Bull. Geol. Soc. Finland 40, 65—70 (1968)

RADIOCARBON AGES FROM THE BOTTOM DEPOSITS OF LAKE SARKKILANJÄRVI, SOUTH-WESTERN FINLAND

PENTTI ALHONEN

Department of Geology and Palaeontology, University of Helsinki, Finland

ABSTRACT

A contribution to the Post-Pleistocene (= Holocene) chronology of south-western Finland, based on pollen stratigraphy and C^{14}-datings, has been presented in this paper. Five sites were compared with the Central Scanian (southern Sweden) sequence at Ageröd mosse dated in detail with radiocarbon method. The results show that the zone boundaries V/VI and VIII/IX seem to be synchronous in the area investigated, whereas T^0, P^0 and P^+ are time transgressive and only reflect local successions.

Introduction

This paper reports the results of radiocarbon datings from the bottom deposits of Sarkkilanjärvi, the pollen stratigraphy and palaeolimnology of which have been discussed in an earlier study (see Alhonen 1967). The Post-Pleistocene (or Post-Glacial or Holocene) time stratigraphic unit has recently been dated by a number of C^{14}-datings from different parts of Finland and the values from Sarkkilanjärvi contribute to the Post-Pleistocene chronology of south-western Finland.

The present study compares the results of C^{14}-determinations from five sites in SW-Finland (see the map of Fig. 1). The Lapaneva bog (1) in the commune of Kihniö is the northernmost site. It has been investigated both with pollen stratigraphical and radiocarbon methods by Salmi (1962). Sarkkilanjärvi (2) lies in the commune of Ikaalinen, and Karhejärvi (3) lies in the commune of Viljakkala, both about 50 km north of the town of Tampere. The pollen stratigraphy of Karhejärvi with a radiocarbon age for subfossil waternut (*Trapa natans* L.) has been described by Alhonen (1964). Some pollen diagrams from the Karhejärvi area have been previously published by L. Aario (1932). Var-

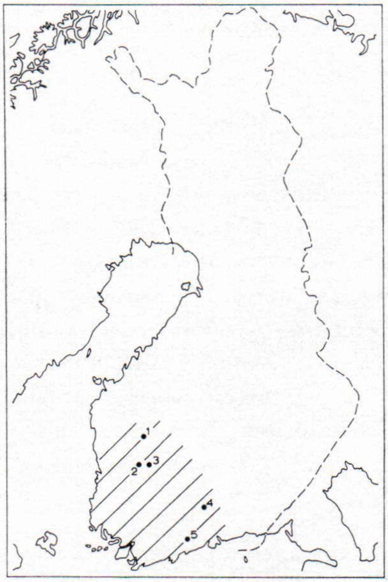

Fig. 1. Map of sites and the area. Numbers refer to site numbers used in the text.

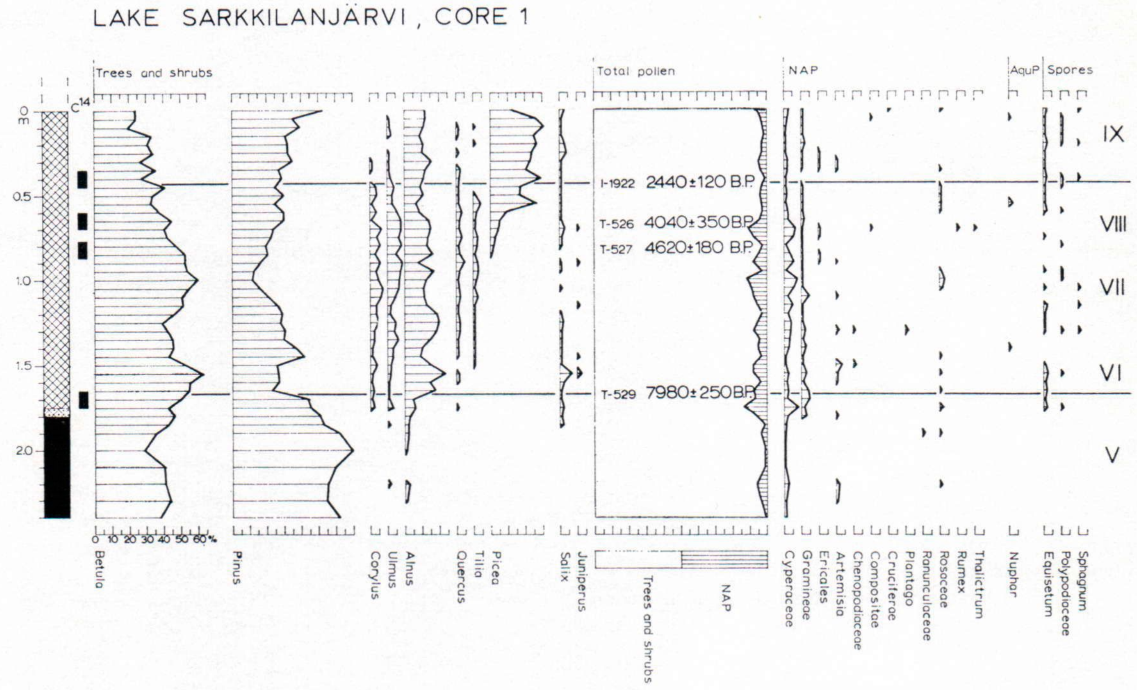

Fig. 2. Pollendiagram of Lake Sarkkilanjärvi with the radiocarbon dates. From Alhonen (1967, Fig. 8).

rassuo (4) about 10 km west of the town of Lahti is a bog which has been the object of several investigations (Donner 1951 and 1966; Okko 1957 and Tolonen 1966). The Råbacka bog (5) is situated in the commune of Tuusula about 40 km north of Helsinki. The pollen stratigraphy has been previously published by Mölder, Valovirta and Virkkala (1957) and Virkkala (1959). A re-investigation employing radiocarbon datings has been made by Virkkala (1966).

Radiocarbon ages

The radiocarbon ages from Sarkkilanjärvi are presented in the diagram of Fig. 2. The oldest date of this series, 7 980 ± 250 B.P. (T-529), represents the zone transition V/VI, where the pollen curve of *Pinus* declines and the curve of *Alnus* rises clearly as stated by Sauramo (1958) and Donner (1963).

The next date, 4 620 ± 180 B.P. (T-527), is from the beginning of the continuous pollen curve of *Picea*, marked P° in Table 1. The radiocarbon age 4 040 ± 350 B.P. (T-526) dates the time when *Picea* became common in the area, as is indicated by the marked rise of its pollen curve (P^+ in Table 1). These two datings are very local chronological fixed points, as we shall see later in this study.

The youngest date 2 440 ± 120 B.P. (I-1922) gives the radiocarbon age for the zone boundary VIII/IX, which is best indicated by the end of the continuous pollen curves for *Corylus*, *Ulmus*, *Quercus* and *Tilia*, the rise of *Pinus* and the decline in the curves for *Betula* and *Alnus* (cf. Sauramo 1958 and Donner 1963).

Comparisons and conclusions

In Table 1, C^{14}-ages obtained for the pollen stratigraphy of Sarkkilanjärvi have been com-

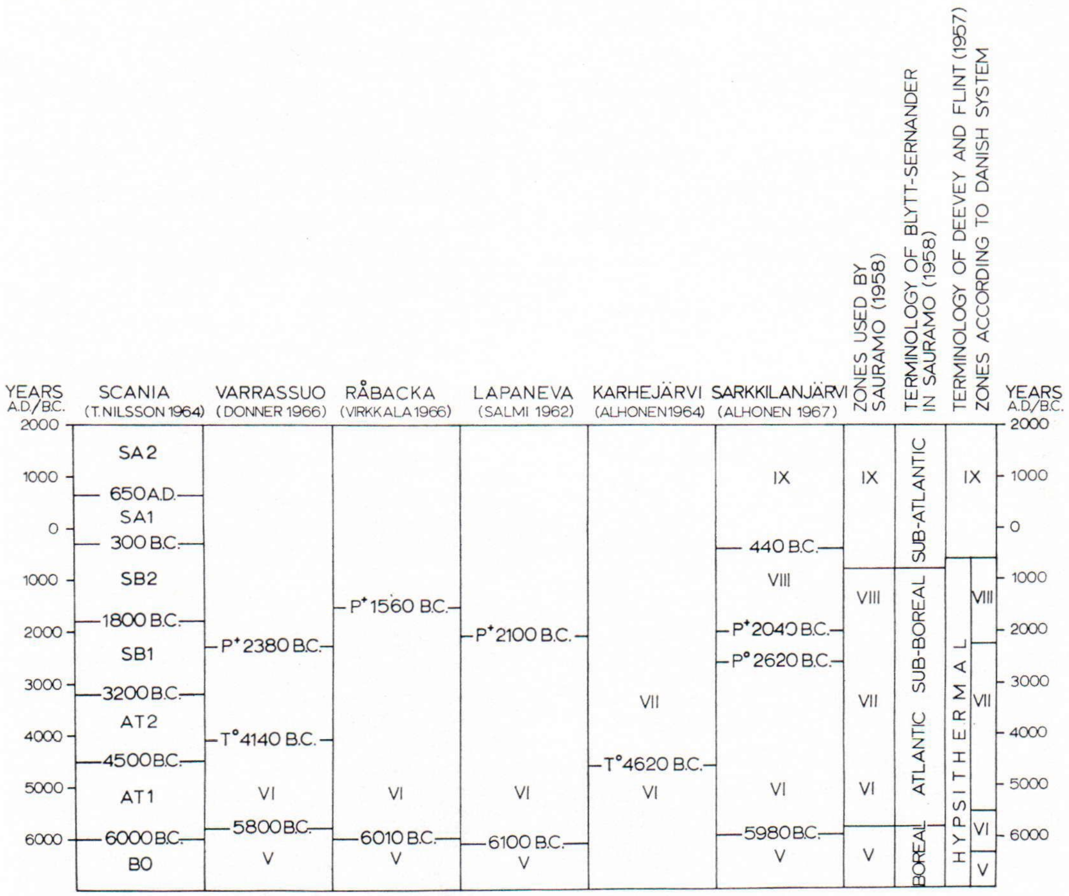

Table 1. Comparison of the radiocarbon chronology of sites in south-western Finland with that of Scania and with zones used by Sauramo (1958), terminology of Blytt-Sernander and that of Deevey and Flint (1957).

pared with the pollen stratigraphical units of the last 8 000 years from the raised bog Ageröds mosse in Central Scania (southern Sweden) based on radiocarbon determinations of 33 samples (Nilsson 1964). The pollen zone boundaries have been given approximate dates. The two oldest Scania dates in Table 1 have not been converted, but the dates are based on the Libby value for the half life of C^{14}. The younger determinations are, however, converted values as in Nilsson (1964), because the differences between the converted and non-converted dates are very small in this case.

Table 1 also comprises the C^{14}-determinations from the other sites in south-western Finland listed above (see the map of Fig. 1). The pollen zones are according to Sauramo (1958), the names of the climatic periods follow the scheme of Blytt-Sernander. The terminology of Deevey and Flint (1957) is also included in the table. Their time stratigraphical unit Post-Glacial Hypsithermal Interval has been dated from approximately 7 000 B.C. to approximately 600 B.C.

The C^{14}-datings of the zone boundary V/VI from the comparison sites in south-western Finland show that the rise of *Alnus*, one of the characteristic features of this zone transition (as defined by Sauramo 1958 and Donner 1963), can well be used as a synchronous horizon in the

Post-Pleistocene chronology of south-western Finland. The mean value of four datings (see Table 1) for the zone boundary V/VI is approximately 5 973 B.C. It is also worth mentioning that Tynni (1966, p. 58) has obtained a radiocarbon age of 5 170 B.C. for the rise of *Alnus* in Askola (southern Finland). Another sample, only 10 cm lower down in the same series and below the beginning of the alder curve was, however, of the age of 6 650 B.C. If we use both of these values, we get a mean of 5 910 B.C. for the zone boundary V/VI, which then complies with the dates discussed above.

The radiocarbon dating 4 620 B.C. for the rational border of *Tilia* (T°) in Karhejärvi gives the age for the zone limit VI/VII. This age has been regarded in Finland as forming the boundary between the older and the younger part of the Atlantic period (cf. Sauramo 1958). As can be seen from Table 1, the C^{14}-age of T° 4 140 B.C. in Varrassuo is about 500 years younger, and it can thus be used only more or less locally for the defining of the zone boundary VI/VII (see also Donner 1957, pp. 10—12). It can also be stated that *Tilia* became general in south-western Finland during the younger part of the Atlantic period (zone VII) (Donner 1963, Fig. 10).

The immigration process of *Picea* into Finland is well illustrated in a map of Donner (1963, Fig. 11). The C^{14}-age of P° in the Sarkkilanjärvi series is likely to date the moment of immigration of *Picea* into this area, and the dating 2 040 B.C. gives an age for the general spread of *Picea* (P^+), which is seen as a sharp rise in its pollen curve. The difference in age between P° and P^+ is about 600 years, which denotes the time that was needed for *Picea* to become a common tree in the forests of the Sarkkilanjärvi area after its immigration there, if the interpretation of P° is correct. The palaeobiogeography of *Picea* in Finland has also been studied in detail by R. Aario (1965, isochron map Fig. 3) and Aartolahti (1966, isochron map Fig. 6). They give several radiocarbon datings for the time when spruce became common in different areas. As can also be seen in our table, the rise of *Picea* (P^+) clearly varies in age and is thus time transgressive already within a limited area. Thus, P° and P^+ can only be used as very local chronological fixed points, as was also mentioned above. It should be mentioned in this connexion that Virkkala (oral information) has recently obtained a new C^{14}-determination from the Råbacka bog for a point just below his previous sample 1 ($= P^+$) (see Virkkala 1966, Fig. 1). This value 4 620 $\pm$ 130 B.P. (2 670 B.C.) (Su-59) corresponds exactly with the age of P° in Sarkkilanjärvi. As an explanation, it can be stated that deposition in the Råbacka bog has been very slow compared with that in Sarkkilanjärvi.

The youngest radiocarbon age, 440 B.C., in the Sarkkilanjärvi series dates, as mentioned above, the zone boundary VIII/IX. No corresponding horizons to this pollen stratigraphical limit have been previously published in the radiocarbon chronology of south-western Finland. Nilsson (1964) gives an approximate date of 300 B.C. for the boundary SB 2/SA 1 at Ageröds mosse in Scania, and the same date has been obtained with radiometric dating by Berglund (1966) for eastern Blekinge. In his Late-Quaternary time-scale Sauramo (1958, p. 44) marks this boundary at ca. 800 B.C., and Donner (1963) in his schematical pollen diagram (see p. 7) at ca. 500 B.C. It can be concluded that the C^{14}-date for the zone transition VIII/IX from the bottom deposits of Sarkkilanjärvi is in rather good agreement with the Swedish results.

We may summarize our conclusions as follows. The indicator of a marked vegetational change in south-western Finland, the steep rise of the *Alnus* curve, which is the characteristic feature of the zone boundary V/VI, seems to be, according to the present material, nearly (or practically) synchronous in the area presented in Fig. 1. The minor differences in age between the C^{14}-datings of this boundary are only methodological. It can also be concluded that the zone boundary VIII/IX, which reflects the climatic deterioration at the beginning of the Sub-Atlantic period, hardly shows any greater variations in time, especially when compared with the results of Scania. These two boundaries V/VI and VIII/IX are thus probably almost synchronous in south-western Finland and perhaps also in a much wider area as stated by Donner (1963, p. 22). The other vegetational changes inside the Hypsithermal Interval probably only reflect local successions. As can be seen in Table 1, T°, P° and P^+ show fairly great differences in age and are thus time transgressive as has been shown earlier by Donner (1957 and 1963).

It is also interesting to observe that the datings of the pollen zones, at least from the beginning of the Atlantic period, obtained with methods other than radiocarbon, seem to comply with the previous datings of Sauramo (cf. 1958) as can be seen in Table 1.

Acknowledgements — The author wishes to express his gratitude to Professor J. J. Donner for all his support during this work, to Dr. Reidar Nydal, Laboratoriet for Radiologisk Datering, Trondheim, for performing the radiocarbon datings marked with T (The date I-1922 was carried out by Isotopes, Inc., USA) and to Dr. Kalevi Virkkala for the new C^{14}-age of the Råbacka series. The author would also like to thank the National Research Council for Sciences (Valtion luonnontieteellinen toimikunta) for the financial aid he received.

REFERENCES

AARIO, LEO, (1932). Pflanzentopographische und paläogeographische Moorunterschungen in N-Satakunta. — Fennia 55, 179 pp.

AARIO, RISTO, (1965). Die Fichtenverhäufigung im Lichte von C^{14}-Bestimmungen und die Altersverhältnisse der finnischen Pollenzonen. — Bull. Comm. géol. Finlande 218, p. 215—231.

AARTOLAHTI, TOIVE, (1966). Über die Einwanderung und Verhäufigung der Fichte in Finnland. — Ann. Bot. Fenn. 3, p. 368—379.

ALHONEN, PENTTI, (1964). Radiocarbon age of waternut (Trapa natans L.) in the sediments of Lake Karhejärvi, SW-Finland. — Mem. Soc. Fauna et Flora Fennica 40, p. 192—197.

ALHONEN, PENTTI, (1967). Palaeolimnological investigations of three inland lakes in south-western Finland. — Acta Botanica Fennica 76, 59 pp.

BERGLUND, BJÖRN, E. (1966). Late-Quaternary vegetation in eastern Blekinge, southeastern Sweden. A pollen-analytical study. II. Post-Glacial time. — Opera Botanica 12: 2, 190 pp.

DEEVEY, EDWARD, S. and FLINT, RICHARD, FOSTER, (1957). Postglacial Hypsithermal Interval. — Science 125, p. 182—184.

DONNER, J. J. (1951). Pollen-analytical studies of Late-glacial deposits in Finland. — Bull. Comm. géol. Finlande 154, 92 pp.

DONNER, J. J. (1957). The post-glacial shore-line displacement in the Kuopio district. — Ann. Acad. Sci. Fennicae, Ser. A, III, 49, 33 pp.

DONNER, J. J. (1963). The zoning of the Post-glacial pollen diagrams in Finland and the main changes in the forest composition. — Acta Botanica Fennica 65, 40 pp.

DONNER, J. J. (1966). The Late-glacial and early Post-glacial pollen stratigraphy of southern and eastern Finland. — Comm. Biol. Soc. Scient. Fennica 29, 24 pp.

MÖLDER, K., VALOVIRTA, V. und VIRKKALA, K. (1957). Über Spätglazialzeit und frühe Postglazialzeit in Südfinnland. — Bull. Comm. géol. Finlande 178, 49 pp.

NILSSON, TAGE, (1964). Standardpollendiagramme und C^{14}-Datierungen aus dem Ageröds Mosse im mittleren Schonen. — Lunds Universitets Årsskrift, N.F. Avd. 2, 59, 52 pp.

OKKO, VEIKKO, (1957). The second Salpausselkä at Jylisjärvi, east of Hämeenlinna. — Fennia 81, 46 pp.

SALMI, MARTTI, (1962). Radiocarbon determinations from the bog profile of Lapaneva, Kihniö, Western Finland. — Bull. Comm. géol. Finlande 204, p. 195—205.

SAURAMO, MATTI, (1958). Die Geschichte der Ostsee. — Ann. Acad. Sci. Fennicae, Ser. A, III, 51, 522 pp.

TOLONEN, KIMMO, (1966). Stratigraphic and rhizopod analyses on an old raised bog, Varrassuo, in Hollola, South Finland. — Ann. Bot. Fenn. 3, p. 147—166.

TYNNI, RISTO, (1966). Über spät- und postglaziale Uferverschiebung in der Gegend von Askola, Südfinnland. — Bull. Comm. géol. Finlande 223, 97 pp.

VIRKKALA, K. (1959). Maaperäkartan selitys. Lehti 2 043. Kerava. 1: 100 000. Suomen geologinen kartta. 99 pp.

VIRKKALA, K. (1966). Radiocarbon ages of the Råbacka bog, southern Finland. — C.R. Soc. géol. Finlande 38, p. 237—240.

Manuscript received, February 5, 1968.