LOCAL SETTLEMENT HISTORY OF THE LAHTI AREA AS SHOWN BY POLLEN ANALYSIS

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From the point of view of its settlement history, the town of Lahti is situated in an interesting position at the intersection of the areas of eastern and western influence within Finland. The area possesses archaeological finds dating back almost 9000 years.
Detailed palynological analyses were carried out on sediments from two lakes located about 3 km apart to the east and north-east of the town. Those taken from Alasenjärvi contain pollen indicative of local settlement from the Mesolithic period onwards, with a quantitative and qualitative increase during the Neolithic. The first Cerealia pollen dates from the early Iron Age, and the first pollen indicative of permanent agriculture is encountered at 525 ± 180 BP (St-6339) = AD 1425.
The Joutjärvi diagram extends back as far as the transition from the Neolithic period to the Bronze Age, and is identical with that from Alasenjärvi in its indications of early settlement. On the other hand, this site in the immediate vicinity of Salpausselkä possesses earlier evidence of permanent agriculture, from 1025 ± 90 BP (St-6338) = AD 925, coinciding with the age of a cemetery site from the Viking period at the village of Ahtiala, east of Alasenjärvi. Although the artefacts found at this site are of an eastern style, the C^{14}-date obtained does not point to the arrival of agriculture from that direction, for dates of 1380 ± 100 BP (Hel-509) and 1600 ± 150 BP (Hel-403) (Vuorela 1975) have earlier been reported for the corresponding event about 80 km west of Lahti in the parish of Hattula, also immediately adjacent to Salpausselkä.

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Introduction

The applications of pollen analysis in recent years have come to include archaeological and historical research directed at ever more restricted geographical areas (Hafsten 1975, Hicks 1976, Salvesen *et al.* 1977, Vuorela 1978). With improved knowledge of the cultural indicators to be found in the microflora of sediments (see Kukkonen & Tynni 1970, 1972, Tolonen *et al.* 1976, Huttunen & Tolonen 1977), pollen analysis in combination with radiocarbon dating has emerged as a reliable means of investigating periods in local settlement history, the details of which have previously been ascertainable only from archaeological finds or ancient archives. The research reported on here, which was carried out at the instigation of the Municipal Museum of Lahti, aims to contribute to a project concerning the settlement history of the Päijät—Häme area by studying two lake sites, Alasenjärvi located to the north-east of Lahti, and Joutjärvi, located to the east.

Archaeology and settlement history of the area

The environs of Lahti fall within the archaeologically extremely interesting area of Päijät—Häme, the southern parts of which were probably settled by the oldest culture

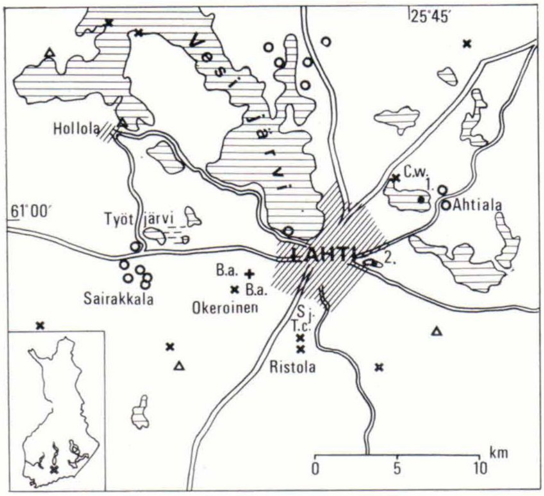

Fig. 1. Map showing the position of the sampling sites and the archaeological sites in the surroundings of Lahti.

known in Finland, the Mesolithic Askola culture, and all of which was affected by the later Suomusjärvi culture, around 7000—4200 BC. Both these cultures are represented at the Ristola site, to the south of the town, for instance. The Porvoo river, which rises south of Lahti and flows into the Gulf of Finland, served as a major communication route from the coastal districts inland throughout prehistoric times, and both the large number of individual Stone Age finds in its headwaters and the relatively dense network of settlement sites established in the area (Fig. 1) point to the possibility that the area has been one of continuous settlement.

A number of remains from the Neolithic period have been recorded in the area. The Combed-ware culture is best represented by a typical Combed-ware pot apparently filled with *Trapa natans* nuts, found at Orimattila to the south of Lahti. The find has yielded two dates: 5370 ± 140 (Hel-12) and 4840 ± 190 BP (Hel-24) (Meinander 1971). Potsherds from the same cultural period have been found at a rich settlement site on the northwestern shore of the lake Alasenjärvi, northeast of Lahti, but it has not been possible to date these. Other important Neolithic finds include artefacts from the south-western Boat-Axe culture found at the village of Okeroinen, on the south-western edge of Lahti itself, and a grave of the same age containing a large number of artefacts, and also some Corded-ware sherds found at Ristola, to the south of the town. In addition to the above, over 30 scattered Stone Age stray finds, all stone implements or parts of such implements, are recorded within the parish of Hollola.

The locations of permanent Iron Age dwelling sites, possibly villages, in the area are indicated by the dozen or so burial mounds identified. It is known that during this period settlement spread to the north of Salpausselkä, into the vicinity of Vesijärvi. One of the largest cemeteries from this period is located at Sairakkala, a village about 10 km west of Lahti.

The majority of the early hill forts marked on the map date back to the Late Iron Age, the time at which indications of settlement reappear after the at present unexplained lacuna in archaeological finds corresponding to the Roman Iron Age. It is thought improbable that there really was an absence of settlement during the latter period, even though the first archaeological evidence of permanent dwellings goes back only to the Merovingian period, AD 550—800, and includes artefacts suggestive of the establishment of Iron Age peasant settlement in the region of Vesijärvi, either in the form of an entirely new population, or more likely, as a result of new cultural influences. At this period the Lahti region lay at the intersection of the western and eastern spheres of influence, for the grave finds from the Viking period discovered at the village of

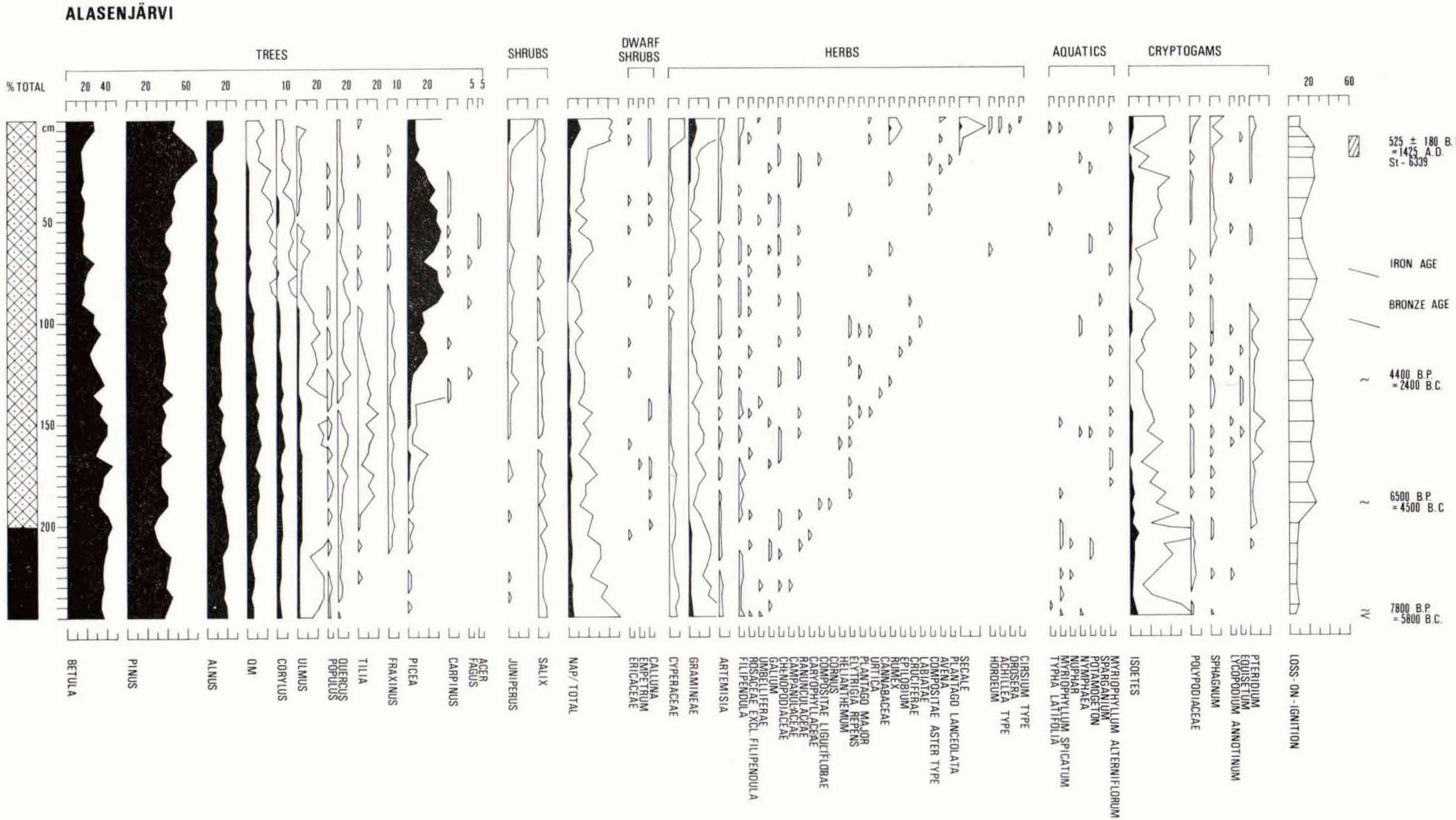

Fig. 2. Relative AP + NAP diagram from Alasenjärvi sediments. The dating of the diagram is based on one local C^{14}-determination and previous forest historical timings on the area.

Ahtiala (itself a name of Karelian origin), to the east of Alasenjärvi, are of the eastern type.

The peasant farming settlement around Vesijärvi which began in the Iron Age continued almost up to the present day, with industry and its associated way of life an extremely recent feature. The first farmer to till the land in the area of the present town of Lahti is known to have done so at AD 1440 on the eastern shore of Alasenjärvi, but it was only at the beginning of the present century that the town was founded.

Sampling sites and methods

Alasenjärvi (61°01'N lat., 25°45'E long.) is a lake of area approx. 2 km² with its surface level at 95 m a.s.l., situated about 5 km north-east of Lahti, to the east of the main Lahti—Heinola road (Fig. 1). The largest areas of agricultural land bordering on the lake at present are situated to the north-west and the east, and belong to the villages of Ahtiala and Honkala. These have yielded a number of significant archaeological finds (*cf.* Fig. 1). The lake is nowadays surrounded by deciduous trees *(Betula, Salix, Alnus),* which separate it from the nearby fields.

Joutjärvi (60°58'N lat., 25°43'E long.) is a small lake of area approx. 0.3 km², located about 2.5 km east of the town centre (see Fig. 1). Its surface is at 110 m a.s.l. It borders on the Salpausselkä ridge to the south, and its other shores contain settlement and industry. The shores are lined with deciduous trees, but there is no agriculture. No archaeological finds are reported from the vicinity of this lake.

The samples from both of these sites were taken using a Livingstone borer in spring 1977. The material composition of the sediments was gyttja in the case of Joutjärvi, and clay-gyttja for the upper 200 cm and clay at 200—250 cm in Alasenjärvi.

The pollen slides were prepared by the KOH and acetolysis methods (Faegri & Iversen 1964), with the addition of *Lycopodium* spores for absolute pollen counting (Stockmarr 1971). Both cores were sampled at intervals of 5 cm and counted to a total of 1000 AP for the relative pollen diagrams.

The results are presented first in the form of a general relative pollen diagram representing the overall vegetational history of the area (Figs. 2 and 4) and then as an 'absolute pollen diagram' depicting the influx of certain critical species (Figs. 3 and 5).

Results

Alasenjärvi. Isolation of the lake as a separate basin is clearly marked at the 200 cm level by a sharp transition from clay to clay-gyttja. The arboreal pollen relations suggest that the whole profile represents almost 8000 years of development, the isolation point occurring around 6500 BP, or 4500 BC. These estimates are obtained by cross-reference with dates of 7780 ± 110 BP for the spread of *Alnus* at Varrassuo, to the west of Lahti (Donner 1966) and of 6250 ± 180 BP and 6760 ± 120 BP for the spread of *Tilia* in two neighbouring parishes, Asikkala (Saarnisto 1971) and Janakkala (Tolonen & Ruuhijärvi 1976) respectively. A further reliable reference point would be the sharp rise in *Picea* at a level of approx. 130 cm, the date for the corresponding feature at Varrassuo, 4380 ± 150 BP (Donner 1966), also being applicable to the present diagram.

A new radiocarbon date was obtained from the 10—20 cm level in this diagram, being the point at which changes in the pollen flora together with an increase in mineral material in the lake sediment are suggestive of the establishment of permanent agriculture-based settlement in the area. This gave a result of 525 ± 180 BP, i.e. AD 1425.

The relatively constant rate of sedimentation implied by the dates given above is such that it will permit the events appearing in

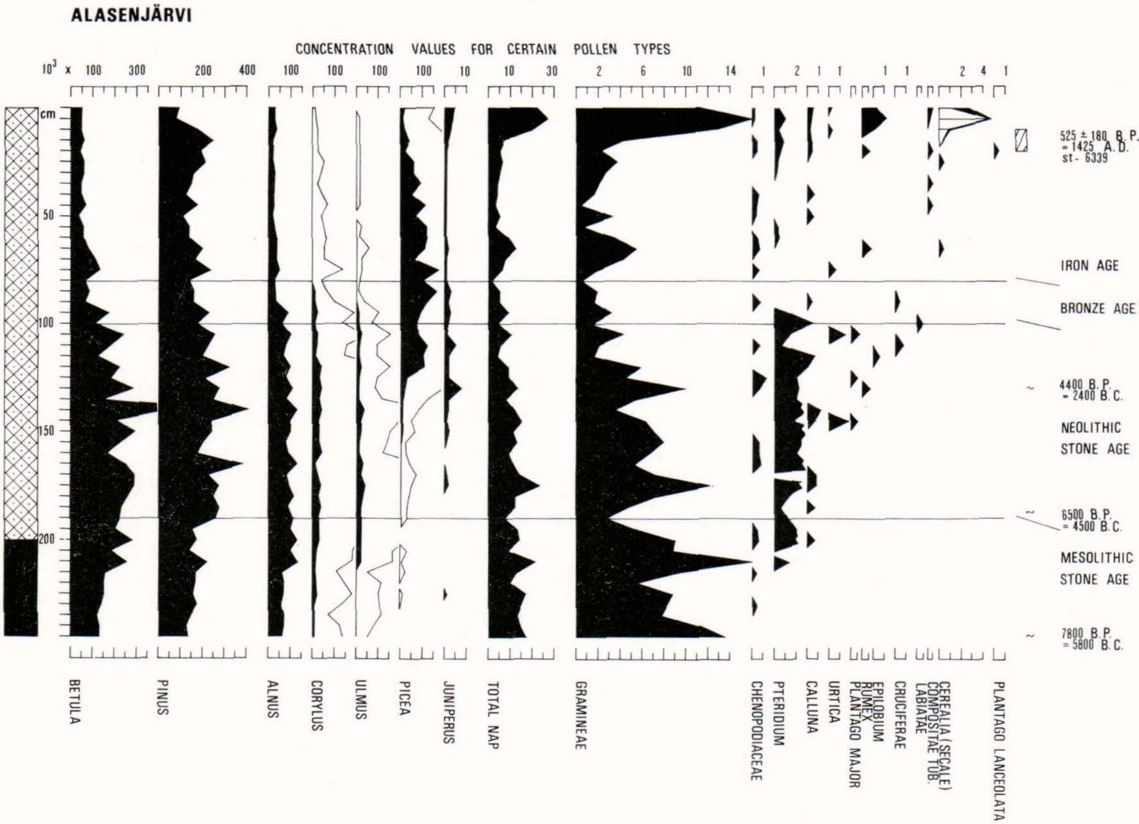

Fig. 3. Pollen frequency diagram for the principal arboreal and culture indicative species in Alasenjärvi sediments.

the diagram to be assigned directly to appropriate archaeological periods. The lowermost section of the profile, with its increase in the pollen of the 'noble' deciduous trees, *Corylus, Ulmus, Quercus* and *Fraxinus,* and the first appearance of some of these, is indicative of a steady warming of the climate, while the herbaceous species present at this stage are typical of marine shore conditions, featuring large amounts of Gramineae, and also Chenopodiaceae, *Artemisia, Filipendula* and *Myriophyllum.* The presence of *Typha, Nymphaea* and *Nuphar* is similarly indicative of littoral conditions.

This period of climatic amelioration corresponds archaeologically to the *Mesolithic* period (7000—4200 BC), in which the activity of man was in general of a character which would tend to preserve the natural species relationships, so that one cannot speak of any 'indicator flora'. The occurrence of one sensitive indicator of forest clearance, *Pteridium,* immediately after the isolation of the basin gives reason to suspect some measure of human activity in the area, a possibility which is also supported by the discovery at Ristola, to the south of Lahti, of a dwelling site associated with the Suomusjärvi hunting-fishing culture. The indicative role of *Pteridium* must, however, not be overestimated, because it is an indicator of natural forest fires as well.

The *Neolithic* period (4200—1500 BC) gains a rather more varied and numerically more significant representation in the pollen diagrams. The continuous presence of *Pteri-*

dium in association with *Calluna* may well denote partial opening up of the forests, while the simultaneous appearance of *Urtica* and *Plantago major* at the 145 cm level suggest a more permanent mode of settlement. Further increases in the flora then take place with the occurrence of first *Rumex* and *Epilobium* and later Cruciferae and Labiatae pollen. These indicators, together with the simultaneous decline in the proportion of *Picea* pollen, are signs of the reaction of the vegetation to a modest amount of 'slash and burn' cultivation, perhaps also with some grazing, during the late Neolithic. The possibility of grazing is raised by the increase noted in *Juniperus* pollen at this stage (*cf.* Vuorela 1975).

Comparison of this cultural phase as a whole with the arboreal pollen relations shows it to occur during the spread of *Picea*. Various theories have been put forward concerning the connection between Neolithic culture and the advance of spruce, and it has been proposed that prehistoric man both encouraged this advance by his clearance activity and also hindered it mainly with his use of fire (*cf.* Tallantire 1977, Huttunen & Tolonen 1977). Both theories appear to attach excessive importance to man, however, in view of the probable intensity of settlement at that time, and also perhaps overemphasize the extent of the phenomenon. One possibility, of course, is that man may have tended to favour the edges of the distribution area of spruce whenever this could be done and to have availed himself of the advantages it offered.

It is not possible to determine the limits of the Bronze and Iron Ages with accuracy in these diagrams in the absence of specific dates, but the dates presented above enable us to estimate that the former must cover the level 80—100 cm and the latter the level 60—80 cm.

The signs of a decline in settlement activity, the almost complete disappearance of the indicator species, the drop in the amounts of Gramineae pollen and the concurrent return of spruce, to be found during the *Bronze Age* (1 500—500 BC) are in agreement with the archaeological lacuna noted above. The return of the loss-on-ignition curve to the level it occupied at the beginning of the Neolithic period is a further sign of a discontinuation in the working of the land.

The signs of a recovery in settlement in the *Iron Ages* (500 BC— AD 1 200) are relatively weak, but still sufficient to provide evidence of the presence of a population tilling the land, presumably chiefly by the 'slash and burn' technique, in the vicinity of Alasenjärvi. The combined occurrence at 60—70 cm of *Hordeum, Rumex,* Chenopodiaceae and *Pteridium* pollen, together with an increase in Gramineae and a marked absolute decline in spruce, may be interpreted as indicative of 'slash and burn' cultivation. This does not necessarily presuppose that the dwelling site was on the shore of this lake, however, but it may well have been some distance away, possibly close to the Viking cemetery at Ahtiala, for instance. The absence of any indicators of actual settlement illustrates well the local origin of the pollen in the sediment.

The beginning of permanent agriculture in the area, dated by C^{14} to the *Middle Ages* (AD 1425), is reflected in the pollen diagram in the appearance of *Avena, Secale, Plantago lanceolata* and *Achillea* and *Cirsium* types all for the first time, the latter two types including among them a number of weeds of cultivation. At the same time one finds an increase in some pollen types encountered earlier, notably *Rumex,* Gramineae, Cyperaceae, *Artemisia* and *Filipendula.* The increase in the clearance of fields for cultivation is reflected both in the amounts of mineral material washed into the lake basin (field erosion) and also in the occurrence of pollen of *Calluna* and *Pteridium,* both indicators of forest clearance, although the nature of this clearance, mostly for permanent fields rather than short-term 'slash and burn' areas, means that the latter species do not reach either proportionally or absolutely the same levels as during the late Neolithic period.

A reaction is similarly clearly observable in the proportions of the arboreal pollen types, with an increase in *Betula* and *Alnus* at the expense both of the noble deciduous trees and, especially, of *Picea* The simultaneous rise in *Juniperus* pollen would reflect the common practice of pasturing the cattle in the forests.

Joutjärvi. The core from Joutjärvi represents a period of some 3000 years, as determined mainly from the curves for *Picea* and the Quercetum mixtum. The occurrence of *Carpinus* and *Fagus* from the very lowest sediments onwards similarly suggests that the whole profile falls within pollen zone IX. The first appearance of *Carpinus* pollen has been dated to 2930 ± 120 BP = 970 BC at Lammi and 3790 ± 150 BP = 1840 BC at Janakkala (Tolonen & Ruuhijärvi 1976). Even so the species can hardly be said to have grown in the area, but rather to have gained representation by virtue of long-distance transport.

In terms of the archaeological chronology, the Joutjärvi diagram corresponds mainly to the Bronze Age and younger phases, so that it may be seen as equivalent to the upper 100 cm of the Alasenjärvi diagram. This may be appreciated most clearly by comparing the respective curves for *Corylus, Ulmus* and *Picea.* The extremely high pollen figures indicated at the 50, 85 and 120 cm levels in Fig. 4 are presumably due to a technical error in the preparation of the slides, and are of no significance for the vegetation history.

It is difficult to distinguish satisfactory boundaries between the prehistoric periods without recourse to a number of radiocarbon dates. A rough estimate of the level corresponding to the transition from the Bronze Age to the Iron Age at around 500 BC, may be achieved on the basis of the one date available, 1025 ± 90 BP (St—6338) = AD 925, and the approximate timings for the events in the local forest history set out above. The level would be approx. 120 cm.

The diagram contains few signs of *prehistoric settlement,* although the clear decline in the proportion of *Picea* amongst the AP, and the increase in *Betula,* together with the occurrence of *Urtica* and *Plantago lanceolata,* both herb species known to be indicators of human activity, to be found here at a level of 115—125 cm, may well be associated with occupation during Late Neolithic times. These are probably features comparable with those found at 95—110 cm in the Alasenjärvi profile.

Indicators of human activity are even less numerous during the *Bronze Age.* Individual grains of Chenopodiaceae and *Urtica* are to be found, but in view of the lack of any other signs of local settlement, these may very well result from long-distance transport and even if local, they would be suggestive of a culture more resembling that of the Mesolithic hunting-fishing peoples.

The increase in the indicator flora during the *Iron Age* is restricted to a small number of species. The appearance of *Avena* pollen at the 115 cm level is connected with the occurrence of *Elytrigia* from the late Bronze Age onwards and the simultaneous signs of increasing field erosion. The same phase also sees a decline in the proportion of *Picea,* pointing to exploitation of the forests for 'slash and burn' cultivation. These features do not serve to indicate the presence of any true Stone Age settlement in the immediate vicinity of Joutjärvi, but rather denote the practice of 'slash and burn' cultivation in the surrounding areas of forest.

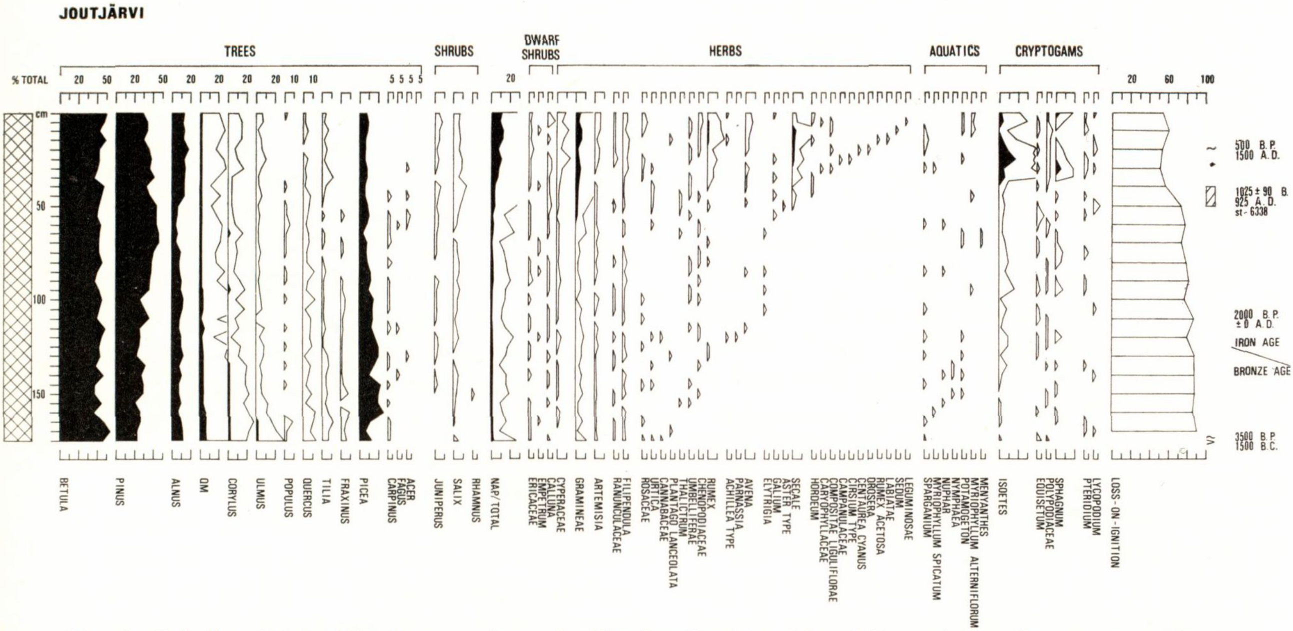

Fig. 4. Relative AP + NAP diagram from Joutjärvi sediments. The dating of the diagram, see Fig. 2.

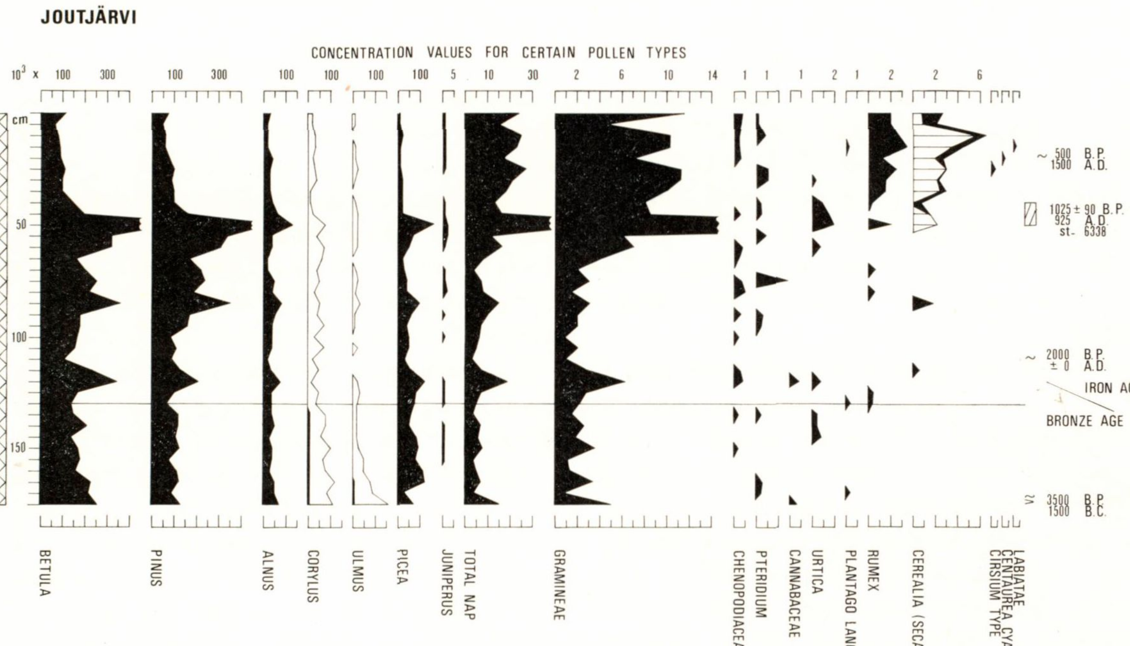

Fig. 5. Pollen frequency diagram for the principal arboreal and culture indicative species in Joutjärvi sediments.

The 40—50 cm level from which the radiocarbon date of AD 925 was obtained represents the Viking period, and it is from this stage onwards that the pollen flora in general reflects the presence of permanent settlement and agriculture. At the same time a marked increase may be noted in the mineral material contained in the sediment.

No detailed analysis of settlement during historical times can be carried out based on this material from Joutjärvi, as the sampling interval itself represents approximately 100 years, but as a general observation one may point to the increasing proportion of *Secale* pollen throughout the period up to about the 19th century, marking the heyday of 'slash and burn' cultivation and the spread of settled agriculture to the area. The new weed species to appear include *Centaurea cyanus*, Labiatae, Leguminosae and *Cirsium*, while *Rumex* and the Gramineae also increase. In the AP relations we find an increase in the proportions of *Alnus, Juniperus* and *Salix*, this being primarily a consequence of the grazing of cattle in the forests (Heikinheimo 1915, Vuorela 1976). Other features associated with the increasingly far-reaching influence of man include the comprehensive decline in the proportion of the Quercetum mixtum, and the absence of *Urtica* and *Plantago lanceolata* both indicators of earlier forms of culture, from the pollen spectra for the uppermost samples.

Summary of the results

The results obtained here using pollen analysis are in agreement with previous interpretations of the settlement history of the Lahti area. They thus underline the reliability of the method when applied also to areas where no previous information on the settlement history is available.

The diagrams contain indications of the Suomusjärvi culture at Alasenjärvi and of middle and late Neolithic settlement at both Alasenjärvi and Joutjärvi. Both of these periods are also documented in the archaeological records of finds in the area. Scarcely any cultural indicator pollen traceable to the Bronze Age is found in the profiles, and correspondingly the few finds from this period point to the existence of a primitive fishing culture at most. The indications of settlement during the Iron Age are similarly weak, but they do reflect working of the land, largely in the form of 'slash and burn' cultivation, and thus denote a relatively stable form of settlement.

When dating events in historical time by the radiocarbon method one frequently finds that the limits of error stated for the dates are inconveniently wide. The date of 525 ± 180 BP, or approx. AD 1425 obtained for the beginning of permanent agriculture at Alasenjärvi is nevertheless in agreement with the historical evidence and may easily be accepted as such. The broad limits of error given in this case are due mainly to the high mineral material content of the sample.

The corresponding date for Joutjärvi, 1025 ± 90 BP, i.e. approx. AD 925 falls within the Viking period, and thus coincides with the establishment of the cemetery at Ahtiala. This result suggests that permanent settlement in the Lahti area may have been confined at first to the immediate vicinity of Salpausselkä itself and spread to more extensive areas only gradually. This may nevertheless be merely a local feature, in view of the nature of the results yielded by this research method.

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APPENDIX

Diatoms in the cores from the lakes Alasenjärvi and Joutjärvi: a contribution to the study of cultural eutrophication.

PENTTI ALHONEN

It is generally accepted that cultural eutrophication has led in many cases to permanent changes in the limnological status of a lake, and it has also been claimed that the variations in the nutrient status of many lakes in Finland can be explained entirely in terms of rapid eutrophication resulting from the influence of human activity, in which case little significance can be attached to the natural eutrophication cycle which appears as lakes age, and which is independent of human agency (see Tolonen *et al.* 1976). The problem is scarcely to be solved as easily as this, however, and each case should be treated on its merits, although it does seem that the sample lakes studied in the old-established agricultural areas of Southern Finland show a course of eutrophication clearly associated with settlement during the Iron Age (Huttunen and Tolonen 1977; Tolonen *et al.* 1976).

Diatoms are recognised as excellent guides to the environmental conditions prevailing at the time of their deposition, and thus any changes in the nutrient status of a lake can be expected to be reflected in the diatom stratigraphy of its sediment. In this respect the pH ecology of the diatom flora of a lake can prove a practical and revealing indicator of its typological progression, including the feature of cultural eutrophication (see Alhonen 1972, pp. 16—19 and the literature cited).

The purpose of this brief contribution is to examine the influence of the cultural phase distinguishable in the pollen stratigraphy of the two lakes in Southern Finland discussed above upon the limnological typology of the lakes in question. The interpretation is thus based on the occurrence of known indicator species within the diatom succession. With this in mind, the species recorded in Table 1 are grouped according to their pH ecology.

Results

The results presented in Table 1 are expressed in the customary way as percentages of total diatoms. Alasenjärvi is shown to have been to a greater or lesser extent oligotrophic limnologically prior to the influence of local agricultural activity, for the lower part of the profile, 20—60 cm, is dominated by an acidophilous plankton characterized by *Melosira distans* var. *lirata* and *Tabellaria fenestrata,* as determined from their proportions of total diatoms. The increase in the proportion of alkaliphilous plankton to 45 % at a depth of 15 cm, on the other hand, points to the onset of the eutrophication progression. Here the characteristic forms are *Cyclotella comta, Melosira italica* and *M. distans* var. *alpigena,* even though *Melosira distans* var. *lirata* still accounts for 24 % of the total flora. This change parallels the beginning of the continuous curve for *Secale* in the pollen diagram, a point which has been dated in this core to 525 ± 180 B.P., or approximately the year 1425 A.D. The plankton community is then augmented in the uppermost 10 cm of the stratigraphy by species including *Cyclotella iris, Melosira granulata* var. *angustissima* and *Stephanodiscus astraea,* the last-mentioned being an alkalibiontic species indicative of particularly alkaline conditions (see Round 1964, Table 2). It is interesting to note that mention is made of this same species as overwhelmingly the dominant element in the increasing total biomass of the eutrophication phase in the limnological history of one lake (Frey 1974, p. 108), and also in association with the pollution of lakes such as Trummen (Digerfeldt 1972, Fig. 32).

The history of Joutjärvi presents a rather different picture. Here a diatom analysis was carried out down to a depth of 60 cm in the sediment, at which point an acidophilous benthic association was dominant, the presence of *Frustulia rhomboides* var. *saxonica* being especially typical of extreme oligotrophic conditions. The proportion of plankton increases at a depth of 35 cm, but the diatom community still possesses a generally acidophilous aspect by virtue of the presence of *Tabellaria* species. A little higher, around 20 cm, one does find an increase in the alkaliphilous forms *Fragilaria construens* and *F. pinnata* to a level of 38 %, but the acidophilous *Tabellaria* plankton are once more clearly dominant in the topmost samples. In the corresponding pollen diagram the continuous *Secale* curve begins at the 50 cm level, a point for which a radiocarbon date of 1025 ± 90 B.P. has been obtained. Thus in this case no clear correspondence is to be seen between the limnological typology of the lake and the existence of a cultural phase in its pollen stratigraphy.

Discussion

The influence of land clearance in prehistoric or historical times upon the history

Table 1. Subfossil diatoms from Alasenjärvi and Joutjärvi

	ALASENJÄRVI												JOUTJÄRVI					
Depth (cm)	1	2.5	5	7.5	10	12.5	15	20	30	40	50	60	1	10	20	35	50	60
Achnanthes didyma acf	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
Amphora ovalis v. libyca alkf	2	1	1	—	2	—	1	1	—	1	1	1	—	—	—	—	—	—
Anomoeoneis follis ind	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
Caloneis silicula alkf	1	—	1	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—
Campylodiscus noricus v. hibernica alkf	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cyclotella comta alkf	30	38	25	27	26	19	18	5	8	4	6	8	—	—	—	—	—	—
C. iris alkf (?)	6	16	18	8	8	8	3	1	3	4	7	1	—	—	—	—	—	—
C. kützingiana ind	—	—	—	—	—	—	2	—	1	2	3	6	—	—	—	—	—	—
C. kützingiana v. radiosa ind	—	1	—	2	—	1	—	—	8	1	—	—	—	—	—	—	—	—
Cymatopleura elliptica alkf	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cymbella aspera alkf	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—
C. cuspidata ind	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C. ehrenbergii alkf	—	—	—	—	—	—	2	—	—	—	—	1	—	—	—	—	—	—
C. gracilis ind	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2	—	1
C. turgida alkf	1	—	1	—	1	1	—	1	1	2	1	—	—	—	2	—	—	—
Diploneis elliptica alkf	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
D. finnica ind	1	1	—	1	1	—	—	1	—	—	—	—	—	—	—	—	—	—
Epithemia sorex alkf	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. zebra v. porcellus alkf	—	1	—	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Eunotia arcus acf	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
E. bidentula acf	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
E. faba acf	—	—	—	—	—	—	1	1	1	—	1	1	—	—	—	1	4	—
E. lunaris acf	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—
E. monodon acf	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
E. monodon v. maior fo. bidens acf	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
E. pectinalis acf	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—
E. pectinalis v. ventralis acf	1	1	—	—	—	—	1	—	1	—	1	—	—	—	—	—	—	—
E. robusta acf	—	—	—	—	—	—	—	—	1	1	2	—	—	—	—	1	5	1
E. robusta v. tetraodon acf	—	—	—	—	—	—	4	—	1	1	1	2	—	—	—	—	—	—
E. veneris acf	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—
Fragilaria construens alkf	—	—	—	—	2	—	—	—	—	—	—	—	4	18	27	6	3	4
F. pinnata alkf	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11	—	—	—
Frustulia rhomboides v. amphipleuroides acf	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—
F. rhomboides v. saxonica acf	—	—	—	—	—	—	—	1	4	—	1	—	—	—	—	15	34	22
Gomphonema acuminatum alkf	—	—	1	1	—	1	—	1	—	1	—	—	—	—	1	—	—	—
Gyrosigma acuminatum alkf	6	10	9	7	3	—	—	1	—	—	—	—	—	—	—	—	—	—
Hantzschia amphioxys ind	—	—	—	1	1	—	—	—	1	—	—	—	—	—	—	—	—	—
Melosira ambigua alkf	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—
M. distans acf	—	1	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
M. distans v. alpigena alkf	1	1	2	4	—	6	12	5	10	5	7	6	—	—	—	—	—	—

M. distans v. lirata acf	—	—	—	—	10	19	24	27	14	20	10	28	—	—	—	—	—	—
M. granulata alkf	8	5	10	3	7	1	—	—	—	—	—	—	—	—	—	—	—	—
M. granulata v. angustissima alkf	—	—	—	4	2	—	—	—	—	—	2	—	—	—	—	—	—	—
M. islandica ssp. helvetica alkf	—	2	2	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—
M. italica alkf	—	—	2	4	7	14	12	4	1	5	3	5	—	—	—	—	—	—
Navicula bacillum ind	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—
N. placenta ind	—	—	—	—	—	—	—		—	—	1	—	—	—	—	—	—	—
N. radiosa ind	1	—	3	1	2	3	1	4	4	2	2	—	2	5	4	6	—	—
Neidium affine alkf	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	6	3
N. iridis fo. vernalis ind	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
N. Sauramoi ind	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
Nitzschia acuta alkf	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pinnularia acrosphaeria acf	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—
P. divergens ind	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
P. gibba ind	—	—	1	2	2	—	1	1	1	1	1	2	—	—	—	2	10	24
P. hemiptera ind	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	2	—
P. interrupta ind	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	18	16	19
P. maior ind	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
P. mesolepta ind	—	—	—	—	—	—	—	—	—	—	—	—	2	—	3	1	—	3
P. nodosa ind	—	—	—	—	—	1	1	1	1	—	—	1	—	—	—	—	—	—
Rhopalodia gibba alkf	—	1	1	1	—	2	—	—	—	—	—	—	—	—	—	—	—	—
Stauroneis anceps ind	1	—	—	—	1	—	2	—	—	—	—	1	4	—	7	10	7	15
S. phoenicenteron ind	—	—	—	—	—	1	1	1	1	—	—	—	—	—	3	1	—	3
S. smithii alkf	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—
Stephanodiscus astraea alkf	8	4	5	2	3	4	—	—	—	—	—	—	—	—	—	—	—	—
Surirella robusta ind	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Synedra acus alkf	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. ulna alkf	1	—	—	1	—	1	1	—	—	—	1	1	2	2	—	—	—	—
Tabellaria fenestrata acf	22	9	10	20	16	11	8	34	30	40	36	30	62	54	31	14	3	—
T. flocculosa acf	4	3	2	1	2	2	4	6	5	7	8	5	24	21	4	20	9	—
Tetracyclus lacustris acf					1	2	1	1	1	1	1	1	—	—	—	—	—	—
Total (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

alkf = alkaliphilous
ind = indifferent
acf = acidophilous

of lakes in Finland has normally been found to act in the direction of a more or less distinct eutrophication (see Huttunen and Tolonen 1977; Tolonen *et al.* 1976), and conversely, it has been suggested that the argillotrophiceutrophic type of lake in Finland is principally an outcome of agricultural activity (Tolonen *et al.* 1975, p. 164). On the other hand, it has been shown that Lake Jalanti, some 8000 years in age and surrounded by clay soils, has a diatom stratigraphy which suggests that is has been limnologically eutrophic throughout its history as an independent basin, probably with argillotrophic or pelotrophic features (Alhonen 1967, Fig. 12), an interpretation which is supported by the surprisingly low loss-on-ignition profile obtained from the bottom sediments. It thus seems that while clearance and cultivation undoubtedly accelerate erosion within the drainage basins of lakes, the Finnish lakes located in areas with clay soils and possessing water with a high electrolyte content must have been inherently eutrophic throughout their history.

Of the two lakes studied here, Alasenjärvi appears to have undergone eutrophication as a result of local cultivation of the land, whereas no corresponding change in the status of Joutjärvi is detectable by the present methods. Since no archaeological evidence is available which would suggest permanent settlement in the immediate vicinity of the lake, it may be taken that the agriculture reflected in the pollen stratigraphy is more distant in origin and failed to affect the nutrient status of the lake itself to any appreciable degree. In contrast, there has been settlement around Alasenjärvi ever since Viking times, and this would explain the cultural eutrophication evident in the diatom flora. Even so, there is no evidence in this case either of human activity in prehistoric or historical times having led to cases of oxygen deficit or oxygen depletion during periods of stagnation, reflected in the presence of black sulphide streaks in the sediment, as has been noted in the palaeolimnology of Lohjanjärvi, for instance (Kukkonen 1973).

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