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Early medieval hillfort of Budeč – reconstruction of environment on the basis of pollen analysis

Raně středověké hradiště Budeč – rekonstrukce přírodního prostředí na podkladě pylové analýzy

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Abstract: Palynological samples from the early medieval hillfort of Budeč were taken during 1989 from the bailey of the hillfort, referred to as site "Na kašně". Archaeological excavation here revealed two phases of occupation. The older phase has been dated to the period from the end of the 9th to the first half of the 10th century AD, and the other (younger one) from the second half of the 10th to the 11th century. During the 12th century, the outer rampart of the defenses, situated close to the settlement, started to break down as a result of gradual abandonment of the site. Palynological analyses of the anthropogenic sediments which were taken during the last phase of the archaeological excavations from the site "Na kašně", represent a basis for the reconstruction of vegetation at the site of Budeč in the earlier phase of the Younger Subatlantic period (Xa - SA2). On the basis of the vegetation development, the section can be divided into two parts: 1) the phase of direct influence of man - samples 1, 2, 10, 3, 4, 7, 8, 9; and 2) the phase of indirect influence of man – samples 5, 6. Greatest anthropogenic impact on the development of local vegetation can be observed within the middle part recorded by samples 4, 7, 8, 9. In the first part (samples 1-9), pollen of Non-Arboreal/herb taxa (NAP) prevail over Arboreal/woody taxa (AP). The plant association was rather of steppe character, the woodland was represented by islands of forests classified as remains of spruce-and-fir and fir-and-spruce woods with possible migration of other wood species. In the second part (samples 5, 6), the influence of man upon the vegetation decreased, and the proportion of AP:NAP changed in favour of wood species. The types of the f. *Chenopodiaceae* and *Asteraceae Liguliflorae* characterize abandonment of the site, as has been proved by the archaeological research as well. According to the archaeological dating of the layers, the section can be divided into three parts: 1) samples 1, 2, 10, 7, 8 (the first phase of settlement dated to the period from the end of the 9th cent. to the first half of the 10th cent.); 2) samples 3, 4, 5, 9 (destruction layers of the outer rampart, which had been built in three stages during the period from the end of the 9th to the end of the 10th cent.); 3) sample 6 (a layer deposited after the abandonment of the hillfort, dated to the 12th cent.). In the absence of any human influence on vegetation development at Budeč, the potential natural vegetation of the area would probably be characterized, under present climatic conditions, by oak-hornbeam forest; a thermophilous, mixed-deciduous woodland type restricted in lowland and hilly terrain to deeper, clayey soils of brown-earth type.

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Budeč – its location, geological situation, and reconstruction of natural vegetation

The hillfort of Budeč (cadastre of Kováry, village Zákolany, district of Kladno) is situated on a broad prominent irregular triangular spur, separated from the Kladno plateau by the deeply cut valleys of the Zákolanský and Týnecký brooks (Demek et al. 1987, 78, 459, 522). The area of the hillfort is delimited by the slopes of the spur, which descend quite steeply to the valley of the Zákolanský brook and more gently to the valley of the Týnecký brook. Both valleys join to the north of the spur. The Budeč spur is joined with the Kladno plateau only by a narrow neck in the south-west. The flat top of the spur corresponds with the irregular circular groundplan of the inner area of the hillfort, which is situated in the southern part of the spur at a level of about 60 metres above the Zákolanský brook floodplain; i.e. about 288 metres above sea level. The inner area of the hillfort (acropolis) measures approximately 3.3 hectares and is delimited by a still visible inner ramp. The acropolis was surrounded in the W, N, and S by a bailey with an outer ramp, which is also still well recognizable. The bailey descended gently to the N, and became more spacious in this direction. The total area of the bailey was c. 20 hectares.

The geology of the Budeč spur comprises, according to a geological report by Kovanda (1991), marine upper Proterozoic rocks, particularly very slightly metamorphosed slates and greywackes with lydite lenses. The outcrops of bedrock are situated at the N and SE slopes

of the spur. Scattered larger outcrops of lydite are found especially on the steep NE slope. The erosional surface of folded and locally tectonically disturbed Proterozoic rocks is overlain discordantly by Carboniferous freshwater conglomerates and sandstones of the Westphalian stage, which cover the entire plain of the Budeč spur. They descend in a NW direction as far as the floodplain level of the Týnecký brook, filling a large predisposed depression of the palaeorelief. The carboniferous bedrock is on the top of the spur discordantly covered with youngest pre-Quaternary rocks, represented by Mesozoic (Turonian) marly and sandy limestones of the surf facies - typical marine transgressive sediments. The Pleistocene mixed eolian and deluvial sediments on the headland of Budeč are represented by typical loesses, loess loams, and slope loams. They occur between the inner and outer rampart on a large area of the N and SE parts of the bailey, covering Carboniferous sedimentary rocks there. The mixed eolian and deluvial sediments appear also on the W slope of the Budeč spur above the floodplain of the Týnecký brook. The foothills of the slopes of the Budeč spur, adjoining the floodplains of the Týnecký and Zákolanský brooks, are skirted by typical upper Pleistocene to Holocene slope sediments (predominantly debris and sandy loams), which cover also some places on the W slope of the spur. The flood plain is filled with overbank loams, which cover clayey and loamy gravel with admixture of subangular to angular fragments of Proterozoic rocks and pebbles from the weathered Carboniferous conglomerates.

In terms of the reconstruction of natural vegetation corresponding with the present climate, Budeč headland represents an area with a potential natural vegetation of oak-hornbeam forests characterized predominantly as a thermophile deciduous mixed growth restricted in the lowland and hilly terrain (on the average up to 450-500 metres above sea level) to the deeper clayey soils of the brownearth type. It should be noted that this potential natural vegetation represents that which would probably cover the land at present times if man has not affected development of the natural vegetation (Mikyška et al. 1968, 15, 38-44; 1972, map M-33-XV).

An outline of the historical development of the Budeč hillfort

The large-scale archaeological excavations at Budeč carried out in 1972-1986, first in the inner area (acropolis) of the hillfort (Šolle 1990, 1991; Šolle - Váňa 1983; Váňa 1981, 1985, 1989), and since 1981 also in the outer area (at the bailey) (Bartošková 1992), have enabled, in conjunction with written sources, establishment of the historical development of the settlement, presented here only in outline.

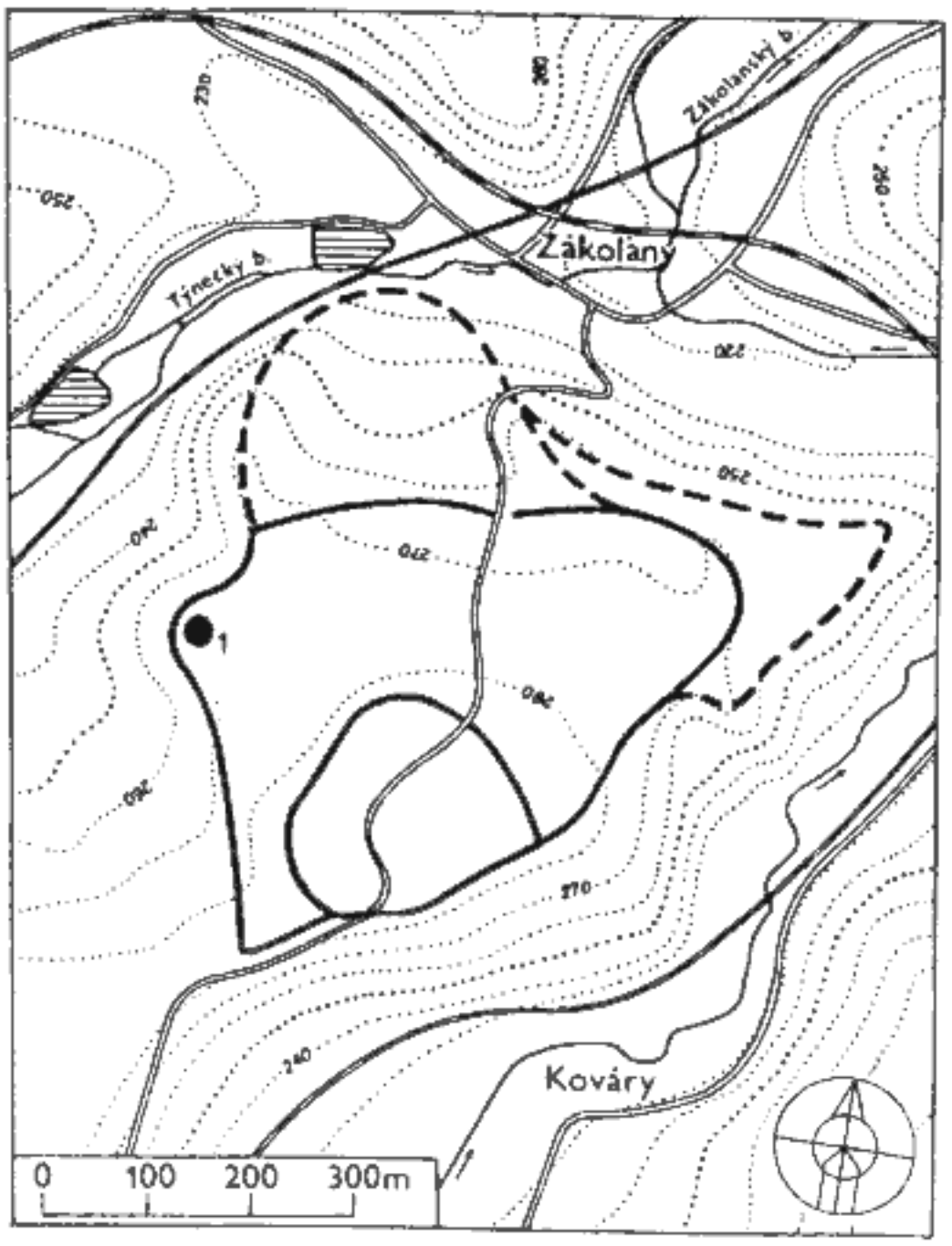
The beginnings of the occupation of Budeč have been dated on the basis of the excavation performed in the inner area of the hillfort to the Late Bronze Age (8th-6th cent. BC). At that time, communities of the Knovíz and Štítary cultures defended their settlements on the Budeč headland. However, the excavations of the Budeč bailey proved that the site had been occupied already in the Middle Bronze Age by people of the Tumulus culture. After the Bronze Age, the site of Budeč remained unoccupied for several centuries until, not earlier than around 800 AD, it started to be re-occupied by new incomers - the Slavs.

Slavic inhabitants made use of loose stones from the disintegrated rampart of the Knovíz period, and built defenses which protected the inner area of the hillfort in the 9th century. The large bailey was not fortified at that time. The outer defenses started to be built at the end of the 9th century, i.e. in the period of the re-construction of the inner fortification circuit, broken down after a fire. Typical dwellings of the Slavs in the 9th century are represented by the so-called sunken-floored houses - square sunken pits (4x4 metres) with a flat bottom and a hearth situated as a rule in the NW corner. The postholes on the bottom or near the sides of the dwellings indicate timber-framed buildings and, together with finds of daub and prints of wattle, demonstrate the form of the above-ground construction, the wattle walls of which were daubed with clay. The sunken-floor type of dwelling is evidenced also for the 10th century. However, at that time types of dwellings with above-ground timber construction and with beaten sandy or loamy floors and a hearth on the surface of the surrounding ground started to prevail.

At the end of the 9th and in the first third of the 10th century AD (under the rule of the dukes Spytihněv, Vratislav, and Václav=Wenceslas), the hillfort of Budeč belonged to the most important sites of the Přemyslide domain. This period is also referred to in written sources. These are the Saint Wenceslas legends written in the Old Church Slavonic language and in Latin which come from the 10th to 11th centuries. They mention the building of St. Peter's rotunda by the duke Spytihněv (895-905), and the stay of young Wenceslas at Budeč, who had been sent there by his father, the duke Vratislav, to learn Latin (Sláma 1988). The archaeological excavation uncovered in the E sector a part of the fortified ducal court, which was situated in the W part of the acropolis and covered mainly the area of the present cemetery. The ducal "palace", which had been built at the beginning of the 10th century, was also associated with the rotunda of St. Peter, with its adjacent cemetery, the earliest phase of which yielded finds of Great Moravian cultural influence.

The constructional and archaeological prospection of St. Peter and Paul church proved that the standing nave built of clay slate is the original Spytihněv's building from the turn of the 9th and 10th centuries. This is the oldest standing building on the territory of Bohemia. The ducal

court was abandoned in the first half of the 11th century, i.e. in the period which is not mentioned in written sources concerning Budeč. However, the archaeological research proved continuous intensive occupation of the acropolis as well as of the bailey, which is evidenced, for example, by remains of timber houses built on stone base walls. The significance of the Budeč hillfort lasted from the mid 10th century supposedly mainly in the economic sphere; whereas its political significance decreased. Budeč started to be administered by an appointed castle supervisor. His court, built on the acropolis in the second half of the 10th century, joined from the E the earlier ducal residence. The court of the castle administrator also owned another church built at Budeč - the church of Virgin Mary, which was presumably founded in the second half of the 10th century. (The church of Virgin Mary has been preserved only in basements, since its ruined above-ground masonry was used as building material during the 18th century). At the end of the 10th century, probably in association with the destabilization of the Přemyslide state, the inhabitants of the hillfort strengthened its inner and outer defenses. The busy life prevailing at the site even in the 11th century, lost its intensity during the 12th century. The court of the castle administrator was abandoned at that time, and the un-maintained defenses started breaking down. The entire hillfort was depopulated gradually, so that in the 13th century the site was probably used only as a cemetery. In that period, Budeč is mentioned again in written sources after a 350 year gap. This historical statement concerns the year 1262. Queen Kunhuta, the wife of Přemysl Otakar II., transferred her patronage over the rotunda of Saint Peter to the Vyšehrad chapter.



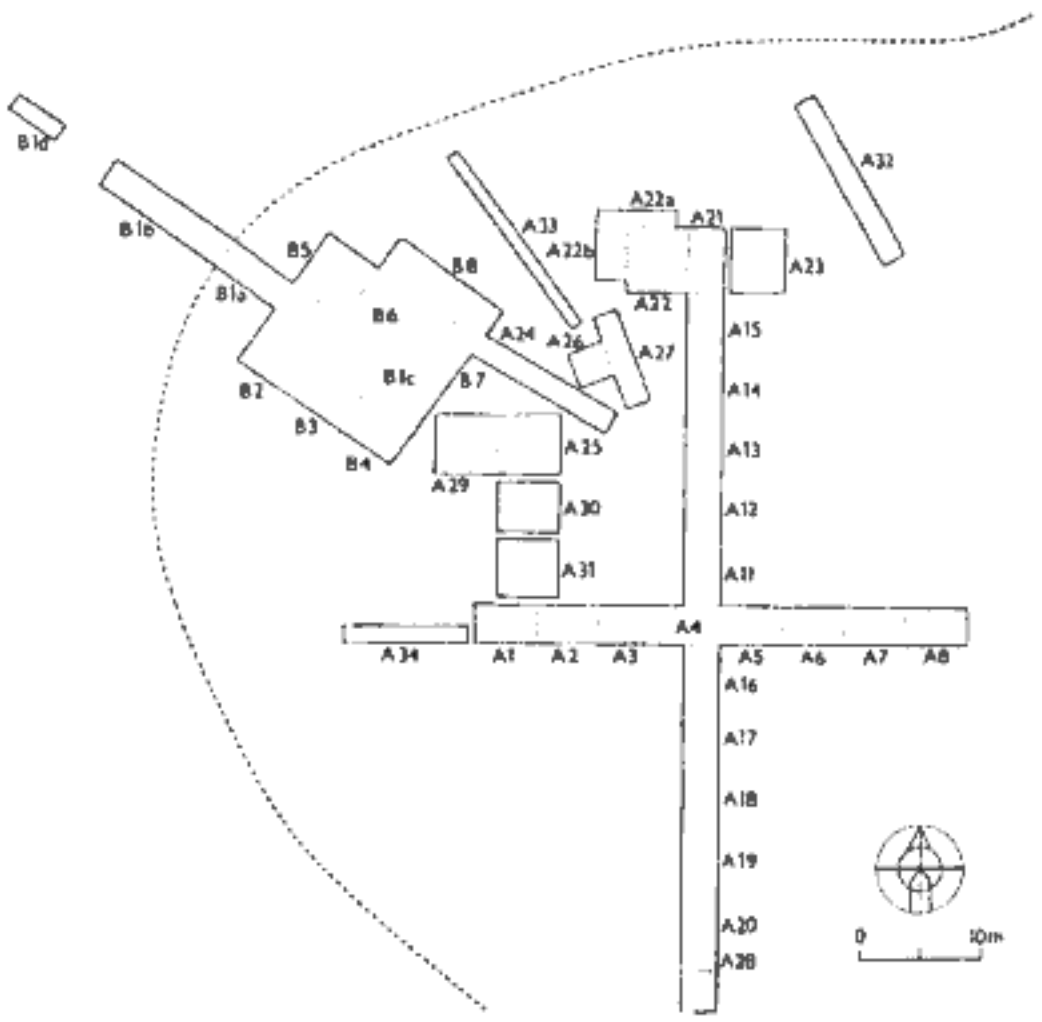
1. Groundplan of the Budeč hillfort. 1 - site "Na kašně".

Budeč bailey, excavation "Na kašně". Archaeological evaluation of the section used for palynological sampling

The samples for pollen analyses were taken at the bailey of the Budeč hillfort during the excavation season of 1989. At that time, the excavation of the site "Na kašně" in the W part of the bailey was close to finishing (see Fig. 1). The results of the excavation, which was carried out from 1981 (with a three-year break) to 1989, can be summarized in a following way:

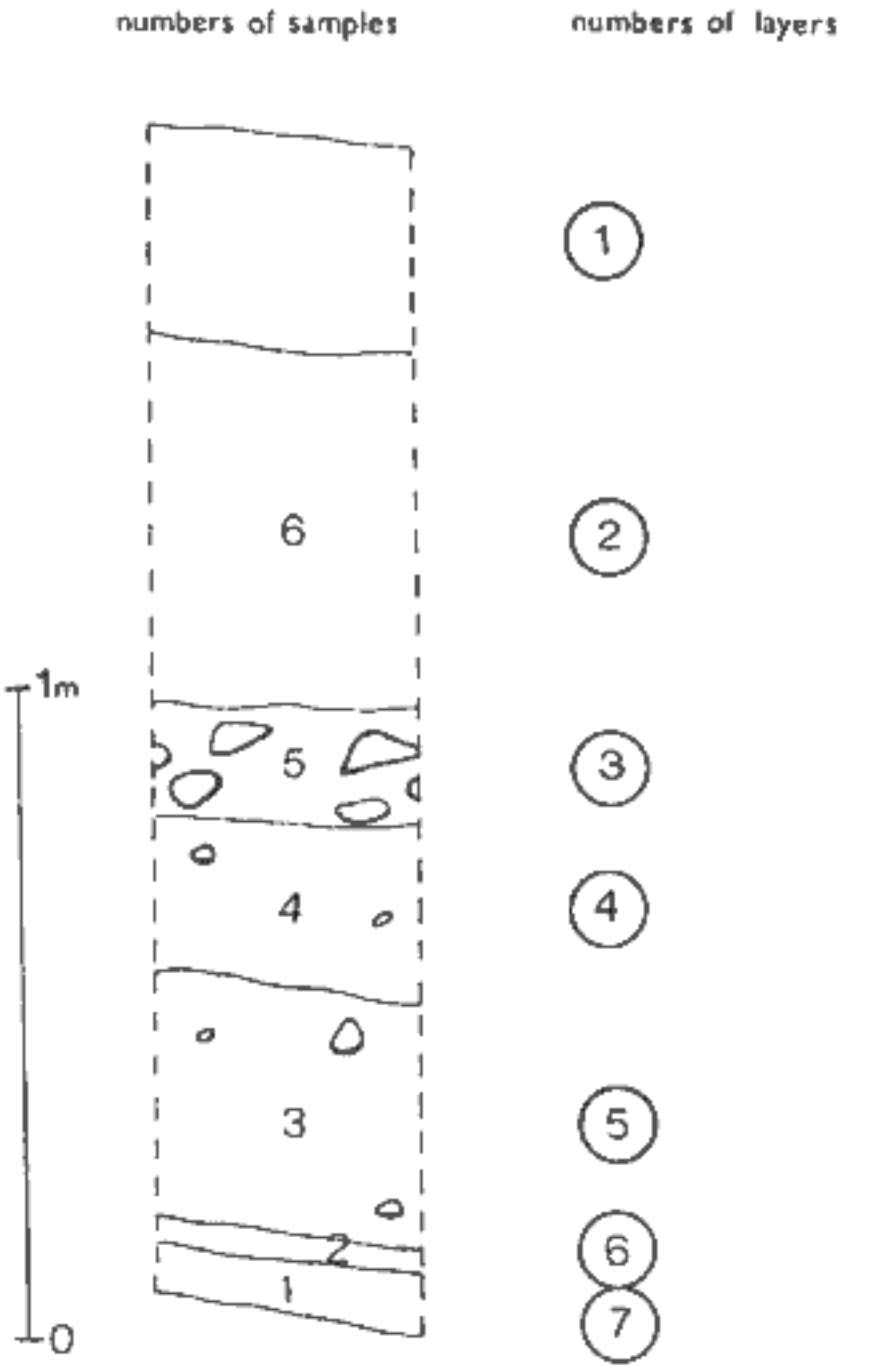
The outer fortification of Budeč (in its present rampart form) delimits the site "Na kašně" as a large curve from the S, W, and N direction. In the NW and S parts of this area, construction of the fortification had been preceded by a sandstone quarry. The central part of the area concerned, which is slightly elevated over the surrounding terrain, has been damaged by recent disturbances. The sandstone quarry had been re-filled just before building the outer rampart, i.e. at the end of the 9th century. It seems probable that the sandstone from the quarry was used for the construction of the front wall of the rampart. The levelling of the ground with sandy rubble created suitable conditions for settlement since the water soaks well and the ground cannot get wet. The occupation was concentrated in the close vicinity of the outer fortification. Sandy and loamy floors with a hearth which represent remains of above-ground features with timber construction of the walls, belong to the first settlement horizon dated roughly to the end of the 9th-first half of the 10th century. In that period, the rampart was strengthened for the first time. The second settlement horizon, which can be approximately dated from the second half of the 10th century to the 11th century, is represented by broken stone wall-bases of above-ground (probably timber) features. This settlement phase was contemporary with a second reinforcement of the outer rampart.

Palynological samples were taken during the final phase of an areal excavation at the site "Na kašně" (B1-B8) in close vicinity to the outer rampart (Bartošková 1992). This area (218 square metres) started to be investigated in 1985, the excavation continued in 1986, and after a three-year break, the excavation was renewed and finished in 1989. For the palynological analysis, the thickest cross-section has been chosen (height 1.80 metres) which had been partly uncovered already in 1986. It is a NW section of the square B2, which was formed as a result of gradual removal of the layers adjacent to the top of the outer rampart. The cross-section is almost parallel with

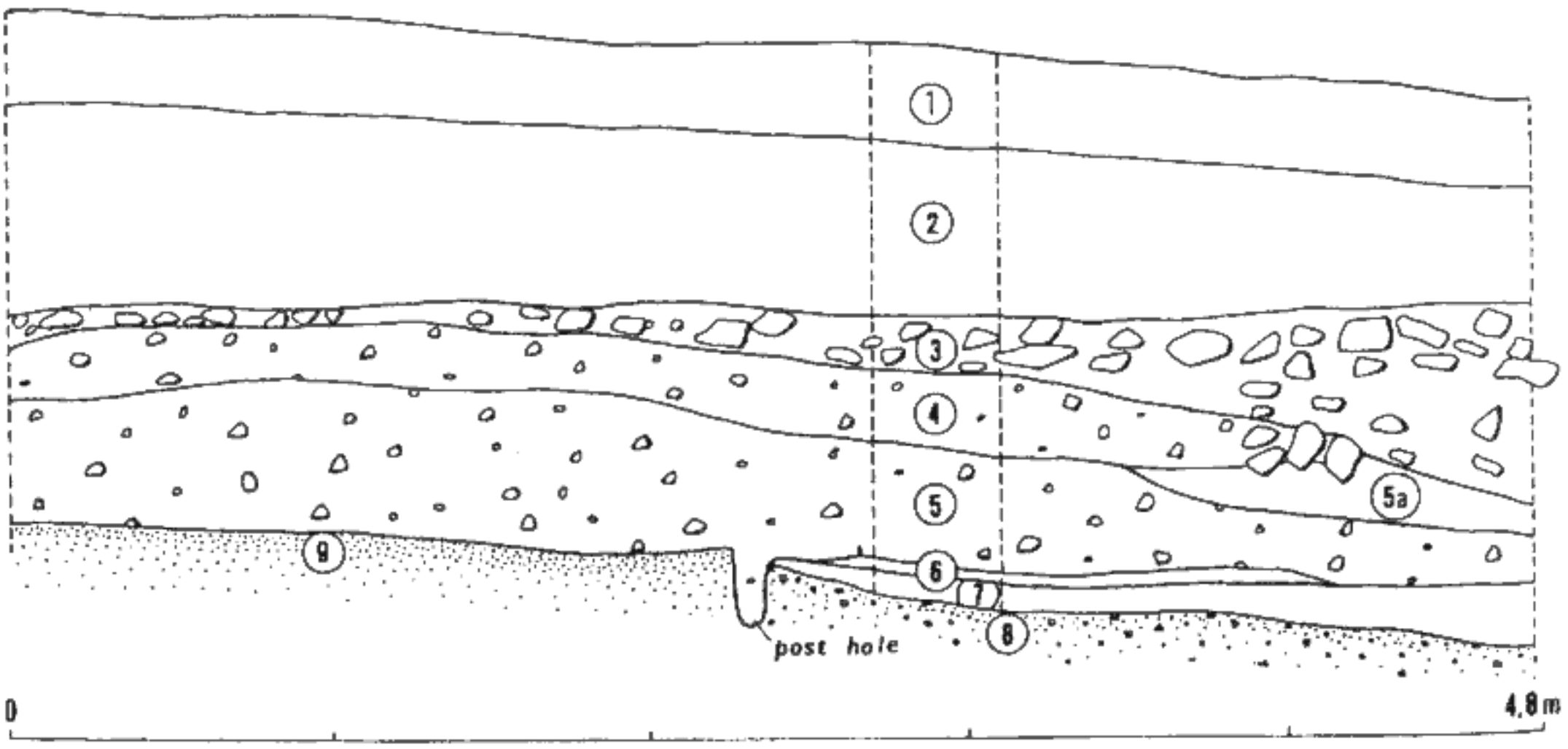


2. Budeč-bailey, site "Na kašně". A system of soundings (incl. numbers of individual sectors) uncovered by archaeological excavation. Palynological samples were taken from sectors B2, B3, B4, B5.

the rampart (see Fig. 2). The outer rampart is nowadays overgrown with a mixed coniferous and deciduous forest, predominantly with pine (*Pinus*) and false acacia (*Robinia pseudoacacia*), with some hazel (*Corylus*) and European elder (*Sambucus nigra*).



4. Budeč-bailey, site "Na kašně". A section of the NW profile of sector B2. Palynological samples (numbers without circles) were taken from individual layers (numbers in circles). The numbers of palynological samples are approx. identical with the areas of taking them.



3. Budeč-bailey, site "Na kašně". NW section of the sector B2; the palynologically sampled area is marked out. Description of the layers: 1 - topsoil; 2 - dark humus layer; 3 - tough sandy loam with stones; 4 - dark greyish brown loose loam with sandstone fragments; 5 - light brown loose loam rich in sandstone detritus; 5a - dark brown loose loam with large quantity of sandstone detritus; 6 - yellow sand with fragments of daub; 7 - brown loose ashy clay-and-sandy layer; 8 - sandstone detritus; 9 - yellow sandy floor.

Stratigraphy of NW cross-section of square B2 including archaeological interpretation

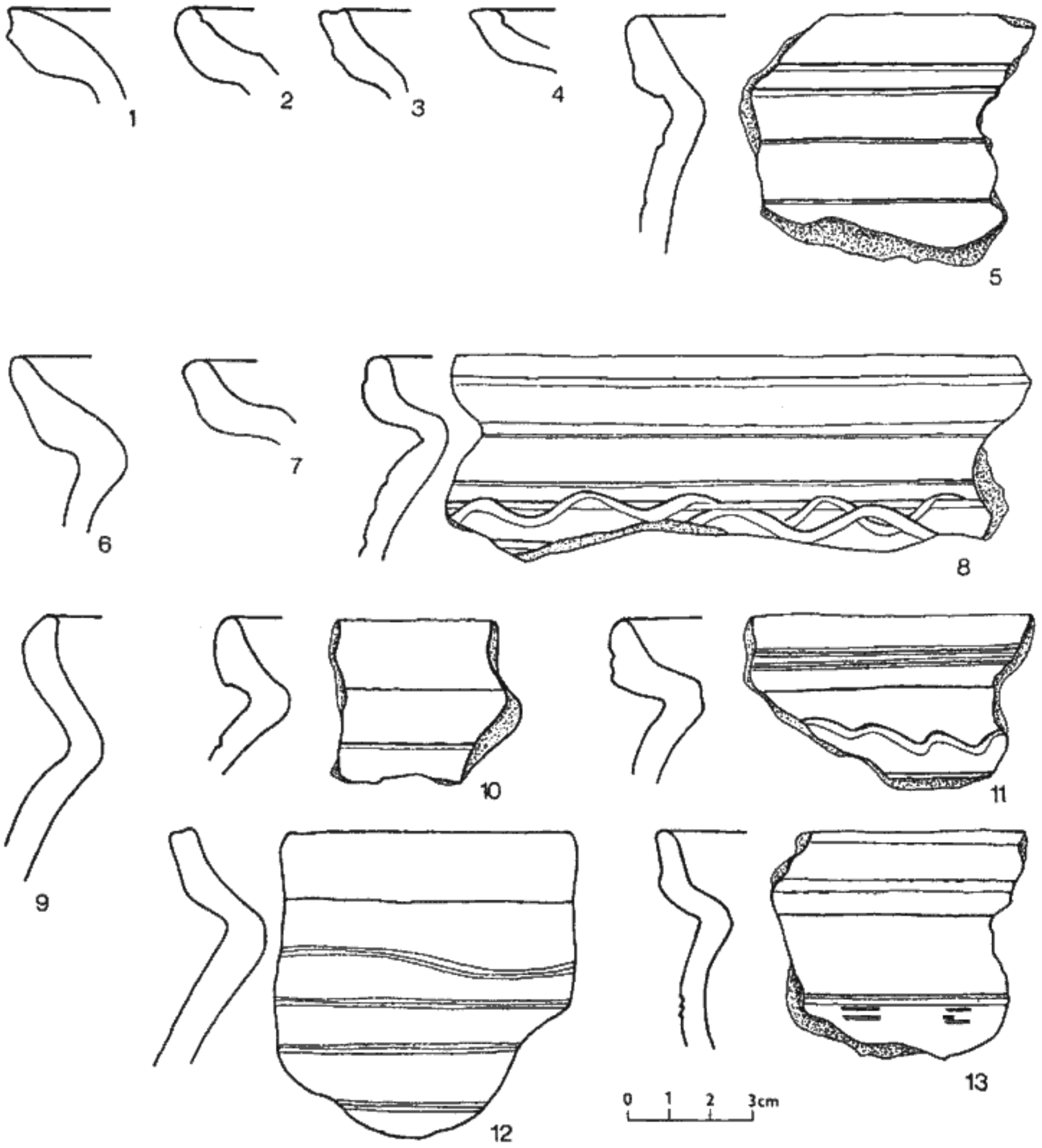
The diagram of the NW cross-section of sector B2 (Figs. 3 and 4) shows the location of palynological samples.

No sample has been taken from layer No. 1 (topsoil), which presumably contains recent pollen and spores.

Layer No. 2 (dark subsurface humus layer) is formed by silt layers redeposited from the inner area of the bailey which were covered with already disintegrated stone wall-bases of the above-ground features, representing the second settlement horizon at the site "Na kašně" (i.e. they come from the Late Hillfort Period). The layer is dated on the basis of the accompanying pottery with chalice-profiled rims to the second half of the 10th and to the 11th century Fig. 5: 1–5). This layer started to be deposited during abandonment of this area, with the unkept rampart already ruined, i.e. after 1100 AD.

Layer No. 3 (large stones, predominantly sandstone, and brown sandy loam) forms the surface of the rampart destruction, i.e. the layer marks the find destruction of the outer rampart during the 12th century. (For selection of pottery see Fig. 5: 6–8.)

Layer No. 4 (dark greyish brown loose loam with sandstone fragments) forms another layer of the ruined rampart bank (for selection of pottery sherds see Fig. 5: 9-13).



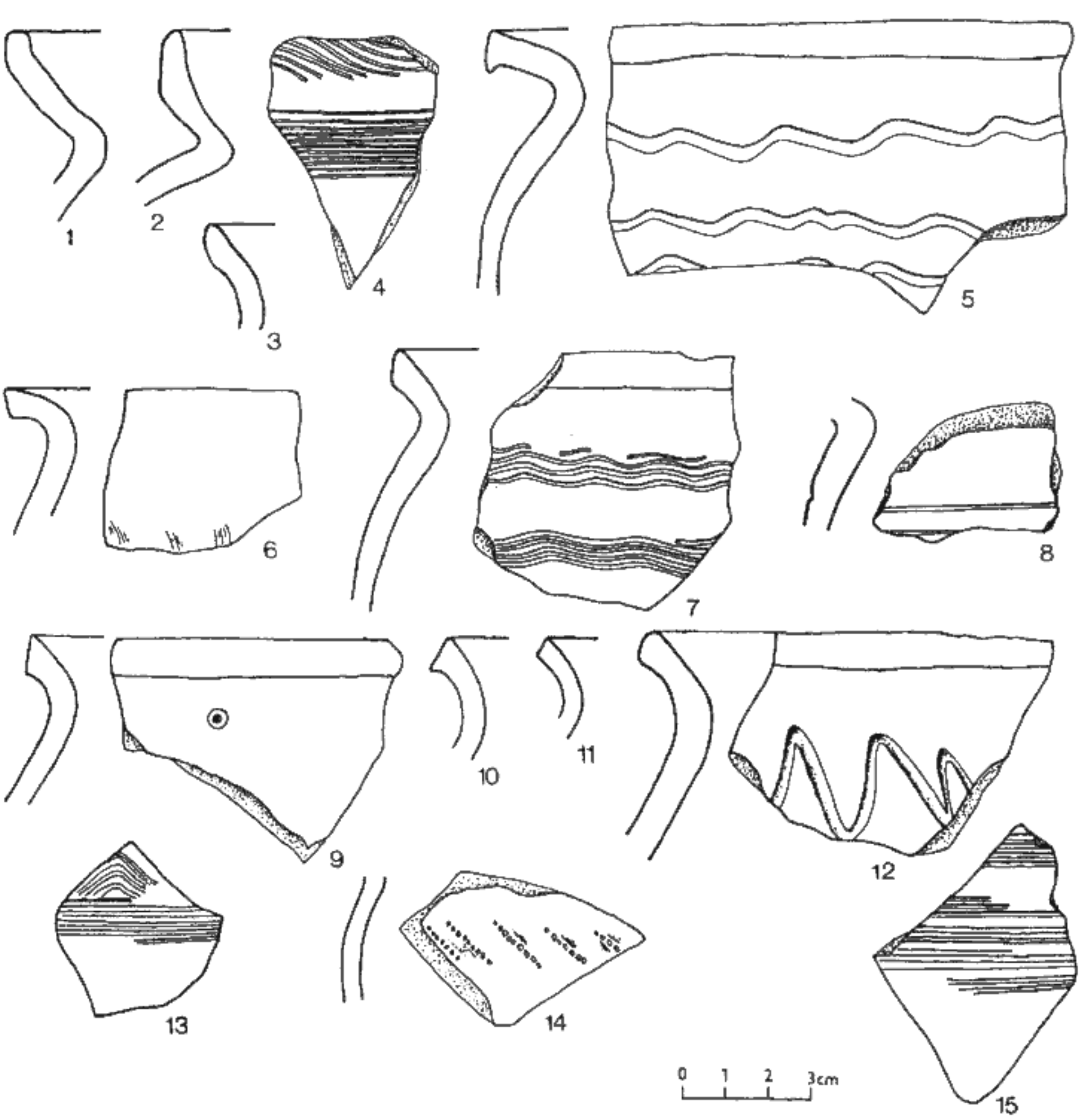
5. Budeč-bailey, site "Na kašně". Selection of pottery found in the NW section of sector B2 in layers (2–4) containing samples for pollen analysis. Pottery sherds from layer No. 2: 1–5; layer No. 3: 6–8; layer No. 4: 9–13.

Layer No. 5 (light brown loose loam with numerous fragments of sandstone rubble and pieces of daub) represents another part of the rampart destruction. This layer, similarly to layers 3 and 4, yielded numerous animal bones and pottery sherds, which represent the evidence of the settlement character of the rampart layers. Choice of pottery is given on Fig. 6: 1–8.

Layer No. 5a (dark brown loose earth with numerous fragments of sandstone rubble) differs from layer No. 5 merely by its darker colour, caused by scattered charcoal pieces in the layer.

Layer No. 6 (a thin layer of yellow sand with pieces of daub) represents the last level of the first settlement horizon, which is composed in the area concerned of sandy or loamy floors as remains of the above-ground features with timber construction. The first settlement horizon has been dated to the end of the 9th–first half of the 10th century.

Layer No. 7 (brown loose ashy sandy-loamy layer), which was uncovered at the level of the sandy floor, had been formed in the period after the levelling of an uneven sandy substratum affected by quarrying, creating thus suitable conditions for settlement at the site "Na kašně". The layer corresponds with the first settlement horizon dated roughly to the later phase of the Middle Hillfort Period, i.e. to the end of the 9th–first half of the 10th century. The first settlement horizon is represented by sandy and loamy floors with hearths (see Plate I), which represent, in addition to the post-holes, uncovered remains of the above-ground features with timber construction.



6. Budeč-bailey, site "Na kašně". Selection of pottery found in the NW cross-section of sector B2 in layers (5, 7), containing samples for pollen analysis. Pottery sherds from layer 5: 1–8; layer 7: 9–15.

Layer No. 5 (light brown loose loam with numerous fragments of sandstone rubble and pieces of daub) represents another part of the rampart destruction. This layer, similarly to layers 3 and 4, yielded numerous animal bones and pottery sherds, which represent the evidence of the settlement character of the rampart layers. Choice of pottery is given on Fig. 6: 1–8.

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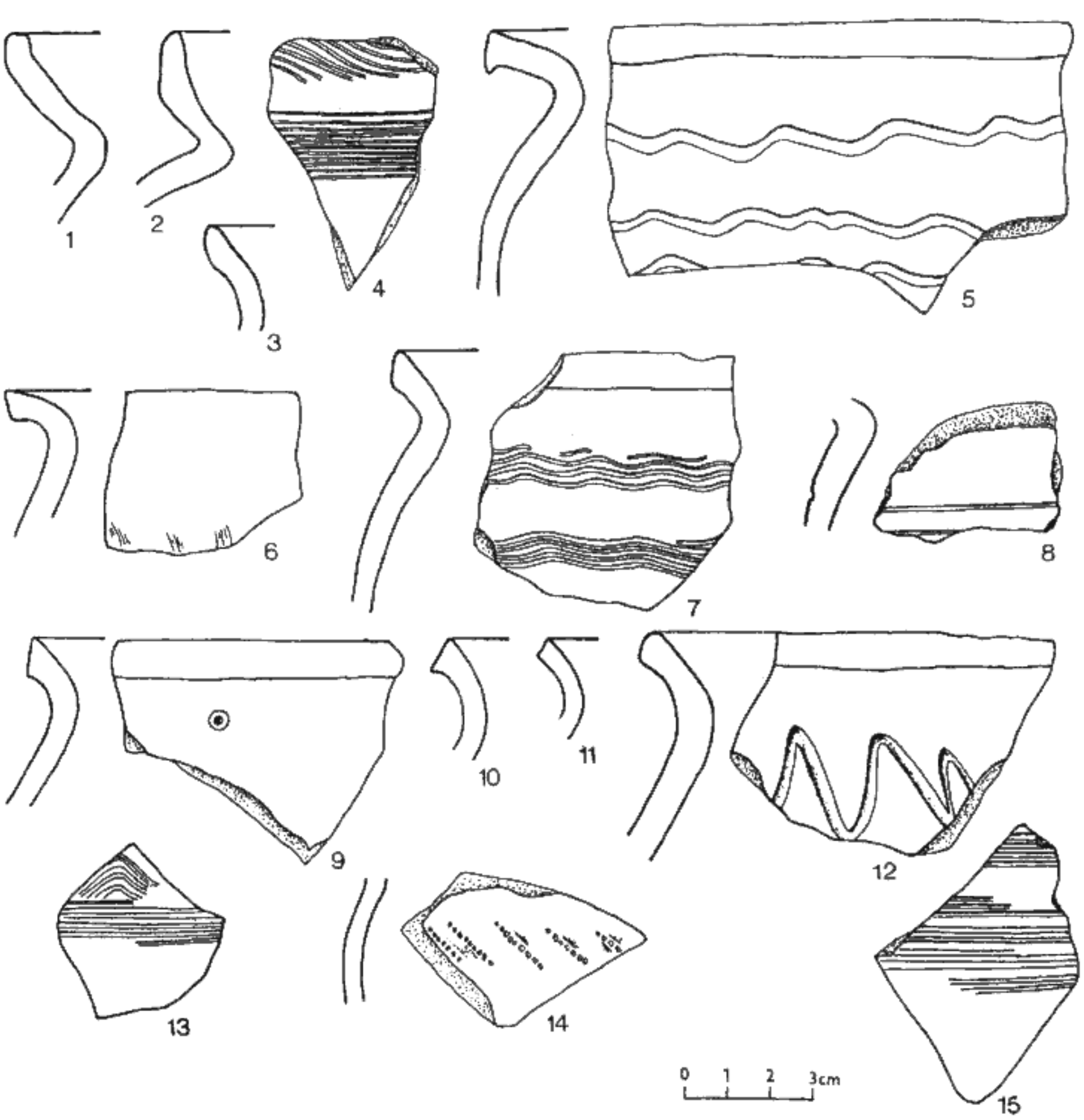
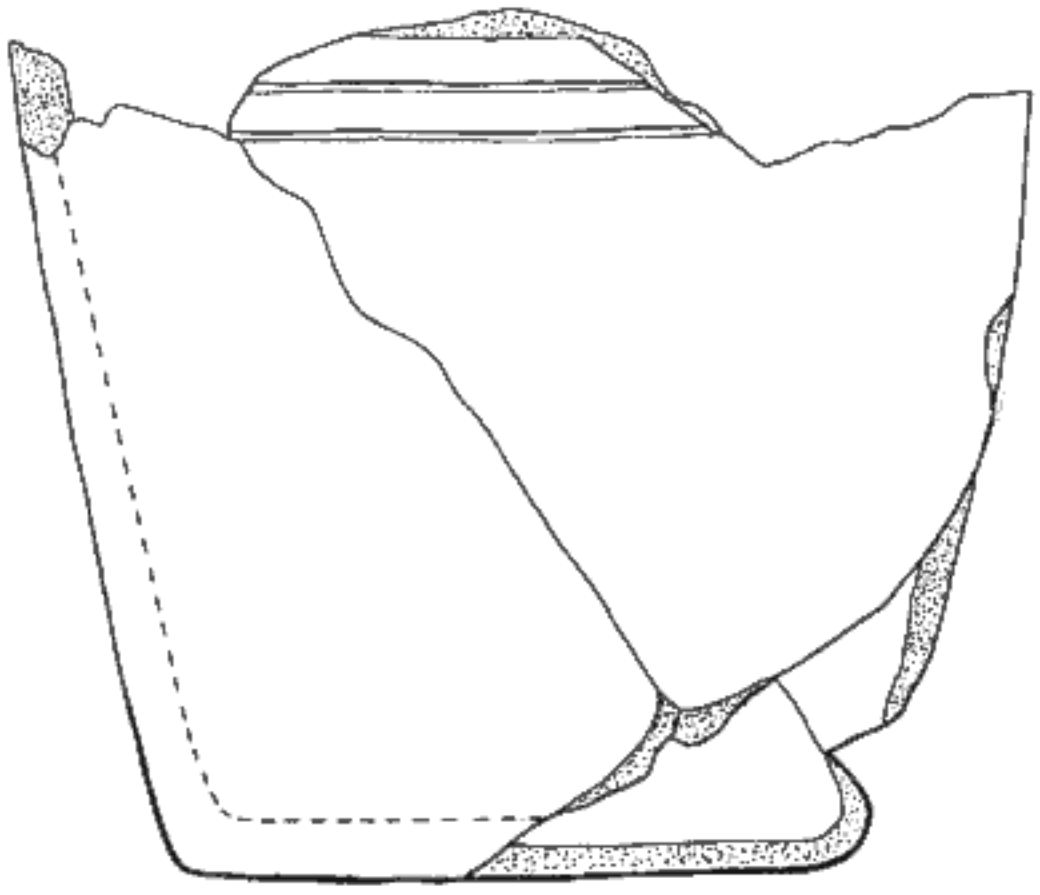


6. Budeč-bailey, site "Na kašně". Selection of pottery found in the NW cross-section of sector B2 in layers (5, 7), containing samples for pollen analysis. Pottery sherds from layer 5: 1–8; layer 7: 9–15.



7. Budeč-bailey, site "Na kašně". Base of a vessel found in sector B5 in the layer of the rampart destruction. Palynological sample No. 9 has been taken from the clayey filling of the vessel.

A selection of the pottery from layer 7 is shown on Fig. 6: 9–15).

For evaluation of the pollen spectra from the B2 section, four additonal pollen samples (Nos. 7, 8, 9, 10) were taken from different sectors of the excavated area. These will be referred to as informative samples. Palynological samples Nos. 7, 8 (sector B4) and No. 10 (sector B3) were taken from the brown loose loamy-and-sandy layer corresponding in the study area with the first settlement horizon dated to the end of the 9th–first half of the 10th century. Palynological sample No. 9 was taken from the loamy filling of a broken vessel (Bp 89-230/8) in the vicinity of the NW section of sector B5. The vessel (base shown in Fig. 7) was uncovered in the layer of greyish brown loose loam with sandstone fragments; the sediment represents one of the destruction layers of the rampart bank.

Pollen analysis

The pollen analysis of samples taken from the B2 section aims to make a contribution to reconstruction of the environment and the way of life of people in the surroundings of the hillfort as well as on the site of Budeč itself. The initial purpose was to determine if the samples are suitable for such research.

Samples for pollen analysis were taken in 1989, first from the carefully cleaned section face of sector B2-NW profile (samples Nos. 1–6), and then from sector B4 (informative samples Nos. 7 and 8), sector B5 (No. 9, contents of broken vessel Bp 89-230/8), and sector B3 (No. 10).

In the laboratory, the samples were processed by an adjusted Frenzel method (according to V. Vodičková – pers. comm.). This is a combination of the methods described by Frenzel (1964), Beuge (1957), and Erdtman (1943, 1954). Its basic operation involves the use of heavy liquid $ZnCl_2$ for separation of the pollen and spores from their sediment matrix, followed by Erdtman's acetolysis (l.c.). The medium for preservation the macerate is the mixture of glycerine-ethyl alcohol-distilled water insuitable proportion. Pollen grains were counted on 1–5 microscopic biological preparations with a cover-glass of 22x22 millimetres.

The pollen grains, spores, and other objects of the microscopic analysis were not well preserved (this is the reason for the considerably large quantity of not determined or undeterminable taxa: varia see Plate 1). Depositional and post-depositional processes at Budeč have not been conducive to good pollen preservation.

A pollen diagram has been constructed for evaluation of the pollen spectra (Plate 1). This shows the percentage representation of the various pollen and spores, together with other microscopic remains. Their real quantity is given on Table 1. Microphotographic documentation of the objects found is shown on Plates II–VIII.

For each sample, a basic sum of all Arboreal (AP) and Non-Arboreal (NAP) pollen (i.e. all tree and herb taxa) has been used for calculation of the percentage values for individual taxa. Other microscopic objects (spores, covers of ova of parasitic worms etc.), while not included in the percentage sum, are shown as a proportion of that sum. The pollen diagram has been zoned according to the scheme of Firbas (1949, 1952). The pollen grains, spores, and other microfossils have been identified on the basis of a comparative collection and accessible references.

The pollen spectra gained from the samples of the B2 sections (Nos. 1–6) and from the informative samples (Nos. 9, 8, 7, 10) have been arranged according to the results of pollen analysis (i.e. the trends of vegetation development) in following succession (from the top of the section): 6, 5, 9, 8, 7, 4, 3, 10, 2, 1, rather than according to their age as determined by archaeological excavation. According to the archaeological evidence, the succession would be as follows: sample No. 6 – silt layer deposited after abandonment of the site; samples Nos. 5,9, 4, 3 – taken from the ruined rampart; and samples Nos. 8, 7, 10, 2, 1 – taken from the occupation layer. The depth in metres of the analyzed samples are given only approximately for setting up the pollen diagram, because they were taken with regard to the type of the sediment rather than depth below the surface. Informative samples have been classified only from the point of view of the vegetation. This is an attempt to reconstruct the environment at the site as well as the impact of human activities on nature.

It is apparent from the character of the sediment (see the description of the sediments in Pl. 1 and chapter "Stratigraphy of NW cross-section of square B2" includ-

ing the archaeologist's interpretation), that the pollen results might be distorted in some cases. Therefore, more sections from the site concerned should be analyzed and compared. Nevertheless, the results obtained have brought interesting data.

Evaluation of the pollen analysis

All the pollen spectra have been assigned biostratigraphically to the earlier phase of the Younger Subatlantic period (Xa after Firbas 1949, 1952; SA2 after Nilsson 1961), in accordance with archaeological results. The informative samples have been classified purely on the basis of the observed pollen spectra.

In sample 1, pollen grains of herbs (NAP) prevail at 93.39 %. This points to the fact that there was no large forest in the vicinity of the site. Pollen grains of woody taxa (AP) were also identified, but their source might have been relatively remote. Of this arboreal pollen, pine (*Pinus*) and birch (*Betula*) were best represented, however, their indicative value in the plant assemblage is comparatively low, since they occur in all types of sediments suitable for pollen analysis, and in all postglacial periods. Another group of Arboreals includes the types of mixed oak groves/forests (QM – the so-called *Quercetum mixtum*). This is mostly represented by maple (*Acer*), while other taxa like oak (*Quercus*), linden (*Tilia*), beech (*Fagus*), and hazel (*Corylus*) occurred sporadically. Pollen grains of alder (*Alnus*) and poplar (*Populus* type) - representatives of hydrophilous wood species - were identified. Of conifers, pollen of fir (*Abies*) and spruce (*Picea*), the typical representatives of fir-and-spruce forests of the Younger Subatlantic period, occurred. Some tree and woody taxa indicate a human presence. Thus the pollen of European elder (*Sambucus nigra*), synanthropic nitrophilous trees, and other probably original dogwoods/ wild cornels (*Cornus mas* and *C.* type (t.) *sanguinea*) occur, though in low quantitites.

Pollen grains of herbs (NAP) in the spectra do not possess the same indicator value as trees (AP) for the stratigraphy and reconstruction of vegetation, but they can complete the picture of the environment. Pollen grains of the families (f.) *Cyperaceae* and *Poaceae* – grasses, usually occurring in pollen diagrams, exist here as well. They occur in roughly equal proportions, which suggests quite humid conditions at the site (however, this need not be a rule, since the individual species cannot be distinguished unambiguously on the basis of pollen analysis).

Other herb types such as *Caryophyllaceae, Asteraceae Tubuliflorae, A. Liguliflorae, Chenopodiaceae*, genus (g.) *Artemisia*, point to more arid steppe conditions at the site. However, as concerns the influence of man, they may also indicate human impact.

The presence of pollen of the so-called cultural grasses or later of cereals (*Cerealia*) points clearly to human activity. The types *Triticum* (wheat) and *Secale* (rye) have been distinguished when possible. They were accompanied by cornflower (*Centaurea cyanus*) as well as by other weed types. In addition to the herbs mentioned above, the pollen grains of the following taxa were determined: *Brassicaceae, Rosaceae, Rubiaceae, Boraginaceae, Knautia* t. *arvensis, Centaurea sp., C.* t. *jacea, Plantago* sp., *Rumex, Lycopus, Lathyrus, Cardamine* typ. They all belong to steppe communities, some of them are weeds, others may be either cultivated or wild. The presence of the covers of the ova of *Trichuris trichiura*, an intestinal parasite in man and pig indicates human activity either in close vicinity or at the site itself.

Sample 2 has been analyzed from layer 6. The pollen assemblage points to changed conditions, controlled either by general increase of humidity or by local events. This is indicated by a slight increase in the pollen curve of alder-tree (*Alnus*) and by the only (in the entire section) quite ample occurrence of *Valeriana* (1.4 %), an indicator of moisture, and of *Myriophyllum spicatum*, an indicator of natural water basins in close vicinity to the site. Similar indicators are *Filipendula* and spores of the *Polypodiaceae* family, which are also present. Sharply raised pollen curves of f. *Asteraceae Liguliflorae, A. Tubuliflorae*, and *Knautia* t. *arvensis* should indicate more likely the local changes. These plants represent the rather steppe-like character of the vegetation, i.e. meadows and pastures of drier character. However, their rapid expansion might have been caused most by man. This layer indicates therefore some human impact, although it seems in some cases that the pollen curves, of cereals, both of wheat and of rye, decrease, similarly to those of f. *Chenopodiaceae* and *Brassicaceae*. With human influence is associated also the occurrence of pollen of other herbs of the taxa; *Caryophyllaceae, Apiaceae, Centaurea* sp., *Artemisia, Ranunculaceae* (can be represented also by swamp types), *Rosaceae, Rubiaceae, Boraginaceae, Plantago* sp., and by the finds of covers of ova of *Trichuris trichiura* (percentage increase of finds). Meadows are indicated also by pollen of *Geranium*, f. *Poaceae* and *Cyperaceae*.

The pollen grains of herbs (NAP) dominated both in terms of quantity and variety over the trees (AP): 95.01 % over 4.99 %. Coniferous trees were represented by pine (*Pinus*), and sporadically by fir (*Abies*), deciduous trees by birch (*Betula*), and sporadically by other types of mixed oak groves, such as hazel (*Corylus*), linden (*Tilia*), oak (*Quercus*), maple (*Acer*), and beech (*Fagus*).

Informative sample No. 10 has been included into the succession of samples given above on the basis of pollen analysis. Again, herbs (NAP = 74.49 %) dominated over woods (AP = 25.51 %). From the viewpoint of vegetation, this sample can be compared with sample No. 3 (layer 5). In comparison to the preceding layer (sample 2), it seems that the conditions on the site had changed, probably as a result of climatic changes, which accord-

ing to the vegetation seems to have been drier, and maybe also warmer. This has been evidenced by finds of pollen grains of *Asteraceae Liguliflorae* and *A. Tubuliflorae, Knautia* t. *arvensis, Caryophyllaceae, Ephedra* etc., as well as by a decrease of the curve of f. *Polypodiaceae*. The highest representation of wood taxa was that of *Tilia* - linden (*T. cordata* and *T. platyphyllos)* in sample 10. As concerns the occurrence of linden, there is a correspondence with the informative samples Nos. 7 and 8, which were taken from the same layer as sample No. 10, i.e. from the layer belonging to the first settlement horizon (horizon of sandy and loamy floors). Of the arboreal pollen, there have been identified pollen grains of pine (*Pinus*), birch (*Betula*), and ash-tree (*Fraxinus*); increasing pollen curve of maple (*Acer*) and alder-tree (*Alnus*). Coniferous taxa on the other hand display decreasing curves of fir (*Abies*) - even interrupted - and of spruce (*Picea*). Sample No. 10 contained the lowest amounts of ova covers of *Trichuris trichiura,* whilst a distinct increase in their occurrence has been recorded in sample No. 3.

Layer 4 is represented by sample 4. The percentage of Arboreal pollen is still low (AP = 7.36 %). Most pollen grains belong to pine (*Pinus*), beside which trace amounts of birch (*Betula*), hazel *(Corylus)*, oak (*Quercus*), linden (*Tilia*), and of alder-tree (*Alnus*) were determined. A large quantity of the pollen belongs to synanthropic plants, for example of f. *Apiaceae, Asteraceae Liguliflorae, Brassicaceae, Chenopodiaceae, Plantago major-media, Urtica, Artemisia, Cerealia* sp., *C.* t. *Triticum, C.* t. *Secale.*

From the viewpoint of the development of vegetation, samples Nos. 7 and 8 have been classified as following-on in the development sequence. These are informative samples taken from the layer corresponding with the horizon of sandy and loamy floors. There is a correspondence between these pollen spectra and that of sample No. 10, with which they can also be compared in terms of archaeological and stratigraphical evidence.

The quantity of herb pollen (NAP) is still dominant, as evidenced by high number of pollen of *Asteraceae Liguliflorae* appearing in the samples 7 and 8 occurred large numbers of pollen grains of *Asteraceae Liguliflorae.* These herbs may represent several types of habitat: most often ruderal communities of roads, less often dry pasturelands, wet/moist meadows and grassfields, land lying fallow. They may also be present as crop weeds in spring and winter agricultural communities (Behre 1981). Another group of plants which indicate human impact includes plantain (*Plantago major-media)*, nettle *(Urtica)*, sorrel (*Rumex)*, willowherb *(Epilobium*), bindweed (*Convolvulus*), wormwood (*Artemisia), Lamiaceae, Chenopodiaceae*, cereals (*Cerealia* sp., *C.* t. *Triticum, C.*t. *Secale*). The pollen curves show that some plants tend to be associated with particular samples: *Filipendula* with sample No. 8, *Caryophyllaceae* No. 8, *Apiaceae* No. 7, *Asteraceae Liguliflorae* No. 8, *Brassicaceae* No. 8, *Artemisia* Nos. 8 and 4. As for the arboreals, a continuous increase in some pollen curves was recognized, e.g. of pine (*Pinus*) - maximum sample No. 8, maple *(Acer*), alder *(Alnus*) - maximum sample No. 7. Other trees occurred in lower numbers (see pollen diagram and Pl. 1).

Sample No. 9 represents the contents of a vessel, and for this reason has been included in the pollen spectrum as an informative sample. The quantity of trees (AP = 21.74 %) starts to increase, although herb pollen (NAP = 78.26 %) are still dominant. Pollen of f. *Chenopodiaceae, Asteraceae Liguliflorae, A. Tubuliflorae* are frequent. The curve of percentage representation of the covers of ova of the parasitic worm showed an ascending tendency with a maximum occurrence just in this sample. The rise of pollen curves is apparent also in trees - maximum occurrence of pollen of fir *(Abies*), largest quantity of pollen of spruce (*Picea*). The analysis of a group of samples 4, 7, 8, and 9 has shown that this part of the pollen sequence from the site of Budeč represents the most distinct impact of man on the natural environment.

Layer 3 is represented by sample 5. The pollen curve of woody species gradually rises (AP = 21.1 %) (see the total diagram at the end of the pollen diagram); this is most apparent in the spectrum of pine (*Pinus*), less in maple (*Acer*), other pollen curves fall (birch *Betula*, spruce *Picea*, fir *Abies*) or their pollen no longer occurs (alder *Alnus*, linden *Tilia* sp., ivy *Hedera*). There is a slight decrease in the number of pollen grains of NAP (78.90 %), and a decrease in the number of herb taxa. The pollen curves of grasses (*Poaceae), Caryophyllaceae, Apiaceae, Centaurea* sp., and of cereals (*Cerealia*) disappear. On the other hand, there occur pollen grains of taxa which characterize rather ruderal sites (previously influenced by man and then abandoned), such as *Chenopodiaceae* and *Artemisia*. F. *Chenopodiaceae* has a peak occurrence (37.97 %). Pollen grains of f. *Cyperaceae* are sporadic. The pollen curves of *Asteraceae Tubuliflorae* and *Caryophyllaceae* rise slightly, may be as a result of a climatic change. *A. Liguliflorae* is still frequent as in the preceding and following layers. Sample No. 5 did not produce any covers of the ova of *Trichuris trichiura.*

Layer 2 included sample No. 6. In this case, the percentage quantity of woody taxa (AP = 52.38 %) equalized the herbs (NAP = 47.62 %). There is no reason to presume continuous cover of the landscape with woods, because the pollen grains of pine *(Pinus)* have been determined again in their maximum quantity in this layer: 48.1 % (much more than spruce *Picea* 2.38 %). This high representation of pine might have been caused by intentional planting. Of the other woody taxa, there have been identified pollen grains of *Cornus* t. *sanguinea*; pollen curves of maple (*Acer*) and fir (*Abies*) fell slightly. Other types did not occur any more. As concerns the herbs, the curves of *Asteraceae Tubuliflorae* rose gradually, as well as those of *A. Liguliflorae* and *Cyperaceae* (slightly); pollen grains of f. *Brassicaceae* occurred again, *Artemisia* was still present. Of the spores, there occurred the

types of f. *Polypodiaceae*, sporadically of *Botrychium*, together with an isolated find of fungus *Ascomycetes.*

Summary of the results

The results of pollen analysis from the archaeological site of Budeč represent the basis for an attempted reconstruction of the vegetation in the vicinity of the site during the earlier phase of Younger Subatlantic period (Xa - Firbas 1949; 1952; SA2 - Nilsson 1961).

According to local vegetation conditions, the section can be divided into two parts: direct impact of human activities - samples Nos. 1, 2, 10, 3, 4, 7, 8, 9; indirect impact of human activities – samples Nos. 5 and 6. This classification of samples is based on a number of common features. The most distinct human impact is apparent in the middle part of the section in samples 4, 7, 8, and 9 (see Pl. 1). In this part, also the maximum quantities of pollen grains of some plants occurred (see detailed description of individual layers and samples).

In the first part (samples 1, 2, 10, 3, 4, 7, 8, and 9), pollen grains of herbs (NAP) prevailed unambiguously over woody taxa (AP), with evidence for direct human impact as a whole, the plant association found there can be evaluated rather as of steppe character with various degrees of human influence. As far as trees are concerned, these were represented probably in the form of isolated forests classified as remains of spruce-fir and fir-spruce growths with some invasion of other tree taxa, e.g. of pine (*Pinus*). Pine itself, however, possesses a low indicator value, since it occurs in all types of pollen spectra, similarly to birch (*Betula*) and others. Further on, there were found pollen grains of arboreal taxa thought to represent mixed oak groves (QM): elm (*Ulmus*), oak (*Quercus*), linden (*Tilia – T. cordata* and *T. platyphyllos*), maple (*Acer*), beech (*Fagus*), ash (*Fraxinus*), dogwood (*Cornus* t. *mas, C.* t. *sanguinea*), and in the undergrowth hazel (*Corylus*). The pine might have entered both mixed or coniferous forests, or it might have occupied inaccessible rock steps or sandy sites, where it could be preserved in relict pine groves. The pollen of g. *Ephedra* might contribute as well to the indication of a larger woodless area (it is probably a light-loving xerophyte element). Similarly hazel (*Corylus*) is representative of a warmer climate and larger woodless areas (greater production of pollen at not overshadowed places). In sample 10, a distinct quantity of pollen grains of g. *Tilia* (linden) has been recognized which in some cases could have been distinguished as *T. cordata* and *T. platyphyllos*. This might have had both natural and intentional reasons (e.g. the linden-trees might have been planted - they served as symbols among Slavic nations).

There grew probably clumps of alders along the water streams, with isolated poplars and the undergrowth of herbs of f. *Poaceae* (grasses), *Cyperaceae*, and of damp-loving types like *Caltha* type, f. *Ranunculaceae, Potamogeton, Myriophyllum spicatum, Polygonum amphibium, Filipendula,* f. *Polypodiaceae, Sphagnum.*

The pollen spectrum of herbs (NAP) indicates not only human activities but at the same time serves as a basis for indication of several types of plant habitat: synanthropic nitrophilous communities of dumps, ruderal communities growing along roads, dry pasturelands, wet meadows and grassfields, fallowland, weed associations (of cereals, root-crops), trampled areas, ways and paths, agricultural areas etc.

The most significant pollen grains of plants accompanying human activities which have been identified in the sediments, belong, of the woody taxa (AP), especially to *Sambucus nigra*; and, of herbs (NAP), to *Cerealia, C.* t. *Triticum, C.* t. *Secale, Poaceae, Centaurea cyanus, Caryophyllaceae, Apiaceae, Lathyrus, Asteraceae Tubuliflorae, A. Liguliflorae, Convolvulus, Urtica, Plantago* sp., *P. major-media, Rumex, Artemisia, Epilobium, Brassicaceae,* etc. Human presence is indicated by finds of parasitic worms (*Vermes),* i.e. *Trichuris trichiura* ova covers, living in the caecum/blind gut and large intestine of man and pig; the ova get into the soil or water, and people then get infected from the food contaminated by them.

The climate in the whole first part of the section is characterized by a drier vegetation. There then occurred a change in layer 6 (sample 2) - this was either a local change on the site or in its broader vicinity. Samples Nos. 4, 7, 8, and 9 show a distinct impact from human activities on the vegetation, because in this part appeared a number of plants with maximum occurrences of pollen grains (*Apiaceae, Asteraceae Tubuliflorae, A. Liguliflorae, Brassicaceae, Plantago major-media, Artemisia,* as well as the occurrence of ova covers of *Trichuris trichiura).*

In the second part of the section (layers 3 and 2, samples 5 and 6), the direct impact of man on vegetation gradually diminishes, and the proportion of AP: NAP changes in favour of arboreals (this is apparent especially in sample 6). In the last layer (sample 6), the proportion of arboreals and herbs is balanced. The woody taxa are in the pollen spectrum represented especially by pine (*Pinus*) 48.1 %, which is not reliable in terms of its indicator value (the pollen might be transported from remote areas, or the pines might have been planted - its provenance cannot be determined on the basis of pollen grains). In these layers, also other wood species become more numerous, the wood associations are similar as in the preceding part. Synanthropic plants lose their significance; and *Trichuris trichiura* ova have not been found in the sediment.

The individual layers 3 and 2 also differ. In sample 5, NAP still prevails over AP, but herbs occur there characterizing rather the abandonment of the site, i.e. ruderal types of f. *Chenopodiaceae,* and *Asteraceae Liguliflo-*

rae. In sample 6, the percentage representation of pollen grains of AP and NAP equalized due to the pine (*Pinus*), and slightly to spruce (*Picea*) (planting?). In comparison to the preceding layer, the climate was probably slightly cooler.

On the basis of archaeological dating, the section can be divided into three parts:

1. samples 1, 2, 10, 7, 8 – first phase of the settlement dated to the end of the 9th–first half of the 10th cent.

2. samples 3, 4, 5, 9 – destruction layers of the outer rampart, which had been built in three stages during the period from the end of the 9th to the end of the 10th cent.

3. sample 6 – layer deposited after the abandonment of the hillfort, it is dated to the course of the 12th cent.

A more detailed and precise reconstruction of the environment in the vicinity of the site of Budeč would demand a larger quantity of analyzed material, and a new interpretation of the results obtained.

K tisku doporučil J. Kovanda
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Raně středověké hradiště Budeč – rekonstrukce přírodního prostředí na podkladě pylové analýzy

(Resumé anglického textu)

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Palynologické vzorky z raně středověkého hradiště Budeč byly odebrány v průběhu r. 1989, kdy archeologický výzkum probíhal na budečském předhradí v poloze Na kašně.

Archeologickým výzkumem zde byly zjištěny dvě fáze osídlení, z nichž první je datována rámcově do konce 9. až 1. pol. 10. stol. a trvání druhé fáze lze klást do doby od 2. pol. 10. stol. až do průběhu 11. století. V průběhu 12. stol., kdy život na hradišti postupně zanikal, začala destruovat vnější hradba, v jejíž bezprostřední blízkosti se osídlení nacházelo. Palynologické vyhodnocení antropogenních sedimentů odebraných v závěrečné fázi archeologického výzkumu v poloze Na kašně je podkladem pokusu o rekonstrukci vegetace na lokalitě Budeč v období starší fáze mladšího subatlantika (Xa-SA2).

Na základě vývoje vegetace lze profil rozdělit na dvě části:

1. přímý vliv člověka - vzorky 1, 2, 10, 3, 4, 7, 8, 9 a
2. nepřímý vliv člověka - vzorky 5, 6. Největší dopad na vývoj vegetace je vidět ve střední části u vzorků 4, 7, 8, 9.

V 1. části profilu (vzorky 1–9) jde o jednoznačnou převahu pylových zrn bylin (NAP) nad dřevinami (AP). Rostlin-

né společenstvo má spíše stepní charakter; pokud jde o lesní porosty, šlo o nezapojené lesy, klasifikované jako pozůstatky smrkojedlových a jedlosmrkových porostů s průnikem dřevin dalších.

Ve 2. části profilu (vzorky 5, 6) končí projevující se vliv člověka na vegetaci, mění se poměr AP : NAP ve prospěch dřevin. Typy č. *Chenopodiaceae a Asteraceae Liguliflorae* charakterizují opuštění stanoviště, což potvrzuje také archeologický výzkum. Podle archeologického datování vrstev lze profil členit do tří částí:

1. vzorky 1, 2, 10, 7, 8 – 1. fáze osídlení, datovaná do konce 9. až 1. pol. 10. stol.;
2. vzorky 3, 4, 5, 9 – destruované vrstvy vnější hradby, jejíž budování probíhalo třietapově v období od konce 9. stol. až do konce 10. stol.;
3. vzorek 6 – vrstva uložená po zániku hradiště, je kladena do průběhu 12. stol.

Z hlediska rekonstrukce přirozené vegetace odpovídající současnému klimatu zaujímá budečská ostrožna plochu s rekonstruovanou vegetační jednotkou dubohabrových hájů, charakterizovanou převážně jako teplomilný listnatý smíšený porost vázaný v nížinném až pahorkovitém terénu na hlubší hlinité půdy typu hnědozemě.

Vysvětlivky k obrázkům

1. Půdorys budečského hradiště.
1 - poloha Na kašně.
2. Budeč-předhradí, poloha Na kašně. Systém sond (včetně očíslování jednotlivých sektorů) odkrytých archeologickým výzkumem. Odběr palynologických vzorků byl proveden v sektoru B2, B3, B4, B5.
3. Budeč-předhradí, poloha Na kašně. Severozápadní profil sektoru B2 s vyznačením místa odběru palynologických vzorků. Popis vrstev:
1 - ornice; 2 - tmavá podorniční humusová poloha; 3 - tuhá písčitá hlína s kameny; 4 - tmavá šedohnědá sypká hlína s úlomky pískovce; 5 - světle hnědá sypká hlína s množstvím úlomků suti pískovců; 5a - tmavě hnědá sypká hlína s množstvím úlomků suti pískovců; 6 - žlutý písek s kousky mazanice; 7 - hnědá sypká až popelovitá hlinitopísčitá vrstva; 8 - suť z rozpadlého pískovce; 9 - žlutá písčitá podlaha.
4. Budeč-předhradí, poloha Na kašně. Výsek sz. profilu sektoru B2, odkud byly z jednotlivých vrstev (čísla v kroužcích) odebrány palynologické vzorky (čísla bez kroužků). Umístění čísla palynologického vzorku se přibližně kryje s místem jeho odběru.
5. Budeč-předhradí, poloha Na kašně. Výběr keramiky, vyskytující se v sz. profilu sektoru B2 ve vrstvách (č. 2-4) s odebranými vzorky pro pylovou analýzu. Keramika z vrstvy č. 2: 1-5; z vrstvy č. 3: 6-8; z vrstvy č. 4: 9-13.
6. Budeč-předhradí, poloha Na kašně. Výběr keramiky, vyskytující se v sz. profilu sektoru B2 ve vrstvách (č. 5, 7) s odebranými vzorky pro pylovou analýzu. Keramika z vrstvy č. 5: 1-8; z vrstvy č. 7: 9-15.
7. Budeč-předhradí, poloha Na kašně. Spodní část nádoby nalezené v sektoru B5 ve vrstvě destruovaného valového tělesa. Z hlinitého obsahu nádoby byl odebrán palynologický vzorek č. 9.

Vysvětlivky k přílohám

Příl. I

Budeč-předhradí, poloha Na kašně. 1 - sektor B2, B3, B4; komplex písčitých a jílovitých pozůstatků podlahových úprav včetně žlábku a kůlových jamek, dokládajících nadzemní dřevěnou konstrukci; 2 - sektor B6: písčitá podlaha s kamenným ohništěm.

Příl. II

Pylová zrna: 1. *Pinus* sp. (B2); 2.-3. *Sambucus nigra L.* (B10/1); 4. *Ulmus* sp. (B2), zvětšeno 1 000x; 5. *Abies* sp. (B1), zvětšeno 500x.

Příl. III

Pylová zrna: 1.-2. *Cornus sanguinea* L. (B1); 3.-4. *Tilia platyphyllos* Scop. (B10/1); 5.-6. *Tilia* sp. (B10/1); 7.-8. *Centaurea* sp. (B2). Zvětšeno 1 000x.

Příl. IV

Pylová zrna: 1.-4. *Caryophyllaceae* (B10/2); 5.-7. *Valeriana* sp. (B2). Zvětšeno 1 000x.

Příl. V

Pylová zrna: 1. *Cerealia* t. *Secale* (B2); 2. *Cerealia* t. *Triticum* (B2); 3. *Poaceae* (B1); 4. *Artemisia* (B2); 5. *Asteraceae Liguliflorae* (B2). Zvětšeno 1 000x.

Příl. VI

Pylová zrna: 1. *Knautia* t. *arvensis* (B2); 2. *Brassicaceae* (B2); 3.-5. *Chenopodiaceae* (B10/1, B6/2); Spory: 6.-7. *Botrychium* sp. (B6/2). Zvětšeno 1 000x.

Příl. VII

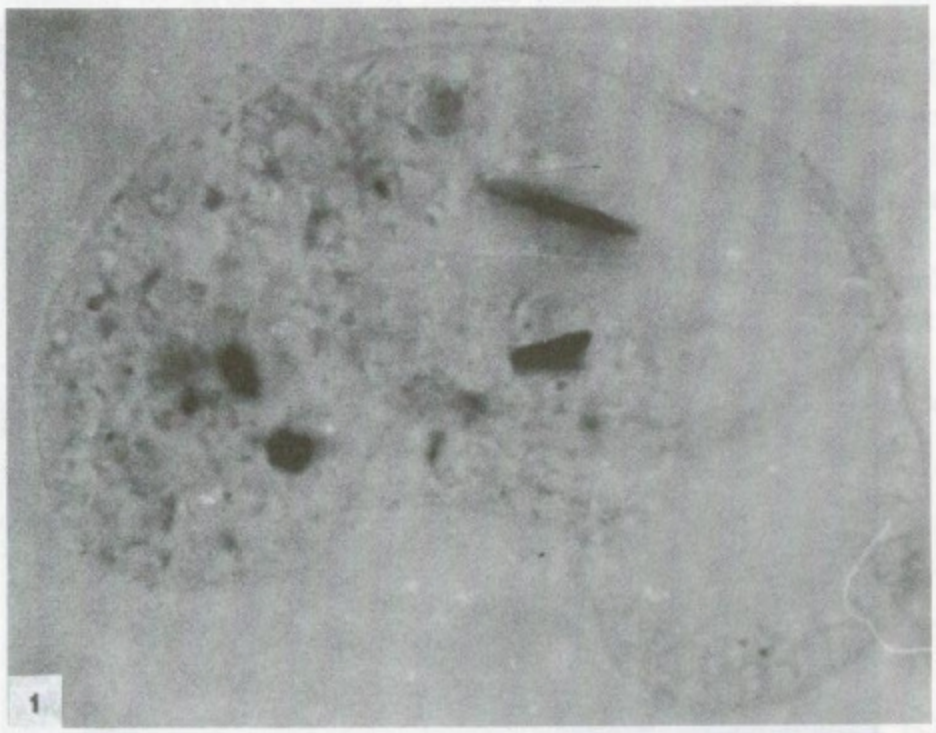
Vermes: 1.-3. *Trichuris trichiura* (B2, B1); *Fungi*: 4. *Ascomycetes* (B2). Zvětšeno 1 000x.

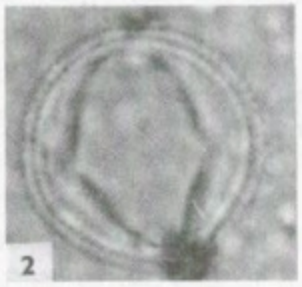
Příl. VIII

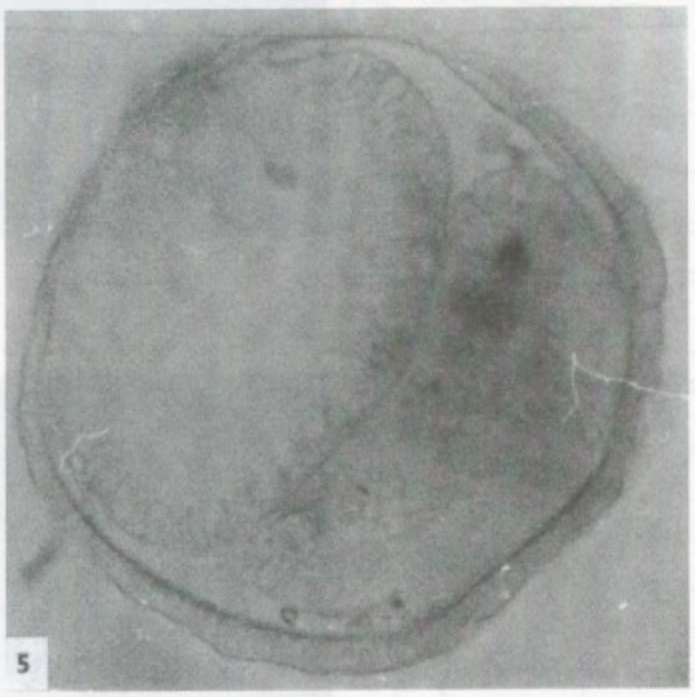
1.-2. varia (B6/2); 3.-4. varia (B1). Zvětšeno 1 000x.

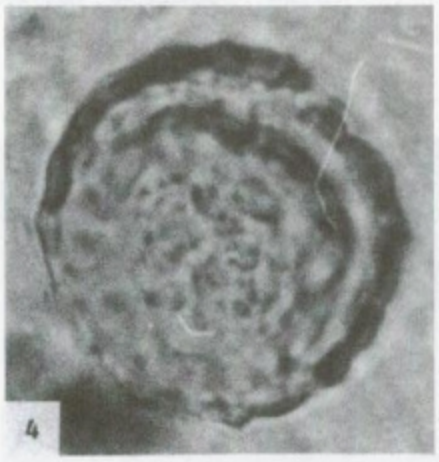
Budeč-bailey, site "Na kašně".
1 - sectors B2, B3, B4: complex of sandy and loamy remains of floors incl. trenches and post-holes indicating an above ground timber construction;

2 - sector B6: sandy floor with a stone hearth.

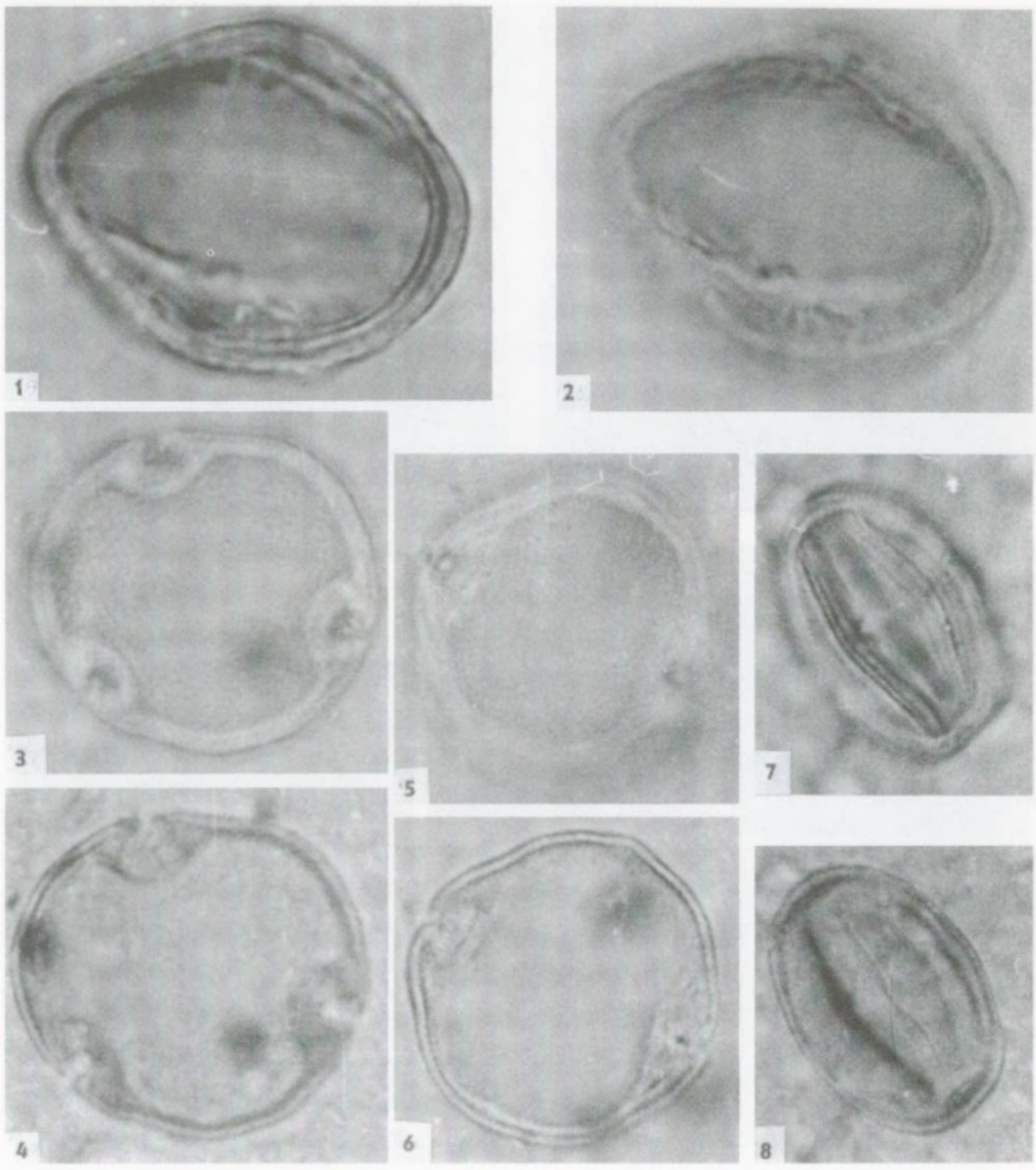




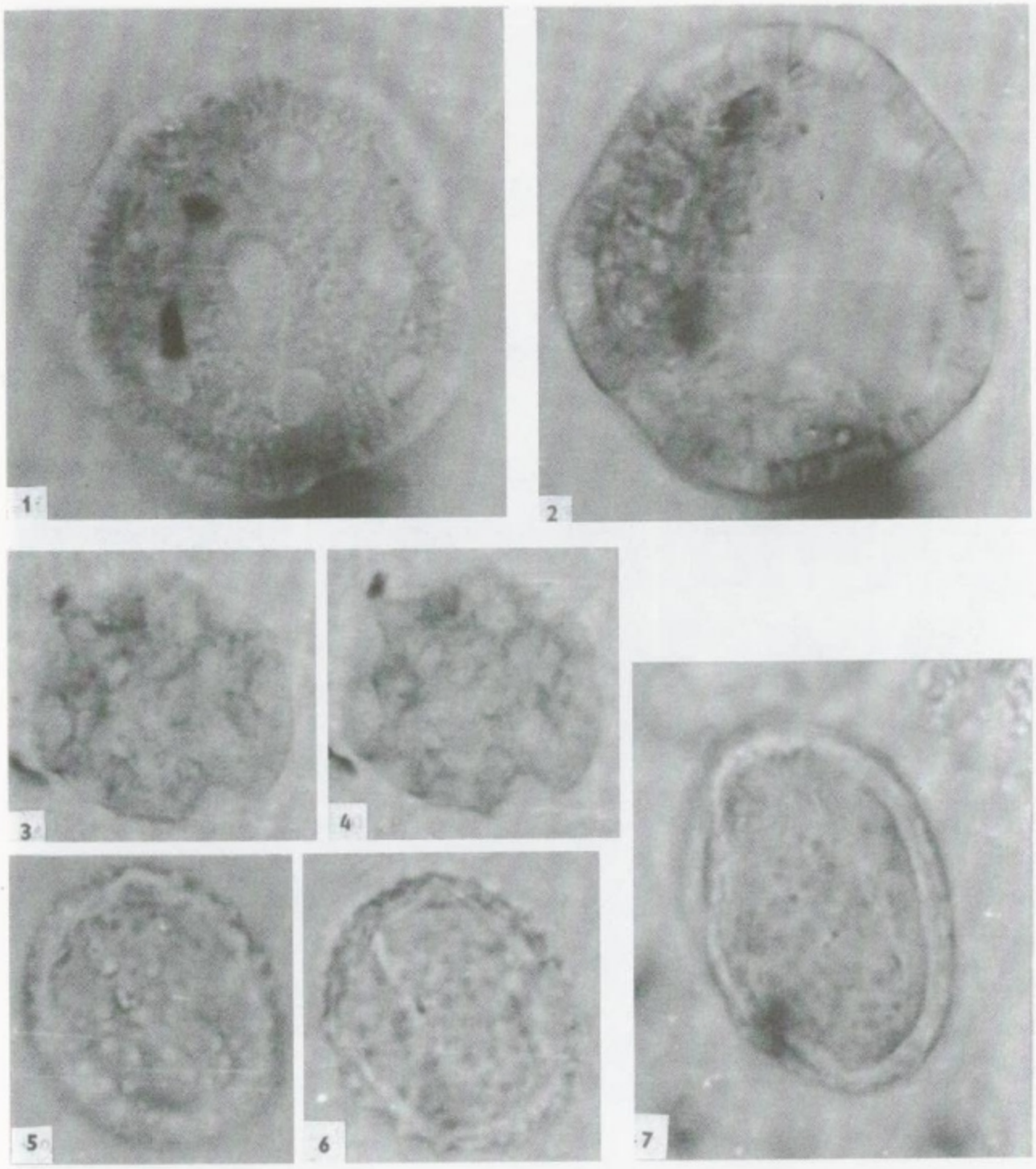




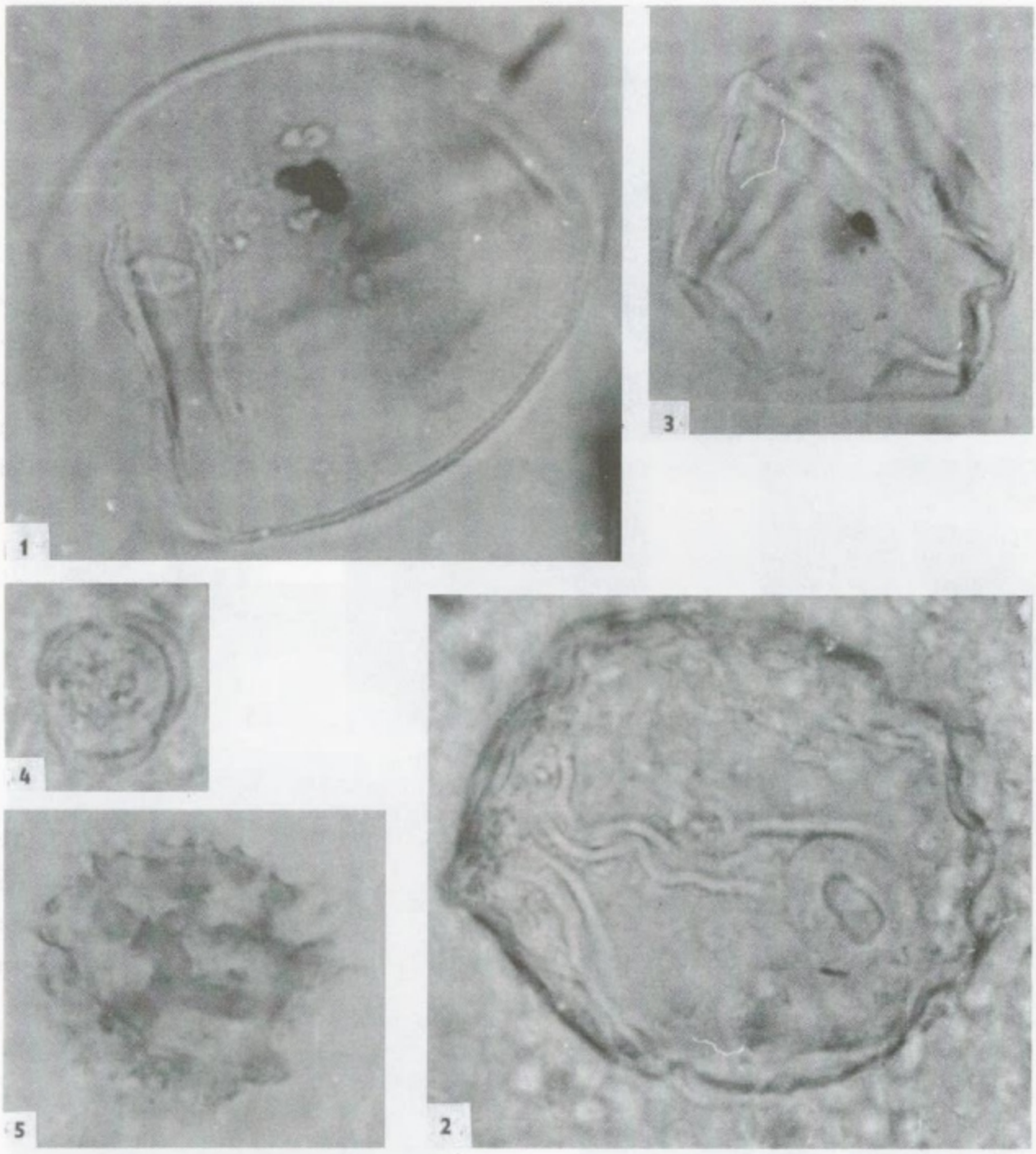
Pollen grains: 1. *Pinus* sp. (B2); 2.-3. *Sambucus nigra* L. (B10/1); 4. *Ulmus* sp. (B2). Enlarged 1,000:1. 5. *Abies* sp. (B1). Enlarged 500:1.



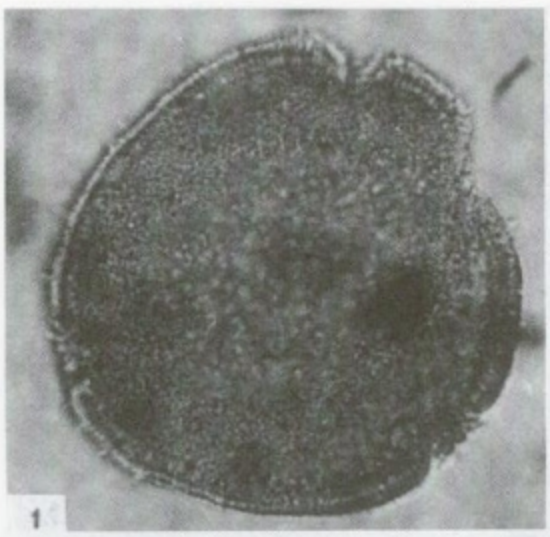
Pollen grains: 1.-2. *Cornus sanguinea* L. (B1); 3.-4. *Tilia platyphyllos* Scop. (B10/1); 5.-6. *Tilia* sp. (B10/1); 7.-8. *Centaurea* sp. (B2). Enlarged 1,000:1.

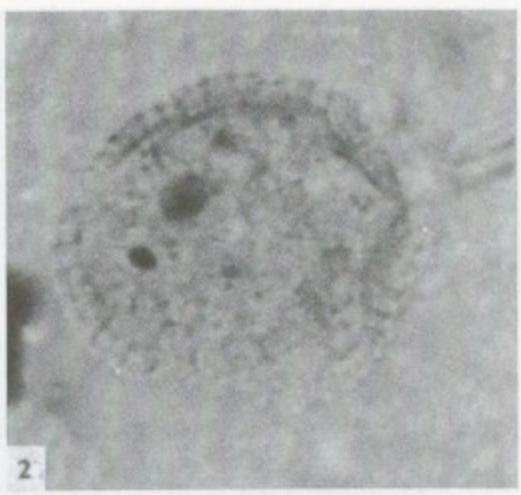


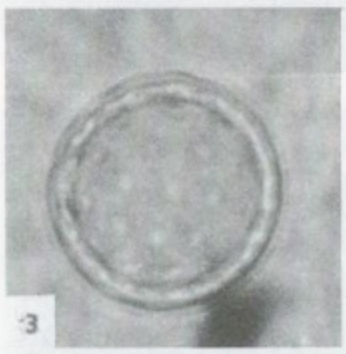
Pollen grains: 1.–4. *Caryophyllaceae* (B10/2); 5.–7. *Valeriana* sp. (B2). Enlarged 1,000:1.

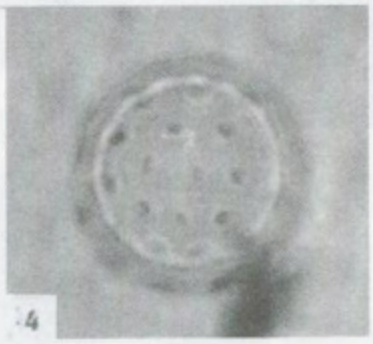


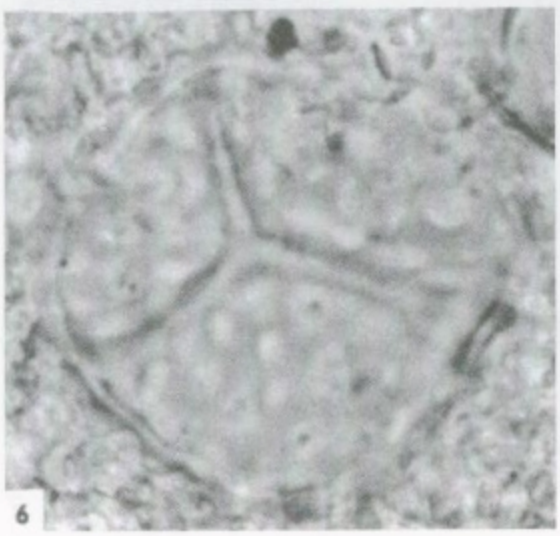
Pollen grains: 1. *Cerealia* t. *Secale* (B2); 2. *Cerealia* t. *Triticum* (B2); 3. *Poaceae* (B1); 4. *Artemisia* (B2); 5. *Asteraceae Liguliflorae* (B2). Enlarged 1,000:1.

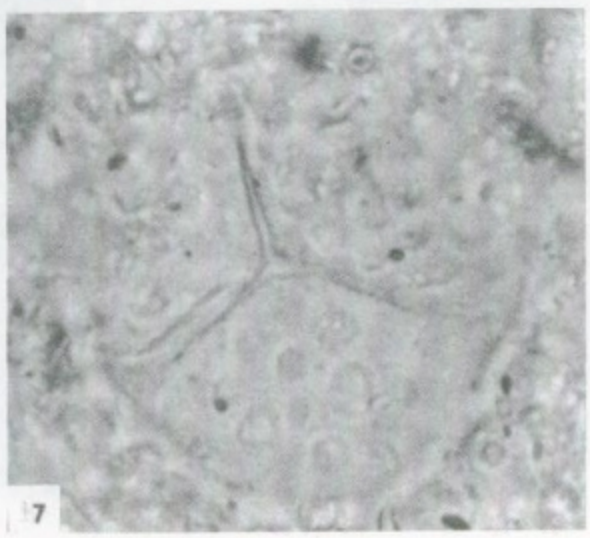




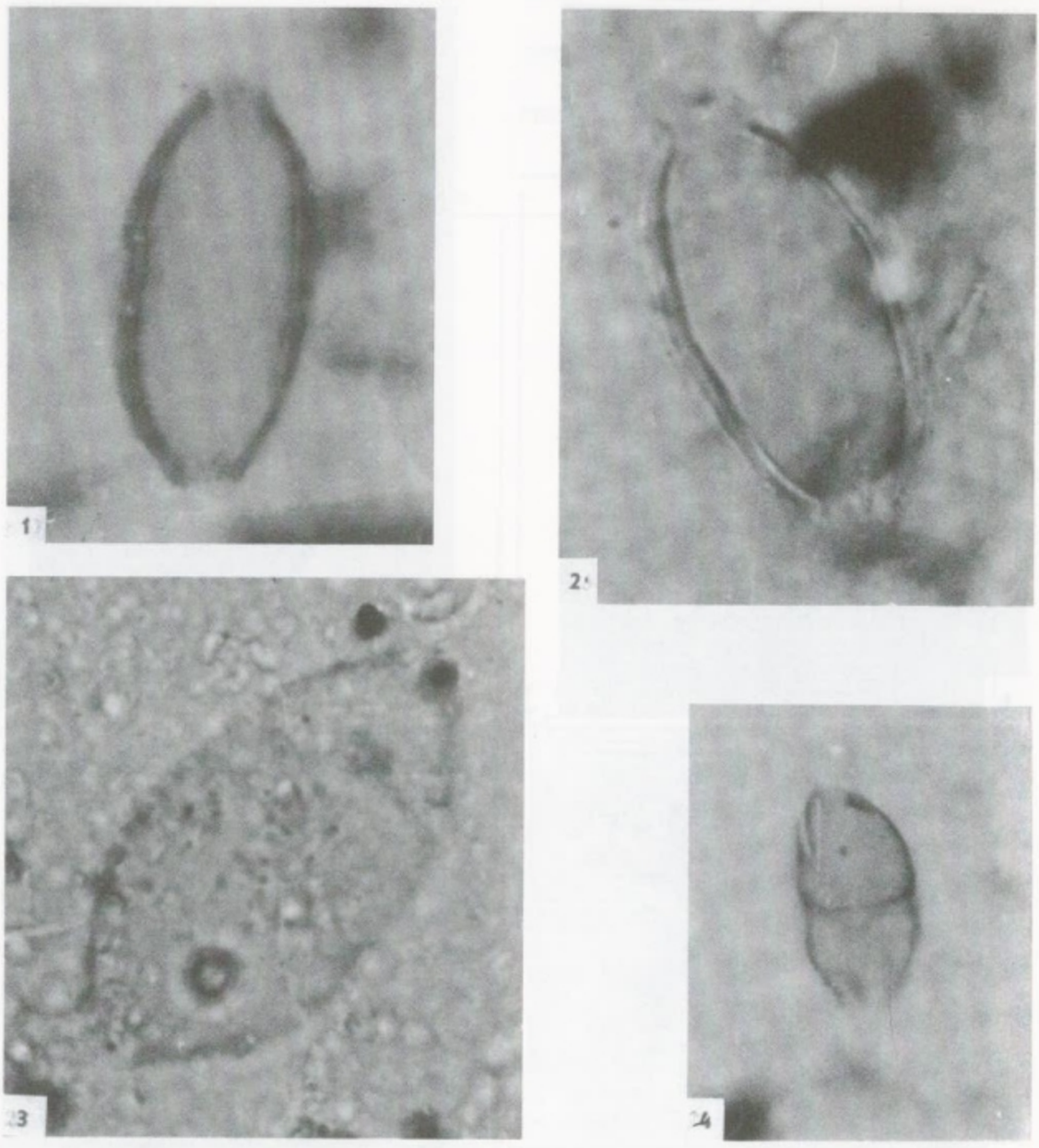






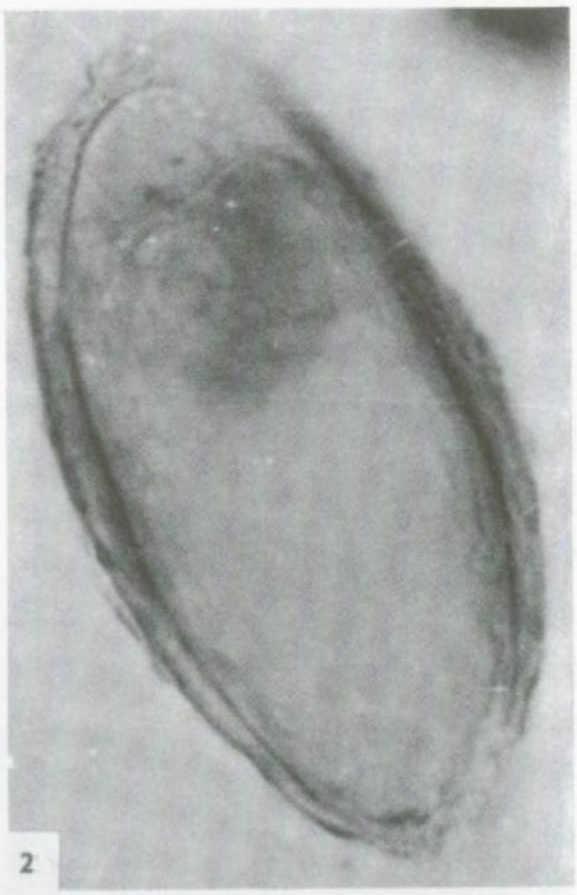


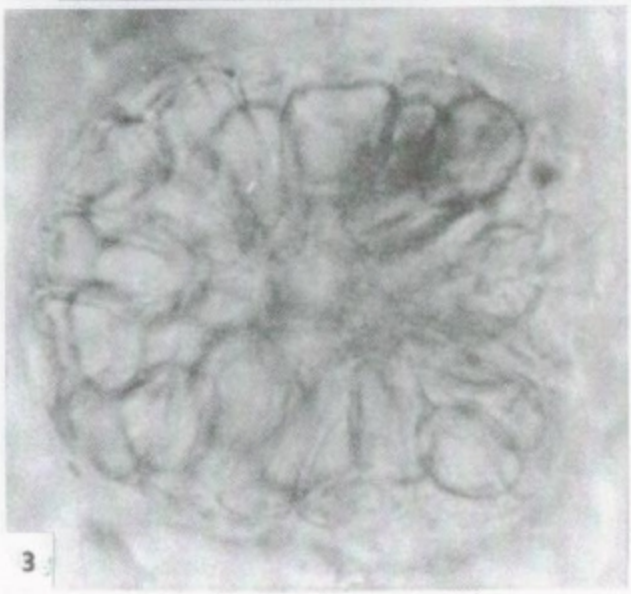
Pollen grains: 1. *Knautia* t. *arvensis* (B2); 2. *Brassicaceae* (B2); 3.–5. *Chenopodiaceae* (B10/1, B6/2). Spores: 6.–7. *Botrychium* sp. (B6/2). Enlarged 1,000:1.



Vermes: 1.–3. *Trichuris trichiura* (B2, B1). *Fungi*: 4. *Ascomycetes* (B2). Enlarged 1,000:1.


1


2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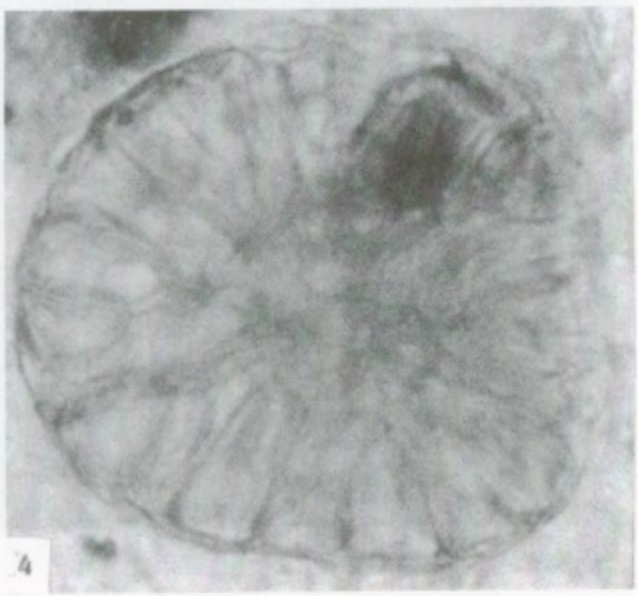
4

1.–2. varia (B6/2); 3.–4. varia (B1). Enlarged 1,000:1.

Photos by A. Bartošková (I) and E. Břízová (II–VIII).