SOIL MICROMORPHOLOGIC INVESTIGATION OF THE SECTION AT DOLNÍ VĚSTONICE II

Libuše Smolíková

Two undisturbed monolithic samples were taken from strata 4 - 9 of section 5 at burial place DV XVI for soil micromorphologic investigation (Tab. 1; Fig. 41). The lower monolith includes strata 9 and 8. Sample 3 comes from a humous horizon of its upper part (10 YR 2/2; examined in dry state); sample 2 from the humous horizon substrate (10 YR 5/4); sample 1 from the lower part of the lower monolith (10 YR 6/4). The upper monolith includes strata 6 to 4 and is represented by 4 samples. Sample 4 (5 Y 6/4; examined in wet state) was obtained from the cultural layer and sample 5 (2,5 Y 6/4) from the loess above; the latter was taken 20 cm above the upper limit of the cultural layer. Samples 6 (5 Y 6/3) and 7 (5 Y 5/4) were collected 10 cm above sample 5 and from the upper part of the monolith respectively.

Micromorphology

Sample 1: It is characterized by (a) matrix bedding with a sparse network of more-or-less parallel wide cracks of rough walls, (b) fine pseudogleyfication showing especially narrow "manganolimonite" coatings on supply channel walls, (c) a number of minute, well worn fragments of carbonates corresponding in grain size to medium to coarse-grained sand.

Sample 2: Pale ochreous flocculated matrix devoid of humous is marked by incoherent fabric with much carbonate. Grain size and mineralogico-petrological composition of the microskeleton are much like those of sample 3. - Fragments of material building up strongly humous soil occur sporadically. - Small fragmentary bones are numerous.

Sample 3: Pale ochreous-brown, weakly humous, completely flocculated matrix displays a fabric extremely abundant in open pores. Aggregation has not yet attained an advanced stage so that the fabric not uncommonly "inherits" typical loess composition. In addition to regularly distributed micropores in the groundmass proper, macropores occur abundantly as open spaces between aggregates and as calcareous tubes or a sparse network of wide cracks with faintly defined walls. - Soil microskeleton is represented expecially by silt finer rather than coarser in grain size; it consists chiefly of grains of quartz and plagioclase, biotite, muscovite, orthoclase, pyroxenes and amphibole; rocks are dominated by fragmentary limestone.
- Traces left by fossil biogenic activities are indistinct, being only represented by sporadically preserved coprogenic elements of earthworms and by calcareous tubes; humification is weak and quite irregular. - Matrix nevertheless contains fragments of strongly humous soil material redeposited at a high rate; they are angular, not rounded, in most cases.
- There are two types of charcoal fragments: those occurring

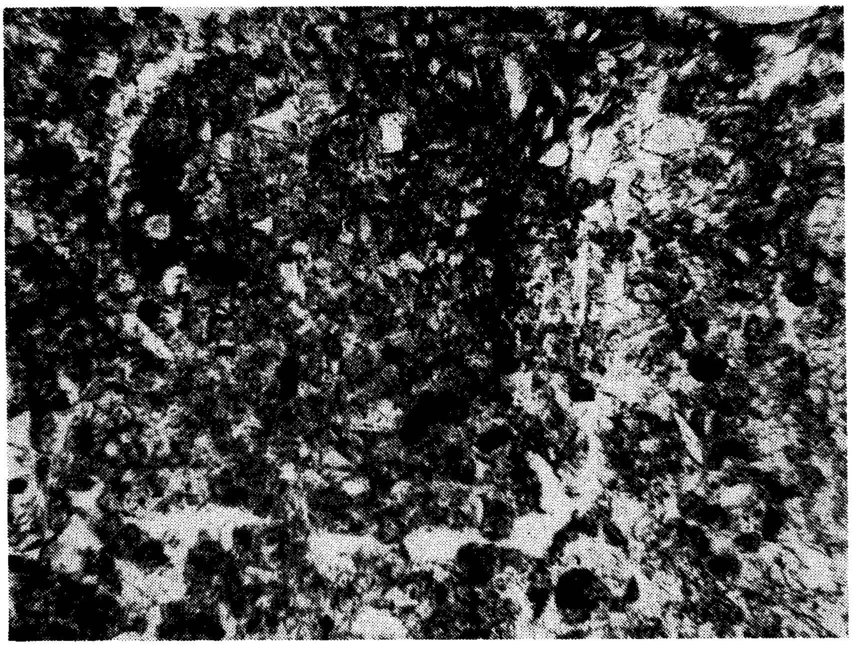

Fig. 30. Flocculated soil groundmass is concentrated in coprogenic earthworm element separated from surrounding, biogenically unaffected matrix by fine cracs. - Cultural bed, sample 4. x32.

Fig. 31. Weakly humous groundmass cut by wide cracks contains minute braunlehm nodules (middle). - Cultural bed, sample 4. x32.

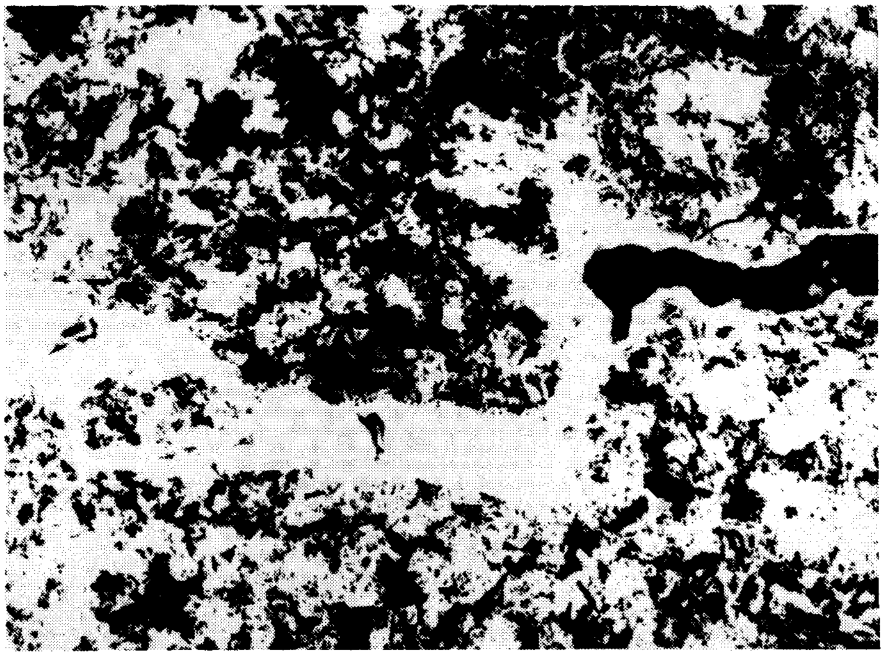

Fig. 32. Structural photogram (black: pores and mineral grains, white: fine soil substance showing redeposited material of humous soil containing a large number of pores. - Cultural bed, sample 4. x50.

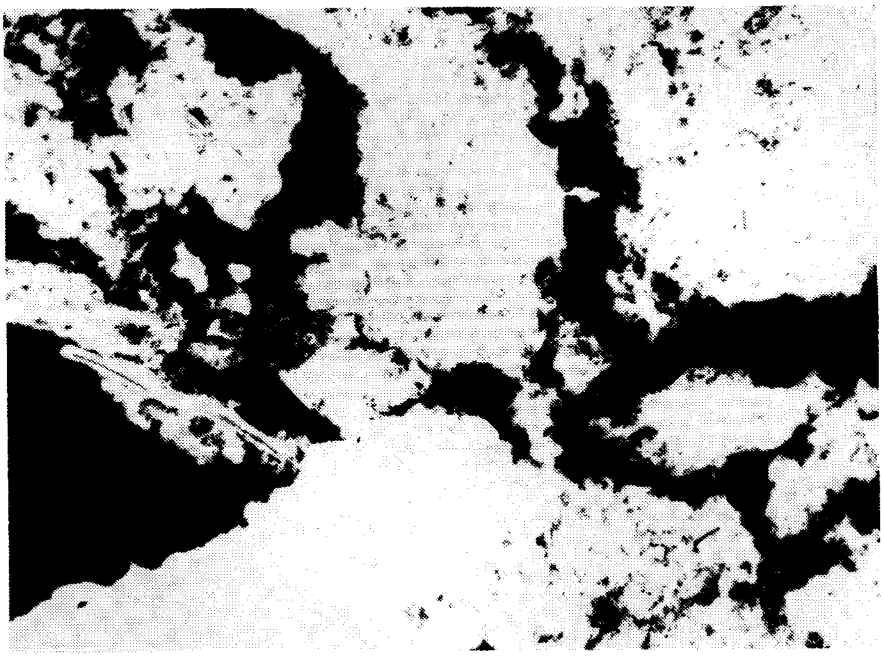

Fig. 33. Structural photogram showing soil substance consisting of braunlehm plasma containing a small number of pores. - Cultural bed, sample 4. x50.

in the matrix show completely preserved cellular structure, while those found frequently in strongly humous soil relics are decomposed and strongly damaged mechanically. - Small grains of opal phytoliths occur sporadically (cf. Smolíková 1988). - Pseudogleyfication effects are very slight, illustrated only by weakly developed and rare pseudogley nodules in the matrix. - Soil groundmass primarily consists of evenly distributed carbonate, as may be evidenced by an intimate compaction of primary components by amorphous calcite forms; coarser pores are filled with minute calcite spicules. Carbonate filling of supply channels suggests secondary calcification.

Sample 4: Weakly humous flocculated matrix tinted grey and brown. It incorporates numerous parts consisting of humous material (Fig. 31) and non-humous brown material containing a low amount of small- and medium-sized pores (Fig. 32). These two types of soil sediment are included in the matrix as clodded rounded forms and angular soil fragments. Some are composed of dark brown braunlehm plasma. - Traces of biogenic activities are left by rarely preserved coprogenic elements of earthworms (Lumbricidae - Fig. 30) and mites (Acari - Oribatei), calcareous tubes and burrows left by earthworms, etc; minute, angular and red excrements of mites are grouped in small burrows. Opal phytoliths occur sporadically, whereas charcoal fragments occur in large numbers, attain various sizes and show a various state of preservation; charcoal displays well developed cellular structure or even is completely disturbed. - Primary components are well sorted with predominant silt and are unweathered in appearance; quartz, plagioclase, orthoclase, biotite, muscovite, augite and amphibole are the main components, followed by glauconite and limestone fragments coarse in grain size corresponding to or larger than sand. - Matrix also contains small braunlehm nodules (Fig. 31), some of which are mechanically damaged. - Soil groundmass includes much carbonate; the fragments of carbonate (micro)skeleton mentioned above are accompanied by numerous epithelia of supply channels consisting of amorphous $CaCO_3$ forms; cement of primary components is also observed as finely crystalline (pelitomorphic) calcite. - Narrow red "manganolimonite" coatings on walls of some supply channels indicate slight pseudogleyfication.

Sample 5: Pale ochreous matrix is fully flocculated. Primary components of this sample are the same as those of sample 1 in both grain-size (dominant silt) and mineralogico-petrological composition; all components are perfectly unweathered and richly filled with calcite; calcite rhombohedrons occur in some wide open spaces. - Redeposited braunlehm nodules and rounded parts consisting of braunlehm plasma at places occur in this carbonate loess.

Sample 6: Pale ochreous flocculated matrix is finely but regularly cut by pseudogley nodules separated from the groundmass by slightly radial faces and showing coherent fabric (fig. 34). - Soil (micro)skeleton is much like that of samples 1 and 2 and also contains minute limestone fragments sporadi-

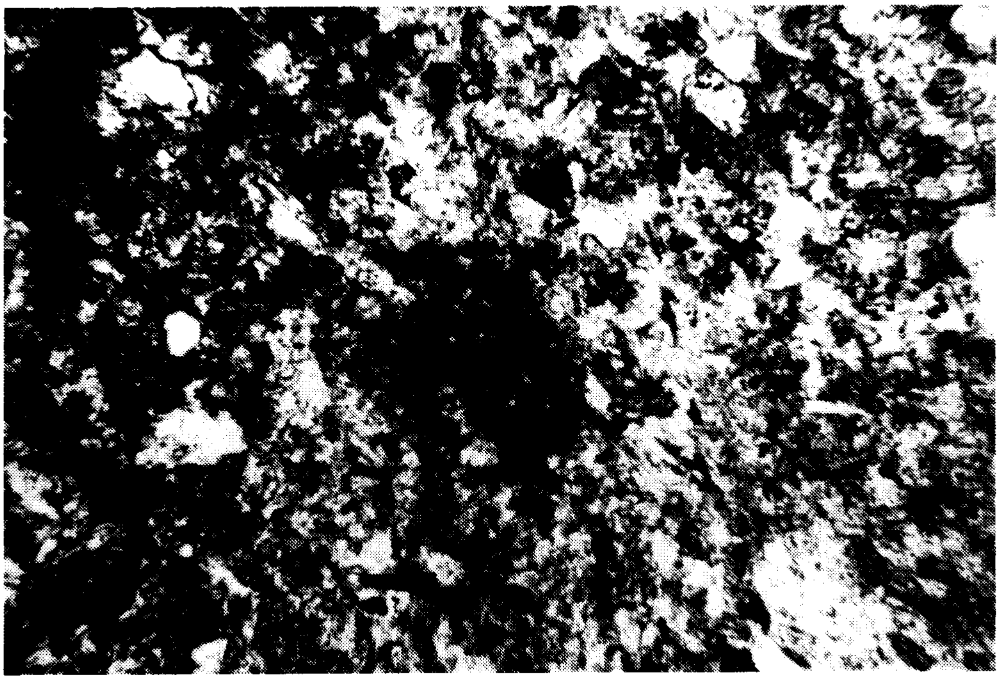

Fig. 34. Irregularly radial pseudogley nodule surrounded by slightly leached soil material. - Sample 6. x32.

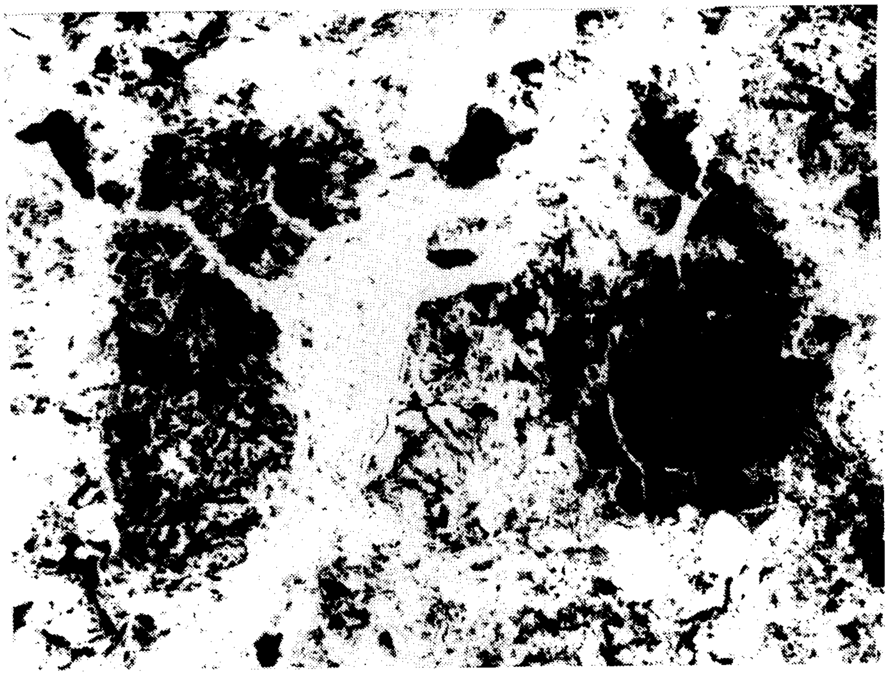

Fig. 35. Structural photogram exihibiting traces of weakly fossil biogenic activity. - Sample 6. x50.

cally accompanied by braunlehm nodules. - Groundmass shows signs of slight bedding and weak biogenic effects (i.e. calcareous tubes and earthworm burrows only, Fig. 35). These supply channels are at places rimmed or even filled with calcite rhombohedrons.

Sample 7: Irregularly greyish-brown, slightly humous flocculated matrix has less pores than observed in sample 3, as is reflected in its more compact but rather indistinct fabric (Figs. 36, 37); it cannot therefore be assigned to any of the four principal fabric forms as defined by D. Schroeder (1978). - Primary components of this sample are much like, if not identical with, those of samples 1 to 3 in mineralogico-petrological aspect, but are a little coarser-grained in size; evidence used in support of this observation is primarily the larger number of rounded, usually slightly corroded fragments of limestones. - Pseudogley nodules are sparsely but evenly distributed in the groundmass and are "explosive" in outline; soil material surrounding the nodules is slightly leached. - Biogenic effects are only documented by rare earthworm burrows and calcareous tubes with walls at places having fine rims consisting of "manganolimonite" coatings; generations of calcite rhombohedrons are also seen on the walls. This carbonate form and the worn limestone fragments described above are accompanied by the cement of soil (micro)skeleton represented by pelitomorphic calcite.

Genesis

The base of the section consists of redeposited loess (sample 1) mixed with small worn fragments of carbonate rocks and fossil soil sediments. A slight pseudogleyfication affected this horizon before it was covered by horizon 2, indicating a short-term, cool and humid oscillation. The humous soil substrate is represented by the overlying carbonate loess (sample 2) of a slightly slope wash nature.

The humous soil (sample 3) corresponds to weakly developed pararendzina. It developed over a short period of time, as is based on megascopic evidence of its small thickness; microscopically, it shows especially indistinct biogenic activities (i.e. sparse traces left by fossil edaphic activities, slight and uneven humification) and incoherent fabric still not differing remarkably from loess as a parent substrate. - The development of the soil was undoubtedly influenced by continuous deposition alternating with sediment transport. This is corroborated megascopically by its sharp boundary with underlying and, in particular, overlying strata; microscopic observations indicate soil bedding, e.g. wide cracks have not smooth walls and are not angular in outline, etc. so that they do not owe their origin to frost effects; moreover, numerous fragments of strongly humous soils are present; these fossil soil sediments were supplied at a high rate (e.g. their fragments were not worn during transport). Two kinds of soil material can therefore be distinguished: the autochthonous fossil soil corresponds to weakly developed pararendzina and the fossil soil sediments can be equated with redeposited material of chernosems (PK II or chernosem PK III). This observation is in

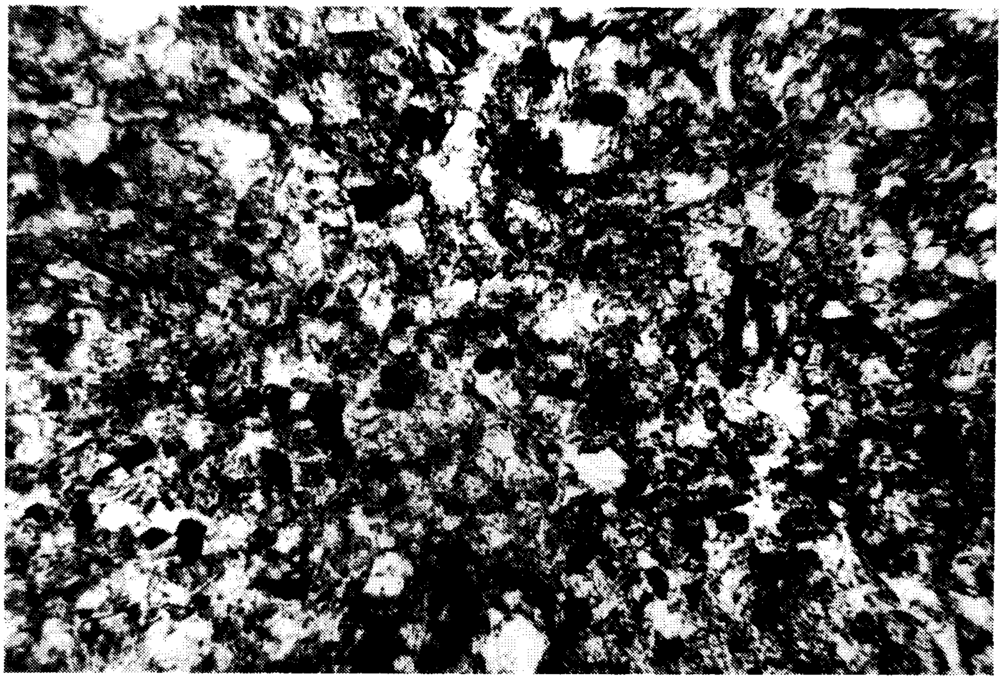

Fig. 36. Indistinct fabric of unevenly coloured and slightly humous flocculated groundmass. Sample 7. x32.

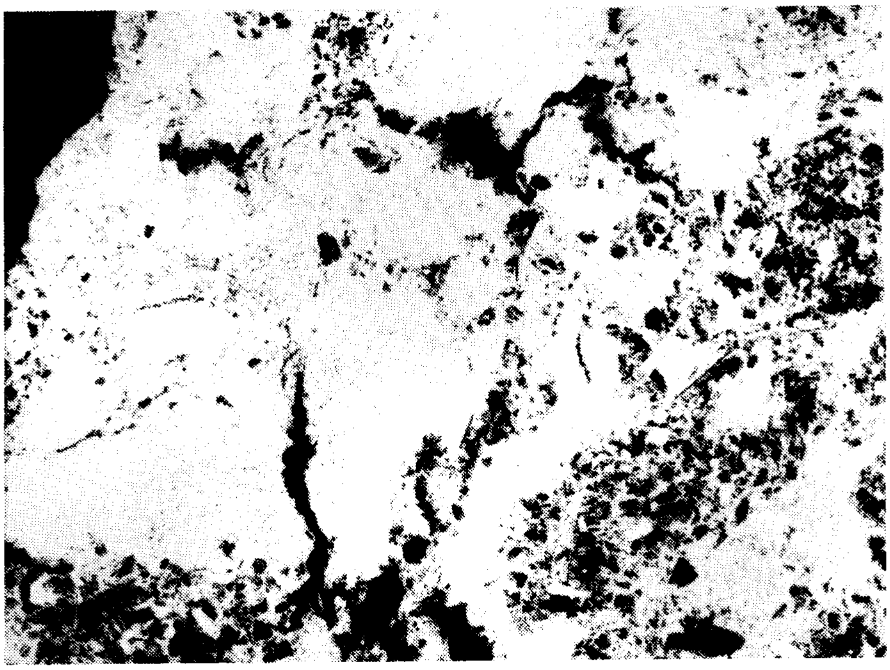

Fig. 37. Structural photogram of indistinct soil fabric. Sample 7. x50.

agreement with two generations of charcoal: charcoal relics in the pararendzina matrix show completely preserved cellular structures, while those occurring in redeposited material of earlier humous soils are strongly destroyed.

This weakly developed pararendzina was formed within a short time interval under cool and relatively dry climatic conditions accompanied by continuous deposition and sediment transport. The soil in question can be ranged (sensu W.L. Kubiena 1956) to the Arctic palaeopedological province including soils of initial development stage.

The soil was subsequently slightly pseudogleyed (wet climate) and ultimately recalcified (fully glacial climate).

The cultural layer (sample 4) is represented by a fossil soil sediment. It consists of humous and brown soils; the composition of the humous substance shows close relationships to humous soils Stillfried A (PK II, III) and the features of the brown material (braunlehm nodules, dark brown parts composed of braunlehm plasma, etc.) might be an equivalent of either the PK III basal soil or earlier pedocomplexes. These redeposited components were mixed in a rapid way since numerous soil fragments, similarly as the fragmentary limestone contained, are clearly angular. An increased activity of the edaphon and vegetation followed, as indicated by preserved coprogenic elements of soil meso- and macrofauna, earthworm burrows and calcareous tubes, opal phytoliths and a number of charcoal; in this case the opal phytoliths and charcoal must not be autochthonous. Turbulent conditions prevailing at the site are suggested, e.g., by mechanically damaged charcoal (in contrast to fragments showing well-preserved cellular structures and even broken braunlehm nodules). This mixture of secondarily renewed soil material was subject to slight pseudogleyfication and subsequently covered by loess.

Aeolian deposition was replaced by weak redeposition (limestone fragments, rounded particles consisting of braunlehm plasma, braunlehm nodules, bedding). This substrate produced a weakly developed pseudogley. Its main micromorphologic features are: pseudogley nodules sparsely but evenly distributed in soil matrix, narrow "manganolimonite" rims on supply channel walls, inconspicuous fabric and insignificant biogenic effects (cf. Kubiena 1956). Thisshort-term pseudogleyfication was interrupted by dry climatic effects resulting in recalcification; calcite rhombohedrons occur in broader open spaces. Next to it came another slightly renewed deposition producing, e.g., a higher number of coarser-grained components in the surface part (sample 4).

The sequence of above mentioned processes - weak pseugleyfication, recalcification and unweathered material supply - provides evidence of slight climatic oscillations (humidity, dryness, alternation of humic and dry climatic fluctuations). The whole development was terminated by the onset of a fully glacial climate to which the overlying loess accumulation can be attributed.

The weakly developed soil (samples 6, 7) overlying the cultural layer (sample 1) with intervening loess (sample 5) shows close affinities to the soil lying in a similar position at Milovice (sample 4, cf. Smolíková, n.d.). These two soils correspond typologically to pseudogley in its initial development stage.

Features shared by both soils are the inconspicuous fabric forms and slight biogenic/chemical weathering effects. They differ from each other in that at Milovice the soil substrate is formed of mixed fossil soil sediments with loess, while at Dolní Věstonice the parent rock is represented by loess with rare braunlehm nodules and material from earlier, strongly weathered soils. Consequently, the formation of the soil at Milovice was preceded by strong transport and sedimentation leading to the exposure, disturbance and redeposition of soils varying in both origin and age. On the contrary, at Dolní Věstonice the formation of soil sediments at that time was controlled by aeolian deposition. Another difference lies in that, although both types of the substrate display bedding, the pseudogleyfication at Milovice did not obliterate original bedding, while that known from Dolní Věstonice did it somewhat obscure (see sample 6). This of course is not to provide evidence that the pseudogleyfication at Dolní Věstonice was more distinct compared to Milovice but that this process operates more easily on loess than it does on various heterogeneous substrates.

The typological soil identity at both localities, if coupled with uniform stratigraphy, bears testimony to a phenomenon occurring on a regional rather than local scale. Present-day work is tentative and requires continuation at other localities.

The fact that the soil at Dolní Věstonice is a little more advanced than that at Milovice can also be exemplified by case of the soil exposed from beneath the loess underlying the cultural layer; the last-mentioned soil sampled from Milovice corresponds to weakly developed pseudogley, while that from Dolní Věstonice is a pseudogleyed, weakly developed pararendzina. This insignificant difference is also due to various substrates, namely loess at Dolní Věstonice and mixed soil sediments at Milovice.

The soil developed from the loess overlying the cultural layer is attributed to completely glacial immature soils and hence to W.L. Kubiena´s (1956) Arctic paleopedological province. Typologically, it corresponds to pseudogley at initial development stage.

References

Kubiena, W.L. 1956: Zur Mikromorphologie, Systematik und Entwicklung der rezenten und fossilen Lößböden. Eiszeitalter u. Gegenw., 7, 102-112.

Schroeder, D. 1978: Bodenkunde in Stichworten. F. Hirt-Verlag, Kiel.

Smolíková, L. 1988: Pedologie. Vols I, II. SPN, Praha.

- n.d.: Půdně - mikromorfologický výzkum na lokalitě Milovice (okr. Břeclav).

Faculty of Science
Charles University

Albertov 6
120 00 Praha 2