Airborne Charcoal Particles as Components of Urban Cultural Layers

Abstract

Three examples are given of the difficulties and possibilities involved in using charcoal analysis as an archaeometrical means of investigating medieval urban environments.

The abundance of charcoal in pollen slides, the fragmentation of microscopical charcoal particles during sample preparation and the difficulties involved in comparing charcoal influx values with the historical data of a town are all discussed.

Micro and macrofossil analysis play an important part in palaeoecological research. Among the fossil groups available pollen, plant macrofossils and diatoms have proved to be the most suitable for reconstructing the history of the landscape. Recently, additional archaeometrical analyses have been increasingly used to expand knowledge of the impact of man on his environment. Among the indicators of human activity microscopical charcoal particles which, at least in part are wind transported, have proved to be an important fossil group (Patterson III *et al.*, 1987 and the literature mentioned therein). Although the taphonomical processes leading to the deposition of charcoal dust and its preservation in soil layers are not yet thoroughly known, certain applications and interpretations can be made, especially in cases where the results of charcoal analysis are combined with those of other kinds of micropalaeontological or stratigraphical analyses.

Of the taphonomical processes, the distance of the final sampling site from the source of the charcoal - the fire itself, the intensity of the fire, the wind direction and the method of transportation are among the most important factors affecting the fossil composition. Charcoal dust, when occurring in deposits of urban communities, is easily exposed to erosion and redeposition, a fact which has to be taken into consideration when interpreting the fluctuations in this fossil type.

Fig. 1. The location of Helsinki, Turku and Porvoo on the S. and SW. coasts of Finland.

The amount of anthropogenic charcoal dust, reflected by the charcoal concentration values of cultural layers or natural deposits, increases towards the present day (e.g. Huttunen, 1980, fig. 24) this development being closely related to the increase in population. In urban medieval environments the use of fire played an important part in the every-day life of the inhabitants. Especially at higher latitudes, the heating of buildings situated close to each other, not to mention the frequent fires which occurred inside medieval towns, supply the charcoal dust present in the cultural layers of these environments.

Charcoal analyses were carried out in connection with pollen analytical investigations of the cultural layers of three medieval towns in Finland, Helsinki, Porvoo and Turku (Fig. 1). Of the results obtained and observations made, the following phenomena are emphasized.

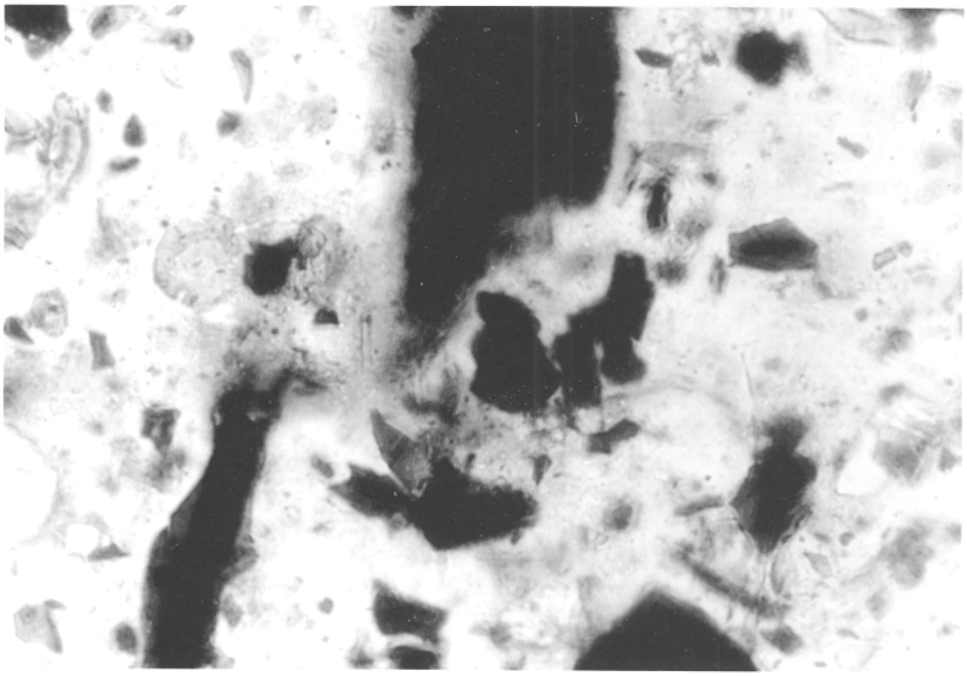

Fig. 2. Micrograph from a pollen slide prepared from material from a cultural layer of the medieval town of Helsinki. A corroded pollen grain of Tilia can be seen to the left.

1. Because of the considerable chemical resistance of charcoal particles, the concentration of this fossil group in pollen slides from urban cultural layers is considerable, to the extent that it hampers the identification of the pollen material. This difficulty is further emphasized by the fact that the pollen in terrestrial mineral soil is itself corroded and oxidized being probably affected by the increased pH-values due to the higher ash content of the soil (Saarisalo-Taubert, 1963).

   This phenomenon is clearly seen in the micrograph (Fig. 2) of a slide prepared from material which was taken from the cultural layer of the medieval town of Helsinki (Vuorela, 1989). It could, however, as well represent any of the urban cultural layers investigated in Finland.

2. The size division of charcoal particles which still lacks a standardized classification, varies in most of the published investigations dealing with this fossil material. In the study carried out on two cultural layers of the medieval town of Porvoo (Fig. 3), an attempt was made, using a rough size division of charcoal particles, to delimit those fires which occurred in the town during 16th-18th centuries.

   At site I these layers are clearly seen in the soil profile, indicated by five soot layers and dated by archaeological data. The reflection of these local fires in the pollen data is described by Vuorela and Hiekkanen (1991).

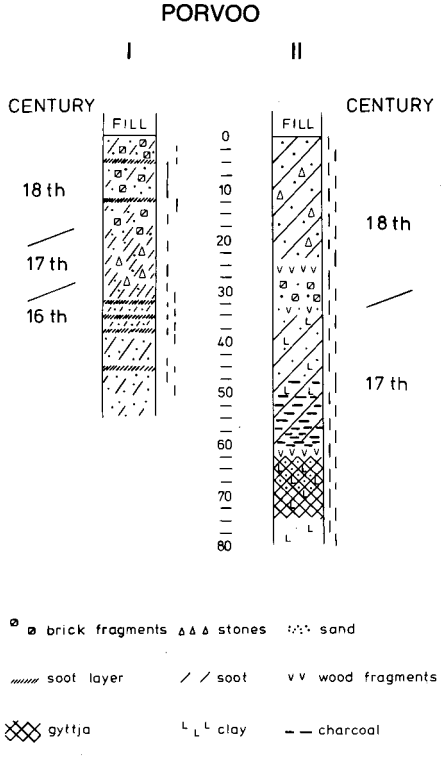

Fig. 3. The stratigraphy of two profiles through the cultural layers of the medieval town of Porvoo (Vuorela and Hiekkanen, 1991).

At the Porvoo II site , situated at about only 150 m distance from site I, the cultural layer covers the 17th and 18th centuries. In the bottom part of the profile high charcoal frequencies indicate the burning of a local building in the early 1700's. Fires of the 18th century and those of a more regional character were traced by the size distribution of charcoal particles (Fig. 4).

This was done by dividing the slides analyzed into three groups according to a rough size distribution :

i. those in which charcoal particles < 5 µm dominate
ii. those in which charcoal particles > 100 µm dominate and
iii. those in which different sizes were evenly distributed.

It is immediately obvious that the early local fire of the 17th century is clearly indicated by large charcoal particles whereas the two later fires of the 18th century are reflected only by high relative frequencies at the 0-10 and 17.5-30 cm levels and are not distinguishable on the basis of size distribution. The reason for this is not clear. It is possible that the larger charcoal particles have been broken down during preparation of the slides. This interpretation supports the theory that size distribution is a less reliable basis for evaluating the distance between the fire and the sampling site (cf. Clark, 1984).

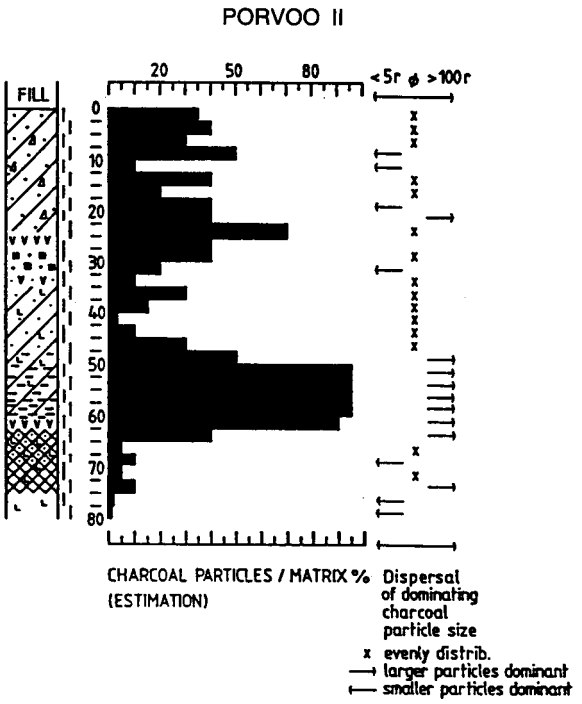

Fig. 4. An estimation of the relative fluctuations in charcoal material in the cultural layer at site Porvoo II, with a rough size division for the charcoal particles (Vuorela and Hiekkanen, 1991).

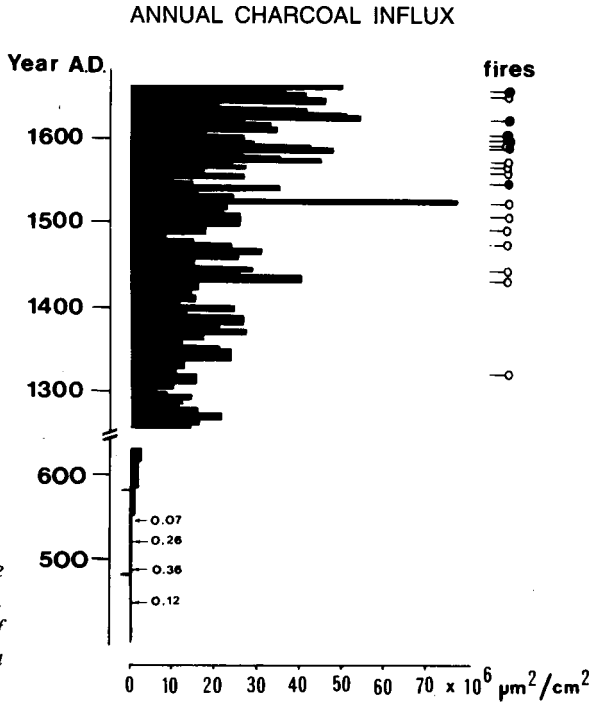

Fig. 5. Charcoal influx values in the sediment of Lake Mätäjärvi, Turku, compared with the chronology of fires in the medieval town of Turku (Salonen et al., *1985).*

3. Annual charcoal influx values were determined from the limnic cultural layers of the medieval town of Turku (Fig. 5 ; Salonen *et al.*, 1985, fig. 4). In this particular case the charcoal material has obviously been transported to the sampling site by both wind and water. The results were correlated with fires in the town during the time span AD 1300-1700 and demonstrate the difficulties involved in relating of the maximum values of charcoal particles to the history of the town since individual peaks only seldom coincide with dated fires. The steadily rising values, however, clearly indicate the development of the urban environment and increasing human impact in the early town of Turku. This is especially true of the layers from 17th century where the high influx values reflect the great fires which destroyed housing in the proximity of Lake Mätäjärvi.

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