PLANT REMAINS FROM THE ANCIENT LAKE MÄTÄJÄRVI IN TURKU, SW FINLAND

T. LEMPIÄINEN

Institute of Biology, University of Turku
SF-20500 Turku

Introduction

There are no published records of the old local vegetation of Turku dating from the late Middle Ages. The oldest paper is the plant catalogue of Elias Tillandz (1673). The other evidence is indirect. According to the dissertation of Justander (1679), the town was founded on marshland (»Wilia Suoo», meaning literally 'cereal marsh'). From the old maps of Turku (Kivikoski and Gardberg 1972, Kostet 1978) it is possible to make some assumptions about the types of vegetation in the centre of the old town as far back as the early Middle Ages.

According to C^{14} dating, the soil material of this study covers the period from the 6th to the 18th century. An interruption or hiatus in the sedimentation was found in the period from 500 to 1200 AD. The history of the town of Turku starts in the 13th century (Kivikoski and Gardberg 1971). Because of the central situation of Mätäjärvi in Turku, ca. 300 m SE of the cathedral, the human effect on the vegetation has been strong. Mätäjärvi was the only area near the cathedral that was still not built up as late as at the beginning of the 18th century, but the natural vegetation in the close vicinity of the lake was very limited.

In general, the macroscopic plant remains mainly reflect the local vegetation. In the present case, seeds and fruits transported by man and/or animals may be expected and they can indicate activities such as cultivation and collection of plants or fruits for food, medicinal purposes, animal fodder, thatching houses, etc.

The Mätäjärvi research project, started in the summer of 1982, involved cooperation among the fields of archaeology, history, geology, mineralogy, pollen studies, diatomology, zoology and botany, among others. The results of the different specialists will be published separately.

The aim of the botanical studies was to identify, on the basis of subfossil remains, all the features in the local vegetation which may reflect the human impact during a period of a thousand years.

Material and methods

Treatment of plant remains

In connection with the archaeological excavations of Mätäjärvi in summer 1982, two profile samples of soil (size: 100 × 12 × 10 cm) were taken 736.5—836.5 m above sea level for examination of the seed content and other plant remains. The position, profile

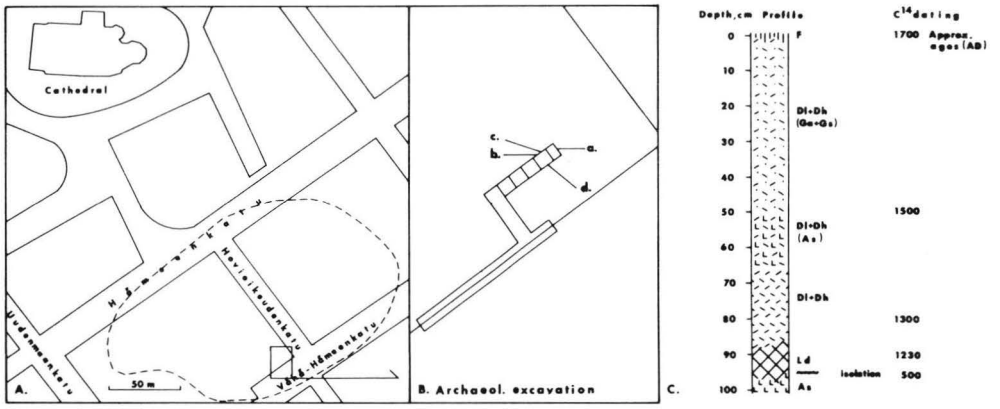

Fig. 1. The position (A, B), profile and dating (according to C^{14}) (C) of the samples taken from Mätäjärvi for examination of plant remains. A: Dotted line = situation of the ancient Lake Mätäjärvi in Turku. B: a = profile sample 1, b = profile sample 2, c = series A, d = samples for germination experiments. C: F = filling earth, Dl + Dh(Ga + Gs) = coarse detritus gyttja with sand and gravel, Dl + Dh(As) = coarse detritus gyttja with clay, Ld = fine detritus gyttja, As = gyttja clay.

and dating (according to C^{14}) of the samples are presented in fig. 1. The third sample series (series A in fig. 1) of six bags was taken near the site of the second profile sample. The data from them are combined with the results from the corresponding layers of the profile samples.

Prior to examination the soil samples were kept at a temperature of +4 — +6°C. The profile samples of 100 cm were divided into subsamples of 10 cm (= 1.2 litre), which were divided into smaller parts during the washing. The subsamples were put into a weak KOH solution (ca. 2—5 %), where most of them were left overnight to break down. The dispersed samples were then washed and sieved through a set of four sieves with meshes of 2, 1, 0.5 and 0.25 mm (later only 1 and 0.25 mm), using a gentle stream of lukewarm water. All of the fractions were examined under a binocular microscope and plant remains were picked out and sorted. The uncarbonized plant remains were stored in a solution of one part absolute alcohol and one part water (later one part glycerine was added).

Germination experiments

In the germination experiments six samples from three different levels were used. The size of a sample was ca. 4—5 litres. In the excavation (August 1982) the samples were spread in a 3—5-cm-thick layer in ordinary seedling boxes (ca. 30 × 50 × 7 cm), enclosed immediately in plastic bags and transported to the Botanical Garden of University of Turku. Over the winter the boxes were covered with bags made of fibercloth (Agryl P 17) used in horticulture, and were placed outdoors in a cold frame covered with window glass. In May 1983 the boxes were transported to the greenhouse. They were watered through the cloth. The bags were opened once a week for a short time in order to follow the germination. The samples were kept under observation until December 1983.

Identification

The following reference works were used to identify the plant remains: Behre (1976, 1983), Beijerink (1947), Berggren (1969, 1981), Bertsch (1941), Brouwer and Stählin

(1975), Hjelmqvist (1955), Körber-Grohne (1964, 1967), Kroll (1983) and Musil (1963). In addition, reference was made to the collections of fruits and seeds at the Institute of Biology, University of Turku, at the Botanical Museum, University of Helsinki, and at the Niedersächsisches Landesinstitut für Marschen- und Wurtenforschung, Wilhelmshaven, FRG. Herbarium material at TUR (Herbarium, University of Turku) was also consulted and specialists in some plant groups gave generous help with the identification work.

The plant names follow Hämet-Ahti et al. (1984). In this paper the word 'seed' is used as a general term for both seeds and fruits functioning as diaspores and found in the soil.

The term 'sp.' is used when it was not possible to establish whether the seeds represent one or more species. When seeds of two or more species were clearly present, 'spp.' is used.

Results

Number of seeds in soil samples

The mean number of seeds per cm^3 was ca. 19. Fig. 2 presents the percentage distribution of seeds among the different levels of the Mätäjärvi samples. *Ranunculus scele-*

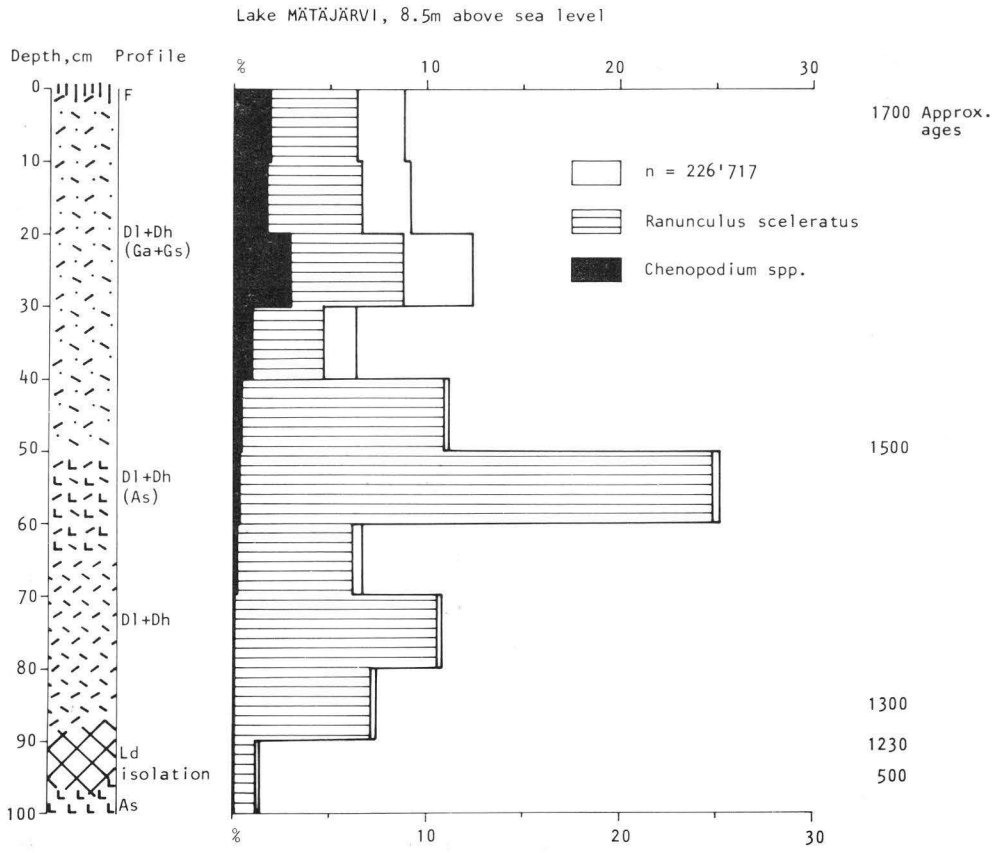

Fig. 2. The percentage distribution of seeds at different levels of the profile.

Table 1. The list of identified plant remains and the numbers of seeds at the studied levels (c = carbonized, a, b, c = ecological groups, see text).

Group	Plant list	Depth, cm									
		100	90	80	70	60	50	40	30	20	10	0
	Alismataceae											
a	Alisma plantago-aquatica L.	—	—	—	—	—	—	—	—	—		1
	Apiaceae	—	—	—	—	—	—	—	—	1		—
	Asteraceae											
bc	Achillea millefolium L.	—	—	—	—	—	—	—	—	1		—
c	Anthemis arvensis L.	3	—	1	—	—	—	—	1	—		2
bc	A. tinctoria L.	—	—	—	—	—	—	—	—	2		1
	Anthemis sp.	—	—	—	—	—	—	—	—	19		28
ac	Bidens tripartita L.	—	—	—	—	—	1	4	2	21		36
	Bidens sp.	—	—	—	—	—	—	—	—	1		—
c	Centaurea cyanus L.	1	—	4	2	—	1	1	—	—		5
	Centaurea sp.	—	—	—	—	—	—	1	—	—		—
a	Cirsium palustre (L.) Scop.	—	—	—	—	1	—	—	—	—		—
	Cirsium sp.	—	—	—	—	—	—	—	—	1		—
bc	Leucanthemum vulgare Lam.	—	—	—	—	1	1	—	—	1		1
b	Tripleurospermum maritimum (L.) Koch	—	—	—	—	—	1	—	—	—		1
	Betulaceae											
	Betula pendula Roth/ B. pubescens Ehrh./scales	3	4	5	4	3	11	32	7	4		1
	Betula sp./seeds	—	—	—	1	5	2	3	—	1		—
	Boraginaceae											
	Myosotis sp.	—	—	—	—	—	—	—	—	—		2
	Brassicaceae											
c	Brassica sp.	—	—	—	—	—	—	—	—	—		1
c	Descurainia sophia (L.) Webb ex Prantl	—	—	—	1	—	—	—	—	1		—
ac	Rorippa palustris (L.) Besser	—	—	1	3	12	54	16	45	15		16
c	Thlaspi arvense L.	—	—	—	—	—	—	—	2	1		—
	Campanulaceae											
b	Campanula sp.	—	—	—	1	—	—	3	6	4		14
	Cannabaceae											
c	Humulus lupulus L.	2	13	22	16	6	15	6	4	2		21
	Caryophyllaceae											
c	Agrostemma githago L.	—	—	—	—	—	—	1	—	—		—
b	Dianthus deltoides L.	—	—	—	—	—	—	3	—	—		—
	Gypsophila sp.	—	—	2	—	—	1	—	—	—		—
a	Lychnis flos-cuculi L.	—	—	1	4	3	9	6	7	2		3
a	Montia fontana L.	—	1	—	—	—	—	—	—	—		—
bc	Sagina sp.	—	—	—	1	—	—	—	—	—		—
b	Scleranthus annuus L./calyx	—	—	—	—	1	1	—	—	—		—
b	Silene sp.	—	—	—	—	—	—	1	1	—		—
c	Spergula arvensis L.	—	—	2	—	—	1	6	1	3		9
c	Stellaria media (L.) Vill.	23	9	10	6	16	298	862	625	605		300
bc	S. graminea L.	4	1	5	7	6	16	20	10	16		9
	Chenopodiaceae											
ac	Atriplex sp.	4	1	2	3	1	9	5	1	2		1
c	Chenopodium album L.	11	2	6	11	10	63	163	88	44		41
c	C. glaucum L.	53	6	7	21	33	244	1192	5889	3267		3491
c	C. rubrum L.	50	25	—	7	7	63	143	101	35		136
c	C. suecicum J. Murr	38	25	16	39	31	208	542	683	600		422
c	Chenopodium sp.	13	7	—	—	9	30	90	—	—		—
	Cichoriaceae											
a	Lapsana communis L.	3	2	1	4	—	7	3	—	1		2
abc	Leontodon sp.	—	—	1	1	—	—	—	—	—		—

Table 1. (cont.)

Group	Plant list	Depth, cm									
		100	90	80	70	60	50	40	30	20	10	0
abc	Taraxacum sp.	—	—	—	—	—	—	1	—	—	—	
	Corylaceae											
	Corylus avellana L.	—	—	1	—	—	—	—	—	—	—	
	Cupressaceae											
	Juniperus communis L./needles	4	1	1	2	—	1	—	—	—	—	
	Cyperaceae											
a	Carex sp./2-sided achenes	83	345	433	453	187	310	444	446	449	371	
a	Carex sp./3-sided achenes	15	25	38	60	19	57	61	75	81	54	
	Carex sp.	—	—	—	1c	1c	2c	1c	2c	2c	2c	
a	Eleocharis sp.	5	11	21	23	11	11	32	57	74	38	
a	Scirpus sylvaticus L.	13	16	19	30	13	15	22	2	1	9	
a	S. tabernaemontani C.C. Gmelin	3	1	—	—	—	—	8	7	7	1	
a	Scirpus sp.	5	1	—	—	—	—	—	—	—	—	
	Empetraceae											
b	Empetrum nigrum L.	2	4	2	—	3	—	2	2	—	7	
	Ericaceae											
b	Arctostaphylos uva-ursi (L.) Sprenge	1	2	6	3	1	2	—	—	—	—	
b	Calluna vulgaris (L.) Hull	—	1	2	2	—	—	—	—	2	—	
b	Vaccinium myrtillus L.	—	9	2	—	—	—	—	—	6	12	
a	V. uliginosum L.	1	4	11	4	—	—	1	—	9	12	
ab	Vaccinium sp.	1	3	2	1	—	—	—	—	1	—	
	Euphorbiaceae											
c	Euphorbia helioscopia L.	—	—	1	—	—	—	—	—	—	—	
	Fabaceae											
b	Trifolium sp.	2	1	—	—	—	—	—	1	—	—	
b	Vicia hirsuta (L.) S.F.Gray	—	1	—	—	—	—	—	—	—	—	
b	V. tetrasperma (L.) Schreber	—	—	1	—	—	—	2	—	—	—	
	Fagaceae											
	Quercus robur L.	—	1	1	1	—	—	1	—	—	—	
	Hippuridaceae											
a	Hippuris vulgaris L.	—	—	—	1	—	—	—	—	—	—	
	Juncaceae											
a	Juncus spp.	2	91	49	54	40	24	5	240	133	124	
a	Luzula spp.	2	5	9	30	14	35	20	33	17	11	
	Lamiaceae											
c	Galeopsis sp.	—	2	5	2	—	3	3	—	2	6	
c	Lamium purpureum L.	4	1	1	2	1	55	74	46	9	6	
c	Lamium sp.	—	—	—	1	—	11	12	4	3	1	
ac	Mentha arvensis L.	—	—	—	—	—	1	2	—	3	—	
c	Prunella vulgaris L.	—	1	7	4	2	3	—	—	4	3	
	Linaceae											
c	Linum usitatissimum L.	—	—	—	—	—	—	—	—	—	1	
	Pinaceae											
	Picea abies (L.) Karsten/needles	23	59	141	158	40	75	14	23	69	111	
		—	—	10c	2c	—	19c	5c	5c	4c	5c	
	» » /seeds	—	—	—	—	—	—	—	—	1	—	
	Pinus sylvestris L./needles	—	—	1	—	—	—	—	—	1	2	
	» » /seeds	—	—	1	—	—	—	—	—	—	—	
	Picea/Pinus sp./seeds	—	—	—	1	—	—	—	—	—	—	
abc	*Poaceae*	8	9	1	7	5	4	4	21	6	43	
	Polygonaceae											
bc	Fallopia convolvulus (L.) A.Löve	1	5	8	8	2	2	1	2	1	6	
c	Polygonum aviculare L.	30	81	42	52	13	15	7	3	27	81	
a	P. hydropiper L.	4	13	—	—	2	1	—	—	—	6	

a	Polygonum lapathifolium L.	4	4	6	2	1	4	19	28	8	23
a	P. persicaria L.	9	12	—	—	—	4	—	2	1	9
a	Polygonum sp.	1	2	7	2	1	—	—	—	—	—
bc	Rumex acetosa L.	—	1	1	1	1	—	—	—	—	—
bc	R. acetosella L.	1	3	7	11	6	7	6	1	2	6
a	R. hydrolapathum Hudson	—	—	1	—	—	—	—	—	—	—
	Rumex sp.	1	—	—	—	—	—	—	—	—	—
	Ranunculaceae										
a	Caltha palustris L.	—	—	—	1	—	—	—	2	—	2
bc	Ranunculus acris L.	—	1	7	7	5	2	3	3	2	10
a	R. flammula L.	11	49	27	33	27	14	11	13	17	7
a	R. repens L.	5	15	10	14	16	7	9	5	10	8
ac	R. sceleratus L.	2837	16063	23845	13931	56131	24728	10333	19717	15077	14373
	Ranunculus sp.	—	—	—	—	1	1	—	—	—	1
	Primulaceae										
a	Lysimachia sp.	—	—	—	1	—	—	—	—	—	—
	Rosaceae										
b	Alchemilla sp.	1	—	3	2	3	9	8	8	3	10
a	Filipendula ulmaria (L.) Maxim.	1	—	1	1	—	—	—	—	—	2
bc	Fragaria vesca L.	4	44	44	88	81	34	23	22	14	7
c	Potentilla anserina L.	1	2	1	5	8	9	14	7	2	6
ab	P. erecta (L.) Räuschel	4	5	10	10	4	12	9	10	10	6
a	P. palustris (L.) Scop.	—	4	4	—	1	3	1	6	4	5
b	Potentilla sp.	—	1	2	1	2	—	2	—	1	—
b	Rosa sp.	—	—	—	1	1	1	—	—	—	2
bc	Rubus idaeus L.	—	2	1	3	3	—	2	5	1	1
	Rubiaceae										
ab	Galium sp.—	—	—	—	—	—	—	—	—	—	4
	Scrophulariaceae										
a	Pedicularis palustris L.	—	3	5	1	—	3	—	2	3	3
	Solanaceae										
c	Hyoscyamus niger L.	—	—	—	—	—	—	1	—	—	—
a	Solanum dulcamara L.	2	—	3	—	1	4	5	8	3	3
c	S. nigrum L.	—	—	—	—	—	1	8	4	—	—
	Urticaceae										
c	Urtica dioica L.	1	1	5	7	6	5	9	15	9	11
		—	1c	—	—	—	—	—	—	—	2c
c	U. urens L.	—	3	8	35	2	2	10	2	1	1
	Valerianaceae										
a	Valeriana sp.	—	—	—	—	—	—	—	—	1	—
	Violaceae										
ab	Viola sp.	—	1	3	3	2	2	5	3	6	1
	Zannichelliaceae										
a	Zannichellia palustris L.	—	—	—	2	1	—	—	—	—	—
	Indet.	5	12	11	10	16	30	19	27	17	25
	Bryophyta										
	Sphagnum sp./leaves, stems	8	14	26	12	2	15	5	3	19	40
	Indet. /leaves, stems	12	25	37	2	—	6	4	12	13	16
	Fungi										
	Sclerot.	5	8	4	3	11	11	11	7	5	5
	Pieces of wood	38	131	353	318	488	438	688	61	33	>2000
		2c	26c	68c	205c	283c	221c	84c	19c	12c	>1000c
	Others										
	Pisces/scales, bones	43	42	69	17	47	15	1	—	—	3
	Insects + molluscs/many kinds of parts, eggs	99	182	215	157	188	153	359	682	389	742
	Bryozoa/Cristatella mucedo	—	—	—	—	—	—	—	1	—	—

ratus constituted 73.8 % of the counted seeds and this species was very abundant in all the layers. Seeds of species of *Chenopodium* (cf. *C. album, C. suecicum, C. rubrum* and *C. glaucum)* also formed a great part of the total seed number, especially in the 0—40-cm layer. The seeds of *Ranunculus sceleratus* had a maximum in the 50—60-cm layer, where the total seed density was ca. 46 800 per litre. At its lowest the total number of seeds was over 2 000 per litre. At the 20—30-cm level, for instance, the content of *Chenopodium* seeds was ca. 5 600 per litre. Because of *Ranunculus sceleratus* the contents of seeds were very high. According to Jensen (1979), the average seed content of soil samples from medieval layers from Svendborg (Denmark) was ca. 1 000 per litre.

Species represented

The identified plant remains are presented in table 1. The remains consist mostly of fruits and seeds; other plant parts are indicated after the plant name. The ecological groups to which the species belong are indicated by small letters to the left of the plant name. The ecological groups are described below. The families and the plant species are listed alphabetically. The remains belonging to the families Poaceae (Gramineae), Cyperaceae and Juncaceae are not always identified to species. *Carex* species are divided into those with two-sided and three-sided achenes.

To aid the interpretation of the data, the plant species are assigned to the following ecological groups: A. Aquatics and hygrophytes, i.e. water plants and wet meadow plants. B. Plants of dry meadows and forest clearings, rocks and cliffs. C. Indicators of settlement, i.e. all the species that indicate human influence: remains of cultivated

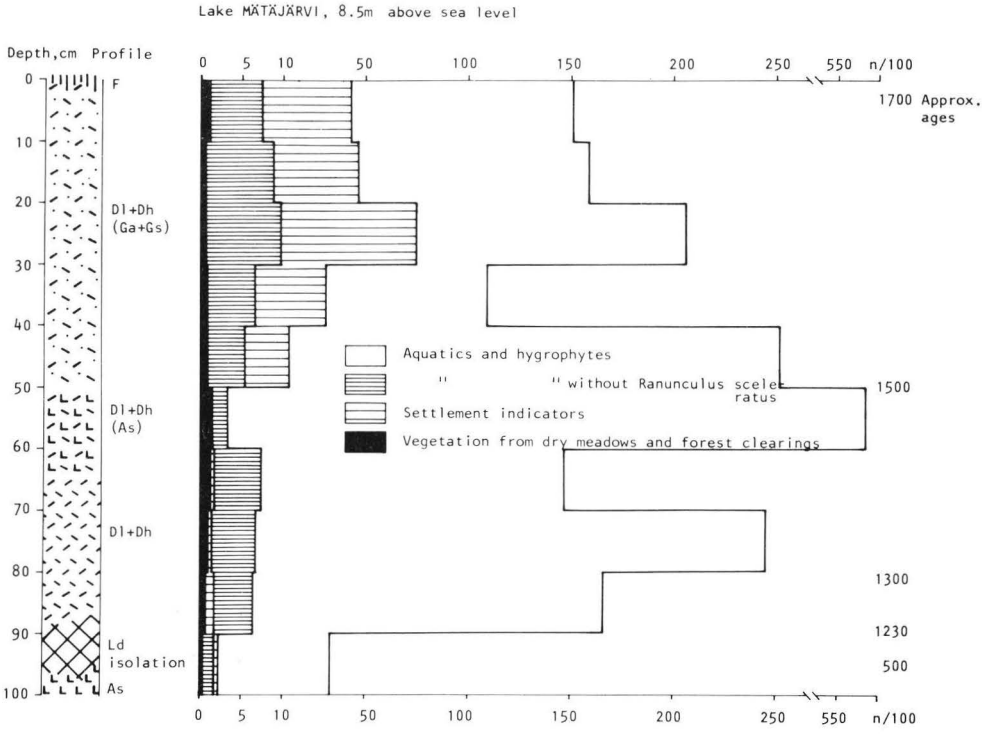

Fig. 3. Numbers of seeds of different habitats at different levels of the profile.

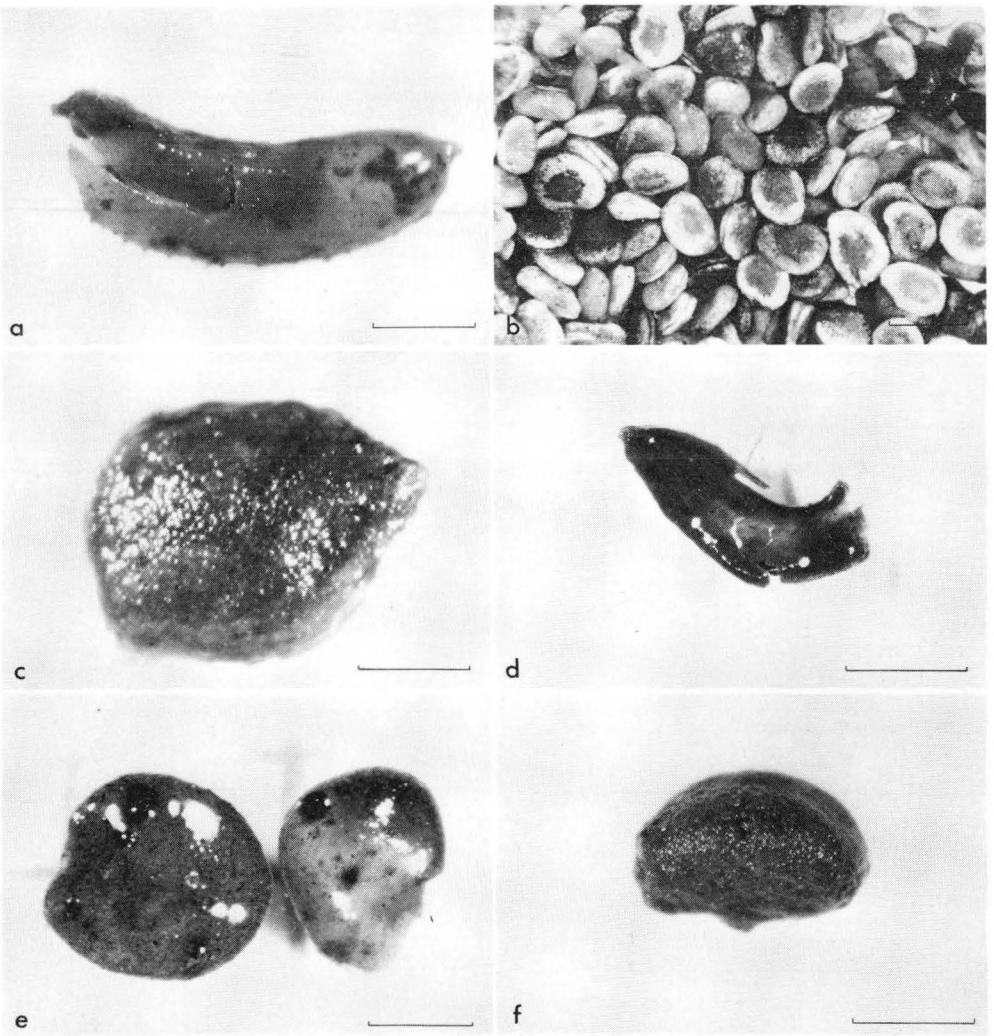

Fig. 4. Plant remains from Mätäjärvi. A. *Zannichellia palustris,* level 30—40 cm, b. *Ranunculus sceleratus,* level 50—60 cm, c. *Ranunculus repens,* level 20—30 cm, d. *Filipendula ulmaria,* level 90—100 cm, e. *Solanum nigrum* (right), level 30—40 cm, *S. dulcamara* (left), level 20—30 cm, f. *Empetrum nigrum,* level 10—20 cm. Line = mm.

plants, both imported and local ones, plants gathered from nature, common field weeds and ruderal plants. The assignment to the groups is partly artificial, because many plant species occur in nature in several different environments. Plant remains have been divided into similar groups in many earlier studies, e.g. by Behre (1969, 1983) and Knörzer (1975) in north Germany, by Fredskild (1971) and Jensen (1979) in Denmark, Griffin (1978) in Norway and Blomqvist and Mårtensson (1961) in Sweden. Group C can be divided into five or six subgroups but in this connection they are considered together. Fig. 3 presents the numbers of seeds of the different ecological groups in every studied layer and figs. 4—5 some photographed plant remains from Mätäjärvi.

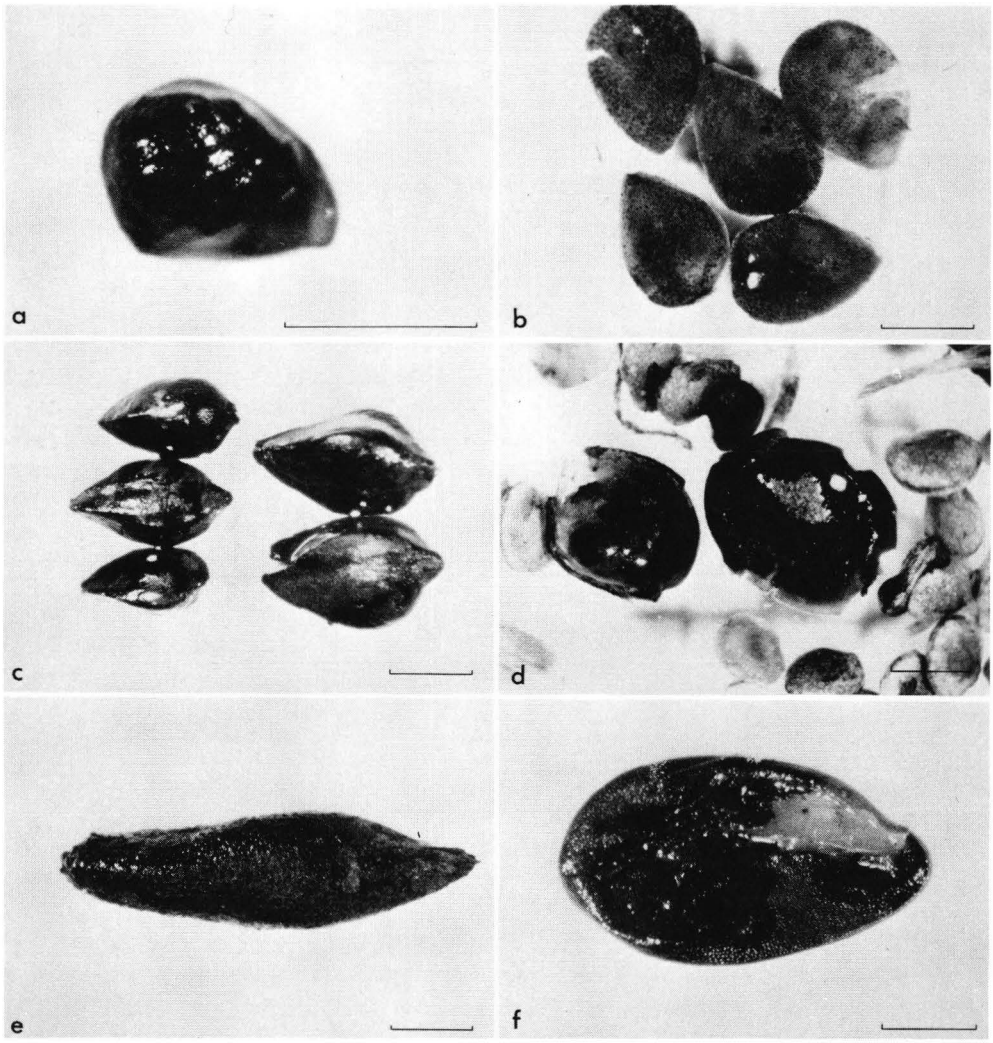

Fig. 5. Plant remains from Mätäjärvi. a. *Fragaria vesca,* level 10—20 cm, b. *Urtica urens,* level 60—70 cm, c. *Polygonum aviculare,* level 80—90 cm (left), 0—10 cm (right), d. *Humulus lupulus* with *Ranunculus sceleratus,* level 50—60 cm, e. *Secale cereale,* carbonized, level 0—10 cm, f. *Linum usitatissimum,* level 0—10 cm.

Discussion

The following discussion is divided into three parts according to the C^{14} dating. The first part deals with the level from 90 to 100 cm in the profile, which represents the time before the isolation of Mätäjärvi from the Baltic Sea and also the interruption in sedimentation (hiatus). The second part discusses the layers from 50 to 90 cm and the last part the layers from 0 to 50 cm.

The level of 90—100 cm

The number of seeds was at its minimum in these layers. No definite aquatic plants were found but characteristic wet meadow species were *Carex* spp., *Scirpus spp. (S.*

sylvaticus, S. tabernaemontani), Eleocharis spp. and *Juncus* spp. (mostly *bufonius), Ranunculus sceleratus, R. repens, R. flammula,* also *Filipendula ulmaria, Polygonum persicaria, P. lapathifolium, P. hydropiper* and *Solanum dulcamara.* Most of these grow on the shoreline, in shallow water or in typical moist meadow communities. Species belonging to the vegetation of dry grassland, forest clearings, cliffs, rocks or other more or less natural communities were *Fragaria vesca, Alchemilla* sp., *Trifolium* spp., *Stellaria graminea, Rumex acetosella, Vaccinium* spp. and *Empetrum nigrum.* Plants that may have been gathered for food were *Fragaria vesca, Vaccinium* spp. and possibly also *Empetrum nigrum.* Cultivated plants were represented only by some nuts of *Humulus lupulus,* but there were some seeds of weeds typical of cultivated fields, small gardens and disturbed areas, for instance: *Urtica dioica, Potentilla anserina, Stellaria media, Chenopodium* spp., *Polygonum aviculare, Fallopia convolvulus, Lamium* sp., *Anthemis* sp., *Centaurea cyanus* and *Lapsana communis.* Remains of trees and shrubs were very rare, consisting of needles of *Picea abies* and *Juniperus communis* and scales of branches of *Betula* sp.

The greater part of the macrofossils belong to the wet meadow plant community, but there were also some seeds of weeds of disturbed and possibly cultivated areas. *Humulus lupulus* occurred much more abundantly in the upper layers. The cultivation of *Humulus* for use in beer started much later than the Iron Age, but its natural occurrence in Finland dates to the end of the glacial period, ca. 7 000—9 000 B.C. (Suominen 1982) and there may have been suitable natural habitats for the plant near the shores of Mätäjärvi.

The level of 50—90 cm

This period consists of the lake phase of Mätäjärvi. The settlement at Turku spread from around the cathedral to the close vicinity of Mätäjärvi during the 14th—16th centuries (Kivikoski and Gardberg 1971). The disturbed places around the lake increased and the marshy shore area may also have increased if attempts were made to fill in and/or drain the lake during that period (Kivikoski and Gardberg 1971). The shores must long have been waste land that was perhaps used for grazing.

A relic of sea conditions was the find of some achenes of *Zannichellia palustris* (Fig. 4). Wet meadow plants were dominant at this level of the profile as well. The number of seeds of *Ranunculus sceleratus* was at a maximum, especially in the layers deposited in the 15th century, when the lake was most polluted (Räsänen et al. 1985). The abundant presence of this species indicates a very nutrient-rich and polluted environment; ditch waters, pools receiving runoff from manure heaps, pastures, etc. The achenes of this plant are produced in great numbers, and being very light are easily carried away from the close neighbourhood (Jalas 1964, Hegi 1965) (Fig. 4). The wet meadow plants were mostly the same as at the level of 90—100 cm; *Carex* spp., *Scirpus* spp., *Eleocharis* spp., *Luzula* spp., *Juncus* cf. *bufonius* and *Ranunculus repens, R. flammula, Filipendula ulmaria, Potentilla palustris, Polygonum persicaria, P. lapathifolium, P. hydropiper, Pedicularia palustris* and *Lychnis flos-cuculi.* Plants of dry habitats possibly collected by man were *Rubus idaeus, Fragaria vesca, Rosa* sp., *Vaccinium* spp. and *Empetrum nigrum. Arctostaphylos uva-ursi* may have been transported by man from the cliffs of Kerttulinmäki, or dispersed by birds. Weeds of settlement were *Urtica urens, U. dioica, Potentilla anserina, Euphorbia helioscopia, Stellaria media, Spergula arvensis, Chenopodium* spp., *Polygonum aviculare, Fallopia convolvulus, Prunella vulgaris, Galeopsis* spp., *Lamium* spp., *Centaurea cyanus, Lapsana communis* and *Agrostemma githago* which at present is a very rare species.

Humulus lupulus was an important cultivated plant in the Middle Ages. As early as the 14th century people paid their tithes in hops to the Turku bishopric and hop gardens may have been very common in the medieval town. There were even laws against hop thieves (Kaukonen 1946, Suominen 1978, Tillandz 1673).

One carbonized corn of *Secale cereale* was found at the level of about the 15th century. Rye was cultivated in the southern part of Finland as early as AD 600—800 (Tolonen et al. 1977).

There were plenty of needles of *Picea abies* (partly carbonized), a few needles of *Juniperus communis,* scales and seeds of *Betula* sp. and pieces of acorns *(Quercus robur)* and nuts *(Corylus avellana).* Pieces of wood increased from the level of 90 cm to 50 cm and the amount of charcoal was especially high in those samples, too.

The level of 0—50 cm

During the period from the 16th to 18th centuries the settlement by the cathedral expanded continuously and surrounded Mätäjärvi (Ranta 1975). Around the lake (or 'pool') was an area that was flooded at times (Ranta 1975). The number of seeds of species from natural wet meadows was found to be higher than earlier, although the amount of seeds of *Ranunculus sceleratus* was lower. One reason could be that the meadow was periodically flooded and surrounded by small kitchen gardens and cabbage patches.

The most noticeable change was in the numbers of seeds of indicators of settlement. The greatest increases were noted for the seeds of *Stellaria media, Chenopodium glaucum, C. rubrum, C. suecicum, C. album, Lamium* spp. and also *Urtica dioica* and *Solanum nigrum.* These are all species of disturbed areas, gardens, fields and all kinds of cultivated land.

The seeds of species of dry habitats were the same as in the lower levels, and possibly included remains of plants gathered for various purposes.

A number of nuts of *Humulus lupulus* were found. There was also a seed of *Linum usitatissimum.* Flax was an important fibre and medicinal plant until the end of the 19th century and an article of commerce in the towns on the coast of Finland (Soininen 1974).

Needles of *Picea abies* were still common, both uncarbonized and carbonized. Pieces of wood were very abundant in the uppermost levels of the profile.

Other remains

Leaves and pieces of moss stems were found at every level of the profile. The leaves of *Sphagnum* sp. could be distinguished from the other mosses. The sphagna are all species of continuously wet or marshy habitats. Mosses may also have been used as building material in huts or as litter for cattle.

The sclerotia of fungi were found at every level of the profile and also pieces of insects and chrysalides, and eggs of molluscs. Abundant pieces of fish bones and scales probably indicate kitchen garbage.

The small bryozoon *Cristatella mucedo* is a species of small lakes and ponds, which forms an elongate, creeping gelatinous colony, with zooids on the upper surface (Engeman et al. 1981, Pratt 1948).

Germination of old seeds

Experiments were carried out with carefully protected soil samples. One seed of *Vicia tetrasperma,* dated to the end of the 17th century, germinated a year after collection

Fig. 6. Vicia tetrasperma, five months after germination.

(Fig. 6). The growth of the plant was very vigorous and after six months the height was ca. 40 cm. Being an annual plant, it died during the winter of 1984. The profile samples contained seeds of *Vicia tetrasperma* and these were assigned to the group of plants of dry habitats.

The seeds of the Leguminosae are fairly indifferent to external conditions and can retain their ability to germinate for considerable periods (Mayer et al. 1963). The seed coats of many members of this family are very hard, resistant to abrasion and covered with a wax-like layer. The length of time for which seeds can remain viable also depends on the storage conditions. The seed of *Vicia* that germinated was deposited in Mätäjärvi in the final phase of the lake. The water content of the soil diminished after the lake filled in and the conditions among the abundant wood litter were apparently favourable for storage.

Summary

Two profile samples and six smaller samples from the excavation of Mätäjärvi, Turku, were analysed for plant remains, and six samples were taken for gemination experi-

ments with old seeds. The aim of the botanical studies was to identify any features in the local vegetation which might reflect the impact of the settlement during a period of a thousand years. The identified plant remains were grouped as follows. 1. aquatics and wet meadow plants, 2. plants from dry habitats and 3. indicators of settlement, including cultivated crops, plants gathered from nature, field weeds and ruderals.

The analysis showed that a wet marshy meadow occurred in the neighbourhood of Mätäjärvi until the beginning of the 18th century. The seeds of *Ranunculus sceleratus* were most abundant, and this indicated a very polluted environment. Some of the remains of dry habitat plants consisted of berries probably collected locally. These were found at every level in the samples. Settlement indicators, especially weeds of disturbed land, increased noticeably after the beginning of the 16th century, when the settlement spread to the close vicinity of the lake area. Very few remains of cultivated plants were found. The most abundant were the nuts of *Humulus lupulus.* Carbonized rye dating from the 15th century, and a flax seed from the end of the 17th century probably came to Mätäjärvi in kitchen garbage. The remains of trees and shrubs were rather rare at every level. The most abundant of these were the needles of *Picea abies,* found in all the layers.

Abundant fish bones and scales clearly originated from kitchen garbage.

One seed of *Vicia tetrasperma,* dating from the end of the 17th century, germinated from the carefully protected samples.

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