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SOME COMMENTS ON THE POLLEN-ANALYTICAL RECORDS OF CEREALS AND THEIR DATING IN SOUTHERN FINLAND

Abstract

On the basis of the radiocarbon dating of horizons with cereal grass pollen in pollen diagrams from 22 sites in southern Finland it can be stated that the oldest record of agriculture dates from the beginning of the Bronze Age. Sporadic records of temporary clearances date from the Bronze Age, the pre-Roman Iron Age and later. The introduction of rye is dated to 950–1500 B.P. (A.D. 450–1000). No regional differences in the introduction of cereals can be demonstrated on the basis of the available published material.

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The introduction of agriculture in southern Finland can be traced in pollen diagrams, especially if the diagrams are from sites close to the areas cleared for cultivation. The present discussion deals mainly with southern Finland because so far very little is known from areas further north. The 22 sites of earlier published pollen diagrams, in which the records of cereal grass pollen have been radiocarbon-dated, group themselves into a relatively small area, as shown in Fig. 1 (for sites see Table I). The apophytes, native plant species which because of human activity became more common than they had been, are not included in the discussion as their evidence is more difficult to assess (see BEHRE 1981). Some occurrences of, for instance, *Artemisia,* Chenopodiaceae, *Plantago* and *Rumex* in higher frequencies at certain levels in the diagrams may, however, be indicators of the influence of man on the surrounding vegetation near Neolithic sites, as already noted by LAPPALAINEN (1960) and ALHONEN (1965 , 1970) in their studies in southern Finland. The *Humulus-Cannabis*-type pollen, which cannot always be separated, are not either dealt with here, even if hops (*Humulus*) and hemp (*Cannabis*) have been commonly cultivated, nor are the records of flax (*Linum*).

Of the cereal pollen, that of rye (*Secale cereale*) can be identified in normal pollen counting, whereas the identification of those of wheat (*Triticum*), barley (*Hordeum*) and oats (*Avena*) require more careful analysis, including measurements of especially annulus diameters (ANDERSEN 1978, BEHRE 1981). Poaceae pollen can, according to ANDERSEN (1978), be divided into four groups, the first represented by those of wild grasses. The second group is the *Hordeum* group, which includes such wild grasses as *Agropyron repens* and *Elymus arenarius.* The third group is the *Avena-Triticum* group and *Secale cereale* alone represents the fourth group. In pollen analysis it is important to note that of the cereals only *Secale* has a large proportion of wind-borne pollen (GODWIN 1975), but the primitive cereals were, however, more wind-pollinated than modern ones (IVERSEN 1973). This means that the cultivation of rye is likely to be clearly recorded in pollen diagrams, whereas wheat, barley and oats cannot easily be traced in the pollen counts. As wheat and barley were introduced well before rye and oats (GODWIN 1975) it is especially the early stages of agriculture which are difficult to study, and it is just here that the occurrences of pollen of wild grasses similar to those of cereals can cause errors in

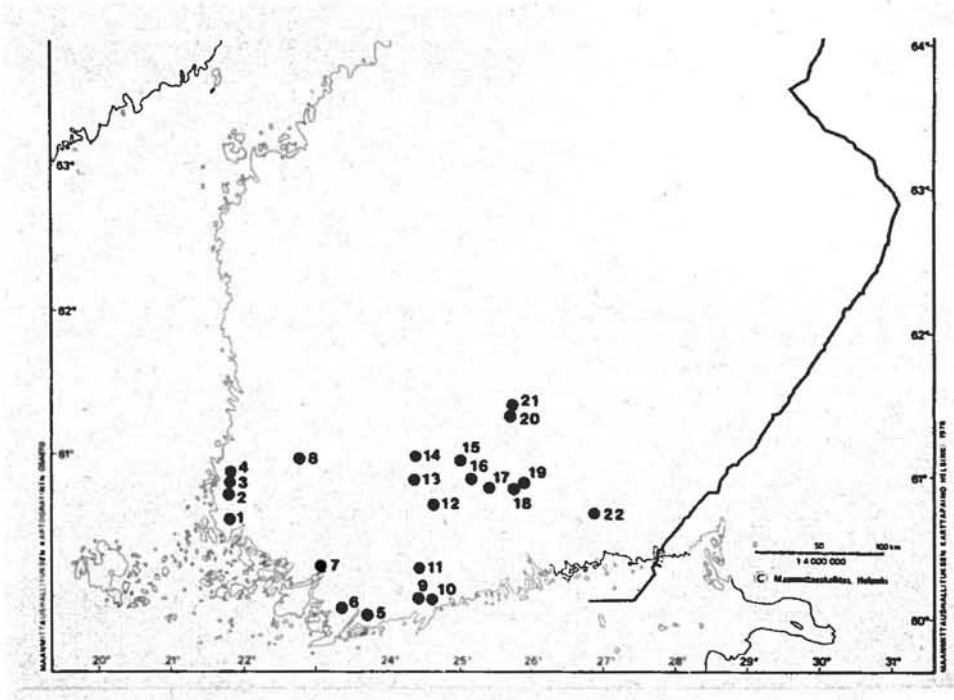

Fig. 1. Sites in southern Finland of published pollen diagrams in which records of *Cerealia* have been dated with radiocarbon dating.

the interpretation. Because of the uncertainties in the identification of cereal pollen they have in the present comparison been lumped together to represent *Cerealia*. In making comparisons with the radiocarbon dates three limits in the occurrences of the cereal pollen were used. The 'absolute' limit marks the earliest presence of cereal pollen, the 'empiric' limit the beginning of the continuous pollen curve and the 'rational' limit an expansion of the relative frequency of cereal pollen. The 'empiric' and 'rational' limits may in some diagrams coincide. The comparison of the ages of the earliest occurrences of cereal pollen is hampered by the fact that the total number of pollen counted per sample varies between the diagrams from under 100 to over 1000. The amount counted can also vary greatly within one diagram so that a great number may have been counted only in the upper part of the diagram where cereal pollen are common. Because of the above-mentioned statistical uncertainties, the results give only a rough idea of the occurrences of cereal pollen. The original conventional radiocarbon dates were used for the period dealt with here, mainly 1000–3000 B.P., as a calibration of the dates would not alter them much.

The radiocarbon dates are plotted from west to east in Fig.2, the numbers of the sites being the same as in Fig.1. The archaeological chronology, also based on radiocarbon years, is according to Siiriäinen (oral information). Some radiocarbon dates below the earliest presence of cereal pollen were included in Fig.2 because they give some additional evidence of the occurrences of these pollen. In addition, dates of sporadic occurrences above the 'absolute' limit were included. The conclusion which can be drawn from Fig.2 is that the oldest record of cereal pollen is from the beginning of the Bronze Age and that there are sporadic records through the Bronze Age and some more from the pre-Roman Iron Age and later, probably mainly caused by temporary clearances. The distribution of the dates only show the statistical scatter of occurrences of cereal pollen in the diagrams and cannot be used in tracing possible clearance phases. From only one site, Työtjärvi, west of Lahti (17), is there a continuous curve from nearly 3000 B.P. onwards, but its significance cannot be assessed on the basis of this diagram alone. In contrast to the sporadic occurrences of cereal pollen in the early stages of agriculture in southern Finland the dates of the 'empiric' limit, in most diagrams between 950–1500 B.P. (A.D. 450–1000), show that there was either an increase in cleared land or a

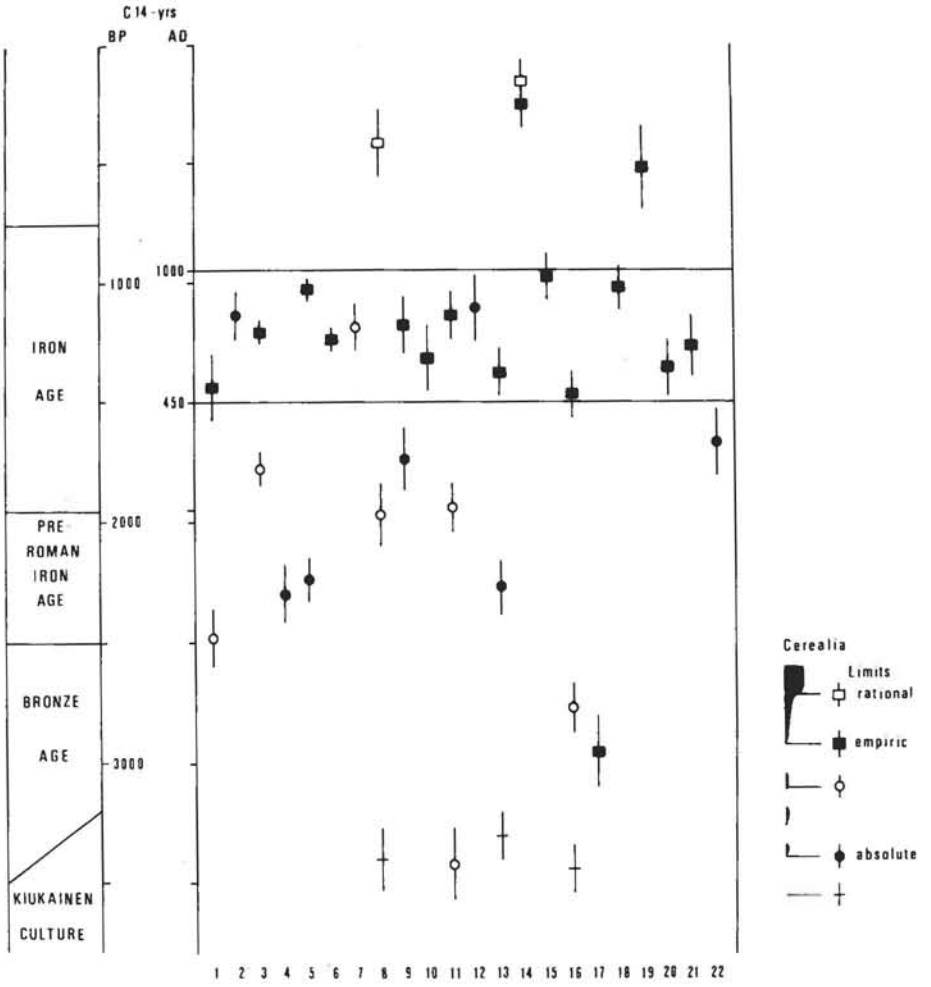

Fig. 2. Radiocarbon dates of *Cerealia* plotted from west to east (for sites see Fig. 1) and compared with archaeological chronology.

change in crops from that time onwards. As it seems clear from the published diagrams that the 'empiric' limit marks the introduction of the cultivation of rye into southern Finland (K. TOLONEN et al. 1979) the change may have been caused solely by rye, which as mentioned above, has a large proportion of wind-borne pollen. Thus, there is no evidence on the basis of cereal pollen of an extensive increase in farming at this time. It is only later, a few hundred years ago, that the 'rational' limit of the *Cerealia* curve reflects the beginning of intensive farming. As this is a very young event its study with the help of pollen diagrams and radiocarbon dates does not add much to what is known from historical accounts. The introduction of rye into southern Finland at about A.D. 450–1000 is later than further west and south-west. From the Åland Islands FRIES (1961, 1962) obtained a date of A.D. 340 for the beginning of the *Secale* curve but mentioned that the correct date is perhaps somewhat younger, about A.D. 500. In Denmark rye was introduced a few hundred years earlier, during the Danish Roman Iron Age, A.D. – A.D. 400 (IVERSEN 1973).

The results so far from southern Finland only give the general outlines of the introduction of cereals. No regional differences, for instance, can yet be detected on the basis of the available dates, as seen from Fig.2. The same difficulties as in dating the pollen records of cereals are encountered in dating other cultivated plants

and apophytes. The radiocarbon dating cannot be made much more accurate, but some inconsistent dates can probably be ruled out by careful study of the sediments dated, including a study of the microvarves (see M. TOLONEN 1978a and b, HUTTUNEN 1980).

Microvarves may be useful in dating the youngest lake sediments where radiocarbon dates are not of much help. In dating early records of cereals or apophytes a reliable chronology based on microvarves is, however, more difficult to obtain because of possible errors in counting and defining the varves and is not necessarily more correct than that based on radiocarbon dates.

The study of the pollen grains can be improved by using all available methods for identification. Further, the statistical treatment of the results can also be developed, such as by taking into account the number of pollen counted per sample when comparing different sites with one another. When studying the possible influence of man on the vegetation before the introduction of agriculture, an ecological approach is of particular importance. All these improvements should make pollen analysis an even more powerful tool for the study of early agriculture and human influence on the vegetation in general.

Even if the present discussion is restricted to dealing with southern Finland, where the results are generally consistent, some results from further north may be mentioned. By counting on an average 3000 pollen grains per slide REYNAUD and HJELMROOS (1980) found the first occurrences of pollen identified as *Cerealia* in sediments dated at nearly 6000 B.P. in diagrams from around the Oulu river valley in Pohjanmaa, northern Finland. The cultivation of cereals in permanent fields was, however, dated at about 1500 B.P., thus agreeing with the results from southern Finland. The early date for the first occurrences of cereal pollen, assuming that they are correctly identified, contrasts, however, with the results from southern Finland and show how great the discrepancies in the interpretations between these two areas still are. At least some of the dates from the Oulu river valley were, on the other hand, considered too old as a result of the hard-water effect, the sediments dated being from a limestone area (REYNAUD and HJELMROOS 1980). The conclusions from northern Finland about the early *Cerealia* pollen, from the early Combed Ware period, have to be confirmed before the full consequences of these finds can be discussed (SIIRIÄINEN 1982). The oldest finds of *Cerealia* pollen from Kuusamo, north-eastern Finland, are about 200 years old (HICKS 1976).

Table I. List of sites and radiocarbon ages B.P. used in Figures 1 and 2.

1.	Kirkkojärvi, Vehmaa	Hel-434	1440 ± 140
	(VUORELA 1975, 1982a)	Hel-435	2480 ± 120
2.	Pärkönsuo, Laitila	Hel-719	1140 ± 100
	(K. TOLONEN et al. 1979)		
3.	Isorahka, Laitila	Su-435	1210 ± 50
	(K. TOLONEN et al. 1979)	Su-436	1780 ± 70
4.	Väiskänsuo, Laitila	Hel-582	2300 ± 120
	(K. TOLONEN et al. 1979)		
5.	Läppträsket, Karjaa	Su-433	1030 ± 50
	(K. TOLONEN et al. 1979)	Su-429	2240 ± 90
6.	Bonästräsket, Tenala	Su-428	1240 ± 50
	(K. TOLONEN et al. 1979)		
7.	Ketohaka, Salo	Hel-1111	1190 ± 100
	(M. TOLONEN 1982)		
8.	Loimansuo, Huittinen	Hel-355	420 ± 140
	(VUORELA 1975, 1982a;	Hel-356	1970 ± 100
	SIIRIÄINEN 1982)	Hel-357	3400 ± 130
9.	Lojärvi, Espoo	Hel-457	1180 ± 120
	(K. TOLONEN et al. 1979)	Hel-460	1740 ± 130
10.	Lappböleträsket, Espoo	Hel-461	1320 ± 140
	(K. Tolonen et al. 1979)		
11.	Katinhännänsuo, Vihti	Hel-352	1140 ± 100
	(VUORELA 1972, 1975,	Hel-353	1940 ± 100
	1982a; JUNGNER 1979;	Hel-354	3420 ± 150
	SIIRIÄINEN 1982)		
12.	Piilonsuo, Janakkala	Hel-53	1110 ± 140
	(K. TOLONEN and		
	RUUHIJÄRVI 1976)		
13.	Armijärvi, Hattula	Hel-509	1380 ± 100
	(VUORELA 1975, 1982a)	Hel-510	2270 ± 110
		Hel-511	3300 ± 100
14.	Retulansuo, Hattula	Hel-814	160 ± 90
	(NÚÑEZ and VUORELA	Hel-816	260 ± 100
	1979; VUORELA 1982a;		
	SIIRIÄINEN 1982)		
15.	Untula, Lammi	Hel-201	980 ± 100
	(HUTTUNEN 1980, 1982)		
16.	Lake Ahvenainen,		
	Koski	Su-692	1470 ± 100
	(M. TOLONEN 1978a	Su-724	2770 ± 100
	and b; SIIRIÄINEN 1982)	Su-695	3440 ± 100
17.	Työtjärvi, Hollola	Hel-849	2950 ± 150
	(DONNER et al. 1978;		
	Vuorela 1982a)		
18.	Joutjärvi, Lahti	St-6338	1025 ± 90
	(VUORELA 1978, 1982a)		
19.	Alasenjärvi, Lahti	St-6339	525 ± 180
	(VUORELA 1978)		
20.	Taruslampi, Sysmä	Hel-1209	1360 ± 120
	(VUORELA 1979, 1982b)		
21.	Kaakotinlampi, Sysmä	Hel-1211	1270 ± 130
	(VUORELA 1979)		
22.	Haukkasuo, Valkeala	Hel-51	1670 ± 140
	(K. TOLONEN and		
	RUUHIJÄRVI 1976)		

Two sites were excluded from the list because their radiocarbon dates were difficult to compare with the limits of the cereal pollen curves used here. The results from these two sites do not, however, disagree with the conclusions presented.

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