wild *Humulus*, but the high frequencies probably represent cultivated hemp. There is a continuous curve of low values from the beginning of zone IX (ca. 300 B.C.) with high maxima at dates which I estimate by interpolation to be around 0–500 A.D.

At Ösbysjö in eastern Sweden FRIES (1962) has reported a curve of *Cannabis-Humulus* type pollen amounting to 10% or more of the total tree pollen. The curve is continuous from a date that can be guessed by interpolation from the zone boundaries to be about 150 A.D., but the maximum values can be placed at about 850–1200 A.D., the Viking period. The C-H curve is not here very closely

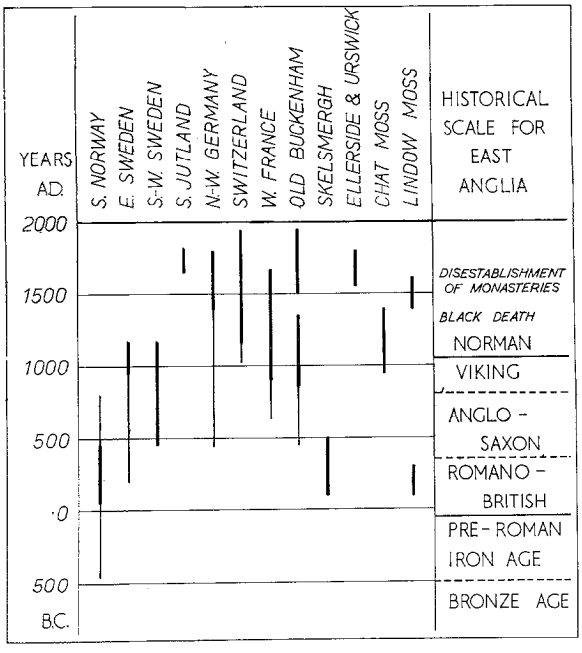

Fig.3. Summary of pollen-analytic evidence for cultivation of *Cannabis* in western Europe. This is presumed where pollen of *Cannabis* itself or *Cannabis-Humulus* type is present in continuous but low frequencies (thin line) or in high frequencies (thick line): sporadic low frequencies are omitted. The attribution of date is based on my own assessment, generally following that of the original author when it has been attempted.

correlated with other indices of arable cultivation but there is a continuous curve for *Secale* from ca. 0 B.C. with high values after 1100 A.D. on the same conjectural time scale.

FRIES (1958) also reported similar evidence from Spånsjon and Kroppsjön in Västergotland in southwestern Sweden where he suggests that "from about the migration period and for some centuries thereafter hemp (*Cannabis*) was locally cultivated." We may take this to be perhaps between 400 and 1200 A.D. This is clearly associated with extensive arable farming and the cultivation of rye.

ANDERSON (1954) reported from Bundsø in S. Jutland a curve of *Humulus-Cannabis* type closely associated with all the indicators of arable cultivation. The maximum was dated about 1600 A.D. by the fact that it closely followed a great agricultural recession which was taken to be that due to the Black Death in the fourteenth century. Anderson reviews the evidence carefully and takes the curve as pointing to the cultivation of *Cannabis*.

From Sehestedt on the northwestern German coast, WIERMANN (1965) reports a substantial "*Humulus*" curve very well paralleled by clearance indicators, especially those of arable ground, i.e., cereals, Cruciferae and *Centaurea cyanus*.

From consideration of known periods of agricultural regression and pollen zone ages reconsidered in the light of recent radiocarbon dating for the region, it might be said that the curve was intermittent from 500 B.C., continuous but low from ca. 400 A.D. and high after ca. 1400 A.D.

From northwestern France come two important sources of evidence. CORILLION and PLANCHAIS (1963) report from Mayenne high values for *Cannabis* type pollen associated with *Secale* and weeds of arable ground within the Subatlantic period and draw attention to historical evidence for the widespread cultivation of hemp in the region from the eleventh to the eighteenth centuries A.D. From sites further west in Finistère VAN ZEIST (1964) has also reported substantial values for the *Cannabis-Humulus* curve associated with arable cultivation of *Secale*. From radiocarbon dates at the sites of pollen analysis we may by interpolation deduce that the continuous curve was low from 600 A.D. and high after about 850 A.D.

BRITISH POLLEN EVIDENCE (FIG.3)

WALKER (1955) reported extremely high values for the "*Humulus* type" pollen curve at the top of a series from Skelsmergh Tarn, a small lake in south Westmorland. This curve accompanies the introduction of cereals and greatly increased values for grasses, *Rumex* and *Plantago*. An extension of the time scale lower in the diagram suggests a Romano-British date for this agricultural episode, but this remains only conjectural. At Ellerside Moss, at no great distance from Skelsmergh, OLDFIELD (1963) distinguishes a series of clearance and forest-regeneration phases, and with the most recent clearance (G), referred to the period 1550–1800, there are substantial amounts of pollen of *Humulus-Cannabis* type, along with greatly increased frequencies of *Plantago*, *Pteridium*, *Rumex*, *Artemisia* and Cerealia. Similar results were obtained also from Urswick Tarn nearby (OLDFIELD and STATHAM, 1963). At Chat Moss to the west of Manchester, BIRKS (1964) describes a "*Humulus* type" curve near the top of the pollen-sequence, coinciding with the onset of a curve for pollen of cereals and a large increase in *Plantago lanceolata*. The main recurrence surface on this bog has now been radiocarbon dated to about 900 B.C., and by interpolation between this and the present day bog surface the "*Humulus*" maximum would lie between ca. 900 and 1500 A.D. The same author (BIRKS, 1965) working on deposits at Lindow Moss, Cheshire, finds a *Cannabis-Humulus* curve associated with two distinct cultivation episodes of an alternating series of cultivation and forest regeneration stages that he dates by comparison of regional pollen zonation and bog-stratigraphy together with some reference to radiocarbon dating. At the first such episode, referred to the Romano-British period, there is the beginning of cereal cultivation (mainly *Secale*) with high values for the *Cannabis-Humulus* and increased Chenopodiaceae and *Artemisia* percentages as well as indications of extensive pastoralism. Pollen of the

Cannabis-Humulus type from the later clearance episode has been referred to Dr. Churchill and Miss Andrew who have confirmed that it is of *Cannabis*: this episode is placed in the Tudor period during which there is historical evidence that hemp was grown locally.

The low and irregular values for *Humulus-Cannabis* pollen in zones VIIb and VIII at Dartmoor (SIMMONDS, 1964) afford rather too slight a basis for deducing the cultivation of hemp or hops.

ACKNOWLEDGEMENTS

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