Sborník geologických věd	Antropozoikum 21	Pages 5-18	4 figs.	1 tab.	8 pls.	ČGÚ Praha 1994	ISBN 80-7075-168-1 ISSN 0036-5270

Loess complex near Sedlec (Southern Moravia)

Sprašový komplex u Sedlce (jižní Morava)

Pavel Havlíček[1] - Libuše Smolíková[2] - Jiří Kovanda[2] - Eva Břizová[1]

Received February 15, 1992

1:50 000: 34-23
Southern Moravia, Lower Pleistocene, Fossil soils, Soil micromorphology, Fossil molluscs, Stratigraphy

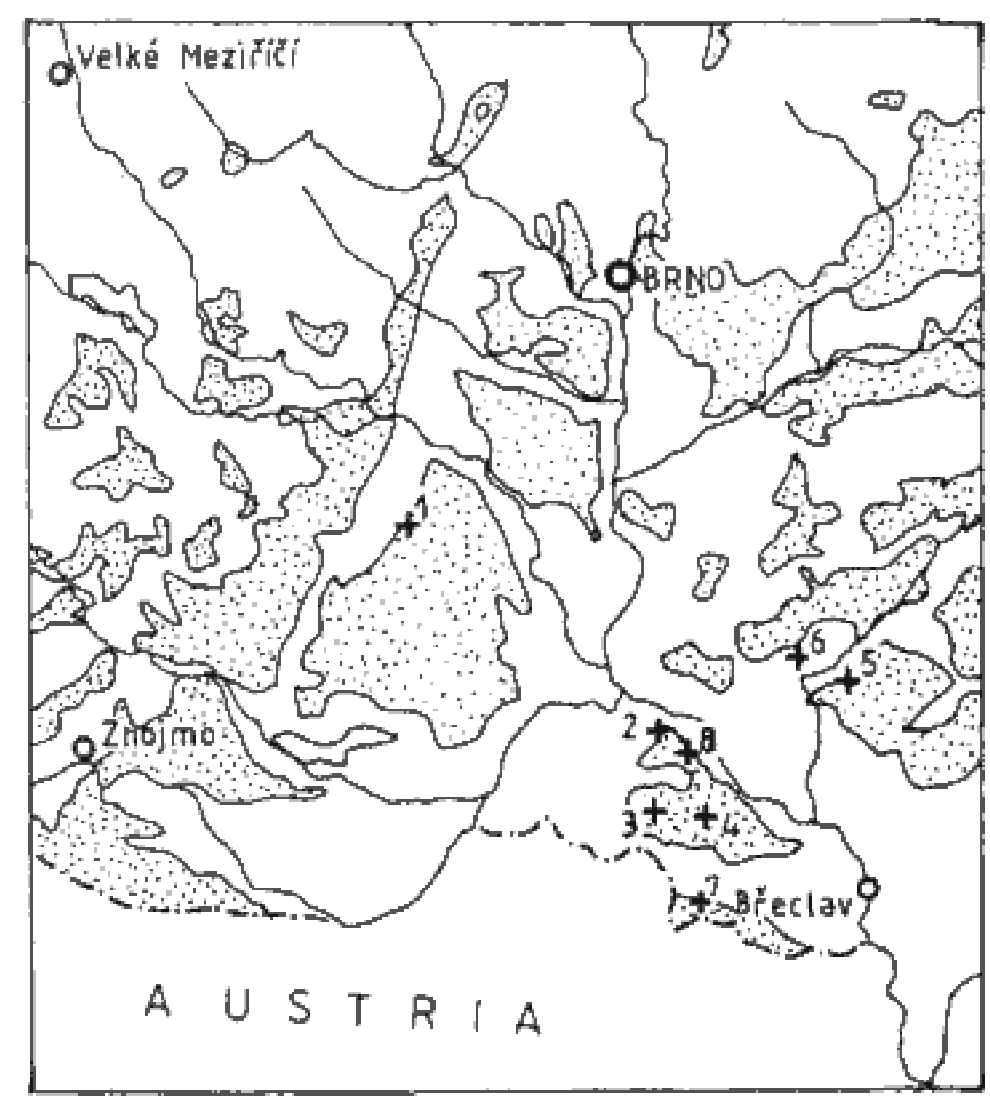
Havlíček, P. - Smolíková, L. - Kovanda, J. - Břizová, E. (1994): Loess complex near Sedlec (Southern Moravia). - Sbor. geol. Věd, Antropozoikum, 21, 5-18. Praha.

Abstract: Attention is paid to new, well articulated loess sequences and soil complexes of Lower and Middle Pleistocene age. Their correlation with similar sequences in Northern Austria will be useful. Of greatest importance is the loess sequence north-east of Sedlec near Mikulov, with a minimum of five pedocomplexes comprising ten fossil soils, identified typologically as rubified, brown earthified and illimerized braunlehm, as well as earthy rotlehm. This sequence can be correlated approximately (using the degree of weathering and soil polygenesis) with sections at Červený kopec Hill (Brno) and the Beroun-highway (Kovanda-Tyráček-Fridrich 1988) and is classified into Lower and Early Middle Pleistocene.

[1]*Český geologický ústav, Klárov 131/3, 118 21 Praha 1*
[2]*Přírodovědecká fakulta UK, Albertov 6, 128 43 Praha 2*

Southern Moravia has been and will undoubtedly continue to be an important region for study of Quaternary geology. Detailed geological mapping is performed currently together with Quaternary geological, palaeontological, palaeopedological and palaeomagnetic studies to provide additional data needed to refine the stratigraphic classification of Quaternary deposits with regard to the palaeogeographical/palaeoclimatic history of the region under study. Until recently, few loess sequences with fossil soil complexes Lower and Middle Pleistocene in age have been known (Havlíček, Zeman 1986) from this region (fig. 1). New data on loess sequences are summarized in this paper. These results permit the early Quaternary units of the region to be correlated directly with those in adjacent areas, such as Brno and Northern Austria.

Soil complexes developed on diverse loess units of Upper, Middle and Lower Pleistocene were exposed either during extensive recultivation of slopes for agricultural purposes, or during exploitation of material needed for the Nové Mlýny earthdam or in the course of archeological investigations. Best exposures with fossil soil complexes (abbrev. PK) are listed below: Sedlešovice – loess and colluvium with PK of Lower to Middle Pleistocene age, Smolíková, Zeman 1979; Vedrovice – loess sequence with PK VII, Havlíček, Smolíková 1992; Bořetice – loess sequence with Lower and Middle Pleistocene PK, Havlíček, Smolíková 1993; Dolní Věstonice



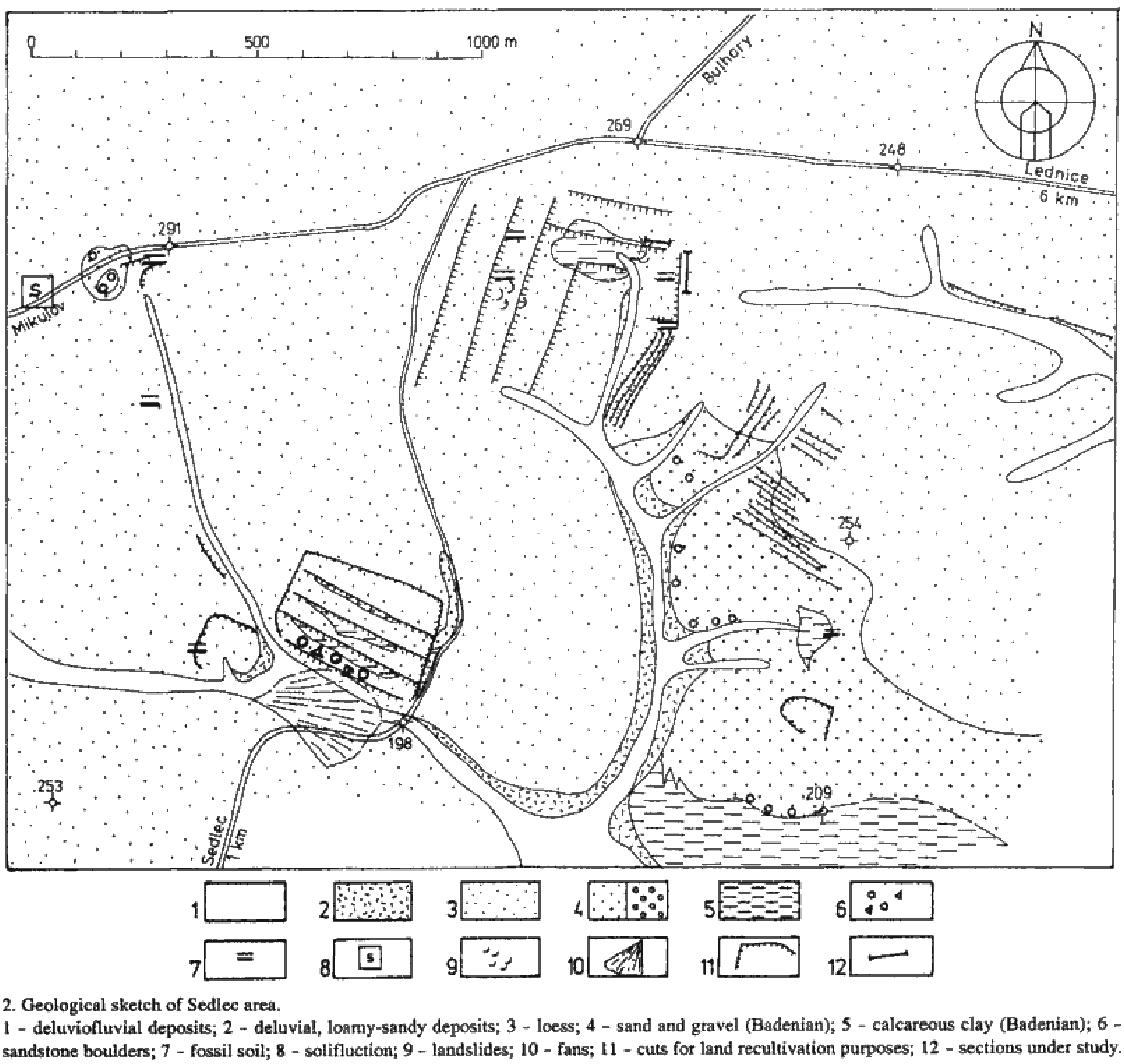
1. Localities of Lower and Middle Pleistocene loess sequence in southern Moravia (with loess distribution after Žebera 1968).
1 - Vedrovice; 2 - Dolní Věstonice II; 3 - Mikulov-Kinberg; 4 - Sedlec; 5 - Bořetice; 6 - Velké Pavlovice; 7 - Úvaly; 8 - Milovice.

II – colluvial deposits, loess, fluvial terrace with PK of Lower and Middle Pleistocene age, Smolíková 1991, Havlíček 1991; Milovice - colluvial deposits and loess with PK VII or older fossil plastosol, Smolíková 1991; Milovice-vinohrady - loess sequence, with at least PK V, Macoun 1966; Mikulov-Kinberg - loess sequence with Lower and Middle Pleistocene PK; Úvaly; locality north of Sedlec, etc.

Sedlec near Mikulov – geology and palaeopedology

During the recultivations in a broad pre-Quaternary valley north-east of Sedlec in the Břeclav district, a 15 m thick loess sequence with minimum five fossil soil complexes was exposed in 1989 as the most important section yet recognized in the area under study. The complexes comprise ten fossil superimposed plastosols displaying a high degree of polygenesis (see Kubiena 1953, 1970). The youngest soil (section D) shows evidence of redeposition; the two soils of the upper soil complex C are also parautochthonous in origin. The soils in section A and B contain, besides horizons Ca and B, well-developed humic A horizons. Two basal fossil soils and the upper soil in PK C show only horizons B, whilst the soil below is developed fully. The lower soil in the section D consists of A and B horizons, whilst the youngest member corresponds to the redeposited A horizon (fossil soil sediment) (figs. 1, 2).

The loess sequence lies on a southern slope in a warm area with mean January temperatures -2 to -3 °C, July temperatures as high as 18 to 19 °C, and mean annual temperatures of 8 to 10 °C; and mean precipitation of 550 to 600 mm; the relative frequency of annual winds



2. Geological sketch of Sedlec area.
1 - deluviofluvial deposits; 2 - deluvial, loamy-sandy deposits; 3 - loess; 4 - sand and gravel (Badenian); 5 - calcareous clay (Badenian); 6 - sandstone boulders; 7 - fossil soil; 8 - solifluction; 9 - landslides; 10 - fans; 11 - cuts for land recultivation purposes; 12 - sections under study.

(January-December) prevailing northeasterly, less commonly southeasterly, southerly and northwesterly (Syrový et al. 1958).

Section A

At the base of the entire loess series (fig. 3 - section A/I) lies a marked soil developed at the surface of colluvial sediments. This unit forms the basal layer which rests on bedrock represented by upper Badenian greyish-green calcareous clays with sandy interlayers (Kalášek et al., 1963).

The soil is composed of slightly bedded humic A horizon (sample 8) and with a dark-red horizon B (sample 7) with marked Ca horizon at is base. It is overlain by loess layer with redeposited humic soil sediments (sample 9). From this loess a younger soil (A/II) developed represented again by a humic A horizon (in the lower part pantherized - sample 12) and a clayey B horizon deep brown in colour (sample 11) again with Ca horizon (sample 10). This soil is overlain by an 8 m thick accumulation of typical fossiliferous loess with pseudomycelia and Ca nodules 5 to 10 cm in diameter. The loess interlayer separating both fossil soils (A/I and A/II) contains typical cold molluscs (see Kovanda this paper). Therefore these soils should correspond to two separate pedocomplexes.

Micromorphology

Fossil soil A/I

Horizon B (5 YR 4/8). Wet sample. Thin section 7: Matrix dark-orange-red; consists of braunlehm plasma mostly forming segregates, rarely aggregates (Pl. I/1); few voids filled with narrow, sharply bent fissures and irregular pores in knots and aggregates respectively; contains large braunlehm nodules often showing distinct concentric arrangement; primary components only represented by mostly corroded quartz grains; minute opal phytoliths occur sporadically; soil shows slight traces of pseudogleyfication as black, irregular "manganolimonite" stains in matrix together with narrow rims along supply channels and mineral grains; strong recalcification produced amorphous calcium carbonate on walls of supply channels.

Horizon A (10 YR 5/6). Thin section 8: Matrix slightly humic, dark-orange-brown, peptized; forms especially polyhedrons and occurs less abundant in earthworm coprogenic elements; voids are represented especially with narrow, sharply bent fissures and joints in knots, with wide fractures between knots and those extending more or less parallel to soil surface; redeposition and bedding of soil material is thus indicated (Pl. II/1). Soil microskeleton consists almost exclusively of quartz grains; orthoclase, muscovite and glauconite occur sporadically; soil matrix contains braunlehm nodules (Pl. II/2); biogenic activity was not high: burrows and earthworm excrements are few; there is little humus unevenly distributed in soil; this is clearly reflected in colour mosaic of matrix. Traces of weak pseudogleyfication and recalcification were observed along supply channels and around some mineral grains.

Typology: Rubified braunlehm.

Loess (10 YR 6/6). Thin section 9: Matrix light-ochreous, flocculated; contains numerous voids and carbonates (especially pelitomorphous calcium carbonate cementing primary components); mineral components well-sorted in grain size; quartz predominates, followed by plagioclase, muscovite and orthoclase; biotite, augite, amphibole, glauconite, etc. are less common.

Fossil soil A/II

Carbonate horizon (10 YR 8/6). Thin section 10: Differs from loess below especially in lighter colour, higher amount of calcium carbonate, and sparse braunlehm nodules coming from horizons above.

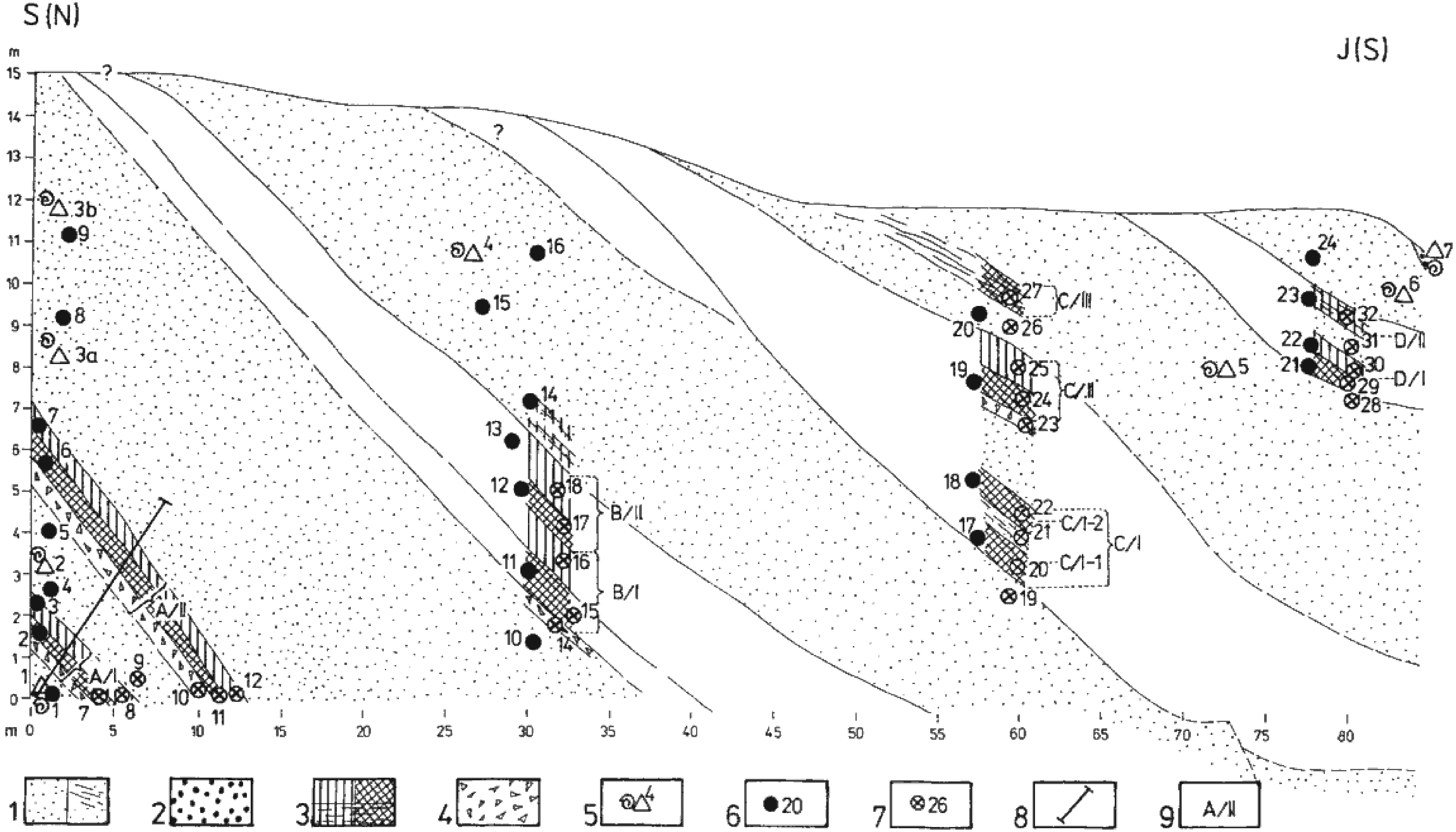
Horizon B (7,5 YR 5/6). Thin section 11: Matrix dark-orange-brown; consists of braunlehm plasma; marked by distinct knotted structure with voids filled exclusively with sharply bent fissures or joints; soil microskeleton fine-sorted as silt to fine-grained sand dominated by quartz grains; horizon shows traces of subsequent weak pseudogleyfication: dark "manganolimonite" stains of irregular radial arrangement occur in soil matrix; subsequent recalcification produced amorphous calcium carbonate on walls of some polyhedrons.

Horizon A (7,5 YR 4/4). Thin section 12: Differs from horizon B below in the following features: humification (and hence the dark colour of the soil matrix); the presence of numerous coprogenic elements and earthworm burrows which, by increasing the extent of voids available, ultimately led to compositional changes (e.g. the excrements are separated from the surrounding soil unaffected by biogenic activities by minute, concentrically arranged joints); and the higher amount of the soil microskeleton containing a large number of unweathered minerals, e.g. plagioclase, indicating a new supply of primary components at the start of a new loess deposition. The other features - braunlehm plasma, its nodules, etc. including secondary pseudogleyfication and recalcification preceding the loess deposition - are the same as those described under thin section 11.

Typology: Braunlehm, light brown earthified.

Section B

Section B (fig. 3) consists of two strongly weathered soils, representing probably one pedocomplex. The basal soil (B/I) contains a thick carbonate horizon (sample 14) with large nodules; a dark-reddish-brown, clay horizon



3. Sedlec - loess sequence in north-south-trending cut.

1 - loess, at places redeposited; 2 - youngest loess, 3 - soil horizons A and B, at places redeposited; 4 - carbonate horizons; 5 - samples for malacofaunal analysis; 6 - samples for pollen analysis; 7 - samples for micromorphological determination of fossil soils; 8 - samples for palaeomagnetic dating; 9 - pedocomplexes in sections A–D, mentioned in the text.

(B) (sample 15); and a humic, slightly redeposited horizon A (sample 16) cut by numerous cracks. The upper, immediately superimposed soil is developed in full thickness from the subsequent loess sheet, again with a dark-reddish-brown clay horizon B (B/II) (sample 17) and humic horizon A (sample 18). This double soil complex is covered by humic soil sediments, loess containing nodules, and other humic soil sediments. Higher in the section is the loess with nodules and calcium carbonate pseudomycelia and includes malacofauna; the loess sheet is terminated genetically by the horizon B of a strongly weathered soil ranged to section C (sample 20).

Micromorphology

Fossil soil B/I

Horizon Ca (10 YR 6/6). Thin section 14: Matrix pale ochreous, flocculated; contains numerous voids; much carbonate; amorphous calcium carbonate cements, primary components and forms supply channel rims; soil matrix shows slight traces of weak subsequent pseudogleyfication.

Horizon B (5 YR 4/8). Thin section 15: Matrix dark-brownish-orange; consists of braunlehm plasma; concentrated in polyhedrons forming knots; voids filled only with fractures between knots and narrow, sharply bent fissures or joints within subpolyhedrons (Pl. III/1). Soil matrix contains braunlehm nodules; soil microskeleton well-sorted as silt and finegrained sand dominated by quartz grains associated with orthoclase and muscovite; fine coatings of "manganolimonite" (weak pseudogleyfication) and amorphous calcium carbonate (final recalcification) along some supply channels.

Horizon A (5 YR 3/3). Thin section 16: Matrix dark-reddish-brown, moderately humic; consists of braunlehm plasma; accumulated especially in earthworm coprogenic elements and less frequently in residual knots (Pl. III/2): in the former case soil contains fairly numerous voids dominated by small and midsized pores; in the latter voids filled only with narrow joints; soil sparsely cut by parallel fractures throughout (bedding of soil material at surface). As with horizon B (thin section 15) below, traces of subsequent weak pseudogleyfication and (re) calcification.

Typology: Braunlehm, rubified.

Fossil soil B/II

Horizon B (5 YR 4/6). Thin section 17: Matrix dark-brownish-red; consists of braunlehm plasma; accumulated in polyhedrons forming knots; voids filled only with a system of sharply bent fissures and joints within polyhedrons and of fractures between knots; microskeleton fine-grained, well sorted,with predominating quartz; soil matrix shows traces of weak secondary pseudogleyfication and recalcification: like amorphous calcium carbonate, calcite spicules occur in wide voids - Pl. IV/1.

Horizon A (7,5 YR 3/2). Thin section 18: Matrix dark-reddish-brown, moderately humic, peptized; accumulated in both knots and aggregates produced by earthworm activity; biogenic burrows numerous as well. Voids are therefore much more numerous in the soil matrix than in the horizon below (thin section 17) unaffected by biogenic activity. Microskeleton much like that of horizon below in both grain size and mineralogical composition; only quartz present; early stage of unweathered material supply indicated by sporadic plagioclase grains. Weak pseudogleyfication and secondary (re)calcification, as in horizon B below: amorphous calcium carbonate coats supply channel walls; calcite spicules in remaining voids.

Typology: Rotlehm, earthy.

Section C

Section C in comparison with other described sections is richest in fossil soils showing the most varied development. The whole section incorporates four fossil soils belonging to two fossil pedocomplexes (C/I and C/II), which are separated by a relatively thick loess. The loess interlayers separating the fossil soils within the pedocomplexes are considerably thinner. All fossil soils are strongly weathered and well-developed. The basal soil of the older pedocomplex is mottled; the basal soil of the younger pedocomplex is characterized by a marked Ca-horizon and many crotovines, frost wedges and traces of other types of frost deformations in the A horizon.

Micromorphology

Loess (7,5 YR 5/8). Thin section 19: Matrix pale-ochreous, flocculated throughout; contains numerous voids; microskeleton well-sorted as silt and fine sand; quartz, orthoclase, plagioclase dominant; mica, augite, amphibole, etc. less common; braunlehm nodules rare; coprogenic elements and burrows of earthworms also present (see cross and longitudinal sections); matrix marked by heavy carbonate accumulation: primary components cemented by pelitomorphic calcite; weak pseudogleyfication.

Pedocomplex C/I

C/I-1 Horizon B (5 YR 3/4). Thin section 20: Soil matrix consists of two components: dark-brown braunlehm plasma concentrated in close fabric polyhedrons and cut by numerous, sharply bent joints (Pl. IV/2); same plasma, dark-brownish-red, accumulated in aggregates with more irregular inner pores; both components contain braunlehm nodules and show slight traces of pseudogleyfication and recalcification.

Typology: Braunlehm, rubified; soil matrix unaffected by rubification throughout.

Loess (7,5 YR 4/4). Thin section 21: Same as loess below (thin section 19) except for as follows: conspicuous pseudogleyfication not confined only to matrix but can be observed also on supply channels with almost black "manganolimonite" knots forming rims to accumulation; these are coated with secondary amorphous calcium carbonate.

C/I-2 Horizon B (5 YR 4/6). Thin section 22: Matrix dark-brownish-red, peptized; accumulated in both knots and aggregates; these differ in both number and void form plus fabric; primary components are only quartz grains forming silt and fine sand; larger grains less abundant; matrix contains sparse opal phytoliths; soil weakly pseudogleyed, strongly recalcified, cut by wide fractures parallel to surface and away from coprogenic earthworm elements (coprogenic forms very compact).

Typology: Rotlehm, earthy.

Pedocomplex C/II

Horizon Ca (10 YR 6/4). Thin section 23: Matrix grayish-white, flocculated throughout; abundant carbonate; primary components are quartz, orthoclase, plagioclase, muscovite, biotite, augite, amphibole, glauconite, etc.; braunlehm nodules secondary: distinct traces of subsequent pseudogleyfication.

Horizon B (7,5 YR 5/6). Thin section 24: Matrix dark-orange-brown; consists of braunlehm plasma accumulated in both residual knots and secondary aggregates, cut by numerous angular joints; aggregates (largely coprogenic earthworm elements) show abundant irregular pores. Braunlehm plasma (Pl. V/1) partly coats or fills supply channels such as fractures between knots, burrows left by earthworms, roots, etc.; light-orange, strongly birefringent, shows characteristic structural/textural features; has well-preserved growth zones, the outer (youngest) of which are strongly granular (dark-brown colour owing to flocculation of Fe^{3+} compounds). When included in coprogenic earthworm elements, plasmatic parts show weak birefringence (illimerization preceding earthification). Primary quartz predominates; plagioclase, orthoclase, mica, etc. also present; secondary braunlehm nodules abundant (Pl. V/2). Soil displays slight pseudogleyfication and calcification.

Horizon A (7,5 YR 3/2). Thin section 25: Matrix brown; contains much humus; flocculated; peptized only in some residual subpolyhedrons; traces of biogenic activity numerous as most soil is accumulated in highly diversified coprogenic elements (close fabric - Pl. VI/1 and VI/2); burrows left by earthworms and roots abundant; mull form of humus; soil microskeleton contains quartz, plagioclase, orthoclase, biotite, muscovite, augite, amphibole, glauconite, etc.; braunlehm nodules numerous; fine rims of "manganolimonite" coat supply channel sections; subsequent amorphous calcium carbonate and calcite needle-like crystals coat channels as well; soil cut by numerous fractures parallel to surface throughout owing to frost effects.

Typology: This parautochthonous, strongly polygenetic soil corresponds to braunlehm; supply of new component resulted in intensive illimerization, along with granulose appearance and subsequent strong brown earthification, apart from final pseudogleyfication, recalcification and strong mechanical disturbance.

Loess (7,5 YR 4/4). Thin section 26: Matrix light-ochreous, flocculated; numerous voids; much carbonate cementing primary components and filling supply channels; well-sorted in grain size apart from grains, particularly quartz, larger than fine sand; braunlehm nodules scarce; earthworm excrements fairly abundant; weak pseudogleyfication.

Fossil soil sediment C/III

Horizon B (5 YR 4/6). Thin section 27: Matrix dark-brown, weakly humic; consists of braunlehm plasma; soil microskeleton corresponding to silt or fine sand; coarser-grained components also present; includes mainly quartz; muscovite and strongly weathered plagioclase admixed; braunlehm nodules less common; soil matrix largely subject to brown earthification leading to the formation of secondary aggregates, accompanied by biogenic activity (numerous coprogenic elements, earthworm burrows, calcareous tubes, etc.); (sub)polyhedrons of original knot-like structure only residual; soil subject to subsequent pseudogleyfication, recalcification; much disturbed mechanically (original material bedding - Pl. VII/1).

Typology: Braunlehm, brown earthified; displaced mechanically after completion of polygenetic development; parautochthonous soil.

At the base of the section D there lies loess (sample 28) overlain by a soil complex consisting of two well-developed soils: the lower shows a distinct horizon B (sample 29) and humic horizon A (sample 30); the upper abuts sharply on a loess interbed (sample 31) and is only represented by a compact, strongly mottled horizon A (sample 32).

Section D

Consist of two superimposed fossil soils D/I and D/II, separated by intervening loess bed.

Micromorphology

Loess (7,5 YR 5/6). Thin section 28: Matrix pale-ochreous, flocculated; much carbonate; numerous voids; well-sorted microskeleton: silt to fine sand of various mineralogical composition (quartz, plagioclase, orthoclase, muscovite, biotite, augite, amphibole, etc.): braunlehm nodules present; dark-orange rims of braunlehm plasma partly coat supply channels; strongly birefringent; flow structures, growth zones; indicate deepreaching illimerization; black coating of "manganolimonite" and subsequently marginal amorphous calcium carbonate on braunlehm rims.

Fosil soil D/I

D/I - Horizon B (5 YR 4/4). Thin section 29: Matrix dark-ochreous, peptized; accumulated especially in aggregates as abundant coprogenic earthworm elements; residual knots sporadical and cut densely by angular joints; braunlehm plasma partly present in soil matrix: if preserved in earthworm excrements, it shows weak birefringence and has dull colour (i.e. evidence of illimerization preceding brown earthification); if found in fragments of original undisturbed supply channels, it has properties discussed under thin section 28; the same applies to effects of subsequent pseudogleyfication (Pl. VII/2) and recalcification; primary components of well-sorted grain size dominated by quartz; soil matrix contains braunlehm nodules, rarely opal phytoliths.

D/I - Horizon A (5 YR 4/6). Thin section 30: Matrix dark-brown, slightly humic, peptized; accumulated especially in coprogenic earthworm elements; braunlehm plasma partly present in aggregates brownish-ochreous, mechanically disturbed; supply channel walls (earthworm burrows, calcareous tubes, etc.) abundantly rimmed or filled with braunlehm plasma dark-orange in colour, showing strong birefringence, with preserved fluidal structures and growth zones (Pl. VIII/1); some plasmatic parts separated from supply channel walls and "packed" into secondary aggregates owing to subsequent earthification; remaining voids of supply channels with fine coating of almost black "manganolimonite" and amorphous calcium carbonate: matrix contains braunlehm nodules; primary components are the same in grain size and mineralogy as those in horizon B (thin section 29).

Typology: This distinctly polygenetic soil corresponds to braunlehm illimerized and then brown earthified after supply of a new component.

Loess (7,5 YR 5/6). Thin section 31: Matrix light-ochreous, flocculated; abundant carbonate; numerous voids; sections of numerous preserved, especially biogenic supply channels coated by abundant rims of dark-orange braunlehm plasma showing optical orientation and having fully preserved growth zones and fluidal structures; soil microskeleton consists of silt and fine sand; contains quartz, plagioclase, orthoclase, amphibole, augite; muscovite and biotite also abundant; matrix contains less common braunlehm nodules; matrix partly accumulated in coprogenic earthworm elements separated from surrounding material by narrow, concentrically arranged joints; slight traces of subsequent pseudogleyfication.

Fosil soil D/II

D/II - Horizon A (7,5 YR 3/2). Thin section 32: Matrix brown, weakly and unevenly humic, peptized, accumulated in secondary aggregates (abundant preserved coprogenic earthworm elements); marked by more numerous inner voids compared with residual knots containing very few inner pores (especially sharply bent joints); soil matrix contains braunlehm nodules; as compared with loess below (thin section 31), microskeletal mineralogical composition is quite simple: only quartz is present but grain-size varies somewhat and textural fractions are abundant and coarser; soil cut by wide fractures throughout and parallel to surface (Pl. VIII/2).

Typology: Sediment consisting of redeposited material of brown earthified braunlehm.

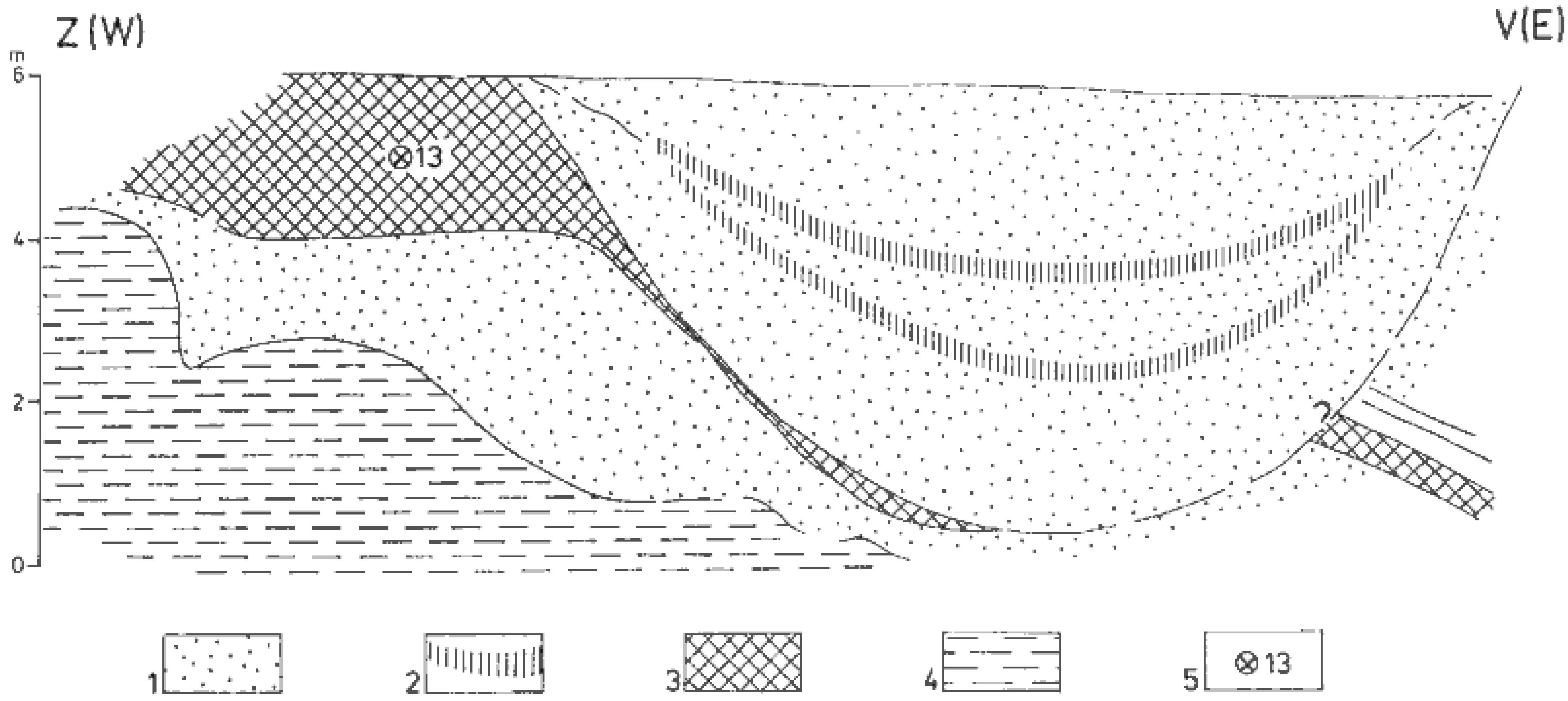
There is a clear evidence of a break in deposition between the loess below (sample 31) and soil sediment (sample 32): no illimerized soil was found above the loess though, numerous traces of its existence are available indicating that it intruded the initial loess substratum (see, e.g., abundant braunlehm plasma). In contrast it is entirely missing in the sediment above. From what has been said above it follows that illimerization phases and subsequent processes including redeposition and pedogenetic effects, with the resultant formation of brown earthified braunlehm, gave way to a phase of strong removal: the youngest braunlehm was disturbed and only the material of its horizon A redeposited gently downslope on the exposed loess.

In the cut trending E-W, perpendicular to the previously described section a strongly weathered reddish 1-2 m thick soil (5 YR 5/6) is exposed (sample 13, fig. 4) within the loess unit. Macroscopically, the soil shows close resemblance to horizon B of the rubified braunlehm (sample 7, fig. 3) of the basal soil in PK A. Micromorphologically, it differs only in more numerous signs of red earthification (rubification, comp. Mückenhausen-Stephan-Zimmermann 1989; more traces left by biogenic activities, particularly earthworm excrements and burrows; Pl. I/2).

Another difference is that it has not horizon A, the surface of soil horizon B is strongly soliflucted, and that it is underlain by loess instead of colluvial deposits. Calcium carbonate nodules of extreme size occur in the loess above and below the soil. The complex development history of the loess sequence is terminated by the presence of the youngest loess of Upper Pleistocene age. This loess is ochreous-brown in colour, with two initial reddish-brown, humic soil horizons in an erosion furrow trending north-south-ward, and its base is covered by soliflucted fragments of the horizon B of the rubified braunlehm described above (fig. 4). The exposed part of the section is disturbed by young man induced landslide.

Summary

The loess series at Sedlec, exposed in extensive sections, contains minimum five pedocomplexes which include



4. Sedlec – cut for land recultivation purposes, trending east-west-ward.
1 – loess, 2 – humic, initial soil horizons; 3 – horizon B of rubified braunlehm; 4 – grayish-green calcareous clay (Badenian); 5 – sample for fossil soil micromorphological determination.

ten fossil soils of the plastosol type (Kubiena 1953, 1970). The youngest soil was strongly redeposited and the two soils of the upper pedocomplex C are parautochthonous.

Chronological sequence of individual sections

MF 6 (=Molluscs fauna, sample No. 6)	loess	
Braunlehm, brown earthified, redeposited		D
Braunlehm, illimerized, brown earthified		
MF 5a	loess	
Braunlehm, brown earthified, parautochthonous		
MF 5	loess	C
Braunlehm, brown earthified, illimerized, granulose, parautochthonous		
....	loess	
Rotlehm, earthy		B
Braunlehm, rubified		
M4	loess	
Rotlehm, earthy		
Braunlehm, rubified		
MF 3	loess	
Braunlehm, light brown earthified		
MF 2	loess	A
Braunlehm, rubified		
MF 1	loess	

These soils show well-developed Ca and B horizons, as well as humic horizons A, in sections A, B; section C is marked by two basal soils and the upper soil with preserved B horizon, whilst the soil underlaying the upper soil is developed fully; section D contains lower soil with A, B horizons, while the youngest soil is represented by fossil soil sediment of a A horizon.

Three fossil soils are conspicuously mottled (Smoliková 1960), namely both upper soils of section A and D in A horizon. The basal soil of section C is mottled too even in B horizon.

All the soils discussed in this paper show a high degree of polygenesis (cf. Smoliková 1968). The braunlehm (or rotlehm) stage occured during extended periods of non-deposition and absence of material removal at interglacial climatic optimum. This brownlehm stage was followed by brown-or red-earthification (rubification) stage. This process attained varying intensity dependent on, and in response to, moisture changes particularly dryness. Earthification processes also enhanced development of the humic horizons A. There followed a period of wetness, typical of cooling the warm periods, which induced a weak pseudogleyfication of all the soils under consideration. Next came a mechanical disturbance of the soils (e.g. in horizons A of both earliest rubified braunlehms), which resulted, at least in some members, in parautochthonous character of the soil, with final recalcification owing to new "loessification" (glacial climate). The two soils displaying the most extensive stage of polygenesis are the basal soil of the upper part of section C and the lower soil of section D. These show the braunlehm replaced by deposition of unweathered material (i.e. some braunlehm plasma was released, etc.) which, when decalcified, was strongly illimerized. In one case i.e. basal soil of the upper part of section C (the soil subsequently became strongly granulose suggesting mild cooling and dryness), but in both cases there followed a dark-brown earthification and other processes as described previously.

The soil micromorphology at Sedlec shows similar characteristics (degree of weathering, typology and complex polygeny), to units observed at Červený kopec (Red

Hill) in Brno, Dolní Věstonice II and Beroun. However some differences exist (cf. Smolíková 1990a, b, 1992, etc.). For the section at Sedlec the absence of weakly developed soils is typical, apart from humic sediments exposed in section A and B. Such soils can be observed, at Beroun or Dolní Věstonice. The pedocomplexes preserved at Sedlec are therefore represented only by their basal members. Another difference is that the number of ten soils grouped into a minimum of five pedocomplexes is the most extensive yet described from known localities of similar age in the Czech Republic. The section at Sedlec shows closest typological resemblance to that at Dolní Věstonice II, with two oldest pedocomplexes again overlain by rubified braunlehm and the braunlehm of the upper pedocomplex is overlain by illimerized braunlehm. However, the succession at Dolni Věstonice is incomplete, with several breaks in deposition and soils that are clearly either parautochthonous or correspond to soil sediments. If one of the illimerized braunlehms and both rubified braunlehms at Dolni Věstonice correspond typologically to identical soils at Sedlec, than another difference between these localities the fact that the two oldest plastosols from the section A in Sedlec are not preserved at Dolní Věstonice. - Insufficient data on the earliest soils encountered in boreholes (cf: Zeman 1984) makes closer correlation with Červený kopec Hill difficult. - Correlation with the Beroun section particulary as to the number of soils most closely approaching those distinguished at Sedlec, is impeded especially by the difference in substratum (e.g. carbonate loess at Sedlec vs. non-calcareous colluvial deposits at Beroun), apart from the differences in palaeopedological provinces.

For these reasons it can now be stated that the section at Sedlec, with its number of fossil soils and their typology corresponds to Lower or to the onset of Middle Pleistocene (cf. Ložek 1973) and includes at least ten warm periods classified into five interglacials. Although only basal pairs have been found preserved in the individual soil complexes, it is evident that the existence of these soils alone bears testimony to a long duration and complex history of the period still based on scanty and largely incomplete data. The section can therefore be used for palaeogeographic and palaeoclimatic reconstructions of warm phases of the particular period in order to reach stratigraphical conclusions.

Fossil molluscs from the Sedlec complex

Excavations for agricultural purposes on slopes in a broad dell north of the Nesyt pond at Sedlec resulted in the discovery of a highly differentiated loess sequence sampled for malacoanalysis. Molluscs were obtained only from loess units; no shells or their fragments were found immediately below or within the soil complexes distinguished at the site.

Seven calcareous layers of superposed aeolian deposits (loess) were sampled. Because the loess units span a long period of time, it was a challenge to our interest to determine whether there are any differences in the occurrence of individual species or assemblages of molluscs during loess deposition in climatically similar phases.

The oldest exposed unit of the sequence is the basal layer of light-ochreous-grey loess with abundant calcium carbonate coatings (section A – sample 1; fig. 3). Only four species of molluscs were identified as follows: *Helicopsis striata, Vallonia tenuilabris, Succinea oblonga*, and a small fragment of snail assigned to the genus *Arianta* or *Bradybaena*. The few shells available are fragmentary and strongly corroded.

The next following layer of ochreous-light-grey loess structured into minute scales, again with abundant calcium carbonate coatings (sample 2), separates two fossil soils (A/I and A/II).

The seven species of molluscs observed in this unit are: *Pupilla triplicata, P. sterri, P. muscorum, Helicopsis striata, Vallonia tenuilabris, Clausilia dubia* and *Succinea oblonga (+elongata)*.

A third layer, in ascending order, separating A and B sections consist of light-brownisch ochreous loess. The layer is several metres thick so that it seemed practical to take two samples one above the other: the lower (3a) structured into minute scales contains less numerous calcium coatings; the upper (3b) contains abundant calcium precipitates. Yet another sample (3) was taken as a representative of the whole layer. The following sp. were observed in samples 3a and 3b: *Pupilla triplicata, P. sterri, P. muscorum, P. loessica, Vallonia costata, V. tenuilabris, Columella columella* (appearing for the first time), *Catinella arenaria* (present only here), *Clausilis dubia, Trichia hispida* and *Succinea oblonga (+elongata)*. This list of species is extended by *Helicopsis striata* identified in sample 3. It is evident that the loess represented by samples 3a and 3b contains the largest number of species, totalling twelve and being richest in individuals. The material available is largely preserved as complete or slightly broken shells.

In contrast, the next layer (in ascending order) is a light-ochreous-grey loess with numerous calcium precipitates (sample 4) separating section B and C. This layer contains, like sample 1, a few fragments of four molluscan species: *Helicopsis striata, Pupilla muscorum, Succinea oblonga*, cf. *Vitrinidae* sp. juv.; i.e. a small number of both species and individuals compared to the layer discussed previously.

Sample 5, taken from the fifth layer of light-greyish-ochreous loess between soil complexes C/III and D/I. This unit produced the following five species: *Helicopsis striata, Pupilla muscorum, Vallonia tenuilabris, Columella columella, Succinea oblonga (+elongata)*. The shells again show and excellent state of preservation, with predominant complete or slightly damaged shells.

The sixth layer of ochreous-light-grey loess (sample 6) rests on uppermost fossil soil D/II of the D section and yields only five following species: *Pupilla triplicata, P. muscorum, P. loessica, Helicopsis striata, Vallonia tenuilabris*. It should be emphasised, however, that small shells of *Helicopsis striata* display a remarkably regular and relatively slight increase in size. This feature distinguishes them from the same species of shells found in lower layers, with a less regular "ribbing", i.e. ribs of varying thickness and strength, coupled with white transparent ribs of small size.

Finally, the youngest member of the sequence seems to fill the erosion furrow at the surface of the preceding layer (sample 6); the basal part of the furrow extends into the surface of the upper soil complex in section D in its fundament. The infilling consists of light-ochreous-grey fine-sandy loess to loamified, medium-grained sand (sample 7). The following six species of molluscs were observed: *Pupilla muscorum, P. loessica, Vallonia tenuilabris, Columella columella, Trichia hispida,* and *Succinea oblonga* (+*elongata*), all with shells showing an excellent state of preservation.

Summary of the malacozoological content is given in a list of species – see Table 1.

Fourteen species of molluscs, if viewed in paleoecological aspect, fall into four ecological groups (sensu Ložek, 1964): three steppe species comprise *Pupilla triplicata, P. sterri* and *Helicopsis striata*. Six species comprise exposed, mostly grassy sites: *Pupilla muscorum, P. loessica, Vallonia costata, V. tenuilabris, Columella columella, Catinella arenaria*. Two euryectic species: *Clausilia dubia* and *Trichia hispida*; and partially hydrophilous *Succinea oblonga*. The remainder of the shell fragments or a juvenile shell (*Arianta* or *Bradybaena* and cf. *Vitrinidae*) can also be undoubtedly assigned to some of the biotopes mentioned above. This refers exclusively to treeless faunas of exposed, grassy, perhaps steppelike biotopes. Members of such faunas present in a climatic/sedimentation cycle of Quaternary age commonly occur in thanatocoenoses of glacial deposits largely aeolian in origin - loess. All the fourteen species can virtually be classified as "loess" species (*Pupilla loessica, V. tenuilabris, Columella columella*), or as species commonly occuring in loess (*Pupilla sterri, Helicopsis striata, Pupilla muscorum, Trichia hispida,* and *Succinea oblonga* with the subspecies *S.o. elongata*), or as species found in loess from place to place (*Pupilla triplicata, Vallonia costata, Catinella arenaria, Clausilia dubia*, cf. *Vitrinidae* sp., cf. *Arianta* aut *Bradybaena*).

Evidence available indicates that loess contains either clearly psychrophilous (boreo-alpinous) or steppe s.l. species; those indentified as typical psychrophiles in our samples comprise *Pupilla loessica, Vallonia tenuilabris,* and *Columella columella,* the last-named being used as a term for coolloving, *Columella*-faunas; the remainder of the species belong to both faunas either of cold or relatively warm steppe.

As far as the stratigraphical significance of the loess species is concerned, it must be emphasised that similar biotope conditions in which all loess deposits were laid down during the Pleistocene can also be recognized in similar molluscan assemblages. For this reason it is virtually impossible to distinguish loess faunas of Lower, Middle or Upper Pleistocene age. A rather unimportant exception to this may be *Catinella arenaria*, with its maximum occurrence falling within the range of Lower Pleistocene faunas. This species was only found in the loess layer (samples 3a and 3) separating sections A and B.

Table 1
Fossil molluscs from the Sedlec loess sequence near Mikulov

Ecol.	List of species	MF Sample No.								
		1	2	3a	3b	3	4	5	6	7
4	*Pupilla triplicata* (Stud.)		x	x					x	
	Pupilla sterri (Voith)		x	x	x	x				
	Helicopsis striata (Müll.)	x	x			x	x	x	x	
5	*Pupilla muscorum* (L.)		x		x	x	x	x	x	x
	Pupilla loessica (Lžk.)			x	x	x			x	x
	Vallonia costata (Müll.)				x					
	Vallonia tenuilabris (Br.)	x	x	x	x	x		x	x	x
	Columella columella (Mart.)				x	x		x		x
	Catinella arenaria (Bouch.-Chant.)			x		x				
7	*Clausilia dubia* Drap.		x	x		x				
	Trichia hispida (L.)				x	x				x
8	*Succinea oblonga* Drap. et *elongata* Sndb.	x	x	x	x	x	x	x		x
	Arianta aut *Bradybaena* frgm.	x								
	cf. *Vitrinidae* sp. juv.						x			

Note: Ecol. = basic species ecological requirements. After Ložek (1964): 4 - steppe, 5 - open ground in general, 7 - ecologicaly indifferent, 8 - moist habitats

As noted earlier, it is not possible to make a firm chronological assignment of the sequence based on the fossil molluscs from the seven loess layers. In the presence of strongly weathered and varicoloured horizons B of most of the fossil soils in soil complexes it seems reasonable to assume that the layers are Lower or, at least in part, Middle Pleistocene in age. Evidence used in support of this statement are the results of micromorphological studies made concurrently on the soil complexes by L. Smolíková. The same age is also attested by the morphology of the sequence at the upper edge of the flat-lying dell; with the imbricate structure of the loess sheets, it can be seen that the earliest layers are always confined to morphologically highest aeolian deposits, while those layers running successively downslope towards a valley are increasingly younger in age.

With these observations in mind, it should be noted that Boreal-Alpine species, particularly abundant in loess of climax and Late Würm age, also persist in all the seven loess layers. Additional evidence is thus available indicating that palaeoecological conditions favourable for loess deposition were similar in the Lower and Upper Pleistocene, although interglacials in the Lower Pleistocene were incommensurably warmer and more humid than those in the Upper Pleistocene.

In conclusion, an assessment must be made of the possible differences in molluscan thanatocoenoses from the individual loess layers of the sequence. In contrast to some loess complexes (e.g. Růženin dvůr near Brno; Smolíková and Kovanda 1983), where differences can be disclosed in species composition during the deposition of several superimposed blankets of loess (e.g. species of the genus *Pupilla*), the Sedlec sequence seems to be generally uniform in the presence of species obtained from individual layers of aeolian deposits. The only exception is, as noted earlier, *Catinella arenaria* restricted exclusively, in ascending order, to the third layer of loess in which *Pupilla sterri* and sporadically occurring *Clausilia dubia* disappear. Greater importance must be attached to *C. arenaria* than to *Pupilla sterri* and *C. dubia*, for the extinction of the two latter species can likely be interpreted as an irrelevant and accidental event.

Palynological analysis of sediments

Samples for pollen analysis were taken for preliminary information from four sections (25 samples) with respect to individual beds and sediment type.

A modified method of Frenzel (1964), Beug (1957) and Erdtman's (1943, 1954) acetolysis was used in combination to examine the samples in laboratory.

Sporomorphs were extracted by using such a heavy liquid as $ZnCl_2$, but the sediments were very poor in both pollen grains and spores. The sediment (loess) also show a poor state of preservation.

Numbers of pollen grains and spores determined in the samples are as follows: samples 2, 4, 6, 7, 8, 17, 22, 23 (Fig. 3) were barren; sample 1 - varia 1; sample 3 - *Betula* 1; sample 5 - *Fagus* 1; sample 9 - *Fagus* 1, *Artemisia* 1, varia 1; sample 10 - *Polypodiaceae* 1, varia 1; sample 11 - *Pinus* 3, *Betula* 1, *Picea* 1, *Chenopodiaceae* 1, *Rumex* 1, varia 1; sample 12 - *Artemisia* 74; sample 13 - *Poaceae* 2, *Artemisia* 2, *Rumex* 1, *Polypodiaceae* 1; sample 14 - *Rumex* 1, varia 1; sample 15 - *Pinus* 1; sample 16 - *Artemisia* 2, *Plantago lanceolata* 1, varia 2; sample 18 - *Pinus* 3, *Alnus* 1, *Filipendula* 1, varia 2; sample 19 - *Pinus* 1, *Frangula alnus* 1, *Chenopodiaceae* 1, *Geranium* 1; sample 20 - *Pinus* 1, *Artemisia* 4, *Filipendula* 1, *Cirsium* type 1, varia 1; sample 21 - *Pinus* 3; sample 24 - *Artemisia* 2, varia 1, *Polypodiaceae* 1; sample 25 - ? *Buxus* 1.

The small number of pollen grains and spores makes reconstruction of the vegetational history and age determination of the beds impossible.

Wood species such as *Betula, Pinus* or *Frangula alnus* indicate rather cold periods. Pollen grains of the genera *Alnus* and *Filipendula* and spores of the family *Polypodiaceae*, suggest moist to boggy environmental conditions. A steppe cold vegetation is represented by pollen grains of the genera *Rumex, Artemisia, Plantago lanceolata*, the family *Chenopodiaceae*. Pollen grains of the genus *Fagus* in loess seem to have been redeposited or transported by wind from more remote areas.

Sample 25 (base of the sequence not shown in Fig. 3) yielded only one, poorly preserved pollen grain probably belonging to the genus *Buxus*, but this plant occurred also in both Pleistocene and Tertiary flora.

Sample 12 was the richest in pollen grains, though they represent only one type of poorly preserved grains of the genus *Artemisia*. No sporomorphs were found in eight samples.

In spite of the fact that the sediments differ in both nature and age, I did not find any differences in the vegetational pattern studied in such a small number of pollen grains and spores. With the exception of *Fagus* and *Buxus*, all the plants seem to indicate a cold or steppe psychrophilous flora.

Conclusions

1. The loess sequence found on the southern slope of the upper part of the broad, south-facing pre-Quaternary valley north-east of Sedlec near Mikulov is one of the best preserved loess sequences in southern Moravia (fig. 3). Its highly complex development history is clearly documented by breaks in deposition, solifluction, parautochthonous fossil soils, and a younger erosion relief with depressions filled by Upper Pleistocene loess with two initially developed fossil soils (fig. 4).

2. Altogether minimum five soil complexes comprising ten fossil plastosol soils can be distinguished in the loess sequence at Sedlec.

3. Micromorphological studies have led to the following conclusions:

a) The soils are assigned typologically to rubified, brown earthified and illimerized braunlehm, as well as earthy rotlehm.

b) Three of the braunlehm soils are conspicuously mottled (panther soils).

c) All the soils occur as basal pairs of five pedocomplexes; overlying (upper) members are identified as fragmentary illimerized soil and several layers of humic soil sediments. Their existence indicates an initially high diversification of soil complexes with recurrent material removal of most of their upper parts.

d) The three lower soil complexes and the basal member of the upper pedocomplex consist of autochthonous fossil soils; both soils of the last-but-one soil complex are parautochthonous in nature, whilst the youngest member of the last pedocomplex corresponds to fossil soil sediment.

e) All the soils present at the site are highly polygenetic; after attaining braunlehm or rotlehm stage, they were exposed to brown or red earthification (rubification) leading to the formation of humic horizons A; there followed weak pseudogleyfication, mechanical disturbance and recalcification; two soils were additionally deposited and illimerized between the braunlehm stage and the earthification process; the older of them became granulose prior to earthification.

4. The number, systematic classification and high polygenesis of the soils preserved are all features indicating that the section provides evidence of at least five interglacials and a long complex history of the period spanning the Lower to early Middle Pleistocene.

5. It was possible to identify palaeomalacozoologically only the molluscs from the seven loess layers intervening between the individual PK members. All the loess layers contain only highly tolerant species of glacial faunas. The soils generally tend to develop progressively from the Lower to Upper Pleistocene (and hence to replace one palaeopedological province by another), whilst the climatic and palaeoecological requirements for the origin of loess remained uniform throughout the Pleistocene. No differences were recorded in the glacial faunas of Lower, Middle and Upper Pleistocene age. This even applies to the earliest glacial periods for which no evidence of continental glaciations is available.

6. It is evident that loess and fossil soils of Lower and Middle Pleistocene age are rather badly fitted for palynological studies. The extremely rare presence of pollen grains, if preserved at all, renders us unable to come to any palaeoecological and stratigraphical conclusions.

Footnote

1. After the completion of this article the loess series in Sedlec and Bořetice was sampled by June Mirecki for dating by aminoacid racemization method. Irrespective of many open theoretical problems by using this method for dating the terrestrial sediments in the periglacial zone the results are encouraging even without absolute dates. They are of great help particularly for locating the gaps and hiatuses in loess sequences and for drawing up the relative stratigraphy at least in limited regions to start with. The paper on aminostratigraphy of loess deposits in south Moravia (Mirecki, J., Havlíček, P. in press) will appear soon.

2. According to the new preliminary palaeomagnetic data (Thomas Forster, ETH Zürich, personal communication) the whole Sedlec sedimentary sequence shows a normal polarity, what means that it corresponds to the Brunhes Normal Palaeomagnetic Epoch. With respect to the typology of fossil soils the section correlates with the older part of Middle Pleistocene; it means that it belongs to the time between 0.430 Ma (Holsteinian) and 0.788 Ma (B/M reversal).

K tisku doporučil V. Ložek
Přeložil V. Marek

References

Beug, H. (1957): Untersuchungen zur spätglazialen und frühpostglazialen Floren- und Vegetationsgeschichte einiger Mittelgebirge (Fichtelgebirge, Harz und Rhön). - Flora, 145, 167-211. Jena.

Erdtman, G. (1943): An introduction to pollen analysis. - New York.

\- (1954): An introduction to pollen analysis. - Waltham (USA).

Frenzel, B. (1964): Zur Pollenanalyse von Lössen. - Eiszeitalter u. Gegenw., 15, 5-39. Öhringen/Württemb.

Havlíček, P. (1991): Dolní Věstonice II - Nová významná kvartérně geologická lokalita. 283-288, Acta Univ. Carol., Geol. Praha.

Havlíček, P. - Smolíková, L. (1993): Sprašová série u Bořetic (jižní Morava). - Věst. Ústř. Úst. geol. 19-24, Praha.

\- (1992): Významný sprašový profil na jv. okraji brněnského masivu u Vedrovic (okres Znojmo). - Věst. Čes. geol. Úst., 441-446, Praha.

Havlíček, P. - Zeman, A. (1986): Kvartérní sedimenty moravské části vídeňské pánve. - Sbor. geol. Věd, Antropozoikum, 17, 9-41. Praha.

Kalášek, J. (1963): Vysvětlivky k přehledné geologické mapě ČSSR 1:200 000, M-33-XXIX Brno. - MS Ústř. úst. geol. Praha.

Kovanda, J. - Tyráček, J. - Fridrich, J. (1988): Early Pleistocene continental sediments west of Prague. - Věst. Ústř. Úst. geol., 63, 2, 81-90. Praha.

Kubiena, W. L. (1953): Bestimmungsbuch und Systematik der Böden Europas. - F. Enke Verlag, 388. Stuttgart.

- (1970): Micromorphological Features of Soil Geography. - Rutgers University Press, 252. New Brunswick, New Jersey.

Ložek, V. (1964): Quartärmollusken der Tschechoslowakei. - Rozpr. Ústř. Úst. geol., 31, 1-374. Praha.

- (1973): Příroda ve čtvrtohorách. - 1-372. Academia. Praha.

Macoun, J. (1966): Předběžná zpráva o stratigraficky významných profilech kvartérními sedimenty na jižní Moravě. - Zpr. geol. Výzk. v Roce 1965, 285-286. Praha.

Mirecki, J. - Havlíček, P. (in press): Aminostratigraphy of Quaternary Loess Sequences at Sedlec near Mikulov and Bořetice, Southern Moravia. - Věst. Čes. geol. Úst. Praha.

Mückenhausen, E. - Stephan, S. - Zimmermann, K. (1989): Rotlehme und Rotlehm-Sedimente, Tirsoide Böden und Kalkkrusten. - Mitt. d. Österr. Bodenkund. Gesell., 39, 29-67. Wien.

Smolíková, L. (1960): Fosilní skvrnité půdy v ČSSR. - Věst. Ústř. Úst. geol., 35, 371-373. Praha.

- (1967): Mikromorphologie der altpleistozänen Fossilböden von Červený kopec bei Brno (Brünn). - Věst. Ústř. Úst. geol., 42, 5, 369-373. Praha.

- (1968): Polygenese der fossilen Lößböden der Tschechoslowakei im Lichte mikromorphologischer Untersuchungen. - Geoderma, 1, 315-324. Amsterdam.

- (1990a): Paleopedologie. In: Němeček, J. - Smolíková, L. - Kutílek, M.: Pedologie a paleopedologie. - 1-546. Academia. Praha.

- (1990b): K vývoji půd ve spodním pleistocénu. - Sborník prací k 80. výročí narození Prof. Dr. Ing. Josefa Pelíška, DrSc. - Sbor. Prací Geogr. Úst. ČSAV, 23, 85-92. Brno.

- (1991): Paleopedologický výzkum na lokalitě Milovice (okr. Břeclav). - Zpr. geol. Výzk. v Roce 1989, 163-164. Praha.

- (1991): Plastosoly na lokalitě Dolní Věstonice II. - Acta Univ. Carol., Geol., 289-302. Praha.

Smolíková, L. - Kovanda, J. (1983): Die Bedeutung der pleistozänen Sedimente des Fundortes Růženin dvůr (Brno-Židenice II) für die Stratigraphie des Brno-Beckens. - Sbor. geol. Věd, Antropozoikum, 15, 9-38. Praha.

Smolíková, L. - Zeman, A. (1979): Fossilböden im Profil von Sedlešovice und ihre Beziehung zu den Flußablagerungen. - Věst. Ústř. Úst. geol., 54, 4, 215-224. Praha.

Syrový, S. et al. (1958): Atlas podnebí Československé republiky. - Ústř. správa geodesie a kartografie. Praha.

Zeman, A. (1984): Otázka vztahů glaciálů, interglaciálů a říčních teras na příkladu jv. Moravy. - Vztahy Slunce-Země. 229-238. Nitra.

Žebera, K. (1968): Mapa kvartéru a zvětralinového pláště ČSSR. - Ústř. úst. geol. Praha.

Sprašový komplex u Sedlce (jižní Morava)

(Resumé anglického textu)

Pavel Havlíček - Libuše Smolíková - Jiří Kovanda - Eva Břízová

Předloženo 31. ledna 1992

Ve svrchní části rozlehlého předkvartérního údolí sv. od Sedlce u Mikulova, směřujícího k J, je na j. svahu zachována jedna z nejlépe vyvinutých sprašových sérií na jižní Moravě (obr. 3). Celou složitost vývoje popisovaného sprašového souvrství dokreslují hiáty v sedimentaci spraší, solifluované polohy, fosilní půdy různého rázu a drobná mulda, vyplněná svrchně pleistocenní spraší se dvěma iniciálně vyvinutými fosilními půdami (obr. 4).

V této sprašové sérii vystupuje nejméně pět půdních komplexů zahrnujících 10 fosilních plastosolových půd (profily A-D, obr. 3). Z jejich mikromorfologického výzkumu vyplývají následující závěry:

1. Typologicky zkoumané půdy odpovídají rubefikovaným, hnědě ozemněným a illimerizovaným braunlehmům a zemitým rotlehmům.

2. Tři z uvedených braunlehmovitých půd jsou výrazně panterované.

3. Všechny zastoupené půdy reprezentují bazální dvojice pěti pedokomplexů; z jejich nadložních členů byla zjištěna ve zbytcích jedna illimerizovaná půda a několik poloh humózních půdních sedimentů. Jejich existence svědčí o původně bohatém členění jednotlivých půdních komplexů a o opakujícím se následném odnosném neklidu, jemuž svrchní úseky pedokomplexů vesměs podlehly.

4. Tři spodní půdní komplexy a bazální člen svrchního pedokomplexu vystupují v modu fosilních autochtonních půd; parautochtonní ráz mají obě půdy předposledního půdního komplexu, nejmladší člen posledního pedokomplexu odpovídá modu fosilního půdního sedimentu.

5. Všechny zastoupené půdy jsou vysoce polygenetické. Po dosažení braunlehmového (nebo rotlehmového) stadia byly vystaveny hnědému nebo červenému ozemnění (rubefikaci), vyúsťujícímu v tvorbu humózních horizontů A, dále mírnému pseudooglejení, mechanickému porušení a rekalcifikaci; u dvou půd proběhla mezi braunlehmovým stadiem a ozemňovacími pochody ještě sedimentace a illimerizace; u starší z nich se ještě před ozemněním uplatnila granulace.

Z počtu dochovaných půd, jejich systematické příslušnosti i jejich intenzivní polygeneze vyplývá, že příslušný profil zahrnuje nejméně pět interglaciálů a je dokladem dlouhotrvajícího a složitého průběhu úseku spodního až spodní části středního pleistocénu.

Z paleomalakozoologického hlediska bylo možno vyhodnotit pouze měkkýše ze sedmi poloh spraší, oddělujících jednotlivé členy pedokomplexů. Ukázalo se, že všechny polohy obsahují pouze vysoce chladnomilné druhy tzv. columellových faun.

Zatímco u půd obecně platí, že jejich vývoj od svrchního pleistocénu ke spodnímu obecně sílí (a mění se tudíž jejich příslušnost k různým paleopedologickým provinciím), platí o spraších, že klimatické a paleoekologické podmínky jejich vzniku byly totožné v průběhu celého pleistocénu. Žádné rozdíly glaciálních faun spodního pleistocénu vůči pleistocénu střednímu ani svrchnímu nelze konstatovat. To platí i v případě, že jde o ta nejstarší glaciální období, pro něž u nás nemáme žádný doklad o existenci odpovídajících kontinentálních zalednění.

Z palynologického hlediska bylo opět prokázáno, že materiál spraší i fosilních půd spodně a středně pleistocenního stáří je velmi nevhodný pro studium. Pylová zrna, pokud se zachovala, byla velmi vzácná, takže nebylo možné dospět k žádným paleoekologickým ani stratigrafickým závěrům.

Vysvětlivky k tabulce

1. Fosilní měkkýši sprašového komplexu od Sedlce u Mikulova. Pozn.: v kolonce ekol. jsou čísly uvedeny základní ekologické požadavky druhů podle Ložka (1964): 4 - step, 5 - otevřená stanoviště, 7 - ekologičtí indiferenti, 8 - vlhká stanoviště.

Vysvětlivky k obrázkům

1. Lokality spodně a středně pleistocenních sprašových sérií na jižní Moravě (s vyznačením rozšíření spraší dle Žebery 1968).
   1 - Vedrovice; 2 - Dolní Věstonice II; 3 - Mikulov-Kinberg; 4 - Sedlec; 5 - Bořetice; 6 - Velké Pavlovice; 7 - Úvaly; 8 - Milovice.
2. Geologická mapa okolí Sedlce.
   1 - deluviofluviální sedimenty; 2 - deluviální, hlinitopísčité sedimenty; 3 - spraše; 4 - písky a štěrky (baden); 5 - vápnité jíly (baden); 6 - balvany pískovců; 7 - fosilní půdy; 8 - soliflukce; 9 - sesuvy; 10 - dejekční kužel; 11 - rekultivační zářezy; 12 - studované profily.
3. Sedlec - sprašová série v s.-j. zářezu.
   1 - spraše, místy přemístěné; 2 - nejmladší spraše; 3 - půdní horizonty A a B, místy přemístěné; 4 - karbonátové horizonty; 5 - vzorky pro určení malakofauny; 6 - vzorky na pylové analýzy; 7 - vzorky pro mikromorfologické určení fosilních půd; 8 - vzorky na paleomagnetické datování; 9 - pedokomplexy v profilech A-D, uváděné v textu.
4. Sedlec - rekultivační zářez v.-z. směru.
   1 - spraše; 2 - humózní, iniciální půdní horizonty; 3 - horizont B rubefikovaného braunlehmu; 4 - šedozelené vápnité jíly (baden); 5 - vzorek pro mikromorfologické určení fosilní půdy.

Vysvětlivky k přílohám

Příl. I

1. Skladba horizontu B bazálního rubefikovaného braunlehmu. Výbrus 7 - sekce A/I. Zvětšeno 30krát.
2. Braunlehmová konkrece v horizontu B rubefikovaného braunlehmu, vystupujícího ve stěně přivrácené k J. Výbrus 13 - obr. 4. Zvětšeno 30krát.

Příl. II

1. Široké trhliny, svědčící o redepozici a zvrstvení materiálu humózního horizontu A rubefikovaného braunlehmu. Výbrus 8 - sekce A/I. Zvětšeno 30krát.
2. Braunlehmová konkrece koncentrické stavby v horizontu A téže půdy. Výbrus 8 - sekce A/I. Zvětšeno 75krát.

Příl. III

1. Volné prostory, reprezentované ostře lomenými puklinami v horizontu B rubefikovaného braunlehmu. Výbrus 15 - sekce B/I. Zvětšeno 30krát.
2. Relikty původních segregátů v humózním horizontu A rubefikovaného braunlehmu. Výbrus 16 - sekce B/I. Zvětšeno 30krát.

Příl. IV

1. Slabé pseudooglejení a následná rekalcifikace v horizontu B zemitého rotlehmu. Výbrus 17 - sekce B/II. Zvětšeno 30krát.
2. Polyedry těsné vnitřní stavby prostoupené úzkými puklinami horizontu B nerovnoměrně rubefikovaného braunlehmu. Výbrus 20 - sekce C/I-1. Zvětšeno 30krát.

Příl. V

1. Dílčí braunlehmové plazma (např. v pravém dolním kvadrantu), lemující stěny přívodních drah. Horizont B spodního, hnědě ozemněného, následně illimerizovaného braunlehmu. Výbrus 24 - sekce C/II. Zvětšeno 30x.
2. Braunlehmová konkrece v horizontu B illimerizovaného braunlehmu. Výbrus 24 - sekce C/II. Zvětšeno 30krát.

Příl. VI

1. Hojné fosilní koprogenní elementy žížal v humózním horizontu A (forma humusu je mul) spodního, hnědě ozemněného a následně illimerizovaného braunlehmu. Výbrus 25 - sekce C/II. Zvětšeno 30krát.
2. Dtto jako VI/1. Výbrus 25 - sekce C/II. Zvětšeno 30krát.

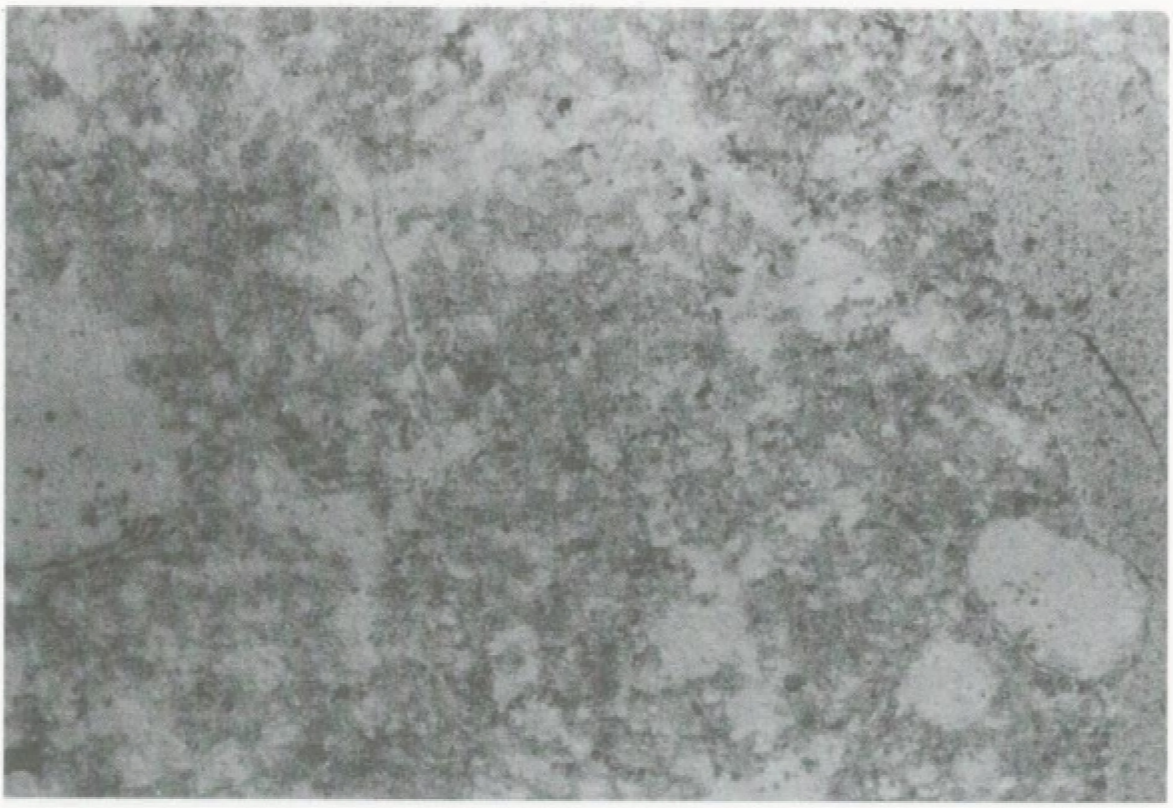
Příl. VII

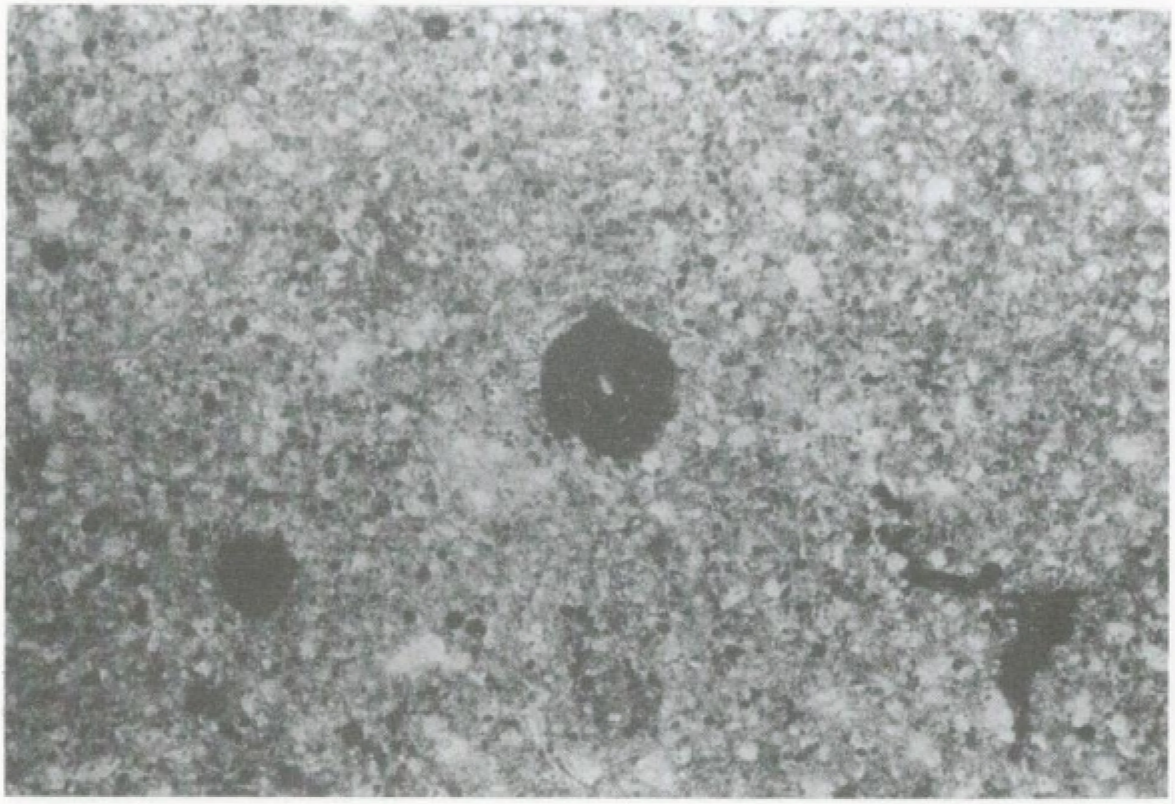
1. Horizont B hnědě ozemněného, mechanicky porušeného braunlehmu. Výbrus 27 - sekce C/III. Zvětšeno 30krát.
2. Nepravidelně paprsčitě omezené pseudoglejové konkrece (uprostřed) z fáze druhotného pseudooglejení. Horizont B svrchního hnědě ozemněného illimerizovaného braunlehmu. Výbrus 29 - sekce D/I. Zvětšeno 30krát.

Příl. VIII

1. Dílčí braunlehmové plazma s dochovanými přírůstkovými zónami a fluidálními strukturami (např. v levém dolním kvadrantu) v horizontu A svrchního ozemněného illimerizovaného braunlehmu. Výbrus 30 - sekce D/I. Zvětšeno 30krát.
2. Paralelně uspořádané široké trhliny v sedimentu horizontu A redeponovaného hnědě ozemněného braunlehmu. Výbrus 32 - sekce D/II. Zvětšeno 30krát.

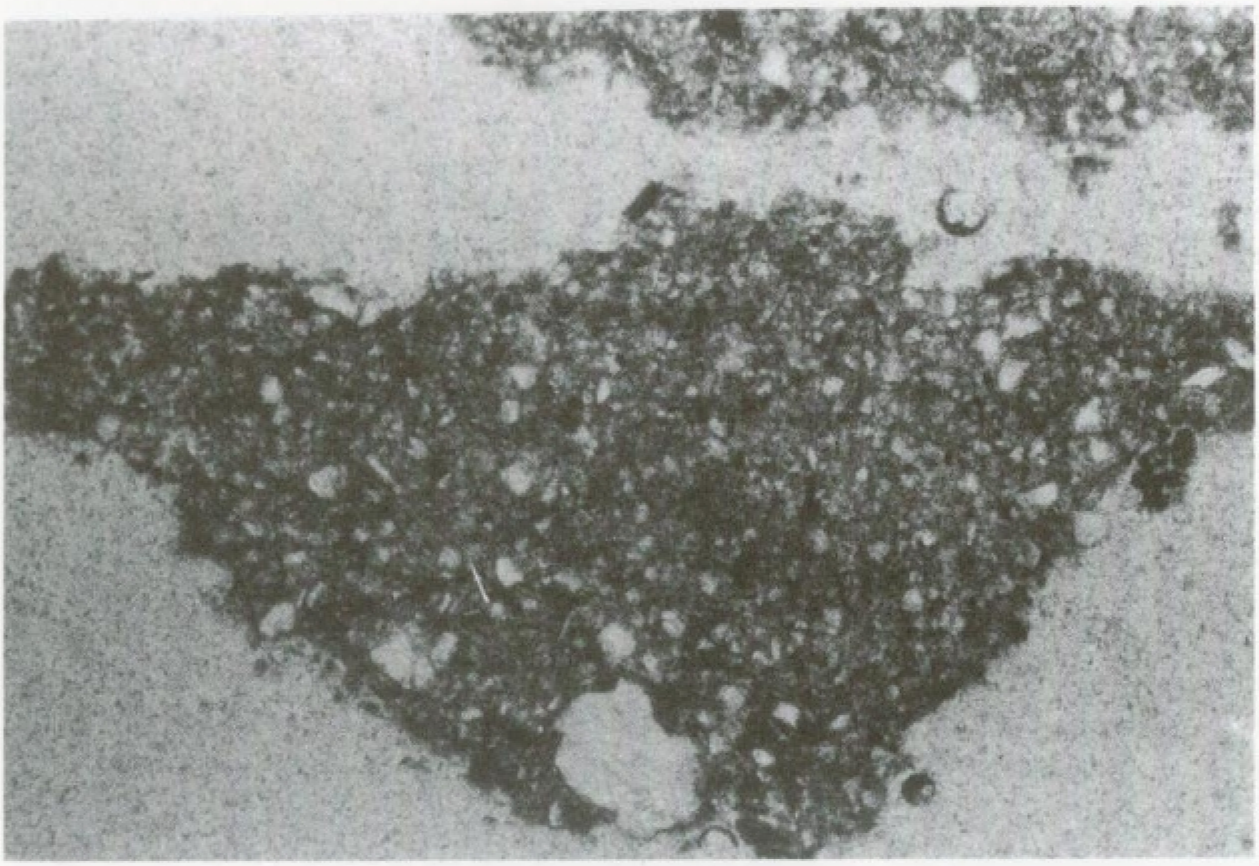
Foto I. Fischer

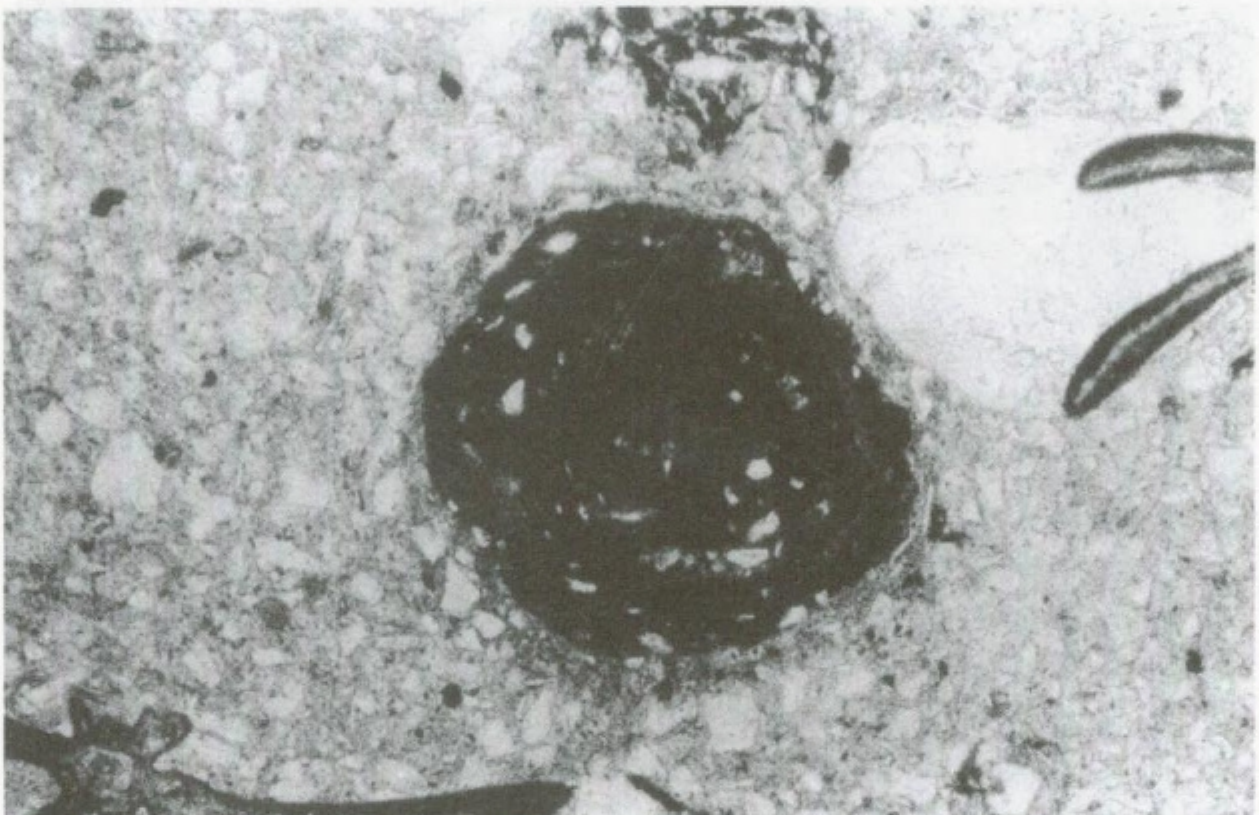




1. Horizon B of basal rubified braunlehm. Thin section 7 - A/I. x30.

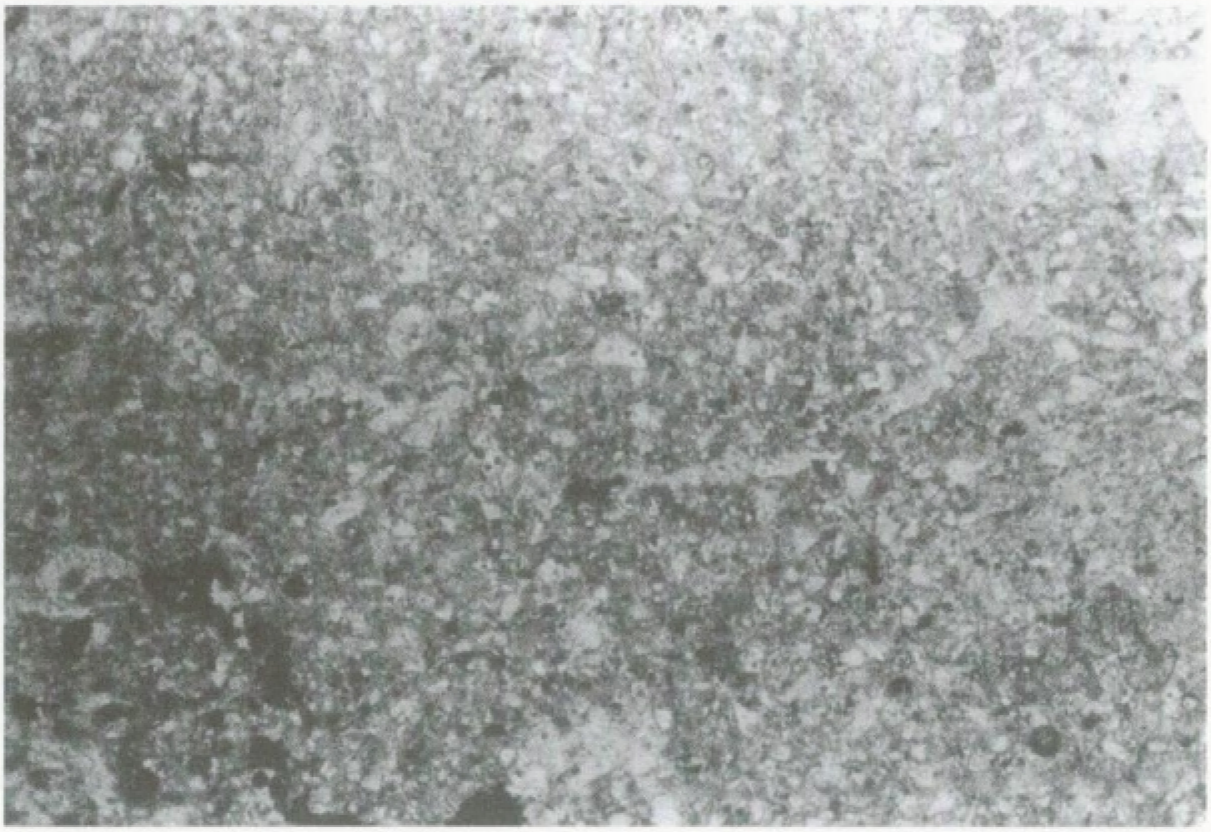
2. Braunlehm nodule in horizon B of rubified braunlehm in exposure facing south. Thin section 13 - fig. 4. x30.

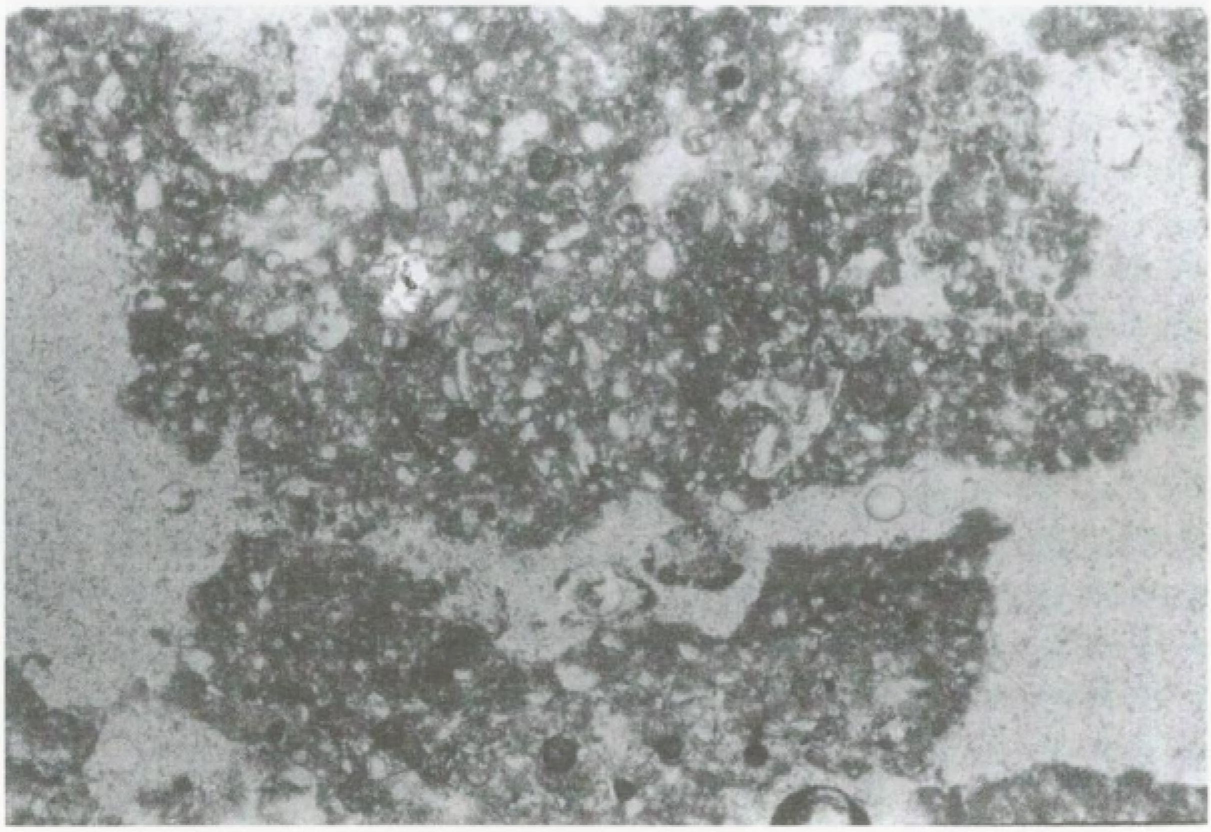




1. Wide fractures indicating redeposition and bedding of humic horizon A of rubified braunlehm. Thin section 8 - A/I. x30.

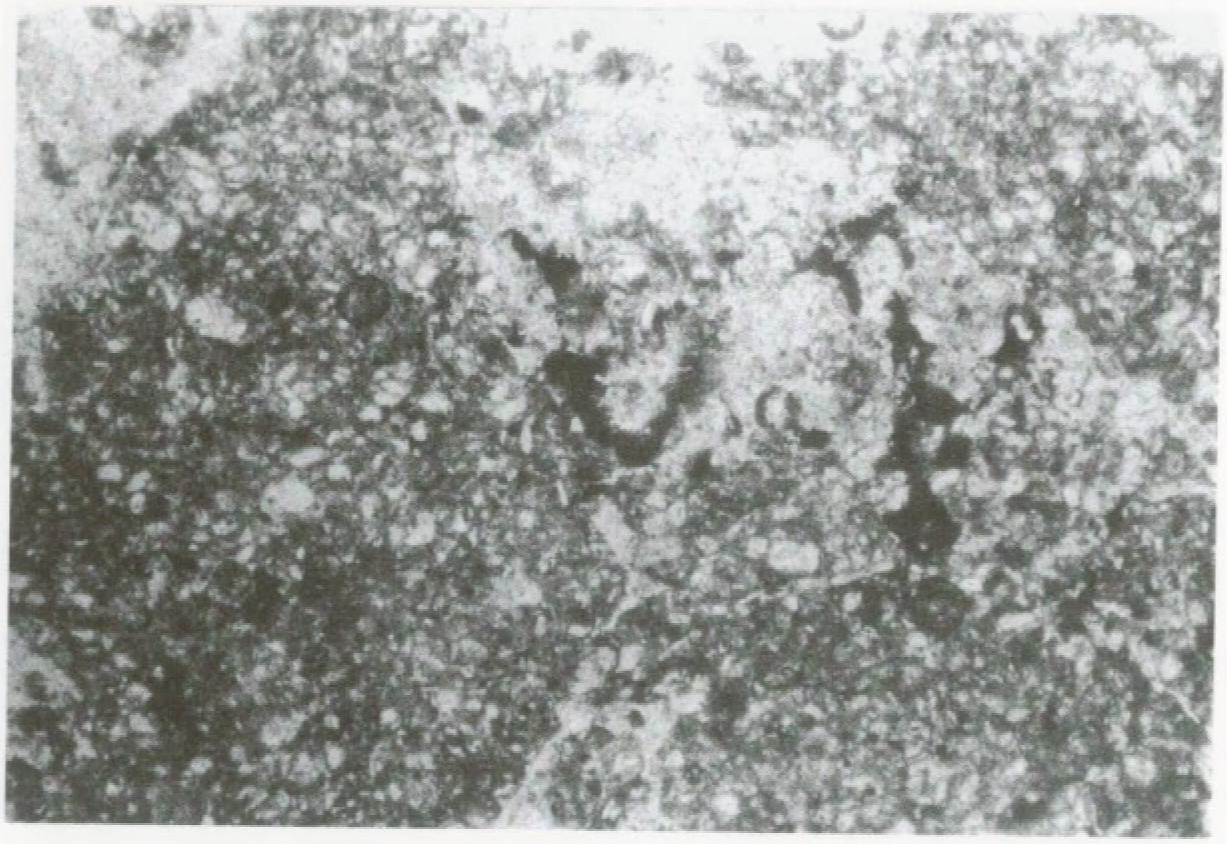
2. Braunlehm nodule arranged concentrically in horizon B of same soil. Thin section 8 - A/I. x75.

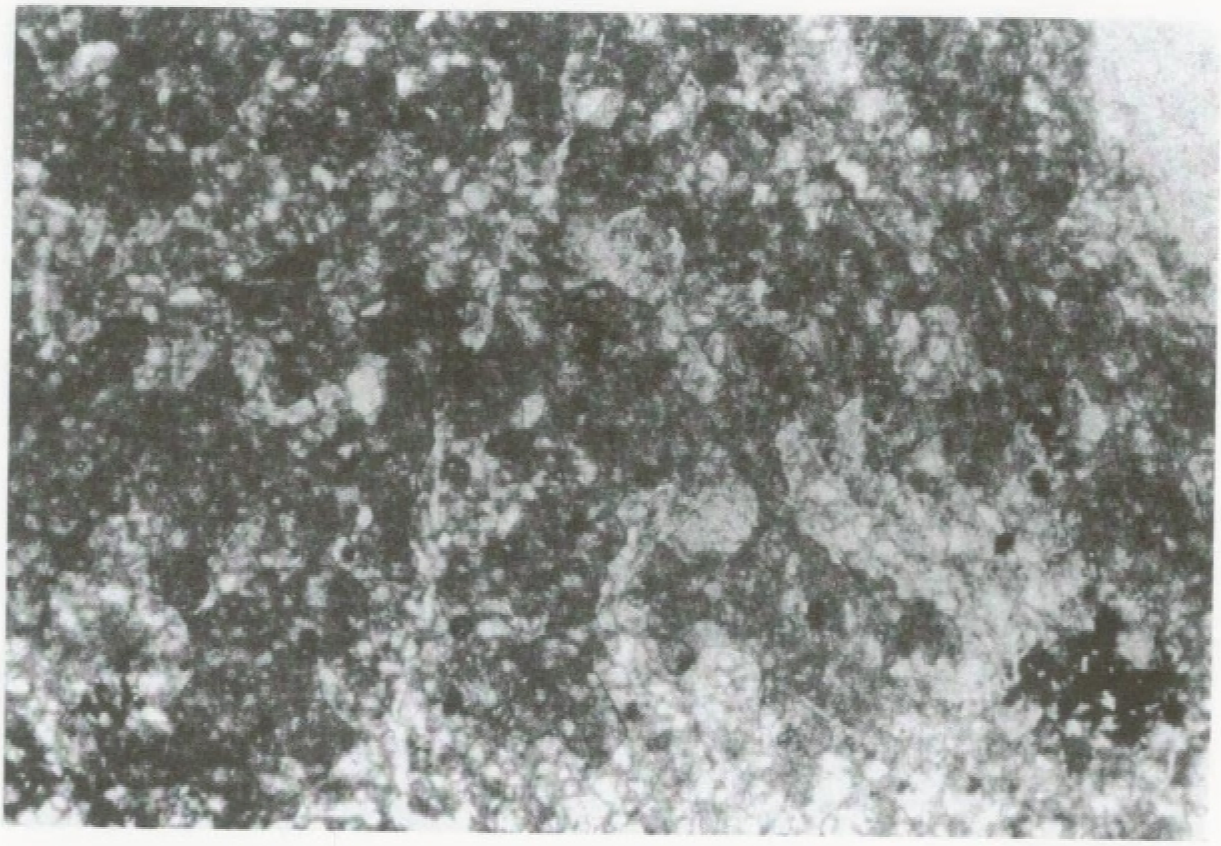




1. Voids filled with sharply bent joints in horizon B of rubified braunlehm. Thin section 15 - B/I. x30.

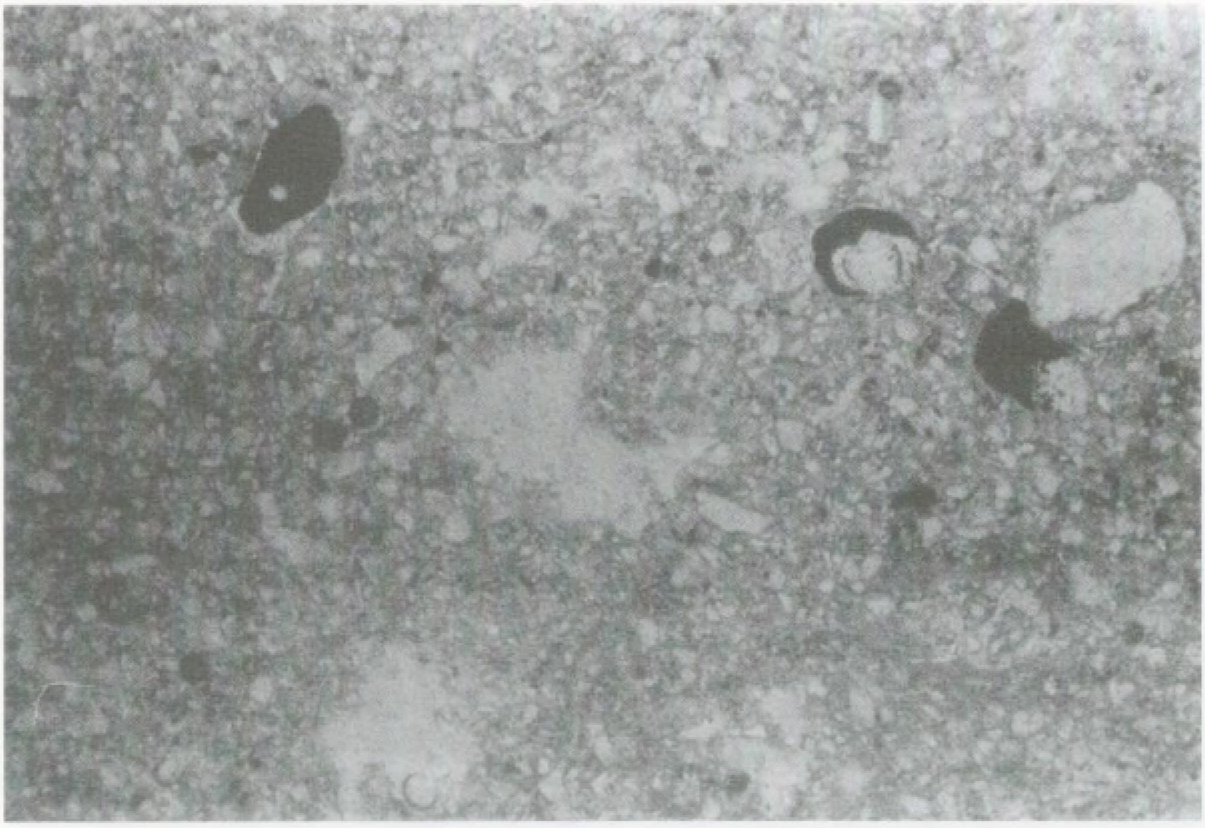
2. Residual knots in humic horizon A of rubified braunlehm. Thin section 16 - B/I. x30.

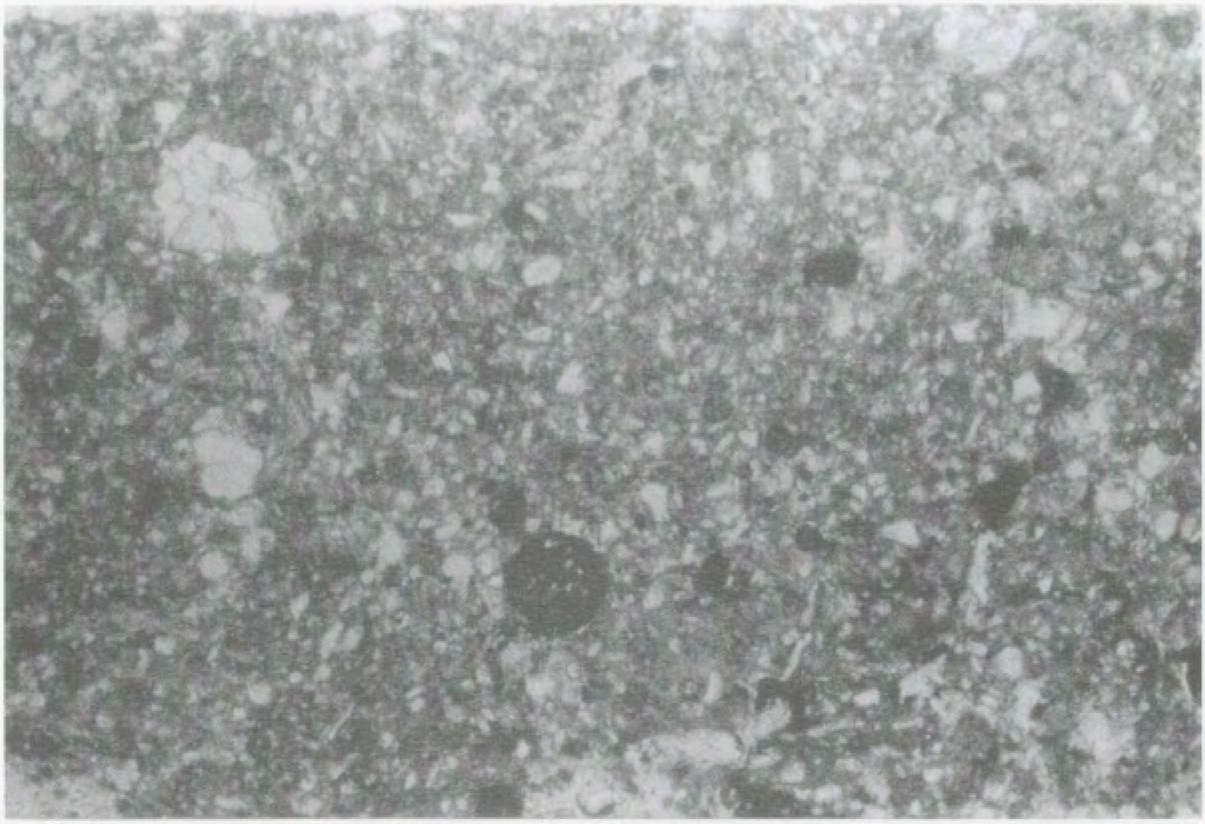




1. Weak pseudogleyfication and following recalcification of the horizon B of earthified rotlehm. Thin section 17 - B/II. x30.

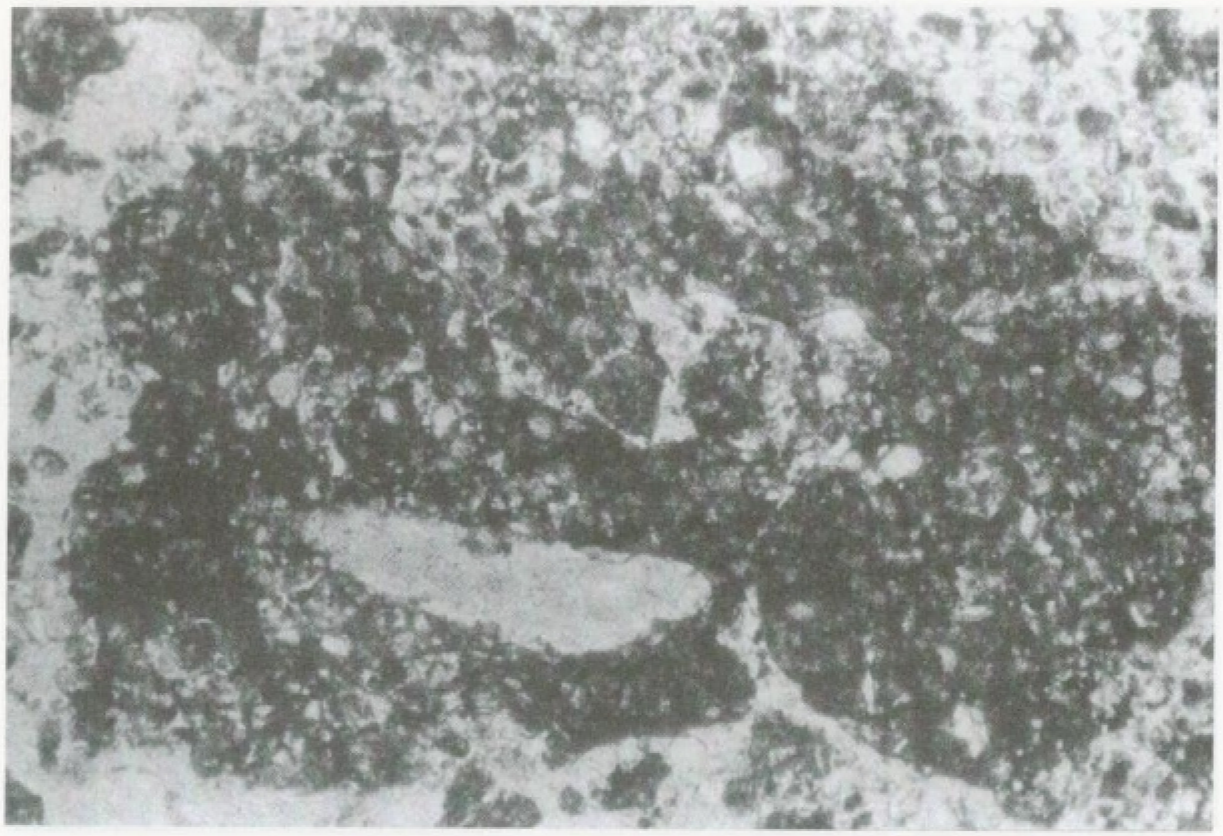
2. Close fabric polyhedrons out by narrow joints. Horizon B of unevenly rubified braunlehm. Thin section 20 - C/I-1. x30.

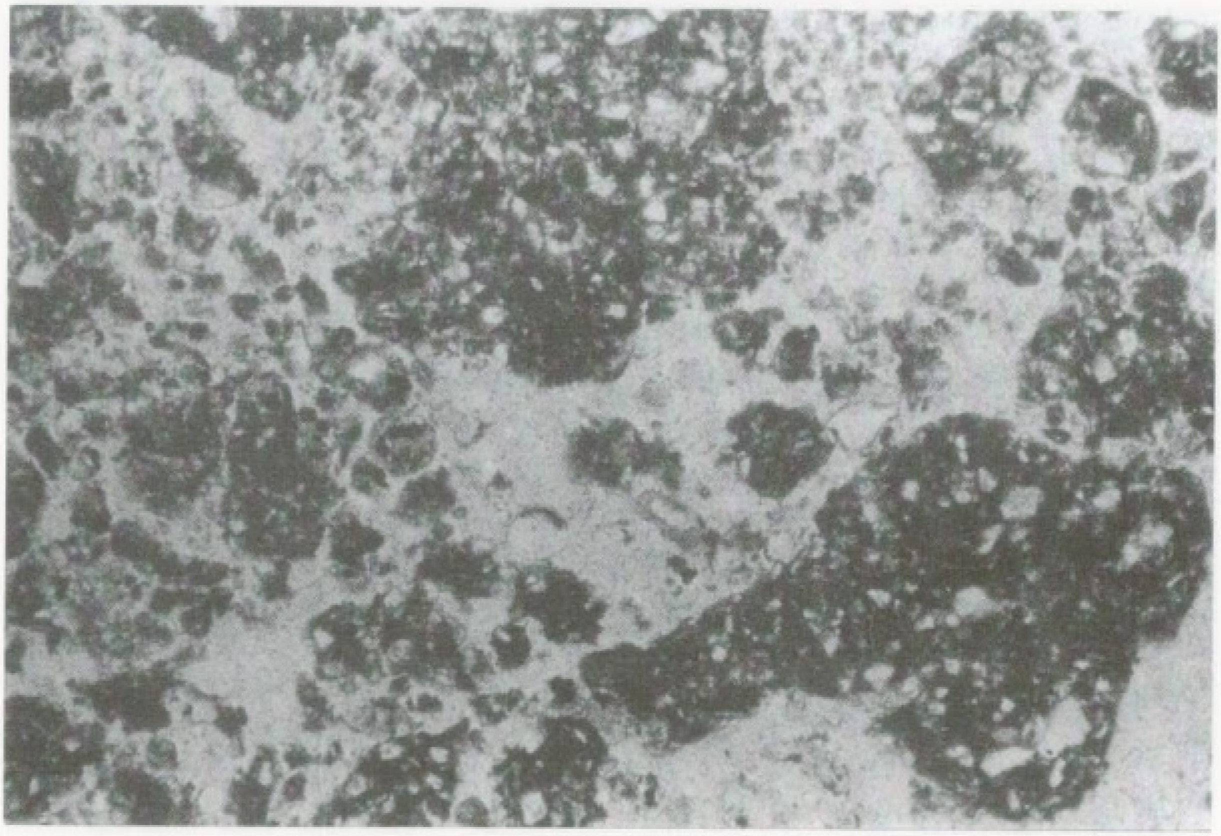




1. Braunlehm plasma (e.g., right quadrant, below) partly rimming supply channel walls. Horizon B of lower, brown earthified, subsequently illimerized braunlehm. Thin section 24 - C/II. x30.

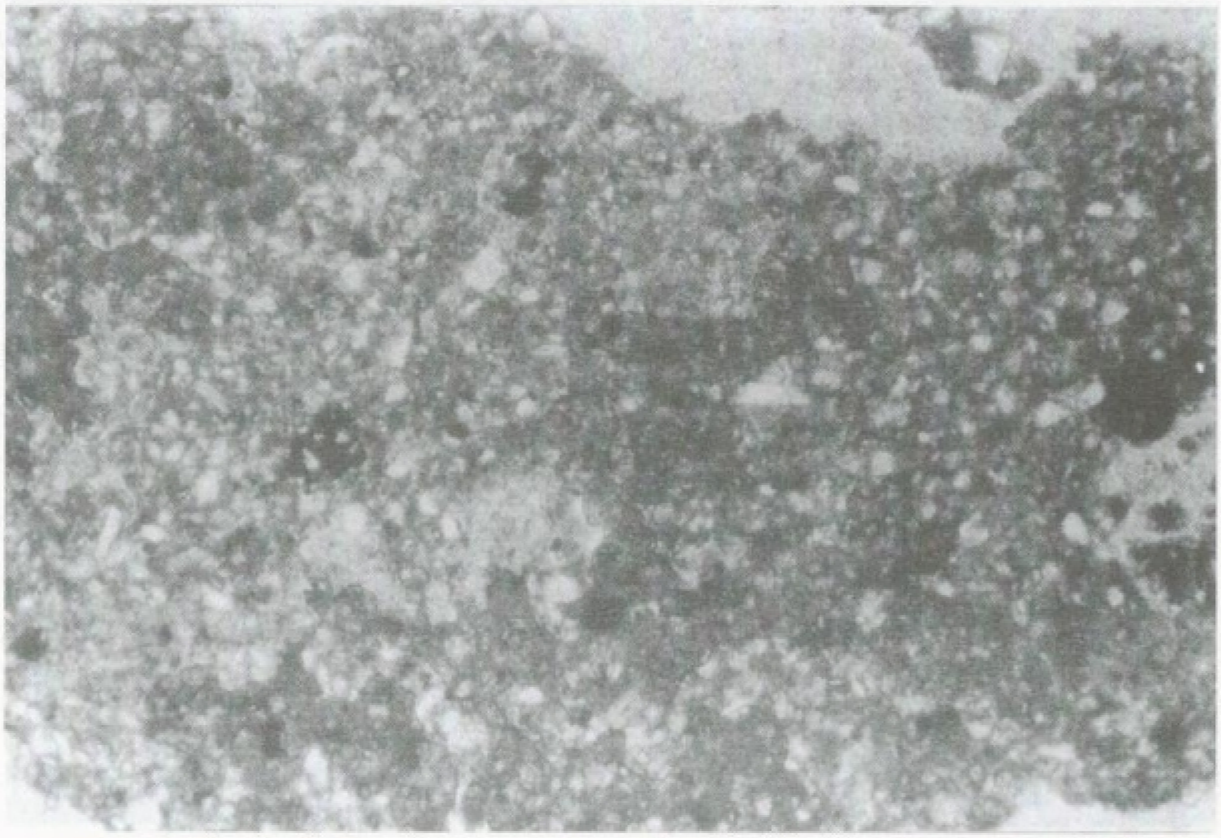
2. The braunlehm concretion in the horizon B of the illimerized braunlehm. Thin section 24 - C/II. x30.

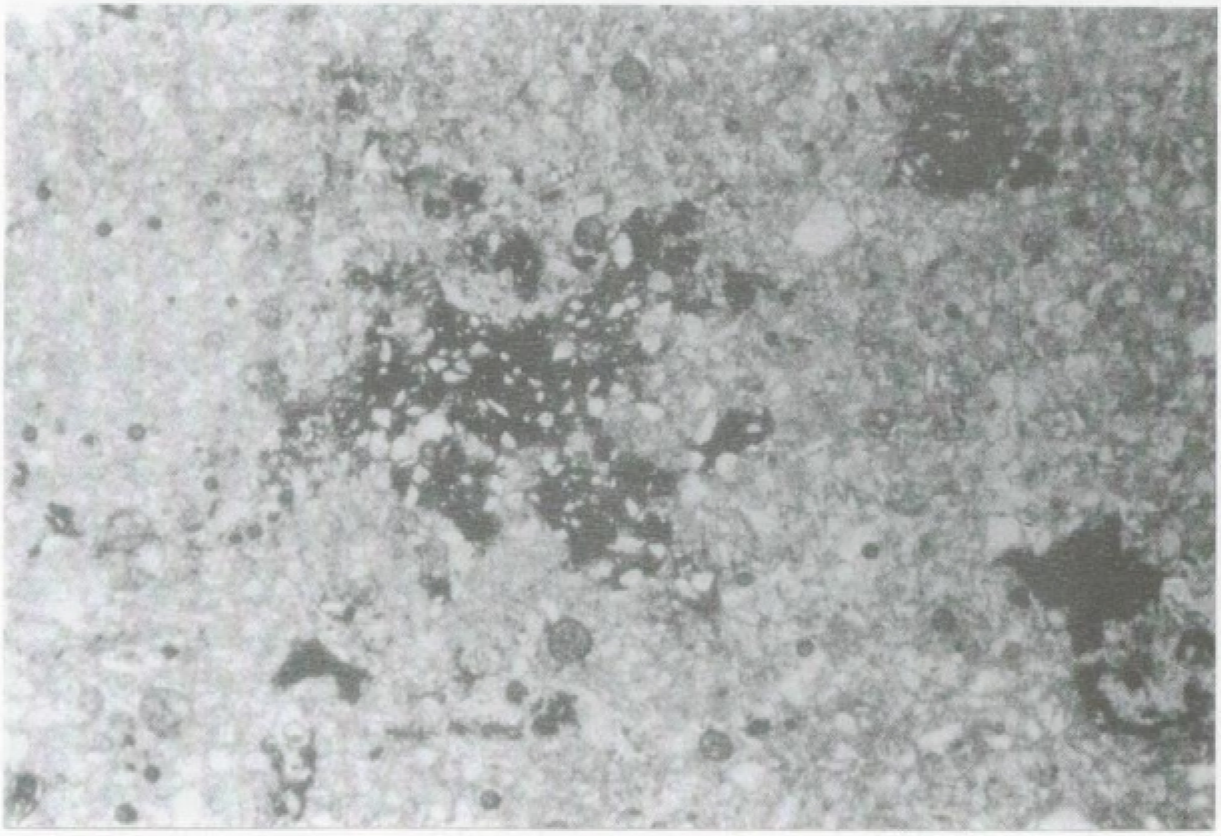




1. Numerous fossil coprogenic earthworm elements in humic horizon A of mull form of humus. Lower braunlehm, earthified, subsequently illimerized. Thin section 25 - C/II. x30.

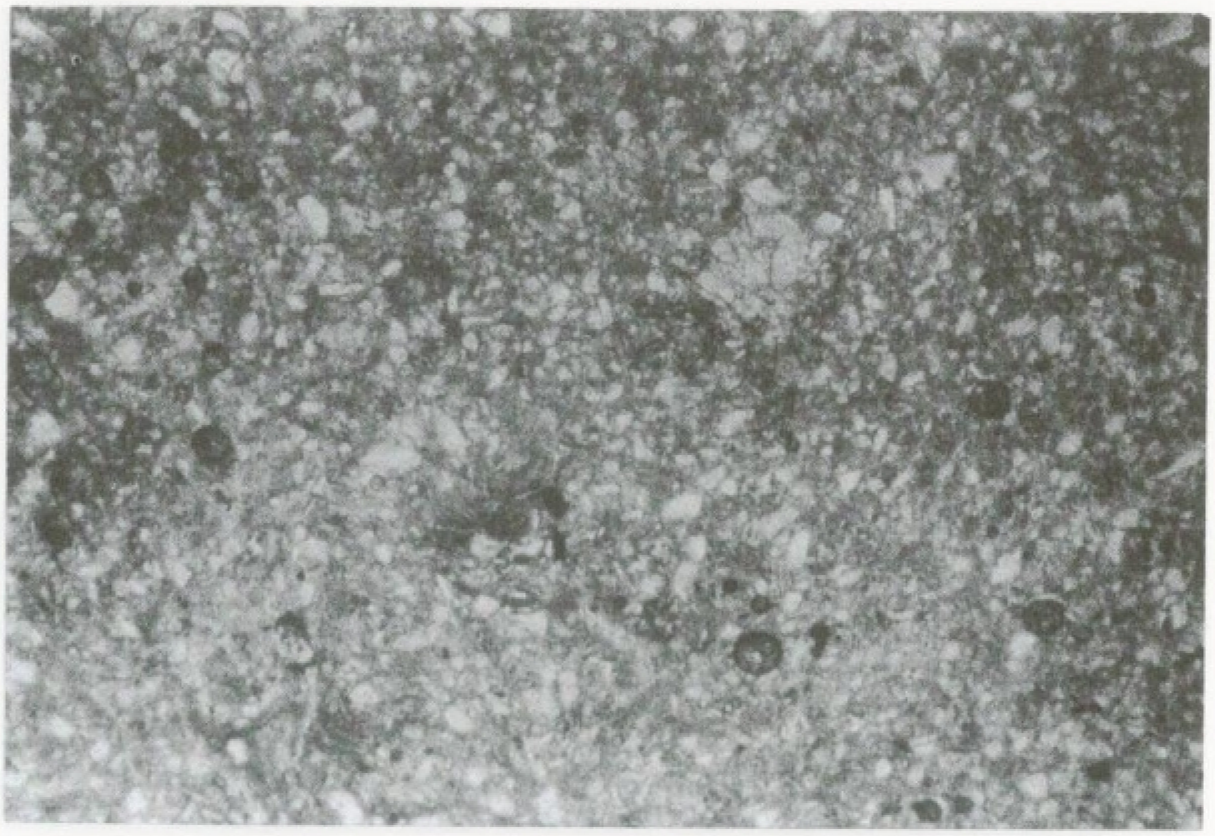
2. Detto as VI/1. Thin section 25 - C/II. x30.

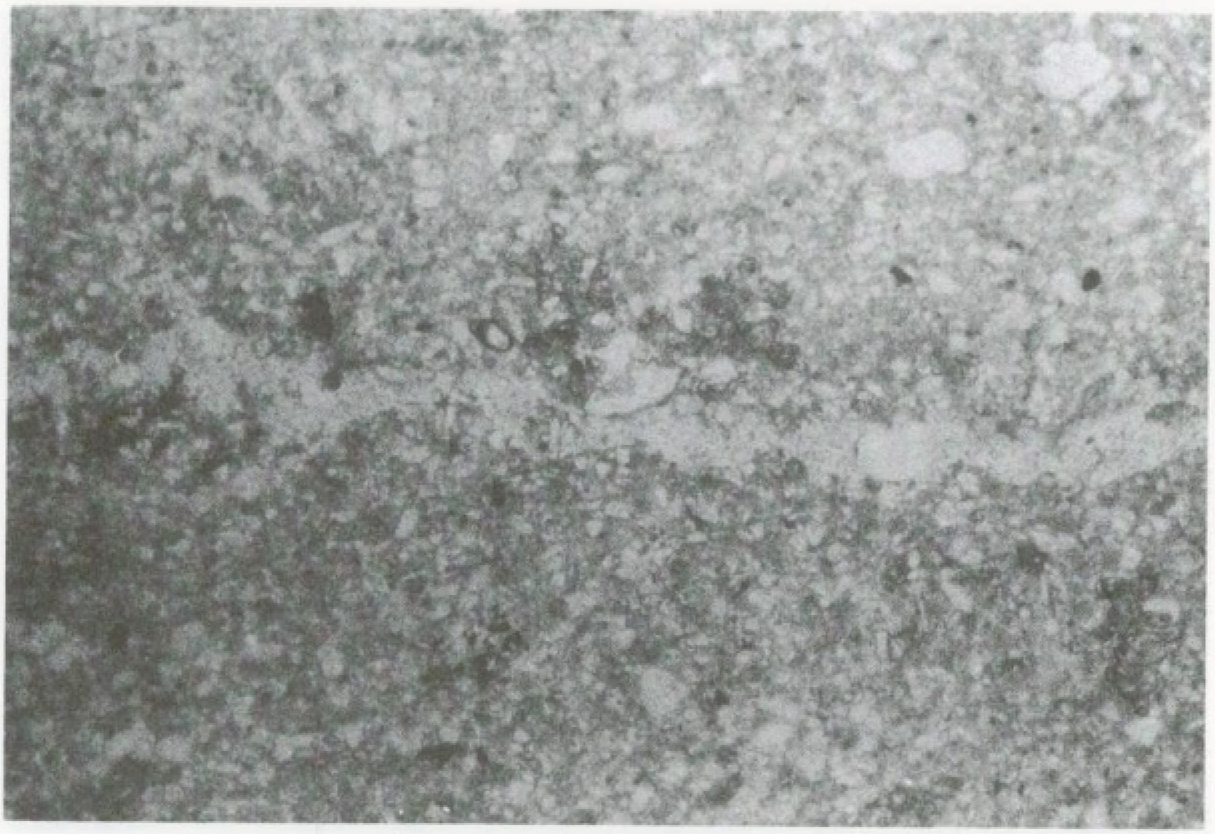




1. Horizon B of the brownish earthified and disturbed braunlehm. Thin section 27 - C/III. x30.

2. Irregularly radial pseudogley nodules (middle) formed during secondary pseudogleyfication. Horizon B of upper brown earthified, illimerized braunlehm. Thin section 29 - D/I. x30.





1. Braunlehm plasma with preserved growth zones and fluidal structures (e.g., left quadrant, below). Horizon A of upper brown earthified, illimerized braunlehm. Thin section 30 - D/I. x30.

2. Parallel wide fractures in sediment of horizon A. Redeposited, brown earthified braunlehm. Thin section 32 - D/II. x30.

Photomicrographs by I. Fischer