Palaeogeobotanical Evaluation of the Holocene Profile from the Řežabinec Fish-Pond
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Keywords

Southern Bohemia, Holocene vegetation, Land occupation, Middle Holocene stratigraphic anomaly

Abstract

RYBNÍČKOVÁ E. et RYBNÍČEK K. (1985): Palaeogeobotanical evaluation of the Holocene profile from the Řežabinec fish-pond. — Folia Geobot. Phytotax., Praha, 20: 419—437. — Stratigraphic, pollen and macroscopic analyses of the Holocene limnic and peat sediments from the Řežabinec fish-pond (southern Bohemia, Czechoslovakia) are presented and evaluated. New information on the sedimentary processes (especially the middle Holocene stratigraphic anomaly), the development of aquatic and mire vegetation, the character of the forest cover and human activity in the Řežabinec area during the Preboreal, Boreal, Subboreal and Subatlantic has been obtained.

INTRODUCTION

A fish-pond of Řežabinec near Ražice and Putim, situated in the north-western part of the Českobudějovická pánev Basin (southern Bohemia, Czechoslovakia), and its close vicinity form a very interesting area from the point of view of plant geography (HEJNÝ et MORAVEC 1948), ornithology (PECL 1978), archaeology (DUBSKÝ 1937, 1949; MOTYKOVÁ-ŠNEJDROVÁ 1963, 1967; VENCL 1970; and others) and also as the authors have recently found, a highly important site for palaeogeobotany and palaeoecology in general. The organogenic sediments, rare in the Českobudějovická pánev Basin, were found first by HEJNÝ and MORAVEC (op. cit.) on the southern shore of the fish-pond. Later, the latter of the two authors suggested the place as a suitable locality for palaeogeobotanical investigation; originally, this was intended to solve the remaining problems concerning the composition of pre-cultural virgin forests in the region between the towns of Strakonice and Písek. However, during work on this problem other questions of Holocene stratigraphy and the history of land occupation have arisen.

The investigation carried on, to a certain degree, the work performed by RYBNÍČKOVÁ (1973) in the neighbouring Otavské Předšumaví foothills and at the same time it checks and extends the palaeogeobotanical information available for the central part of the Českobudějovická pánev Basin (RYBNÍČKOVÁ, RYBNÍČEK et JANKOVSKÁ 1975).

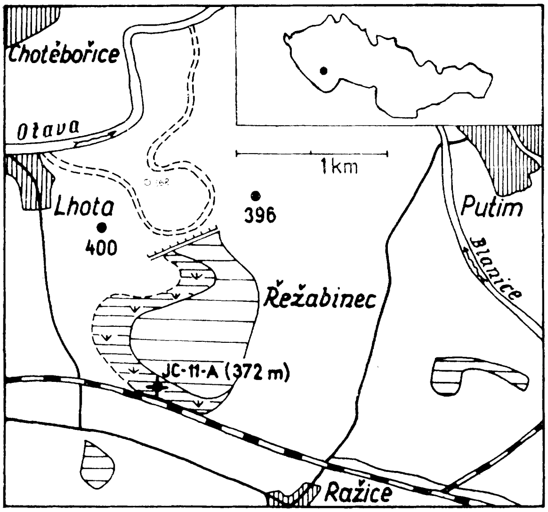

Fig. 1. The localization of the profile JC-**11-A** and the **geographical** situation of the surro undings of the Řežabinec fish-pond.

DESCRIPTION OF THE AREA

The Řežabinec fish-pond is one of the medium-size water bodies (about 0.8 km², incl littoral) in the north-western part of the Českobudějovická pánev Basin. It is situated ca 8 km south-west of the town of Písek, close to the confluence of the rivers Otava and Blanice. The altitude of the water level varies slightly about 371 m ASL (see Fig. 1), the maximum depth varies between 5 and 6 m, the mean depth between 2 to 3 m.

The fish-pond was built before the beginning of the 16th century (KUČERA, pers. comm.) in a small depression formed probably by the eroding and accumulating processes of an old meander of the river Otava. The river affected the hydrology of the depression by waterlogging the soils and forming a system of periodic pools or small, shallow permanent lakes and abandoned channels. This all brought about favourable conditions for sedimentation of organogenic material during the late Quaternary, especially in the southern or south-western part of the depression. In this area, water springs probably existed, and one was still active recently.

The eastern shore of the present fish-pond is formed by a low and flat sand dune. It represents a natural dam separating the depression of the Řežabinec from the broad valley of the Blanice.

The geology of the close vicinity is very simple. The area is covered by Tertiary sands, clays and gravels which are only in some places broken through by biotite paragneiss; a detailed geological map 1: 5000 was published by ŽEBERA (1955).

Climatically, the small area of the Řežabinec forms the only enclave of warm climate in the whole of southern Bohemia. VESECKÝ et al. (1958) classify it as a warm and moderately humid district with mild winters. The annual mean temperature is about 7.5 °C, the January mean temperature −2.4 °C, the July mean temperature 17.3 °C and the mean temperature for the growin season (April to September) has been calculated as 13.7 °C. The annual mean precipitation is 539 mm, the highest monthly precipitation reaches 80 mm in July. (All data come from the nearby town of Písek.)

The open water of the fish-pond is surrounded by stands of swamp vegetation, which have suffered from an overpopulation of water birds since the establishment of a nature reserve there recently. In the southern part of the basin these stands border on fen and transitional fen communities. The dominant species of both formations — *Carex elata*, *Phragmites communis* and *Carex lasiocarpa* — form very simple plant communities at present. However, before the establishment of the nature reserve, when mowing and burning of the stands were more or less regular events, and before the beginning of intensive fertilization of the water for fish husbandry, very interesting fen, swamp and aquatic plants and their communities were described from the site (cf. also HEJNÝ et MORAVEC 1948).

In their geobotanical reconstruction MORAVEC et al. (1969) suppose that the area was covered especially by the *Carpinion betuli* OBERD. 1953 forests and by acidophilic oak forests (*Quercion robori-petrae* BR.-BL. 1932). The alluvia of the rivers Otava and Blanice and the marginal zone of the Řežabinec depression were covered by an alluvial forest with *Alnus glutinosa* as a dominant. Later in the paper this reconstruction will be compared with the results of pollen analyses.

METHODS

The Řežabinec profile (JC-11-A) was opened by digging after previous sounding in the mire at the south-western bank of the fish-pond in June 1972. (For location see Fig. 1.) The description of the layers is based on the classification of sediments by TROELS-SMITH (1955). For colour determination the Munsell soil colour charts (MUNSELL 1954) were used. The material was taken from a cleaned wall as a monolith, using iron sheet boxes $10 \times 10 \times 50$ cm. Later, in the laboratory, samples for pollen analyses, for macroscopic analyses and, additonally, for C-14 dating were taken. The rest of the material was stored.

The usual treatment of sediments for pollen-analytical purposes (acetolysis) was applied (FAEGRI et IVERSEN 1975). Basal samples with a higher content of mineral particles were pretreated with HF. With the exception of the deepest sample, the total sum of AP always exceeded 400 counted grains. Absolute counts of all sporomorphs are presented in Tab. 4. The pollen diagram (Fig. 3 — Appendix 1) is constructed as a total diagram (Σ AP + NAP excl. Sporophyta and Hydrophyta = 100 %).

Standard volumes of 100 cm³ were used for macroscopic analyses of the organogenic sediment. The results are summarized in Tab. 3, where the data on countable fossils (seeds, fruits, etc.) are given in absolute numbers and the data on uncountable components (plant tissues, wood, mosses, etc.) in estimated volume percentage. Tab. 3 also includes pollen-analytical data concerning local elements, so that better understanding of the evolution of the local wetland may be obtained. The material for macroscopic analysis was sampled at intervals of 2 to 10 cm, depending on the thickness of the particular layer.

The samples for C-14 were dated by Dr. Geygh in the C-14 Laboratorium der Niedersachsischen Landesamt für Bodenforschung, Hannover (FRG) in 1981 and 1983.

STRATIGRAPHY OF THE PROFILE AND EVOLUTION OF THE WETLAND ECOSYSTEM

The stratigraphy of the JC-11-A profile closely resembles the buried peat profiles from the Zbudovská blata marshes (cf. RYBNÍČKOVÁ, RYBNÍČEK et JANKOVSKÁ 1975). Like those, the profile from Řežabinec is clearly divided by a 5 cm contact zone (CZ) into two parts: the older part (165 to 123 cm) comprising limnic sediments of the Preboreal and Boreal, and the younger one (118 to 0 cm), formed in this case by organogenic peat sediments of the Subboreal and Subatlantic. Both phases of sedi-

Tab. 1. Description of sediments, Řežabinec, JC-11-A

Depth	Physical properties						Sediment components												
cm	Lim. s.	Nig.	Strf.	Elas.	Sicc.	Color	Sh	Tb_s	Tb_b	Tl	Th	Dh	Dl	Dg	Ld	As	Ga	Gg	[Anth.]
0–10		1	0	1	3	2,5 Y 8/2	.	3^1	.	.	++	1	.	.	.	.	.	.	+
10–20	0	3	0	1	3	10 YR 5/3	.	2^2	.	.	1^2	1	.	.	.	.	.	.	+
20–28	1	4	0	0	2	5 YR 2/1	2	.	.	.	1^2	++	1	.	.	++	.	.	.
28–50	2	2	1	1	1	5 YR 2/2	.	.	1^2	.	2^2	1	.	.	.	.	+	.	.
50–72	1	2	1	1	1	10 YR 2/2	.	.	++	.	2^2	1	.	1	.	.	.	.	.
72–99	1	3	2	2	1	10 YR 2/2	.	.	+	.	2^3	1	0,5	0,5	.	.	.	.	1
99–118	1	4	1	2	1	10 YR 2/1	.	+	.	$0{,}5^2$	2^3	+	0,5	1	.	.	.	.	.
CZ 118–123	1	3	2	2	1	5 YR 2/2	2	.	.	.	1^3	+	1	+	.	.	+	.	.
123–152	2	2	1	1	2	10 YR 3/2	.	.	.	1^2	1^2	+	.	.	2^1	++	.	.	.
152–165	1	1	0	0	2	2,5 Y 4/2	.	.	.	1^2	+	+	+	.	1^1	1	1	.	.
165–175	0	1	0	0	2	5 Y 4/4	.	.	.	+	+	+	+	.	+	+	2	2	.

mentation are separated by a clear stratigraphic discontinuity. For description of sediments in the particular layers see Tab. 1 and the stratigraphic column of the pollen diagram Fig. 3). Absolute C-14 data are presented in Tab. 2; they are also marked on the pollen diagram. The sample at 120—123 cm, dated to 5280 ± 105 B.P., was taken from the contact zone between the two sedimentation phases, where heterogeneous and allochthonous material of uncertain origin can be expected.

Table 2. Absolute C-14 dates from the profile Řežabinec, JC-11-A

Sample No	Depth cm	Age (before 1950)	Year of dating
Hv 10 251	87— 90	2 750 ± 150	1981
Hv 10 252	109—111	3 055 ± 195	1981
Hv 10 253	120—123	5 280 ± 105	1981
Hv 10 254	129—131	8 755 ± 140	1981
Hv 10 255	152—155	9 095 ± 390	1981
Hv 10 256	149—152	8 925 ± 300	1981
Hv 11 537	74— 75	1 220 ± 75	1983
Hv 11 538	114—115	4 185 ± 245	1983
Hv 11 539	125—126	6 860 ± 110	1983

The existence of a middle Holocene stratigraphic hiatus or retardation of sedimentation (growth) is clearly indicated by pollen analyses, by macroscopic analyses and by the different composition and origin of the sediments, and is supported by C-14 dates. The explanation of this stratigraphic anomaly is very difficult. In case of hiatus, this can be a result of erosion activity of the river Otava, which could have flowed, forming a deep meander, through the present Řežabinec depression during the middle Holocene Period. The middle Holocene sediments, if such existed at all, were simply transported away by the water stream. Another possible explanation of the anomaly can be found in the intensive physical and biological humification of the middle Holocene layers under *Alnus* stands (see below). It is, however, interesting that this type of stratigraphy has been observed in two independent places in the same region (Řežabinec and Zbudovská blata). The problem of the middle Holocene hiatus or peat growth retardation thus seems to have wider implications and requires special attention. It has been found that similar stratigraphic discontinuities do exist in other regions too and so the question will be dealt with in a separate paper and in general.

The evolution of local vegetation is shown by Tab. 3. In this combined table micro- and macrofossil finds are ordered according to their time of occurrence and indicator value. The survey clearly shows three developmental epochs with several developmental stages and transitional phases.

The first developmental epoch (1) with one developmental stage (A) is characterized by the predominance of micro- and macrophytic aquatic plants. Planktonic chlorococcal algae (especially several *Pediastrum* species), *Myriophyllum, Batrachium, Potamogeton*, etc. are the leading fossils of the sediment. Roots of alder penetrated from upper layers and are younger.

Table 3. Survey of local plant records in the profile Řežabínec, JC-11-A

Depth cm										
from		165	158	152	149	145	140	135	130	123
to		167	165	158	152	149	145	140	135	130
Period (FIRBAS 1949)		IV		V						
Developmental epoch							1			
Stage, phase							A			
Chlorococcal *Algae*	p	+	+	+	+	+	+	+	+	+
Myriophyllum L.	p	+	+	+	+	+	+	+	+	+
Batrachium DUM.	p	.	.	+	+	+	+	+	+	.
Nymphaea SM.	p	.	+	.	+	.	.	.	.	.
Menyanthes trifoliata L.	p	.	.	+	.	.	.	.	+	.
Potamogeton L.	p	+	+	+	+	+	+	.	+	.
Potamogeton cf. *natans* L.	s	.	.	.	3	.	.	.	.	.
Potamogeton sp.	s	.	.	.	.	.	1	.	.	.
Ranunculus cf. *sceleratus* L.	s	.	.	.	.	.	.	.	.	.
Mentha L.	p	.	.	.	.	.	.	.	.	.
Alisma plantago-aquatica L.	p	.	.	.	.	.	.	.	.	.
Eleocharis palustris (L.) R. et SCH.	s	.	.	.	.	.	.	.	.	.
Lycopus europaeus L.	p	.	.	.	.	.	.	.	+	.
Lycopus europaeus L.	s	.	.	.	.	.	.	.	.	.
Carex pseudocyperus L.	s	.	.	.	.	.	.	.	.	.
Drepanocladus cf. *aduncus* (HEDW.) MŐNK.	m %	.	.	.	.	.	.	.	.	.
Utricularia L.	p	.	.	.	.	.	.	.	.	.
Carex L.	t %	.	.	.	.	10	5	5	10	10
Phragmites communis TRIN.	r %	.	.	.	.	.	.	3	5	5
Phragmites communis TRIN.	st %	.	.	.	.	.	.	.	.	.
Poaceae	p	.	.	.	.	.	.	.	.	.
Equisetum L.	p	.	.	.	.	.	.	.	.	+
Alnus GAERTN.	r %	.	5	10	1	3	5	10	5	5
Alnus GAERTN.	w %	.	.	.	.	.	.	.	.	.
Alnus GAERTN.	p	.	.	.	.	.	.	.	.	.
Filipendula GILIB.	p	.	.	.	.	.	.	.	.	.
Polypodiaceae	p	.	.	.	.	.	.	.	.	.
Cenococcum geophilum FR.	scl	.	.	.	.	.	.	.	.	.
Rubus L.	s	.	.	.	.	.	.	.	.	.
Cyperaceae	p	.	.	.	.	.	.	.	.	.
Carex lasiocarpa EHRH.	s	.	.	.	.	.	.	.	.	.
Potentilla erecta (L.) RAEUS.	s	.	.	.	.	.	.	.	.	.
Potentilla-Comarum t.	p	.	.	.	.	.	.	.	.	.
Caltha L.	p	.	.	.	.	.	.	.	.	.
Lysimachia vulgaris L.	p	.	.	.	.	.	.	.	.	.
Carex cf. *elata* ALL.	s	.	.	.	.	.	.	.	.	.
Carex sect. *flavae*	s	.	.	.	.	.	.	.	.	.
Parnassia palustris L.	p	.	.	.	.	.	.	.	.	.
Carex cf. *fusca* ALL.	s	.	.	.	.	.	.	.	.	.
Carex cf. *panicea* L.	s	.	.	.	.	.	.	.	.	.
Trichophorum alpinum PERS.	s	.	.	.	.	.	.	.	.	.

118	112	106	99	95	90	85	80	75	72	70	60	50	45	35	28	20	15	10	5
123	118	112	106	99	95	90	85	80	75	72	70	60	50	45	35	28	20	15	10
	VIII					IX			X a							X b			
CZ	2							3											
B	C					D		E			F		G	H		I		J	
.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.
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.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.
10	5	10	5	5	5	5	10	20	30	10	5	5	5	10	25	25	20	10	5
5	5	5	5	5	10	20	10	10	10	15	10	1	.	5	10	5	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	1	5	10
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[+]	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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10	5	5	10	10	15	1	1	1	1	.	.	.	.	.	.	10	.	.	+
.	+	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	+	+	+	+	+	+	+	+	+	+	+	+	.	.	.	.	.	.	.
.	.	.	.	.	1	1	3	.	.	.	.	.	.	.	.	.	1	.	.
.	.	.	.	.	1	2	16	5	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	+	+	+	+	+	+	+	+	+	+	+	.
.	.	.	.	.	.	.	.	19	3	6	2	3	.	5	1	1	.	.	2
.	.	.	.	8	.	.	.	.	.	2	1	2	.	3	38	149	48	4	1
.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+	+	+	+
.	.	.	.	.	.	.	.	+	+	+	+	+	+	+	.	+	+	.	.
.	+	.	.	.	.	.	.	+	.	.	.	+	.	+	.	+	.	.	+
.	.	.	.	.	.	.	.	1	.	1	18	26	.	5	.	1	4	.	.
.	.	.	.	.	.	.	.	.	.	5	19	3	.	36	10	4	.	1	.
.	.	.	.	.	.	.	.	.	+	.	.	+	+	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	1	6	.	11	1	2	11	5	1
.	.	.	.	.	.	.	.	.	.	.	.	.	.	56	.	2	.	.	1
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.

Depth cm from		165	158	152	149	145	140	135	130	123
to		167	165	158	152	149	145	140	135	130
Drepanocladus revolvens (TURN.) WARNST.	m %	.	.	.	.	.	.	.	.	.
Pedicularis L.	p	.	.	.	.	.	.	.	.	.
Aulacomnium palustre (HEDW.) SCHWAEGR	m %	.	.	.	.	.	.	.	.	.
Sphagnum palustre L.	m %	.	.	.	.	.	.	.	.	.
Sphagnum teres (SCHIMP.) ANGSTR.	m %	.	.	.	.	.	.	.	.	.
Sphagnum L.	p	.	.	.	.	.	.	.	.	.

In addition occur: *Molinia caerulea* MOENCH 1s (60–70 cm); *Sambucus* sp. 1s (80–85 cm); *Valeriana* sp. 1s (35–45 cm); *Rumex maritimus* L. vel *R. palustris* SMITH 1s (50–60 cm); *Ranunculus flammula* L. 1s (50–60); *Menyanthes trifoliata* L. 1s (60–70 cm); *Caltha palustris* agg. 1s (15–20 cm); *Cirsium* cf. *palustre* SCOP. 3s (75–80).

A high representation of *Pediastrum kawraiskyi* in the Preboreal samples and its disappearance at the very beginning of the Boreal is remarkable. This species has not been found in present-day Czechoslovakia and its occurrence is limited to several places in Europe and Asia only (SULEK 1969). BOTTEMA (1974) speaks about the dependence of this alga on a cold climate; our results seem to be in full agreement with this statement. The late Glacial and early Holocene finds of *Pediastrum kawraiskyi* were evaluated by JANKOVSKÁ and KOMÁREK (1982).

Most of the water plants mentioned above could grow only in a shallow but permanent lake or in a cut-off meander (stagnant waters) which apparently existed in the present Řežabinec depression in the early Holocene Period. It has already been mentioned that the hydrology of the lake (or cut-off meander) was probably influenced by the flow of the river. Elements of aquatic plant communities (*Nymphaeion albae* OBERD. 1957) disappear from our profile at the end of the Boreal, but because of the absence of middle Holocene layers it cannot be said for certain that they did not persist longer.

The link with the succeeding upper Holocene developmental epochs (2, 3) in our profile (between 118 and 123 cm) spans the middle Holocene (?) zone, which is formed by sediments of uncertain origin (see above). This contact zone (CZ) does not contain any macrofossils, but it is marked by a very high occurrence of *Equisetum* spores. The transitional phase (B) with horsetails could be the start of a new successional series of local semiterrestrial vegetation of the upper Holocene at the very beginning of the Subboreal and appearing on the surface exposed to erosion. If the C-14 date of this position (5280 $\pm$ 105 B.P.) is taken as uncertain (see above), this explanation may be acceptable.

The transitional *Equisetum* stands were soon succeeded by *Alnus*-carr (developmental epoch 2, stage C). In addition to the dominating alder, *Betula*, *Frangula* and some trees of *Picea excelsa* formed admixtures. *Polypodiaceae*, *Filipendula* and *Sphagnum* (*squarrosum*?) were found in the herb and moss layers. The alder stands of this type

118	112	106	99	95	90	85	80	75	72	70	60	50	45	35	28	20	15	10	5
123	118	112	106	99	95	90	85	80	75	72	70	60	50	45	35	28	20	15	10
.	.	.	.	.	.	.	.	.	.	.	.	1	.	5	5	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	15	70	70
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	+	+	[+]	+	.

Explanation: p microfossils (pollen, spores, etc.); s seeds, fruits (absolute number per 100 ccm); scl sclerotium (absolute number per 100 cm); t % herb tissue in general (in vol %); w % wood, twigs, etc. (in vol. %); r % roots — *Alnus*, rhizoms — *Phragmites* (in vol %); st % stems — *Phragmites* (in vol %); m % mosses (in vol %); + important occurence of microfossils; [+] maximum occurence of microfossils.

have parallels in some of the present communities of the *Alnion glutinoso — incanae* OBERD. 1953. Such communities indicate a constantly high underground water table, but this does not mean a permanent flooding of the place. Further sinking of the underground water table must have followed during the older Subatlantic, when the transitional phase (D) with *Rubus* spec. div. closed the *Alnus-carr* developmental epoch. The existence of *Alnus* stands with their high humification activity could be in addition to previous erosion, another reason for the disappearance of middle Holocene sediments.

The forest clearings which appeared after the older Subatlantic could have been one reason for a new rise in the water table and for the reactivation of the nearby water spring. This, and possibly periodic river floodings, led to the forming of the *Carex* swamp and fen vegetation (developmental epoch 3). The whole sedge developmental epoch is marked by the presence of *Carex lasiocarpa, Lysimachia vulgaris, Carex elata, Carex* sect. *flavae, Caltha palustris* agg., and *Potentilla erecta.* All these plants also formed the first primitive developmental stage (E) within epoch 3. The next developmental stage (F) brought about an enrichment of this basic plant assemblage with a group of aquatic, mire and swamp species like *Potamogeton, Mentha, Alisma plantago-aquatica, Eleocharis palustris, Lycopus europaeus, Carex pseudocyperus, C. fusca, Utricularia, Drepanocladus aduncus,* etc. and the predominance of *Carex* cf. *elata.* This peat-forming community seems to be close to the present *Caricetum elatae* KOCH 1926. The construction of the dam of the Řežabinec fish-pond at about the beginning of the 16th century could be explain the increase of the underground water table indicated by this type of vegetation.

After a short transitional phase (G), marked by the absolute absence of any macrofossils (40 to 50 cm), a restoration of sedge communities can be observed (developmental stage H). Low sedges like *Carex fusca* and *Carex panicea* (*Caricion fuscae* KOCH 1926) seem to have dominated at that time. *Drepanocladus* cf. *revolvens*

Table 4. Absolute numbers of pollen and spores, Řežabinec JC-11-A

	0	5	10	15	20	25	30	35	40	45	50	55	60
AP													
Abies alba	–	–	–	–	3	11	13	21	22	17	14	13	18
Alnus	11	7	12	7	11	19	13	9	13	17	17	5	6
Betula	354	322	264	90	39	26	39	30	36	30	34	26	13
Carpinus betulus	2	1	1	–	–	1	–	1	–	3	–	–	–
Corylus avellana	3	–	4	6	7	4	9	15	15	7	16	25	5
Fagus sylvatica	–	2	2	1	1	2	2	5	7	9	18	4	7
Fraxinus	–	1	1	2	–	2	1	–	1	–	–	–	1
Juniperus	–	–	–	–	3	6	7	11	14	13	12	5	5
Picea excelsa	31	11	23	68	80	62	66	66	54	39	37	30	56
Pinus	169	101	130	268	274	300	289	265	277	267	269	319	319
Populus	–	–	1	2	2	1	2	1	–	1	–	–	–
Quercus	4	10	4	2	8	11	14	12	12	18	24	14	9
Salix	–	2	2	3	1	–	1	2	4	2	2	1	3
Sorbus	–	–	–	–	1	1	–	–	–	–	–	1	1
Tilia	–	–	–	2	–	–	–	1	1	–	1	–	–
Ulmus	–	3	–	–	–	2	2	3	2	–	–	1	2
AP	574	465	444	446	430	449	459	443	459	423	444	444	447
NAP													
Alisma	–	–	–	–	–	–	–	–	–	1	1	1	1
Artemisia	3	2	1	1	2	2	1	1	–	1	–	2	2
Asteraceae Liguliflorae	–	3	–	2	7	5	7	8	3	2	2	2	–
Asteraceae Tub. t. *Achillea*	1	1	–	1	–	1	1	–	1	–	–	2	–
Asteraceae Tub. t. *Cirsium*	–	3	–	1	–	–	–	–	–	–	–	1	–
Asteraceae Tub. t. *Petasites*	–	–	–	–	2	2	2	2	6	7	11	3	1
Brassicaceae t. *Barbarea*	–	1	–	5	9	8	9	2	1	2	–	2	–
Calluna	1	1	–	1	–	2	2	1	1	–	4	2	–
Centaurea cyanus	–	–	–	–	1	–	1	–	1	3	2	3	1
Cerealia t. *Avena*	–	5	4	4	11	5	7	7	4	6	9	2	2
Cerealia t. *Secale*	5	12	9	35	47	42	51	26	28	15	27	16	15
Cerealia t. *Triticum*	1	3	2	7	5	5	4	3	7	4	6	2	2
Chenopodiaceae	2	1	3	1	8	4	1	–	1	2	4	2	1
Chrysosplenium	–	–	–	–	–	–	1	1	–	–	–	–	–
Cyperaceae	11	18	32	119	216	388	442	367	259	354	173	263	201
Daucaceae	1	1	5	3	7	5	5	–	2	–	3	4	2
Filipendula	–	1	–	6	4	4	5	4	3	2	5	7	6
Galium t.	5	–	21	2	–	–	–	3	2	–	3	1	1
Helianthemum	–	1	–	–	–	–	–	–	–	–	–	–	–
Humulus	–	–	–	–	–	–	–	–	1	2	2	1	1
Lotus t.	–	2	–	1	1	3	–	–	–	1	–	–	–
Lycopus	–	–	–	–	–	–	–	–	–	1	–	–	–
Lychnis t.	–	1	–	–	–	–	3	1	–	1	1	1	–
Lysimachia	5	3	–	–	–	1	–	–	1	–	–	1	–
Mentha t.	–	–	–	–	–	–	–	1	–	–	–	1	–
Plantago lanceolata	2	7	5	7	9	10	7	4	1	7	6	–	6
Plantago media	–	–	–	–	–	–	–	–	–	1	1	–	–
Poaceae	46	285	310	480	222	152	141	88	139	107	188	87	61
Polygonum t. *aviculare*	–	–	–	–	2	1	1	1	–	1	1	–	–
Potentilla-Comarum t.	–	40	14	26	48	32	39	6	3	6	7	7	10
Ranunculaceae t. *Caltha*	–	–	–	2	2	1	–	2	–	5	1	6	2
Ranunculaceae t. *Ranunculus*	2	4	6	6	2	5	6	4	2	6	3	4	–

65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165
17	22	28	22	20	38	47	42	17	17	31	–	–	–	–	–	–	–	–	–	–
15	8	23	58	104	100	53	25	42	61	46	6	2	5	4	3	2	1	3	–	–
18	15	32	44	33	52	92	29	23	43	62	119	212	242	378	310	232	214	154	159	50
1	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2	5	11	31	15	15	17	8	12	17	15	1	9	6	9	8	11	9	6	4	5
4	3	5	5	4	26	16	2	2	2	3	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	1	2	–	1	–	1	–	–	–	–	–	–
13	–	–	–	–	–	–	–	1	–	–	–	1	1	–	2	4	4	11	1	3
41	47	70	103	142	119	41	30	16	20	18	3	4	2	4	1	–	–	1	–	–
289	293	221	157	164	121	333	316	290	366	339	447	480	600	464	473	507	527	437	275	75
–	–	2	–	–	1	–	2	–	–	2	–	–	–	2	4	–	1	–	–	–
18	2	9	7	15	24	21	12	8	6	7	2	1	1	2	2	–	1	–	–	–
3	3	4	6	1	1	3	3	2	1	2	2	3	4	2	5	5	4	8	7	2
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	2	4	6	5	2	1	1	4	2	2	–	–	–	–	–	–	–	–	–	–
–	–	3	2	6	1	–	1	4	–	1	–	5	8	8	2	2	–	–	–	–
421	402	413	441	510	501	624	471	421	536	510	580	720	869	875	811	763	761	621	447	135
1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–
2	2	6	1	–	1	1	3	3	–	2	5	3	6	3	9	9	10	8	18	9
2	2	4	1	–	–	–	3	–	–	1	10	2	–	2	–	–	2	–	–	–
2	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	2	–	–
1	–	5	–	–	–	–	1	1	1	2	–	–	–	–	–	1	–	1	–	–
7	2	–	–	–	–	–	1	–	–	–	–	–	1	–	1	–	–	2	–	–
2	1	–	–	–	–	–	–	–	1	–	1	–	–	–	1	–	–	–	–	–
–	–	1	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
3	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
22	3	4	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	2	–	–	1	1	1	–	–	1	–	3	1	–	1
–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	–	–
290	108	269	41	16	18	24	161	33	35	28	244	19	14	14	29	19	24	17	38	41
–	–	4	1	–	–	2	5	4	1	3	20	1	–	1	–	–	3	2	2	–
–	2	5	–	–	1	9	21	21	8	8	12	4	4	8	7	11	13	7	3	2
1	1	1	–	2	–	–	9	3	–	1	1	1	–	1	–	–	–	1	–	1
–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	1	2
–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	1	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
–	–	1	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
4	1	2	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1
49	81	90	8	8	5	20	89	56	71	84	119	34	42	42	73	55	37	46	94	60
1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1	1	3	2	–	–	3	1	–	–	–	1	–	–	–	–	–	2	1	–	–
4	1	3	–	1	–	–	–	–	–	–	–	–	1	2	1	1	–	–	–	–
1	1	6	4	1	2	2	–	–	–	1	2	3	3	4	5	3	1	4	4	2

Table 4. (Cont.)

	0	5	10	15	20	25	30	35	40	45	50	55	60
Rumex t. *acetosa*	4	4	15	16	24	18	31	17	21	19	12	11	3
Sanguisorba officinalis	–	1	–	–	–	–	–	–	–	–	1	1	–
Sparganium-Typha angust. t.	–	–	–	3	3	5	4	3	5	8	6	5	2
Thalictrum	–	–	–	–	–	–	–	–	–	–	3	–	1
Trifolium t. *pratense*	–	–	6	2	–	1	1	–	–	1	1	–	1
Trifolium t. *repens*	–	–	–	–	–	2	1	–	1	1	–	–	–
Typha latifolia	–	–	–	–	2	–	1	1	2	6	4	1	2
Urtica	–	2	–	2	2	–	1	5	2	3	3	3	3
Vaccinium t.	–	–	–	–	–	–	–	1	1	–	–	–	–
Valeriana t. *officinalis*	–	–	–	–	2	1	2	–	–	–	–	–	5
Varia	2	3	1	2	3	3	4	1	4	1	1	1	1
NAP	91	407	436	737	642	712	783	565	506	585	498	451	337
AP + NAP	665	872	880	1183	1072	1161	1242	1008	965	1008	942	895	784
Hydrophyta													
Batrachium t.	–	–	–	–	–	–	2	–	–	–	–	–	–
Potamogeton	–	–	–	–	–	–	–	–	–	–	–	–	–
Myriophyllum alterniflorum	–	–	–	–	–	–	–	–	–	–	–	–	–
Myriophyllum spicatum	–	–	–	–	–	–	–	–	–	–	–	–	–
Myriophyllum verticillatum	–	–	–	–	–	–	–	–	–	–	–	–	–
Hydrophyta	–	–	–	–	–	–	2	–	–	–	–	–	–
Pteridophyta													
Equisetum	3	1	3	2	12	2	1	11	9	5	14	9	16
Lycopodium clavatum	–	–	–	–	–	–	–	1	–	–	–	1	–
Polypodiaceae	1	1	3	10	14	5	6	9	19	19	12	37	42
Pteridophyta	4	2	6	12	26	7	7	21	28	24	26	47	58
Bryophyta													
Sphagnum	1	1	4	56	455	80	34	12	21	7	24	34	36
Bryophyta	1	1	4	56	455	80	34	12	21	7	24	34	36
Algae													
Botryococcus	–	–	–	–	–	–	1	1	6	8	4	1	–
Pediastrum boryanum	–	–	–	–	–	–	–	–	1	1	3	3	–
Pediastrum duplex	–	–	–	–	–	–	–	2	3	1	3	1	–
Pediastrum kawraiskyi	–	–	–	–	–	–	–	–	–	–	–	–	–
Scenedesmus	–	–	–	–	–	–	–	–	–	–	–	–	–
Tetraedron minimum	–	–	–	–	–	–	–	–	–	–	–	–	–
Algae	–	–	–	–	–	–	1	3	10	11	10	5	–
Rhizopoda													
Callidina angusticollis	–	–	–	1	8	3	–	–	–	–	–	1	–
Rhizopoda	14	1	–	1	9	3	–	–	–	–	–	2	–

65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165
13	2	12	–	1	–	–	2	–	–	–	–	–	1	1	2	–	4	–	–	–
–	–	–	–	–	–	–	–	1	–	–	2	–	–	1	–	–	–	–	–	–
6	–	1	–	–	–	–	–	–	–	–	–	–	–	2	–	1	4	–	1	–
–	–	–	–	–	–	–	–	–	2	–	–	4	–	4	3	2	2	5	6	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2	1	–	–	–	–	–	–	–	–	–	–	1	–	1	1	–	1	1	–	–
4	2	1	–	–	–	1	–	–	–	–	–	2	1	1	4	–	1	1	2	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–
–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
1	1	4	2	3	–	3	1	4	2	4	–	–	–	–	–	1	–	1	4	2
425	213	434	60	33	28	65	303	126	121	136	419	78	75	87	142	105	110	104	177	124
846	615	847	501	543	529	689	774	547	657	666	999	798	944	962	953	868	871	725	624	259
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	5	2	3	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	2	5	1	2	26	18
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	1	2	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	2	1	4	9	22	11	15	12	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9	3	26	24	7
–	–	–	–	–	–	–	–	–	–	–	–	2	1	8	13	38	24	45	66	26
8	6	9	–	2	–	–	–	1	5	24	750	17	29	14	25	9	7	3	3	5
–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
13	34	61	57	25	12	32	42	54	71	85	23	14	21	23	17	5	1	–	2	4
21	40	71	57	28	12	34	42	55	76	109	773	31	50	37	42	14	8	3	5	9
17	4	2	5	4	3	93	26	62	89	103	9	2	–	–	–	–	–	–	–	–
17	5	2	5	4	3	93	26	62	89	103	9	2	–	–	–	–	–	–	–	–
5	–	–	–	–	–	–	–	–	2	–	–	27	28	53	94	98	96	133	99	55
8	–	–	–	–	–	–	–	–	–	–	–	9	33	66	145	207	286	433	–	58
1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	9	7	2	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	11	74	69
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4
5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9	5
20	1	–	–	–	–	–	–	–	2	–	–	36	61	119	245	316	389	579	241	225
–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Tab. 4. (Cont.)

In addition occur:

AP: *Frangula alnus* 5 cm (1), 90 cm (1); *Juglans* 35 cm (1), 60 cm (2); *Larix* 85 cm (1); *Malus* t. 5 cm (3), 125 cm (1), 155 cm (1); *Rhamnus* 125 cm (1); *Ribes* 70 cm (1), 135 cm (1), 140 cm (1); *Sambucus* 5 cm (1), 30 cm (1), 40 cm (1); *Tsuga* (?) 160 cm (1); *Viburnum* sp. 25 cm (1).

NAP: *Asteraceae* t. *Senecio* 35 cm (2), 55 cm (2); *Brassicaceae* t. *Cardamine pratensis* 45 cm (1), 75 cm (1); *Campanula* 55 cm (1); *Centaurea* t. *scabiosa* 60 cm (1); *Cerealia* indet. 75 cm (1); *Epilobium* t. 35 cm (1); *Geum* t. 20 cm (1), 50 cm (1); *Lamium* 25 cm (1), 55 cm (1); *Lysimachia nemorum* 5 cm (1), 25 cm (1), 50 cm (2); *Mynyanthes* 130 cm (1), 155 cm (1); *Parnassia palustris* 55 cm (1); *Polygonum bistorta* 10 cm (1), 160 cm (1); *Polygonum* t. *convolvulus* 15 cm (1); *Polygonum* t. *persicaria* 15 cm (1); *Ranunculaceae* t. *Anemone* 45 cm (1), 50 cm (2), 55 cm (1); *Rosaceae* 5 cm (1), 10 cm (1); *Silenaceae* t. *Scleranthus* 40 cm (1), 45 cm (1), 60 cm (1); *Silenaceae* t. *Silene* 45 cm (1), 75 cm (2), 155 cm (2); *Succisa pratensis* 25 cm (1); *Valeriana* t. 35 cm (1); *Viciaceae* 45 cm (2).

Hydrophyta: *Nymphaea* 150 cm (2), 160 cm (1); *Utricularia* 30 cm (1), 60 cm (1).

Pteridophyta: Lycopodium annotinum 95 cm (1); *Pteridium aquilinum* 75 cm (1).

Bryophyta: Anthoceros 70 cm (1).

Algae: Eunotia sp. 65 cm (1); *Pediastrum biradiatum* 140 cm (1); *Pediastrum boryanum* var. *longicorne* 160 cm (13), 165 cm (11); *Pediastrum integrum* 160 cm (21), 165 cm (18); *Pediastrum muticum* 160 cm (25), 165 cm (5); *Pinnularia* 45 cm (1), 70 cm (1).

Rhizopoda: Amphitrema flavum 0 cm (1), 20 cm (1); *Arcella* 55 cm (1); *Rhizopoda* indet. 0 cm (13), 5 cm (1).

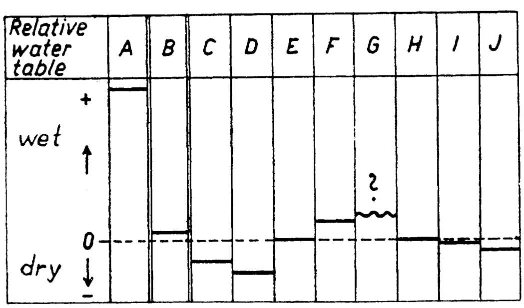

Fig. 2. The reconstruction of the fluctuation of relative water table in the mire of Řežabinec during the Holocene period. A—J: developmental stages and transitional phases of the local vegetation (see text on p. 426, 427, 432).

predominated in the moss layer, *Trichophorum alpinum* was present. Some water and swamp plants still persisted.

The following succession led through the transitional phase (I) with *Potentilla erecta* to the final developmental stage (J), which existed around the sampling place at the time of our field work. It is characterized by a community of low sedges with *Sphagnum palustre* and *S. teres*. *Phragmites communis* begins to spread over the whole surface of the mire and *Betula* seems to expand in the driest places (cf. also the increase in the pollen curve).

Fig. 2 shows the estimated local hydrological conditions, i.e. the probable changes in the relative water table during the sedimentation of the profile. They were reconstructed according to the vegetation types and the indicator values of the plants found.

DEVELOPMENT AND RECONSTRUCTION OF FOREST VEGETATION

The pollen analyses (Fig. 3 — Appendix 1, Tab. 4) give information about forest development since the end of the Preboreal with the exception of the middle Holocene Period because of the stratigraphic anomaly mentioned before.

It is difficult to say anything very concrete about the vegetation in the Preboreal from two basal samples only. The pollen grains were well preserved but their frequency was very low (259 pollen grains of Σ AP + NAP in the sample at 165 cm). In addition, local aquatic elements predominate in the pollen asemblage. Nevertheless, the Preboreal may be regarded as a transitional period in our region, in which an open landscape became covered with forests. This is indicated by an increasing amount of *Betula* and, especially, of *Pinus* pollen. At the same time, the total AP increases from about 50% to about 80 to 85%. At the end of the period, pine forest mixed with birch and with several heliophilous plants in the herb and shrub layers (*Poaceae, Artemisia, Helianthemum, Thalictrum, Juniperus* and some *Corylus*) covered the dry and less developed sandy or clay soils in the vicinity of Řežabinec. Wet soils of the depression and river alluvia were covered mostly by *Salix* stands, probably with some *Betula* trees.

A characteristic feature of the Boreal is the low representation of *Corylus* in the area (cf. the low amount of pollen), also seen in other pollen diagrams from southern Bohemia (Rybníčková, Rybníček et Jankovská 1975; Jankovská 1980) and from some other parts of Czechoslovakia (Rybníčková 1974). Instead of *Corylus* stands, light pine forests with a low admixture of some thermophylic deciduous trees (*Quercus, Ulmus*), with very little *Corylus* and with a few surviving but slowly decreasing heliophilous plants, can be reconstructed. No great changes in the tree composition of stands on the wet and waterlogged habitats (except for *Alnus* and *Picea* immigration) are presumed.

In our pollen diagram, the Boreal pollen spectra are immediately followed by the Subboreal ones. In addition to stratigraphic, macrofossil and C-14 evidences, the middle Holocene anomaly is also marked by an abrupt increase of *Fagus, Abies, Picea* and *Alnus* pollen curves from 115 cm upwards.

The forest vegetation of the Subboreal does not differ very much from that of the older Subatlantic and both periods can be charac erized by *Pinus* and *Quercus* stands with some *Corylus* shrubs on dry and warm (southern) slopes and by mixed coniferous stands (*Picea, Abies, Quercus* and possibly some *Fagus*) on mesic and humid (northern) slopes. The existence of submontane *Fagus* stands is presumed to be at higher altitudes only (ca. 500 m and above), especially in the neighbourhood of the town of Písek, and in the Otavské Předšumaví foothills. Alluvial and waterlogged soils were covered by *Alnus, Salix* and *Picea* stands with an admixture of *Ulmus, Fraxinus* and *Tilia*. This admixture is expected to be found close to the border between wet and dry soils. As in other parts of southern Bohemia, *Carpinus betulus* seems to be very scarce or altogether absent from the Řežabinec area. This statement does not correspond with the previous phytocoenological reconstruction of the geobotanical map (cf. Moravec et al. 1969), where one of the southernmost stands of the continuous occurrence of the *Carpinion* forests was marked just in the area under study.

The forest composition mentioned above for the Subboreal and particularly for the older Subatlantic is believed to characterize virgin stands, i.e. stands untouched (or very little changed) by human activity. The younger Subatlantic is understood here as a period influenced essentially by forest clearance and secondary changes in forest composition, which started some 1200 years. B.P. in this area. The relation between the vegetation and human activity is discussed in the next chapter.

LAND OCCUPATION AND VEGETATION

The area of the Řežabinec fish-pond and its close vicinity is one of the oldest inhabited places in Czechoslovakia. The archaeologists found evidence of a prehistoric settlement on the very periphery of the Řežabinec depression, pointing to the existence of settlement throughout the Palaeolithic at Velký vrch and Pikárna hills, and the Mesolithic at the foot of the Pikárna hill and in sand pits near the eastern shore of the present fish-pond (see Dubský 1949; Mazálek 1951, 1952a, b, 1953; Motyková-Šneidrová 1963, 1967; Vencl 1964). Similar localities can be found in Předmostí near Přerov (Žebera 1955), in the Pavlovské vrchy foothills (Sklenář 1974), and on some Bavarian archaeological sites (Vencl 1970).

The oldest spectra of the pollen diagram from the Preboreal (about 10,000 years B.P.) and all Boreal assemblages probably coincide with the period of the Mesolithic culture. People probably took advantage of the naturally free, light and, at the beginning, open character of the pine forest. The activity of the population of hunters and seed collectors itself did not influence the vegetation at that time in this area; even if they did, the interference was at such a low level that it could not change the degree of forestation nor its virgin character (see above). Among the group of synanthropic plants only some pollen of *Urtica* and *Rumex* t. *acetosa* could in part be attributed to the presence of man; the others are presumed to be part of the natural herb cover of the alluvium.

Two items published in a paper by Mazálek (1952b) should be mentioned here. Puchmajerová analyzed pollen in five of Mazálek's samples from an archaeological, supposedly Mesolithic excavation near the eastern shore of the fish-pond and found the following pollen assemblage: *Quercus* (predominating), and *Corylus*, *Pinus*, *Betula*, *Salix*, *Ulmus*, *Carpinus*, arranged according to the proportion of grains. Puchmajerová herself (cf. Mazálek, op. cit.: 164) said that "there are enough pollen grains, both present and fossil, in the samples". If we compare her pollen finds with those of our pollen diagram in the corresponding period of time (Preboreal and Boreal — Mesolithic) it appears that the isolated samples of Puchmajerová were contaminated or that they must represent the upper Holocene Period. From this point of view the conclusions by Mazálek (op. cit.: 165) concerning the vegetation, especially the representation of *Corylus* and *Quercus*, should be critically assessed. On the other hand, Slavíková (in Mazálek, op. cit.: 164) determined the charcoals from the same excavation and in all cases found pine wood (*Pinus* sp.) only. Her finding fully corresponds with our results.

According to the archaeological evidence there were no Neolithic settlements in the area. It is remarkable that this hiatus in land occupation corresponds exactly to the absence of middle Holocene sediments in our profile. It remains an open question whether insuitable climatic or hydrologic conditions existed for Neolithic people during the Atlantic in southern Bohemia, at the same time influencing the sedimentation process in the Řežabinec depression, or whether this coincidence is due to chance only.

The next archaeological evidence concerns scattered, probably Celtic settlements in the neighbourhood of Řežabinec. They began in the Bronze Age and lasted through La-Tène to Hallstadt (Dubský 1949). During the last century B.C. Germanic agricultural tribes displaced the previous population in the region and occupied it for almost 400 years. Several large villages and their cemeteries (Přešťovice, Čejetice, Lhota) from those days have been excavated in the close vicinity of or inside our area (Dubský 1937; Motyková-Šneidrová 1963, 1967; Sklenář 1974). All archaeological finds testify to extensive agricultural activity and to comparatively dense population of the country.

The period between the 5th and the 9th centuries A.D. before the Slavonic occupation of the central part of southern Bohemia by the so-called Doudleby tribe (approximately during the 9th century A.D.; Sklenář 1974: 311, 312), is not documented by any archaeological data.

Our pollen spectra do not indicate any intensive arable agriculture before the beginning of 8th century of our aera, thus confirming previous palaeogeobotanical conclusions about the non-arable, probably pastoral and military(?) character of older Celtic, La-Tène and Hallstadt sites in the central part of the Českobudějovická pánev Basin (Rybníčková, Rybníček et Jankovská 1975: 174; see also Rybníčková 1973: 128). In the Řežabinec area human interference touched the alluvial habitats first of all by converting forests into meadows and pastures. This activity is reflected by variations in the *Alnus* and *Picea* curves and by an increase (or appearance) of meadow and pasture indicators (cf. pollen curves of *Poaceae*, *Filipendula*, *Plantago lanceolata*, *Rumex acetosa*) in the pollen diagram. The concentration of pastoral activity in river valleys and their immediate neighbourhood is indirectly indicated by the absence of *Juniperus*, which can hardly grow in wet and humid alluvial habitats.

The first agricultural settlements of arable character are supposed to have existed from the beginning of the 8th century A.D. at least. The pollen of cereals (*Secale*, *Triticum*, *Avena*) and other cultivated plants (*Humulus-Cannabis* T.) as well as of weeds and other synanthropic indicators (*Urtica*, *Rumex acetosa*, *Polygonum aviculare*, *Centaurea cyanus*, *Chenopodiaceae*, *Plantago lanceolata*, *Juniperus*, etc.) has occurred since about 1220 years B.P. continuously and in relatively high quantity. Their curves do not show any great variation in agricultural activity. This means that the density of the population did not undergo any great changes. The same is indicated by the ratio of AP : NAP. The curve shows extensive forest clearance and general opening of the landscape just at that time (abrupt change from about 90% to about 50% AP). This situation remained unchanged till very recent times. The deforestation affected all forest types and reduced nearly all tree species (*Pinus*, *Quercus*, *Picea*, *Abies*, *Alnus*) in the area. The retreat of *Fagus* started somewhat earlier. All these changes in landscape management illustrated by pollen diagram correspond approximately to the beginning of Slavonic (Doudleby) settlement or to some very preceding one. A picture similar to the one mentioned above was found also in the nearby profiles from the Zbudovská blata marshes, but the beginning of continuous curves of cultural pollen types was dated by C-14 to 1856 $\pm$ 60 B.P. there (Rybníčková, Rybníček et Jankovská 1975, Rybníčková 1982).

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SUMMARY

Palaeogeobotanical analysis of organogenic sediments on the southern shore of the Řežabinec fish-pond near Ražice and Putim (north-western border of the Českobudějovická pánev Basin, southern Bohemia, Czechoslovakia) has provided information concerning sedimentation and peat-forming processes in the Řežabinec depression, the reconstruction and evolution of the vegetation as well as land occupation and human activity in the region during the Holocene Period.

The Řežabinec profile (JC-11-A) is remarkable for the stratigraphic hiatus or retardation in sediment accumulation in the middle Holocene layers. The pollen and macrofossil analyses show three developmental epochs (1 to 3) in the sedimentation and peat-forming process in the southern part of the Řežabinec depression. The first epoch (1) covers the limnic sedimentation in a relatively shallow water basin of the Preboreal and Boreal. The limnic layers are immediately followed by peat sediments of the Subboreal and Subatlantic, which are denoted as belonging to local developmental epoch no. 2 of the *Alnus*-carr peat and, later, to epoch no. 3 of *Carex* peat formation. The latter epoch can be subdivided into several developmental stages with transitional phases in between (namely the *Carex elata-Drepanocladus aduncus* stage, the *Carex fusca-Drepanocladus revolvens* stage and the uppermost *Carex fusca-Sphagnum palustre* stage).

A reconstruction of forest vegetation in the area can be performed for the Preboreal and Boreal, when heliophilous forest stands of *Pinus, Betula, Juniperus* and only very little *Corylus* can be supposed. For the upper Holocene Period, *Quercus* and *Pinus silvestris* forests on dry and warm southern slopes and mixed coniferous *Picea-Abies* forests for humid and colder northern slopes and habitats were reconstructed as a climax before the beginning of forest clearance some 1220 years B.P. *Alnus* with some *Picea excelsa* covered alluvial and waterlogged habitats.

The pollen diagram indicates the existence of uninterrupted arable activity in the region since the beginning of the 8th century A.D. at least. The previous Bronze Age, La-Tène, Hallstadt and Germanic occupation of more or less pastoral character did not influence the virgin composition of the vegetation in general. It affected only alluvial habitats, converting alder stands with spruce into meadows and pasture land. These results confirm, more or less, the previous conclusions from the Českobudějovická pánev Basin (Zbudovská blata marshes) as far as settlement and human activity in this region are concerned.

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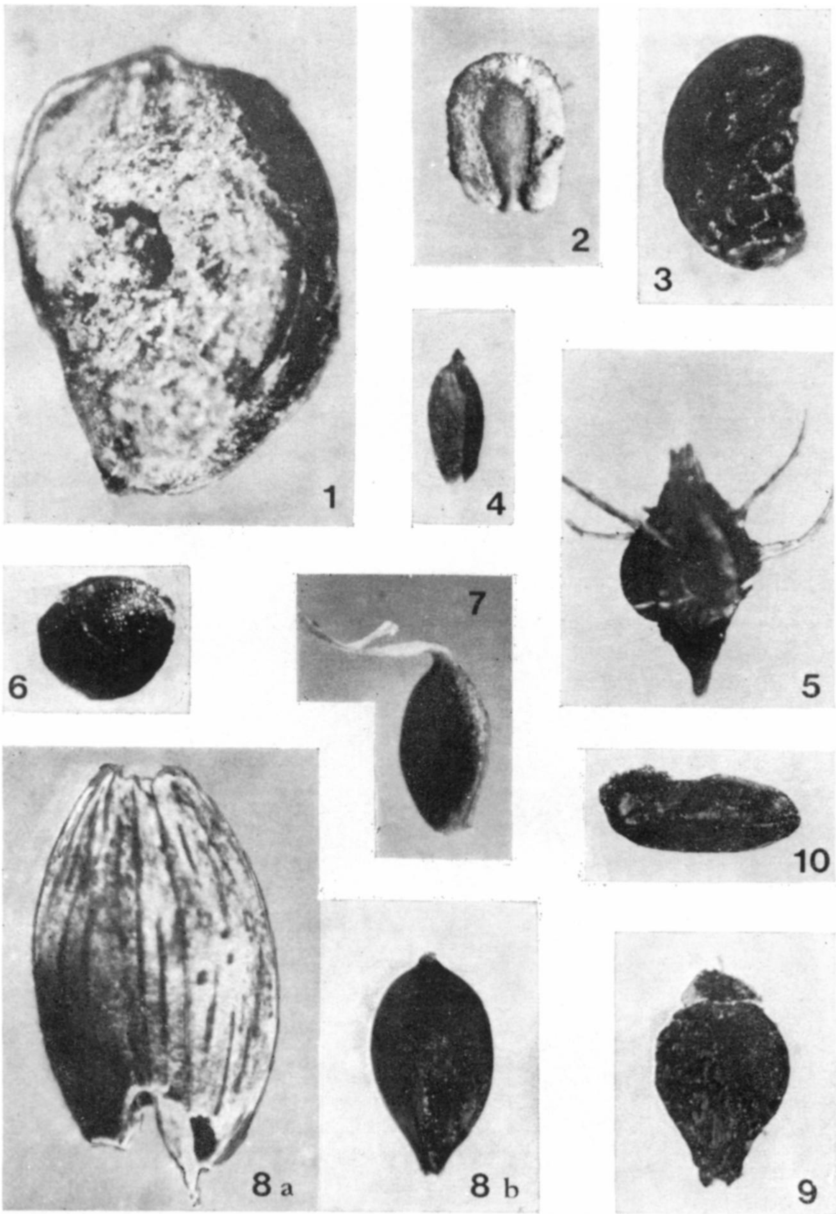
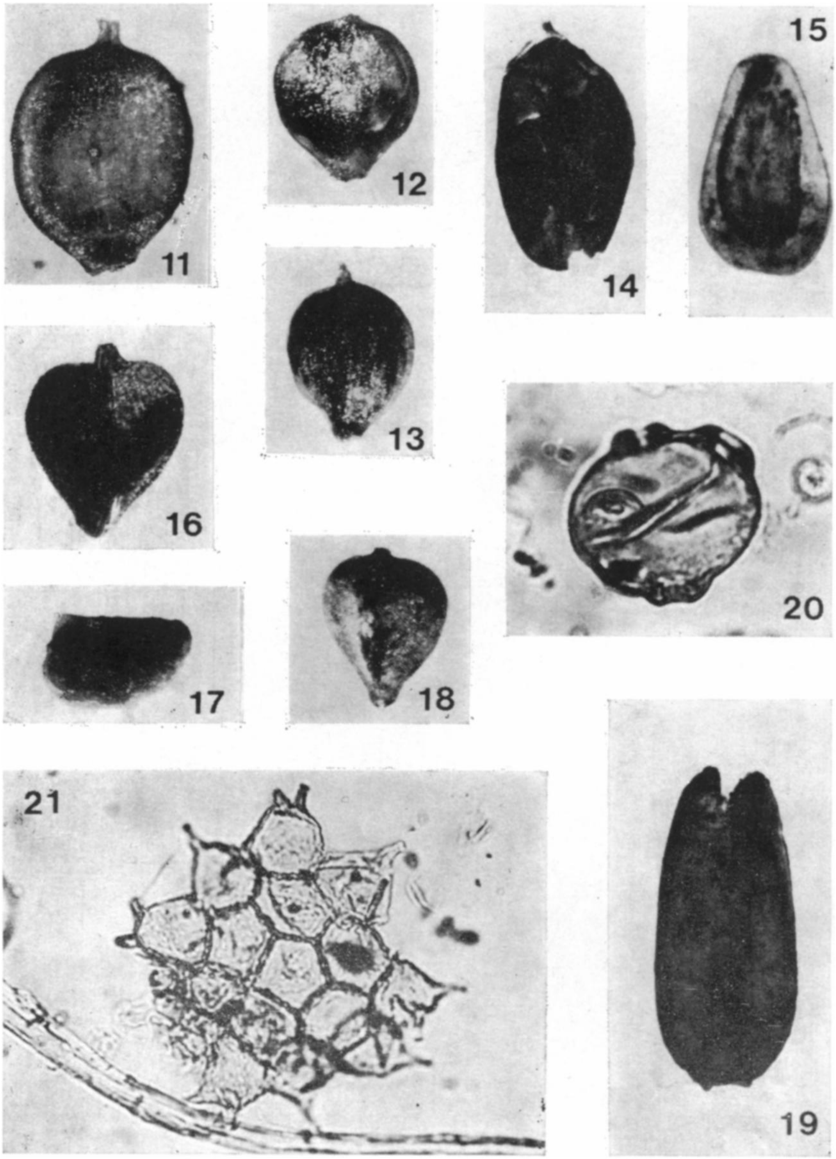
Plates 17, 18
Appendix 1



Plant macrofossils from the profile Řežabinec, JC-11-A. 1. *Potamogeton* cf. *natans*, fruit-stone (149 – 152 cm); *Lycopus europaeus*, nutlet (50 – 60 cm); 3. *Rubus* sp., fruit-stone (75 – 80); 4. *Trichophorum alpinum*, achene (15 – 20); 5. *Rumex maritimus* (vel *R. palustris*), perianth (50 – 60 cm); 6. *Ranunculus* cf. *sceleratus*, nutlet (50 – 60 cm); 7. *Carex pseudocyperus*, achene 8. *Carex lasiocarpa;* a. perigynum, b. achene (50 – 60 cm); 9. *Eleocharis palustris*, achene (50 – 60 cm); 10. *Caltha palustris* agg., seed (15 – 20 cm). Figs 1—9 magnif. 15×; 10. magnif. 10×.



Plant macro- and microfossils from the profile Řežabinec, JC-11-A. 11. *Carex* cf. *elata*, achene (50—60 cm); 12, 13. *Carex* cf. *fusca*, two of extreme morphological types of achenes (15—20 cm); 14. *Molinia caerulea*, caryopsis (60—70 cm); 15. *Valeriana* sp., fruit (45—45 cm); 16. *Carex* cf. *panicea*, achene (20—28 cm); 17. *Potentilla erecta*, achene (35—45 cm); 19. *Cirsium* cf. *palustre*, achene (75—80 cm). Figs. 11—19. magnif. 15× ; 20. *Myriophyllum alterniflorum*, pollen (135 cm), magnif. 1000×. 21. *Pediastrum kawraiskyi*, coenobium (160 cm), magnif. 500×.

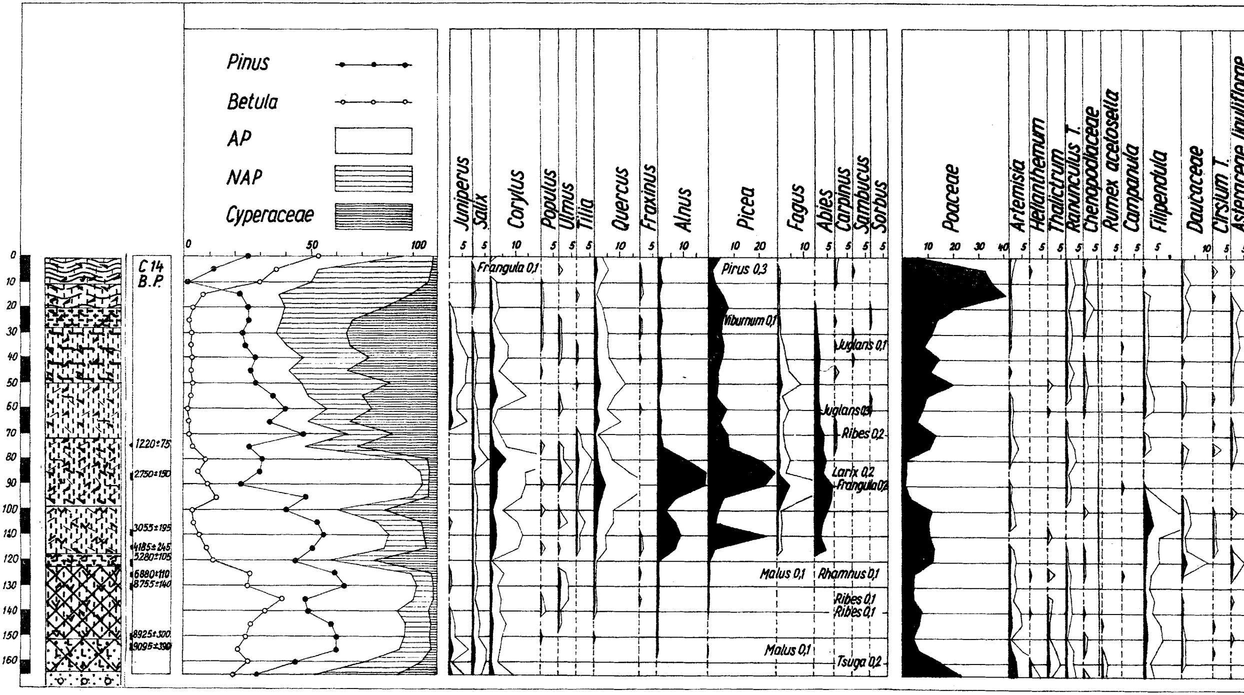
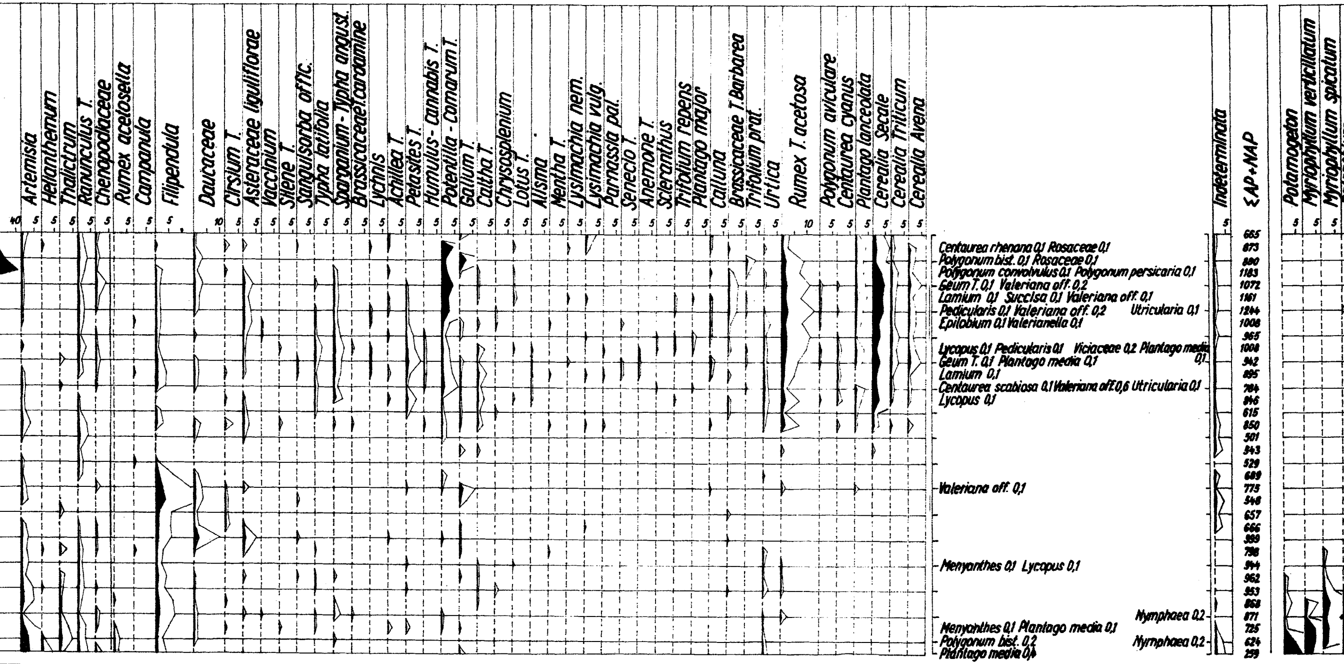


Fig. 3. Total pollen diagram from the Řežabinec mire, JC-11-A



Artemisia
Helianthemum
Thalictrum
Ranunculus T.
Chenopodiaceae
Rumex acetosella
Campanula
Filipendula
Daucaceae
Cirsium T.
Asteraceae liguliflorae
Vaccinium
Silene T.
Sanguisorba offic.
Typha latifolia
Sparganium-Typha angust.
Brassicaceae t.cardamine
Lychnis
Achillea T.
Petasites T.
Humulus-Cannabis T.
Potentilla-Comarum T.
Galium T.
Caltha T.
Chrysosplenium
Lotus T.
Alisma
Mentha T.
Lysimachia nem.
Lysimachia vulg.
Parnassia pal.
Senecio T.
Anemone T.
Scleranthus
Trifolium repens
Plantago major
Calluna
Brassicaceae T.Barbarea
Trifolium prat.
Urtica
Rumex T. acetosa
Polygonum aviculare
Centaurea cyanus
Plantago lanceolata
Cerealia Secale
Cerealia Triticum
Cerealia Avena
Indeterminata
Σ AP+NAP
Potamogeton
Myriophyllum verticillatum
Myriophyllum spicatum
Centaurea rhenana 0,1 Rosaceae 0,1
Polygonum bist. 0,1 Rosaceae 0,1
Polygonum convolvulus 0,1 Polygonum persicaria 0,1
Geum T. 0,1 Valeriana off. 0,2
Lamium 0,1 Succisa 0,1 Valeriana off. 0,1
Pedicularis 0,1 Valeriana off. 0,2 Utricularia 0,1
Epilobium 0,1 Valerianella 0,1
Lycopus 0,1 Pedicularis 0,1 Viciaceae 0,2 Plantago media 0,1
Geum T. 0,1 Plantago media 0,1
Lamium 0,1
Centaurea scabiosa 0,1 Valeriana off. 0,6 Utricularia 0,1
Lycopus 0,1
Valeriana off. 0,1
Menyanthes 0,1 Lycopus 0,1
Nymphaea 0,2
Menyanthes 0,1 Plantago media 0,1
Polygonum bist. 0,2
Nymphaea 0,2
Plantago media 0,1
665
873
880
1183
1072
1161
1244
1008
965
1008
942
895
784
846
615
850
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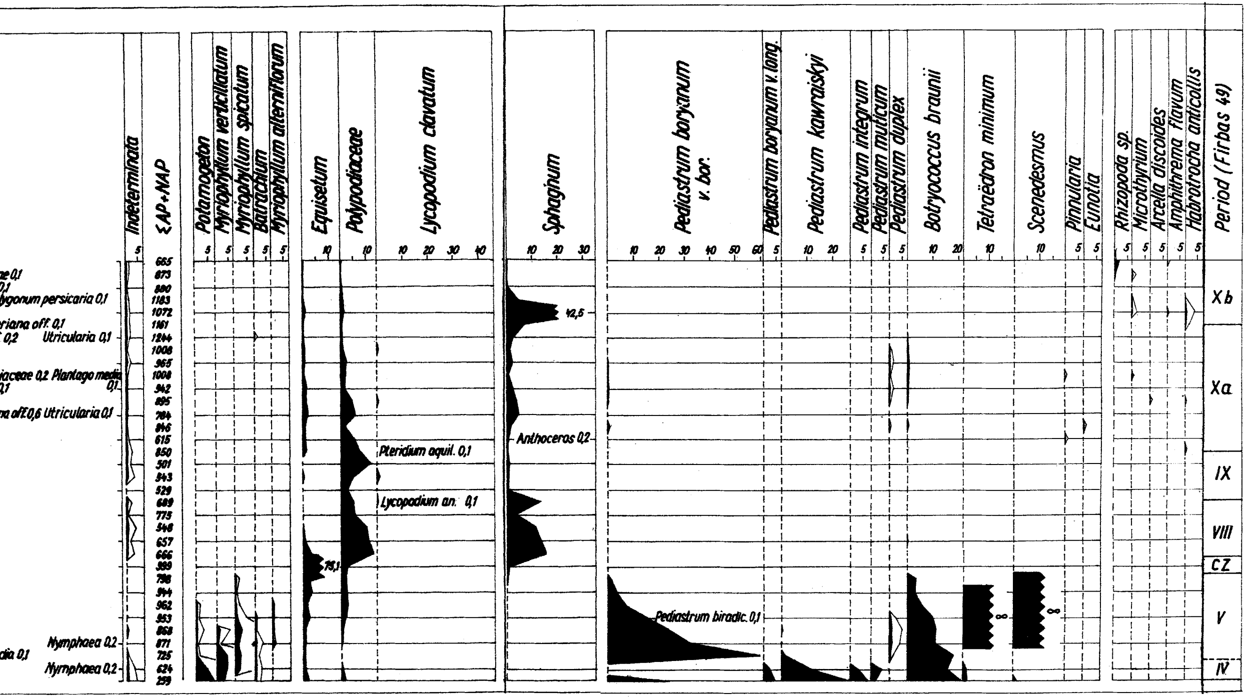

Indeterminata
Σ AP+NAP
Potamogeton
Myriophyllum verticillatum
Myriophyllum spicatum
Batrachium
Myriophyllum alterniflorum
Equisetum
Polypodiaceae
Lycopodium clavatum
Sphagnum
Pediastrum boryanum v. bor.
Pediastrum boryanum v. long.
Pediastrum kawraiskyi
Pediastrum integrum
Pediastrum muticum
Pediastrum duplex
Botryococcus braunii
Tetraëdron minimum
Scenedesmus
Pinnularia
Eunotia
Rhizopoda sp.
Microthyrium
Arcella discoides
Amphitrema flavum
Habrotrocha anticollis
Period (Firbas 49)
Polygonum persicaria 0,1
Utricularia 0,1
Plantago media 0,1
Utricularia 0,1
Nymphaea 0,2
Nymphaea 0,2
Pteridium aquil. 0,1
Lycopodium an. 0,1
Anthoceros 0,2
42,5
Pediastrum biradic. 0,1
Xb
Xa
IX
VIII
CZ
V
IV