Ann. Bot. Fennici 34: 1–13
Helsinki 7 March 1997
ISSN 0003-3847

Palynology and palaeobotany of a cultural layer in the centre of Helsinki

Irmeli Vuorela & Terttu Lempiäinen

Vuorela, I., Geological Survey of Finland, FIN-02150 Espoo, Finland
Lempiäinen, T., Department of Biology, University of Turku, FIN-20500 Turku, Finland

Received 2 August 1996, accepted 16 October 1996

A 45-cm thick cultural layer was analysed in the centre of the town of Helsinki. The microfossil data, comprising the results of pollen and charcoal particle analysis, were supplemented with plant macrofossil data. Together, these data reflect the local development from a closed forest to a rural community which, in the period AD 1640–1910, gradually grew into an urban settlement. The profile can be dated using old maps of Helsinki.

Key words: Charcoal, Helsinki, human activity, Finland, macrofossils, modern history, palaeobotany, pollen analysis

INTRODUCTION

An excellent drawing in the publication of J. Greig (1982) presents sources of pollen transport in a medieval urban context in England. It shows clearly that the town in question had been founded in a former rural landscape. Small areas of cultivated land still remained inside the high walls which usually surrounded urban settlements at that time. Only a few trees represented the former local forest; some new species and individual trees may also have been planted in the town area.

The majority of the herbs were anthropochores and apophytes, and large areas of mineral soil remained bare. The pollen production of this closed assemblage was strongly affected by that of the surrounding areas, where the proportion of forest and field vegetation was greater. Intense human activity in the form of forestry, agriculture, peat collecting and animal husbandry is clearly reflected in the vegetation, i.e., in the areal pollen rain. All these pollen assemblages are fortunately mixed in the cultural layer of the town area with the further addition of regional and long-distance pollen rain.

This description fits the surroundings of 17th–19th-century Helsinki very well with one important exception: Helsinki had no walls between the rural and the developing urban communities. The mixture of pollen assemblages of these two types thus hampers interpretation of the pollen data obtained from the cultural layer found in 1992 during building work for a new underground station in the present-day centre of Helsinki.

OLD MAPS

A 1696 map of Helsinki (Fig. 1; Stenius 1969) shows a wetland area adjacent to the sample site. The same area, in a map from the late 1700s, is documented as cultivated land. In these maps, which were used for the age estimations of the profile, the expansion of urban Helsinki, refounded in

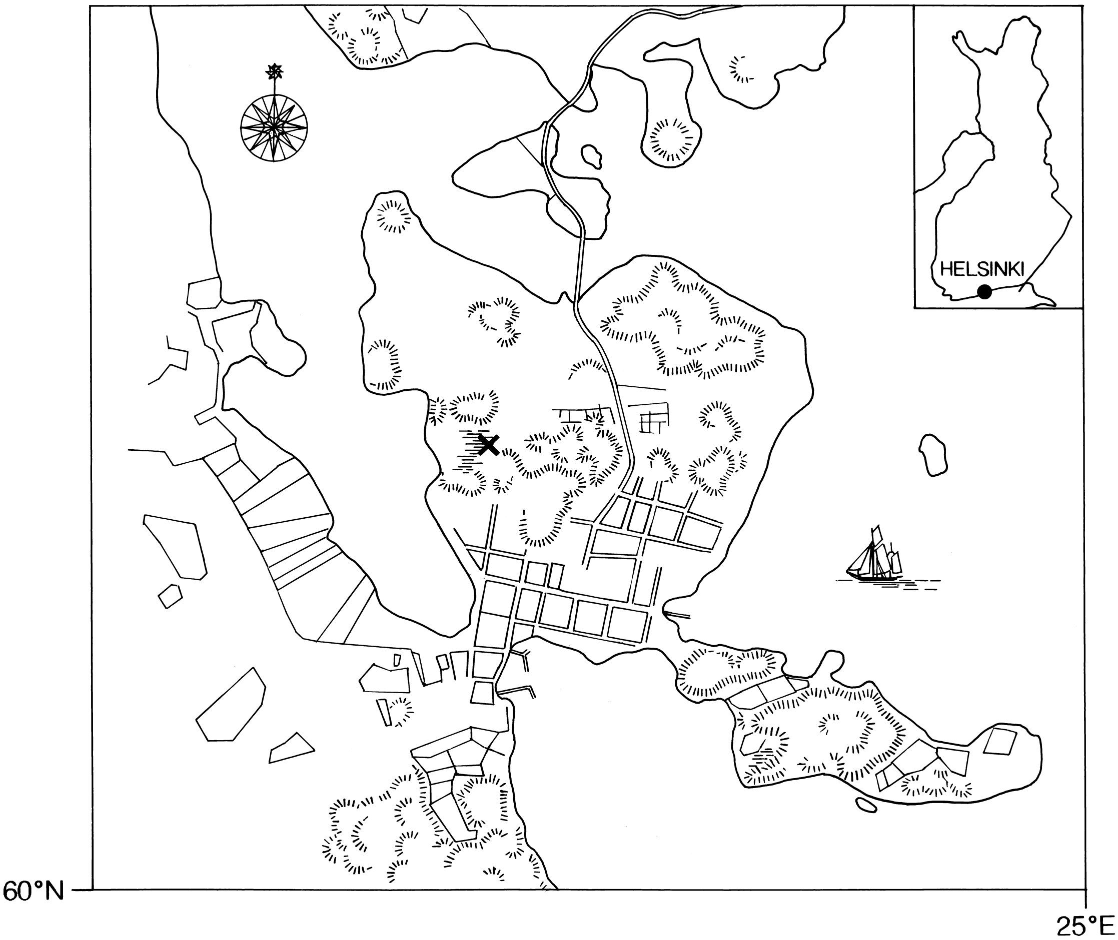

Fig. 1. Location of the sample site and the approach of urban settlement in the Helsinki of 1696 (after Stenius 1969). x = sample site.

its present-day location on a peninsula extending into the Gulf of Finland in 1640, is clearly shown.

MATERIAL AND METHODS

A dark cultural layer of variable thickness was found at the top of the eastern wall of the underground building site. At the sample site, this layer was 45 cm thick and it was covered by a 95-cm thick fill layer and an asphalt layer. In the diagrams the fill layer has been ignored and the depths for the cultural layer are from 0 to 45 cm.

The material was very compact as a result of the lowered groundwater level and the vibration caused by earlier construction around the site and the flow of traffic in modern Kaisaniemi Street. The profile investigated was on a deposit of marine clay, which had emerged from the sea ca. 2 500 years ago (Hyvärinen 1980). The material was a relatively homogeneous mixture of clay, gyttja and sand, characterized by an abundance of charcoal and bone fragments of both fish and mammals, especially at the 25–0-cm level.

Nineteen subsamples were collected at regular intervals. The material was treated with cold HF and KOH methods (Faegri & Iversen 1989). Recent *Lycopodium* spores were added for the determination of pollen concentrations (Stockmarr 1971). The material was mounted in glycerol-gelatine and analysed at 320 × magnification with a Leitz Diaplan microscope. Three hundred pollen grains were identified from each level. The number of pollen grains used was relatively small because of the low pollen concentration values of the upper part of the cultural layer (120–95 cm). Tree pollen frequencies are expressed as percentages of arboreal pollen (AP) and herb pollen frequencies as percentages of the total pollen sum (P). Spores and aquatics are expressed as percentages of P + n. The herb pollen was divided into groups as follows: dwarf shrubs, tall herbs, natural mineral soil vegetation, wetland vegetation, cultivated plants, apophytes and cryptogams. The profile was divided into four local pollen assemblage zones (a–d).

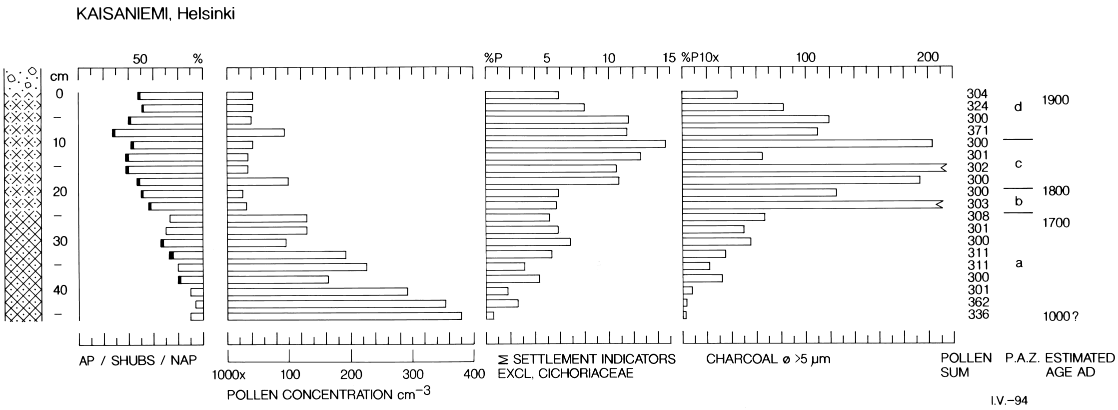

Fig. 2. Pollen ratio of AP/shrubs/NAP, pollen concentration values, settlement indicators excluding Cichoriaceae, and charcoal particles (% AP) in the Kaisaniemi profile, Helsinki.

Charcoal particles > 10 µm were counted and reported as percentages of AP.

The samples for macrofossil analysis were taken together with the pollen samples. Each sample had a volume of 5 dl. The macrofossil material was extracted in the laboratory with salt flotation by washing the floated plant material on a sieve, mesh 0.2 mm, in a gentle stream of lukewarm water. Seeds and other remains were separated using a stereoscopic microscope (WILD M 5) and identified. The plant nomenclature employed here follows that of Hämet-Ahti *et al.* (1986).

CHARCOAL PARTICLES

Charcoal frequencies are expressed as a percentage of AP (Fig. 2). The steady increase in this microfossil group from 20% to almost 700% at the 25-cm level in pollen assemblage zone (p.a.z.) a reflects continuous and increasing use of fire and deforestation in Kaisaniemi. This development corresponds to that expressed by the AP/NAP ratio.

P.a.z. boundary a/b is characterized by a rapid increase in charcoal frequencies to 2 400% P. The charcoal content remains high, especially in p.a.z b and c, and decreases to 4 500% P in p.a.z. d.

POLLEN RESULTS

Main pollen division

The cultural layer (0–45 cm = 95–140 cm below the present-day street surface) can be divided into two main parts with the boundary at the 25-cm level. The lower one (local p.a.z. a) presents the development from a natural to an agricultural landscape. The upper one can be further divided into three pollen assemblage zones (b–d) representing a growing urban environment. Due to the vigour of local human activity, it is possible that some minor contamination has taken place. Since, however, the site has, according to historical documents, never been tilled or built on, no major contamination is expected.

The palaeoecological changes are clearly reflected in the AP/NAP ratios in p.a.z. a–d (Fig. 2). In the lowermost samples, at the 45–40-cm level, herb pollen represents only 6–10% of total pollen, thus reflecting a natural forest landscape with very low human impact. The steady decline in AP in p.a.z. a reflects the opening of the landscape and an increase in human activity.

In p.a.z. b and c the relative herb pollen frequencies continue to increase but they do not exceed 60% of total pollen. The maximum values — 74% P — were reached at the 7.5-cm level. A similar situation was encountered earlier in urban Mätäjärvi material from Turku, southwestern Finland (Vuorela 1985), where the location, close to the sea shore, was also thought to have been the reason for high herb pollen frequencies. Pollen transport by winds blowing in from the sea is smaller than that in air currents in an area completely surrounded by forest. Local herbs are thus better represented in the coastal pollen record. This may also be the case in the Kaisaniemi pollen diagram.

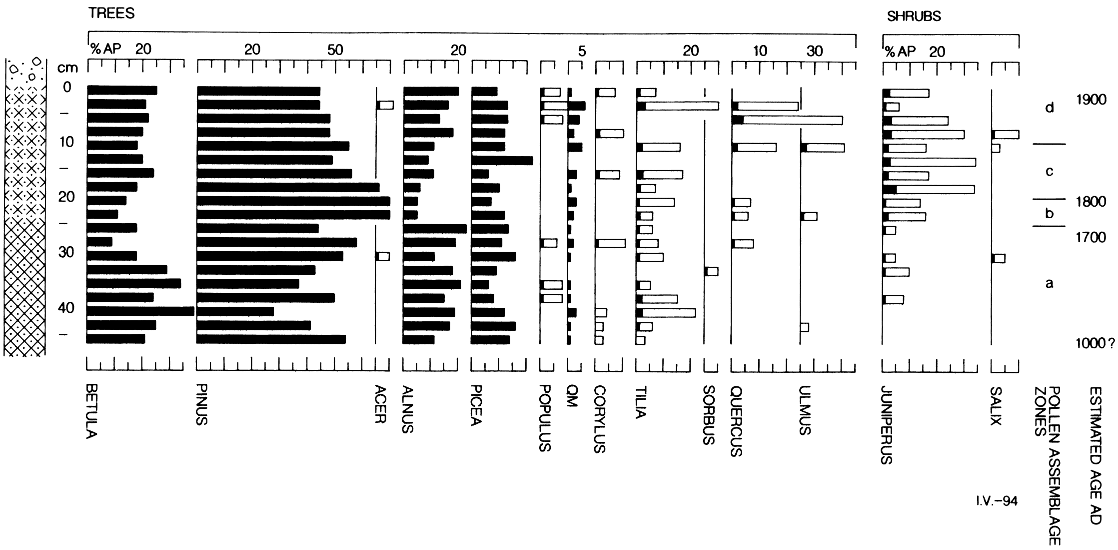

Fig. 3. Relative pollen frequencies of trees and shrubs in the Kaisaniemi profile, Helsinki.

Pollen concentration

The decrease in pollen concentration values from nearly 400 000 to ca. 40 000 cm^{-3} takes place at p.a.z. boundary a/b, i.e., the 25-cm level of the cultural layer (Fig. 2). This could be due to an increase in anthropogenic erosion around the site. The phenomenon corresponds to the decrease in the AP/NAP ratio which simultaneously reflects an opening of the cultural landscape. Later, at the beginning of p.a.z. c and d, at the 12.5- and 7.5-cm levels, the pollen concentration values reach 100 000 cm^{-3}.

The development described above shows that the deposition of the cultural layer started under moist conditions. The low concentration values in the upper part correspond to those met with in the terrestric cultural layers of the post-medieval Helsinki Old Town, which fluctuate between 10 000 and 40 000 cm^{-3} (Vuorela & Lempiäinen 1993).

Trees and shrubs

In the period covered by the Kaisaniemi pollen diagram, climatic conditions played a minor role and human activity was the main cause of the changes in the relative tree pollen frequencies (Fig. 3).

Pinus pollen, which probably mostly originates from vegetation in the rocky surroundings of the sample site, dominates the profile, increasing from 30–50% AP in p.a.z. a to 70% AP in p.a.z. b. In p.a.z. a, deciduous trees (*Betula* and *Alnus*) reflect moist meadows and deforestation. In p.a.z. b relative pollen frequencies of these species rapidly decrease, probably due to increasing human activity. In p.a.z. c and d pollen frequencies of *Betula* and *Alnus* increase together with those of *Picea* which mostly fluctuate between 10 and 15% AP.

The steadily increasing pollen frequencies of broad-leaved deciduous trees (QM) from 0.1–0.3% AP in p.a.z. a up to 6% AP in p.a.z. d reflect human impact, perhaps protection of QM species. *Tilia* and *Quercus* are dominant but pollen of *Ulmus* and *Corylus* also occurs. In 1865, a great number of trees e.g. *Acer* and *Tilia*, were planted in Kaisaniemi park, only some hundreds of metres north of the sample site. Most of the original trees of this park were *Sorbus* and *Prunus*, which are not represented in the pollen data.

Juniperus pollen frequencies are good indicators of the development from a natural to an urban landscape. The juniper pollen frequencies, especially in p.a.z. c and d, indicate grazing in the open area of Kruununhaka (English: Crown grazing land), a name that originates from this kind of

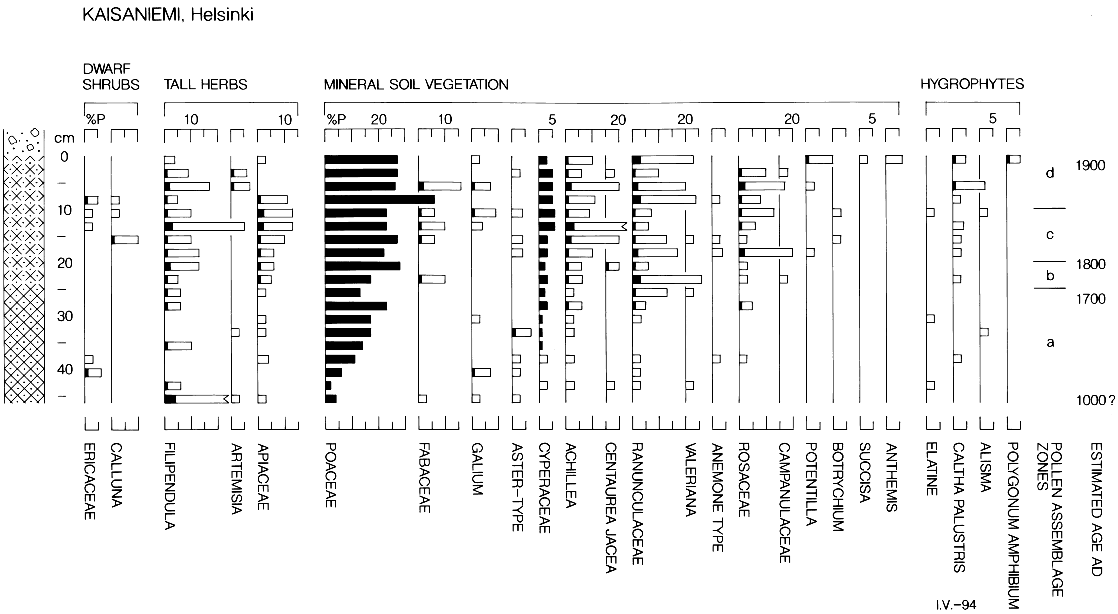

Fig. 4. Relative pollen frequencies (% P) of dwarf shrubs, tall herbs, mineral soil herbs and hygrophytes in the Kaisaniemi profile, Helsinki.

activity in the 18th and 19th centuries (cf. Tikkanen *et al.* 1996).

Dwarf shrubs

Dwarf shrubs are only modestly represented (Fig. 4). At the 37.5–40-cm level Ericaceae pollen grains most probably belong to the original vegetation; they, and especially the *Calluna* pollen grains at the 16–7.5-cm level, reflect surrounding bedrock outcrops.

Tall herbs

In the lowermost sample, *Filipendula* pollen grains indicate natural moist shore vegetation. Later, in p.a.z. c and d they, together with *Juniperus* and Apiaceae pollen, mainly reflect grazing land. The highest *Artemisia* pollen frequencies in p.a.z. d represent an urban environment.

Mineral soil vegetation

This pollen group is dominated by Poaceae, the increase in which from 2–4% to 23% P reflects the opening of the landscape (Fig. 4). At the 25–0-cm level, Poaceae pollen frequencies remain around 25% P, except at the 7.5-cm level where they exceed 40% P. The highest Cyperaceae pollen frequencies (3–6% P) were found in p.a.z. c and d; in the lower part of the profile they remained at 0.3–3% P.

The high pollen values of taxa of zoogamous plants, such as *Achillea*, Ranunculaceae, Rosaceae, Fabaceae (1–3% P), and more sporadic occurrences of *Galium*, *Aster*, *Centaurea jacea*, *Valeriana*, *Anemone*, Campanulaceae, *Potentilla*, *Bothrychium*, *Succisa* and *Anthemis* reflect rich meadow vegetation in the vicinity of the sample site. This type of vegetation is represented by four pollen types in the lowermost sample, 10 pollen types in p.a.z. a and 16 in p.a.z. b–d. The lawn in Kaisaniemi park was famous for its herb vegetation until 1890; this is probably reflected in the abundance of these pollen taxa.

Hygrophytes

According to the map (Fig. 1) and the pollen results obtained (Fig. 4), the study area was originally wetland. This would explain why settlement in the 17th–19th centuries never covered the area.

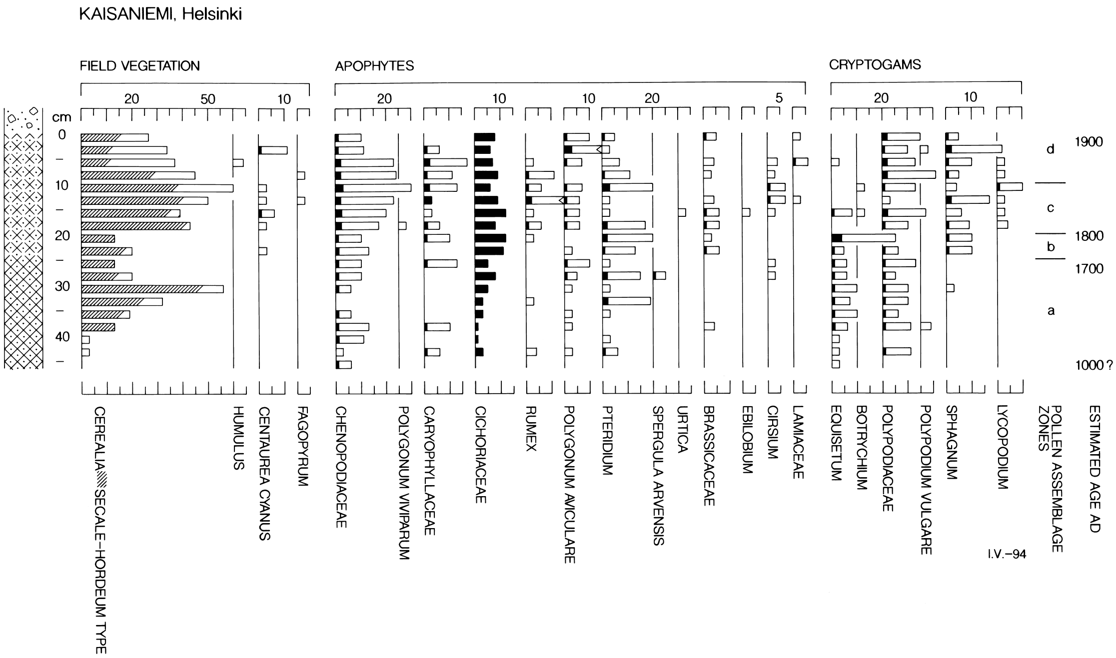

Fig. 5. Relative pollen frequencies (% P) of field vegetation, apophytes and cryptogams in the Kaisaniemi profile, Helsinki.

Confirmation is provided by the frequently occurring pollen grains of aquatics and hygrophytes, such as *Elatine*, *Caltha palustris*, *Alisma* and *Polygonum amphibium*.

Field vegetation

The cereal pollen data (Fig. 5) can be divided into two main phases. In p.a.z. a the strong constant increase in this pollen type reflects local development of the cultural landscape. Another strong representation, preceding a regression, occurs in p.a.z. c. The maximum values of *Secale/Hordeum*-type pollen are 4.7% P in p.a.z. a and c, and most probably refer to local cultivation. In connection with intensive habitation, i.e. in p.a.z. c and d, however, they may also indicate local processing or storage of cereals (cf. Greig 1982, Vuorela *et al.* 1992).

No pollen of *Centaurea cyanus* was found in p.a.z. a (45–25 cm), even though *Secale* was well represented among the cereals (Tommila 1958, Salminen 1958; cf. Behre 1993). Due to its low pollen production, the low pollen frequencies of *Centaurea cyanus* are typical of rural conditions and, especially, winter crops, even at sites where rye is cultivated. In medieval and post-medieval urban cultural layers this pollen type is, however, regularly over-represented, as shown in earlier investigations (cf. Vuorela 1985, Vuorela & Hiekkanen 1991, Vuorela *et al.* 1992). This fact supports the interpretation arrived at here and shows that p.a.z. a represents deforestation and local agriculture and that p.a.z. b–c, with *C. cyanus* pollen frequencies of 0.3–1.1% P, an urban community. The frequencies were highest in the surface sample of the cultural layer, at the 2.5-cm level. They can thus be dated to the end of the 19th and beginning of the 20th centuries.

Among the pollen of other cultivated plants that of *Fagopyrum esculentum* was found at the 7.5 and 12.5-cm levels. This pollen type has earlier been found in several urban late- and post-medieval cultural layers in southern Finland (Vuorela 1985, Vuorela & Hiekkanen 1991, Kankainen *et al.* 1992, Vuorela *et al.* 1992, Vuorela & Lempiäinen 1993).

Even though the connection of *Humulus lupulus* pollen with human activity cannot be confirmed in the present material, this pollen type in the upper part of the diagram (5-cm level) will be classified as an anthropochore.

Apophytes

Among the settlement indicators (Fig. 5), the pollen frequencies of Liguliflorae type (Cichoriaceae) reflect the development of a natural or rural landscape into an urban settlement (cf. Vuorela & Lempiäinen 1993). The species producing this pollen type have not been identified but *Lapsana*, *Hieracium* and *Taraxacum*, and possibly others, too, could be suspected. The pollen frequencies of Liguliflorae type are approximately half those of Poaceae, indicating very strong representation among the herbs. In p.a.z. a, this pollen type increases from 0.3 to 8% P and remains at 8–12% P in p.a.z. b and c.

Intensive settlement is also recorded in the increasing pollen frequencies of Chenopodiaceae, Brassicaceae and *Rumex* in p.a.z. b and c. In p.a.z. a, these pollen types most probably indicate weed vegetation and bare mineral soil; in p.a.z. b–d they reflect, however, dense settlement. Pollen of *Cirsium* and Lamiaceae derives from fields, yards and fallow land, and that of *Centaurea cyanus* (see above) from fields and urban contexts.

Polygonum viviparum, *Spergula arvensis*, *Urtica* and *Epilobium* (probably *E. angustifolium*) occur only sporadically. As such, they are, however, important indicators of marked human impact. A single pollen grain of *Urtica* in the microfossil data at the 15-cm level, for instance, corresponds to a great number of *Urtica* seeds. Spore frequencies of *Pteridium aquilinum* were highest at the 10–32.7-cm level, where they reflect the development of the cultural landscape in the Kaisaniemi area.

Cryptogams

The ecological changes taking place around the sample site are shown most clearly by the cryptogams (Fig. 5). The local wetland conditions prevailing during the earliest phase are reflected by *Equisetum* and Polypodiaceae in p.a.z. a, in which the sporadic spores of *Polypodium vulgare* most probably came from surrounding bedrock areas.

SUMMARY OF MICROFOSSIL DATA

The present material clearly covers only part of the pre-agrarian period in southern Helsinki. The deposit described here represents the cultural layer which started to develop at the beginning of local agricultural activity and ends with the fill material of the early 20th century. The estimated age of the lowermost part of the cultural layer is ca. 1 000 years.

Even though the division of the profile into p.a.z. a–d is based on pollen data, the same zonation is also visible in the rapid changes in spore and charcoal frequencies. It is, however, difficult to tell whether the thickness of the zones corresponds to the length of time they represent. It is also difficult to demonstrate contamination of the material inside the pollen assemblage zones.

Pollen assemblage zone a represents a relatively natural deposit within which the pollen stratigraphy reflects a development from forest to open cultural landscape. Hydrophilous trees are well represented. Deforestation, which increases at the p.a.z. a/b boundary, is also shown by the charcoal frequencies.

As a result of this deforestation, extensive grazing lands developed in the vicinity of the sample site. They are represented in p.a.z. b, especially, by *Juniperus* and herbs such as members of the Poaceae, Apiaceae and Rosaceae. Liguliflorae pollen reflects the encroachment of urban settlement on the sample site.

Owing to increased human activity, contamination may also have increased in p.a.z. c. This is, however, not shown in the pollen frequencies. The continuously opening landscape is reflected in a decreasing AP/NAP ratio and increasing pollen frequencies of the heliophilous trees *Betula*, *Alnus* and *Juniperus*. A simultaneous decrease in spores of *Pteridium aquilinum* indicates a decline in deforestation in the area. Settlement indicators have maximum values; the increase in the pollen frequencies of cereals, *Centaurea cyanus*, *Rumex* and Chenopodiaceae is characteristic of urban settlement.

In p.a.z. d, the increased frequencies of QM species indicate selective control of local tree populations. At the same time, *Polygonum aviculare* pollen reflects open yards, and changes in the cereal division indicate a new period in the settlement of Kaisaniemi. Up until the late 1800s the grass of the adjacent Kaisaniemi park was still in a natural condition (Waronen 1991), a fact that may have had a bearing on the herb pollen flora of the analysed material.

PLANT MACROFOSSILS

Number of plant macrofossils

The total number of plant remains in the five samples analysed was 1 565 (Table 1), with frequencies declining towards the lower layers. There was no clear macrofossil border between the layers corresponding to pollen assemblage zones a and b. However, the number of macroremains is greater in p.a.z. b than in p.a.z. a (ca. 45–25 cm), which seems to be a naturally deposited part of the profile.

The upper part of the profile contained very few macrofossils, with the exception of *Chenopodium album*. The highest number of pollen grains of Chenopodiaceae type and seeds of this plant were found at the same level (10–12 cm; cf. Fig. 5). Macrofossil data showed no clear phases

Table 1. Macrofossil finds from Kaisaniemi, Helsinki, 1992. Unless otherwise mentioned the finds are seeds and fruits. * = charred.

Plant species	Depth, cm 0–10	10–20	20–30	30–40	40–45	Sum
Plants used by man						
Secale cereale	–	–	–	1	–	1
Ficus carica	2	5	1	1	–	9
Fragaria vesca	–	1	–	–	–	1
Hyoscyamus niger	4	1	4	1	–	10
Rubus idaeus	2	5	2	1	–	10
Weeds and ruderals						
Atriplex patula	1	1	3	–	–	5
Capsella bursa-pastoris	–	–	–	1	–	1
Chenopodium album	146	198	177	183	–	704
C. glaucum/rubrum	22	18	6	1	–	47
Fallopia convolvulus	1	–	–	–	–	1
Fumaria officinalis	–	1	–	1	–	2
Galeopsis speciosa	–	1	–	–	–	1
Lamium purpureum	1	2	2	2	–	7
Polygonum aviculare	1	2	–	–	–	3
P. hydropiper	–	–	–	2	–	2
Potentilla anserina	1	1	–	–	–	2
Prunella vulgaris	–	1	–	–	–	1
Ranunculus repens	5	4	–	1	–	10
R. sceleratus	–	1	–	–	–	1
Rumex acetosella	2	–	–	–	–	2
Sinapis/Brassica sp.	–	1	–	–	–	1
Sonchus asper	1	–	–	–	–	1
Spergula arvensis	–	2	–	–	–	2
Stellaria media	27	31	–	1	–	59
Thlaspi arvense	–	1	–	–	–	1
Trifolium repens	–	–	1	–	–	1
Urtica dioica	19	2	7	1	–	29
U. urens	32	55	–	2	–	89
Plants of wet and dry meadows						
Alchemilla vulgaris	6	11	4	2	–	23
Luzula sp.	–	–	–	1	–	1

Continues …

Table 1. Continued.

Plant species	Depth, cm 0–10	10–20	20–30	30–40	40–45	Sum
Poaceae	1	–	–	–	–	1
Rumex acetosa	1	–	–	–	–	1
R. crispus	2	–	–	–	–	2
Scleranthus annuus	–	–	1	–	–	1
Stellaria graminea	–	2	1	–	–	3
Viola sp.	2	1	2	–	–	5
Plants of shores, marshes and water						
Carex sp. 2	58	23	17	–	2	100
Carex sp. 3	16	30	10	5	–	61
Elatine sp.	–	–	1	–	–	1
Eleocharis palustris	6	4	3	–	–	13
Empetrum nigrum	–	–	–	1	–	1
Juncus sp.	41	10	10	–	–	61
J. articulatus	4	–	–	–	–	4
J. bufonius	–	3	–	–	–	3
Lychnis flos-cuculi	1	1	–	–	–	2
Mentha arvensis	–	–	–	1	–	1
Phragmites australis/stems	1	–	–	–	–	1
Potentilla erecta	4	2	–	–	–	6
Schoenoplectus tabernaemontani	51	8	4	1	–	64
Scirpus maritimus	–	1	–	–	–	1
S. sylvaticus	6	3	2	–	–	11
Trees and shrubs						
Betula/Alnus/scale	–	1	–	–	–	1
Picea abies/needle	1*	2*	4*	10*	1*	18
Sorbus aucuparia	–	1	–	–	–	1
Indet.	1	1	–	–	–	2
Sum	469	438	262	220	3	1 392
Other remains						
Bryophyta/*Sphagnum* sp./leaves	5	4	3	–	10	22
Fungi/sclerot.	32	13	38	33	3	119
Wood/charred	+++	+++	+++	+++	+++	+++
Hairs	–	–	+	–	–	–
Pisces/bones, scales	2	15	–	–	–	17
Bone	–	–	12	–	–	12
Insecta	3	–	–	–	–	3
Total sum	511	470	315	253	16	1 565

corresponding to p.a.z. c and d. Mainly cultural weeds and ruderals, which indicate very intensive human activity, were found in this material. The number of pollen grains of Chenopodiaceae, which was present in all layers, decreased downwards. Very similar strata were found in the layers of Lake Mätäjärvi, Turku, which have been dated to the Late Middle Ages (Lempiäinen 1985). Remains of shore plants and aquatics were found among settlement weeds indicating that the site was near wet habitats and small waters. The number of plant remains of dry habitats was clearly lower in the deeper parts of the profile. Contamination of the seeds of these habitats is also possible.

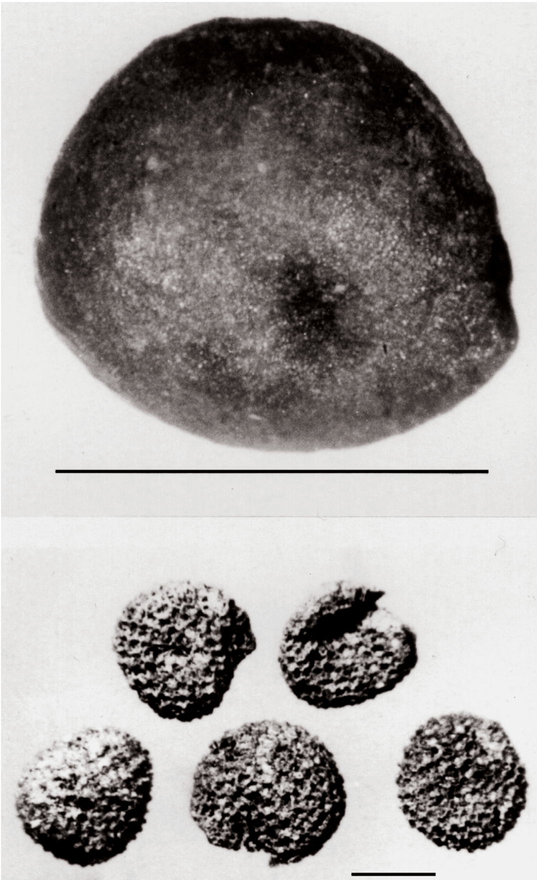

Fig. 6. Macrofossil plant remains from Kaisaniemi, Helsinki. a. *Ficus carica*, fig, seed, b. *Hyoscyamus niger*, henbane, seeds. Scale = 1 mm.

Plants used by man

The remains of locally cultivated plants were very rare in this material. One grain of *Secale cereale* was found at the 35.0–37.5-cm level together with the maximum concentration of *Secale* pollen.

Seeds of *Ficus carica* (Fig. 6) were fairly common in all layers. In Finland, the fig is an article of trade transported from southern via central Europe, mostly from the Mediterranean countries. It used to be stored and carried dry, and was a very well-known fruit and medicinal plant in central Europe (Fischer 1967, Knörzer 1975, Behre 1991). Macrofossil finds of fig are rare in the Nordic countries; medieval seeds have been found in Oslo (Griffin 1979) and Trondheim (Griffin & Sandvik 1989). The earliest finds in Finland have also been dated to the Middle Ages. The medieval sites of Turku (Lempiäinen 1991, 1992, 1995ab, Valo 1993, Aalto 1994), Kuusisto Castle (Lempiäinen 1994) and Helsinki Old Town (Vuorela & Lempiäinen 1993) are all sites of fig finds. In the Middle Ages, fig was transported as a trade to Käkisalmi, on the northwest shore of Lake Ladoga (Vuorela *et al.* 1992, Lempiäinen 1995b).

The oldest written record of fig in Finland is a short discourse on medieval medicines compiled in the convent of Naantali (Erkamo 1944).

Seeds of *Hyoscyamus niger* (Fig. 6) were common in all layers. Nowadays, this plant grows as a native weed in Finland but it was initially transported as a medicine or useful plant by merchants, monks or others. The original habitats are in the eastern Mediterranean countries (Meusel *et al.* 1965, Hawkes 1972). The earliest finds in Finland, dated to the Viking Age, are from Häme (Rapola and Hämeenlinna; Lempiäinen 1991, 1992). There are several medieval finds (e.g. Lempiäinen 1985, 1988, 1989, 1991, 1995a, Valo 1993, Aalto 1994). At that time, henbane was also cultivated. It was known as an important medicine for rheumatism and toothache. At the end of the 19th century henbane was a common plant in the Nordic countries but is now very rare or has disappeared from its earlier habitats (Hultén 1971, Suominen 1979, Lempiäinen 1991).

The first written records of henbane in Finland are from the 17th century, e.g. the 'Catalogus Plantarum' of Elias Tillandz (1673, 1683). In the 18th century it was mentioned as a common plant in North Satakunta, western Finland (Gadd 1751); in the 19th century it was still known as a folk medicine in Finland (Lönnrot 1838, 1860).

Of the wild berries found in the Kaisaniemi profile, *Fragaria vesca* and *Rubus idaeus* were particularly useful for man. They grow in dry habitats, on hill slopes and river banks, at the edges of woods and in meadows.

Weeds and ruderals

Weeds indicating intensive human activity occurred very frequently in the macrofossil flora. *Chenopodium album*, *C. glaucum*, *C. rubrum*, *Stellaria media*, *Urtica dioica* and *U. urens* grow in nutrient-rich soils, yards, pastures, refuse heaps and, especially, near old settlements. Among the weeds of fields, yards and roadsides, *Atriplex patula*, *Fumaria officinalis*, *Galeopsis speciosa*, *Lamium purpureum*, *Polygonum aviculare*, *P. lapathifolium*, *P. hydropiper*, *Potentilla anserina*, *Ranunculus repens*, *R. sceleratus*, *Thlaspi arvense* and *Rumex acetosella* were represented.

Meadow plants

Only a few remains of plants of dry pastures or damp meadows were found, seeds of *Luzula* sp., *Rumex* sp., *Stellaria graminea*, *Alchemilla* sp., *Viola* sp. and *Lychnis flos-cuculi* (see also below) being the most common. Some uncharred remains of Poaceae were also noted.

Plants of shores, marshes and aquatics

Plants of wet habitats were dominant in the Kaisaniemi material. *Carex* sp., *Juncus* sp., *Schoenoplectus tabernaemontani*, *Scirpus sylvaticus*, *Scirpus maritimus*, *Lychnis flos-cuculi* and *Elatine* sp. grow on shores or even in water. *Potentilla erecta* and *Mentha arvensis* are plants of shores or marshes but they also grow in fields and on ditch sides.

Trees and shrubs

Remains of trees and shrubs were very rare. Needles of *Picea abies* were the most common macrofossils of this plant group in the layers of p.a.z. a (45–25 cm).

Other remains

Leaves and stems of mosses, charred wood, mammal bones and fish scales were very common in almost every sample. Such remains are very typical of the settlement layers of intensive human activity (Lempiäinen 1985, 1989, 1995ab). Dirty soil samples refer to refuse and waste heaps at the site of investigation.

COMPARISON OF MACROFOSSIL AND POLLEN DATA

Table 2 gives a side-by-side comparison of the macrofossil and pollen taxa identified in all the samples from Kaisaniemi. Altogether 21 pollen

Table 2. A comparison of the macrofossil and pollen taxa identified in the Kaisaniemi material.

Pollen taxa	Macrofossil taxa
Secale-Hordeum-t. Cerealia	*Secale cereale*
Picea	*Picea abies*
Ranunculaceae	*Ranunculus repens* *R. sceleratus*
Urtica	*Urtica dioica* *U. urens*
Betula	*Betula/Alnus*
Caryophyllaceae	*Lychnis flos-cuculi* *Scleranthus annuus* *Stellaria graminea* *S. media*
Spergula arvensis	*Spergula arvensis*
Chenopodiaceae	*Chenopodium album* *C. glaucum/rubrum* *Atriplex patula*
Polygonum aviculare	*Polygonum aviculare*
Rumex	*Rumex acetosella* *R. crispus*
Elatine sp.	*Elatine* sp.
Brassicaceae	*Sinapis/Brassica*
Potentilla-type	*Potentilla anserina* *P. erecta*
Rosaceae	*Fragaria vesca* *Rubus idaeus*
Sorbus	*Sorbus aucuparia*
Fabaceae	*Trifolium repens*
Lamiaceae	*Lamium purpureum*
Cichoriaceae	*Sonchus asper*
Cyperaceae	*Carex* sp. *Schoenoplectus tabernaemontani* *Scirpus sylvaticus* *S. maritimus*
Poaceae	*Phragmites australis* Other Poaceae

taxa have a correspondence among the 36 macrofossil taxa, the best correspondence being among anthropogenic plants, which reflect the local vegetation. Most of the anthropogenic macrofossil species can be identified at species level, whereas several pollen types can be identified at family level only. The greatest number of macrofossil plant species was identified for the families of Ranunculaceae, Caryophyllacea, Chenopodiaceae, Rosaceae and Cyperaceae.

CONCLUSIONS

The material investigated was deposited under moist conditions, close to an outlet of a bedrock basin. The basin seems to have been overgrown or drained in about the 17th century, when it was already being used as cultivated land. Even so, the sample site seems to have avoided all kinds of tilling or building activities until the early 20th century, when it was covered with fill material and a layer of asphalt.

The material of the cultural layer was very compact partly because of the lowering of the groundwater level, partly because of the heavy fill material and traffic. The current vertical dimension, 45 cm, may represent a considerably thicker natural deposit. The palynological and palaeobotanical data (pollen, charcoal and plant macrofossils) record development from a natural closed landscape, first to a rural, later to an urban, landscape. Cultivation started in the Helsinki district in the Viking Age, at about AD 900 (Vuorela *et al*. 1990). The urban period was also preceded by heavy local grazing activity. Later, the settlement of the 18th–19th centuries is reflected in pollen and macrofossil flora typical of an urban community.

Acknowledgements. The authors thank Prof. Dr. Karl-Ernst Behre (Wilhelmshaven) for valuable comments on the manuscript.

REFERENCES

Aalto, M. 1994: Turun linnan esilinnan kasvillisuus. — TMM Raportteja 16: 21–38.

Behre, K.-E. 1991: Die erste Funde von Nahrungspflanzen aus dem Mittelalter Bremens. — Bremisches Jahrb. 70: 207–227.

Behre, K.-E. 1993: The history of rye cultivation in Europe. — Vegetat. Hist. Archaeobot. 1: 141–156.

Erkamo, V. 1944: Vanhin Suomesta tunnettu lääkeopillinen kirjoitus. (Deutsches Referat: Die älteste aus Finnland bekannte medizinische Schrift). — Duodecim 60: 210–222.

Faegri, K. & Iversen, J. 1989: Textbook of pollen analysis, IV Edition. — John Wiley & Sons, New York. 328 pp.

Fischer, H. 1967: Mittelalterliche Pflanzenkunde. — Georg Olm, Hildesheim. 326 pp.

Gadd, P. 1751: Försök till en oekonomisk Beskrifning ofwer Satakunda Häraders Norra Del (Finnish translation by Murros, K. 1946: Ylä-Satakunnan oloista 1700-luvun puolivälissä). — Stockholm, 148 pp.

Greig, J. 1982: The interpretation of pollen spectra from urban archaeological deposits. — In: Hall, A. R. & Kenward, H. K. (eds.), Environmental Archaeology in the urban context. Council of the British Archaeology, Res. Rep. 43: 47–65.

Griffin, K. 1979: The plant remains from the Oslogate 7 site. — In: Schia, E. (ed.), De arkeologiske utgravninger i Gamlebyen, Oslo 2: 124–133.

Griffin, K. & Sandvik, P. 1989: Forntiden i Trondheim. Frukter, frø og makrofossiler. — Meddelelser 19: 1–108.

Hämet-Ahti, L., Suominen, J., Ulvinen, T., Uotila, P., Vuokko, S. (eds.) 1986: Retkeilykasvio. — Suomen Luonnonsuojelun Tuki, Helsinki. 598 pp.

Hawkes, J. G. 1972: Hyoscyamus L. — In: Tutin, T. G. (ed.), Flora Europaea 3: 195.

Hultén, E. 1971: Atlas över växternas utbredning i Norden. — Stockholm. 56 + 531 pp.

Hyvärinen, H. 1980: Relative sea level changes near Helsinki, southern Finland, during early Litorina times. — Bull. Geol. Soc. Finland 52: 207–219.

Kankainen, T., Lempiäinen, T. & Vuorela, I. 1992: Die Siedlungsgeschichte und Umweltentwicklung von Hämeenlinna Varikkoniemi im Lichte archäometrischer Untersuchungen. — Suomen Museo 1992: 87–107.

Knörzer, K.-H. 1975: Mittelalterliche und jüngere Pflanzenfunde aus Neuss am Rhein. — Zeitschr. Archäol. Mittelalters 3: 129–181.

Lempiäinen, T. 1985: Plant remains from the ancient lake Mätäjärvi in Turku, SW Finland. — ISKOS 5: 258–271.

Lempiäinen, T. 1988: Pflanzliche Makroreste von dem Innenhof des Qwenselschen Anwesens in Turku, SW Finland, vom 17.–19. Jh. — Ann. Bot. Fennici 25: 47–54.

Lempiäinen, T. 1989: Turun muinaisen Mätäjärven kasvijäänteet. — TMM Raportteja 10: 193–214.

Lempiäinen, T. 1991: Past occurrence of Hyoscyamus niger L. (Solanaceae) in Finland according to the macrofossil finds. — Ann. Bot. Fennici 28: 109–128.

Lempiäinen, T. 1992: Pflanzliche Makroreste von der wikingerzeitlichen-frühmittelalterlichen Siedlung Varikkoniemi in Hämeenlinna, S Finland. — Suomen Museo 1992: 109–128.

Lempiäinen, T. 1994: Kuusiston linnan kasvijäännetutkimukset. — Museoviraston rakennushistorian osaston raportteja 8: 1–99.

Lempiäinen, T. 1995a: Macrofossil plant remains from the medieval Turku, SW Finland. — Res archaeobotanicae 1995: 149–164.

Lempiäinen, T. 1995b: Medieval plant remains from the castle of Käkisalmi, Karelia, Russia. — Fennoscandia Archaeologica 12: 83–94.

Lönnrot, E. 1838: Suomalaisen Talonpojan Kotilääkäri. — Helsinki. 153 pp.

Lönnrot, E. 1860: Suomen Kasvio. — Suomalaisen Kirjallisuuden Seura, Helsinki. 376 pp.

Meusel, H., Jäger, E. & Weinert, E. 1965: Vergleichende Chorologie der zentraleuropäischen Flora. — Jena. 583 pp.

Salminen, A. 1958: Nurmijärvi maatalouspitäjänä. — Unpubl. M.Sc.-thesis, Univ. Helsinki, Dept. Geography.

Stenius, O. 1969 (toim.): Helsingin asemakaavahistoriallinen kartasto. — Pro Helsinki Foundation, Helsinki.

Stockmarr, J. 1971: Tablets with spores used in absolute pollen analysis. — Pollen et Spores 13: 615–621.

Suominen, J. 1979: The grain immigrant flora of Finland. — Acta Bot. Fennica 111: 1–108.

Tikkanen, M., Korhola, A., Seppä, H. & Virkanen, J. 1996: Töölönlahden ympäristöhistoria ja veden laadun muutokset pohjasedimenttien kuvastamana. (Swedish summary: Tölövikens miljöhistoria och förändringar i dess vattenkvalitet utgående från analyser av bottensedimentet). — Helsingin kaupungin tietokeskuksen tutkimuksia (Helsingfors stads faktacentrals undersökningar) (4): 1–96.

Tillandz, E. 1673: Catalogus plantarum tam in excultis, quam in cultis locis prope Aboam superiore aestate nasci observatarum. — Aboae.

Tillandz, E. 1683: Catalogus plantarum prope Aboam provenietum cum virtum recensione. — Aboae. 68 + 138 pp.

Tommila, P. 1958: Nurmijärven pitäjän historia I, II. — Vammala. 580 pp. (I), 666 pp. (II).

Valo, O. 1993: Kasveja 1600-luvun Turusta: paleoetnobotaaninen tutkimus Julinin tontilta. — Unpubl. M.Sc.-thesis, Univ. Turku, Dept. Biology. 66 pp.

Vuorela, I. 1985: The pollen data of Mätäjärvi, Turku, SW Finland. — ISKOS 5: 247–257.

Vuorela, I. & Hiekkanen, M. 1991: The urban milieu of the late- and postmedieval town of Porvoo, southern Finland investigated by means of pollen analysis. — Ann. Bot. Fennici 28: 95–106.

Vuorela, I. & Lempiäinen, T. 1993: Palynological and palaeobotanical investigations in the area of the postmedieval Helsinki Old Town. — Vegetat. Hist. Archaeobot. 2: 101–123.

Vuorela, I., Grönlund, T. & Kankainen, T. 1990: Helsingin Vuosaaren luonnon- ja asutushistorian paleoekologinen tutkimus. — Geol. Survey Finland, Archival Rep. KA 43/90/2. 39 pp.

Vuorela, I., Saksa, A., Lempiäinen, T. & Saarnisto, M. 1992: Pollen and macrofossil data on deposits in the wooden fortress of Käkisalmi, dated to about AD 1200–1700. — Ann. Bot. Fennici 29: 187–196.

Waronen, J. E. 1991: Elämää Helsingissä 1800-luvulla. — Helsingin kaupunginmuseo, Narinkka: 8–83.