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Micromorphology of gyttja muck soil of Jawty Małe

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The studies of the morphology of the gyttja soils of the northern part of Poland were carried out after a preliminary investigation of their typology and morphological and chemical properties [4]. The aim of these studies was to find out the differences in micromorphology of the particular genetic horizons of morphologicaly well developed muck-gyttja soil as well as to gather farther information concerning the course of the mucky processes.

The studies were carried out on the gyttja deposits of Jawty Małe, which had emerged as the result of an artificial draining of the lake. As the result of amelioration of the deposits, there developed pronounced mucky processes in the shallower layers of the gyttja. This had led to the distinct degradation of the soil in these places. The surface of the studied area is characterized by the polygonal microrelief. The organic "wedges" occur between the particular small rises of the terrain. They reach down from a few to a dozen centimeters into the profile (Fig. 1).

For the further studies of the micromorphology of the gyttja-muck soil, the monolith (100×15×5 cm) was taken. The thin sections, of the air dry soil, were prepared according to the Kubiëna-Altemüller's method [1] [1, 3] in modification of Kowaliński and Bogda [2].

Soil profile

0-20 cm — AdM_1 — soddy-muck horizon, dark brown, slightly moist, with roots. There may be distinguished the upper part (0-8 cm) of crumby structure, strongly overgrown by the roots, and lower part (8-20 cm) with laminated structure formed from detritus gyttja;

20-35 cm — M_2Gt — mucky horizon, dark brown, slightly moist, with laminated structure, formed from detritus gyttja;

35-50 cm — M_3Gt — mucky horizon, dark brown, moist, with tabular structure (the thickness of the tabule 2-3 cm); detritus gyttja with the admixture of the sand.

[1] The method of the preparation of thin sections in fresh gyttja is now under elaboration.

50-60 cm — the layer of the sand with considerable admixture of detritus, grey, wet;

60-100 cm — detritus-mineral gyttja with predominance of the fine and medium sand, grey brown, wet.

In the middle of the profile there can be seen the mucky wedge. It is composed of fine earth with fine crumby structure and numerous laminae. The wedge reaches up to 48 cm deep.

Designation. Gyttja-muck soil formed of detritus on the detritus mineral gyttja. The pasture with predominance of *Festuca rubra.*

RESULTS

The investigated gyttja shows in whole of its profile a wavy laminated constitution and it contains also significant amounts of the mineral fractions (magnifications 100×200× and 600×). The layering of the gyttja is a result of sedimentary processes of the detritus. The fine fractions of the sand are quite numerous in some places. They originate from the surrounding drainage area nad were deposited in detritus gyttja during the erosion. The presence of the mineral soil plasma was found beside the sandy fraction there. It has settled otherwise than the sandy particles, alternately with the organic layers. In the gyttja the pollen, roots and the seeds were also found.

It was also found that AdM_1 horizon differs in the structure from the lower laying horizons M_2Gt and M_3Gt. It has looser composition of the packets of laminae. Similar but still looser composition (Figs. 1a, 1b, 2a, 2b, 2c, 3, 4a, 4b) may be observed in the soil mass of the wedges. The micro crumbles which occurred here have the character of the irregular tattered "packets" (or their fragments), chaotically distributed, revealing in this way a vigorous activity of the soil fauna and the roots in the upper soil horizon. It is worth-while noticing that there are the numerous brown, amorphous substances, which are the humified organic matter, and different organic structures.

Moreover it has been found, that the organic substance of the upper horizons shows, in non polarized light, more intense rusty-yellow colour than in the lower horizons.

Due to these still very superficial and incomplete descriptions of the micro-structure of the gyttja-muck soil, all the horizons of the investigated profile (together with the AdM_1 horizon) have developed from the detritus gyttja, which has an increasing admixture of the fine sand in the lower layers of the profile. The discussed observations prove also that in the upper horizons, and particularly in the AdM_1 horizon as well as in the substance of the wedge, well developed mucky processes occur. Their development has a great influence on the metamorphosis of the gyttja, changing its physical and chemical properties and first of all its structure

Fig. 1. The wedge between two small rises with humous substances.

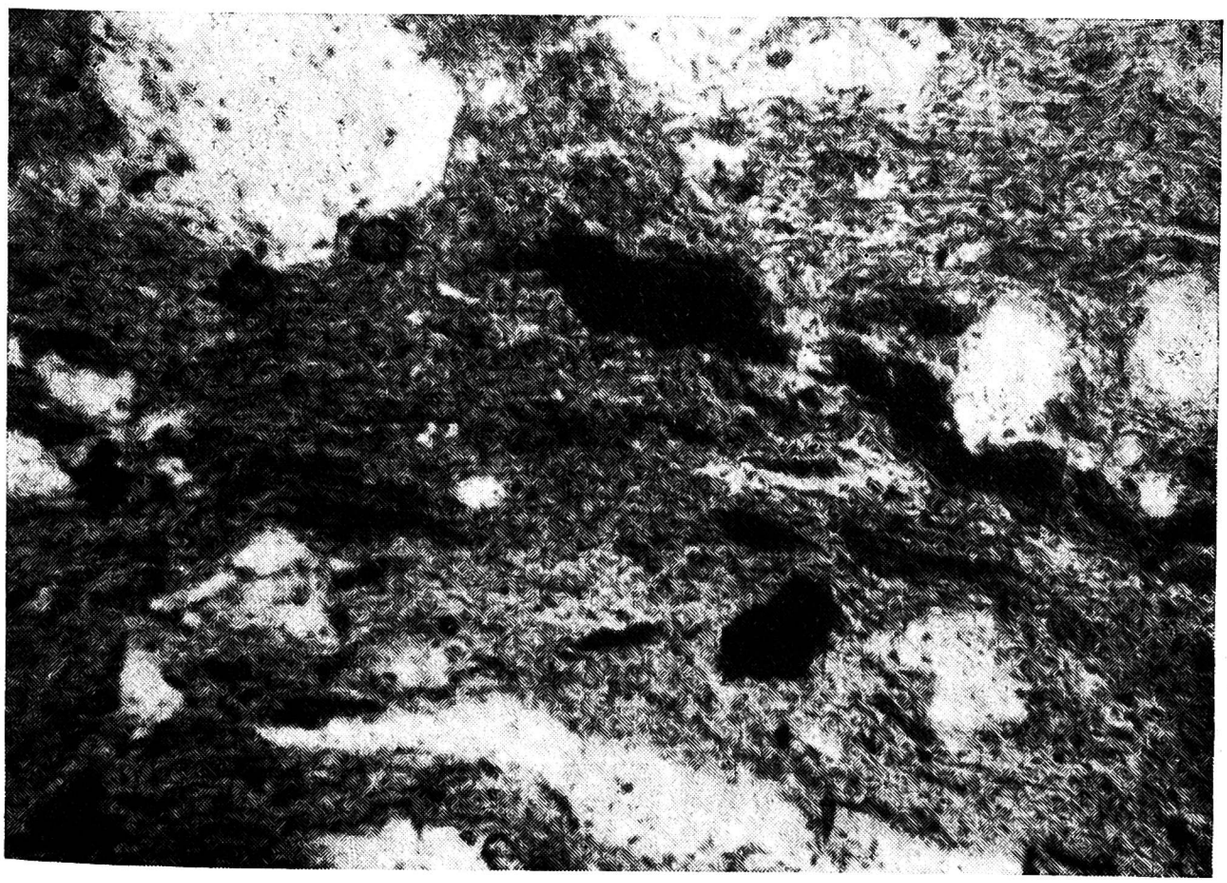

Fig. 1a. Ad M_1 horizon, magnif. ×100.

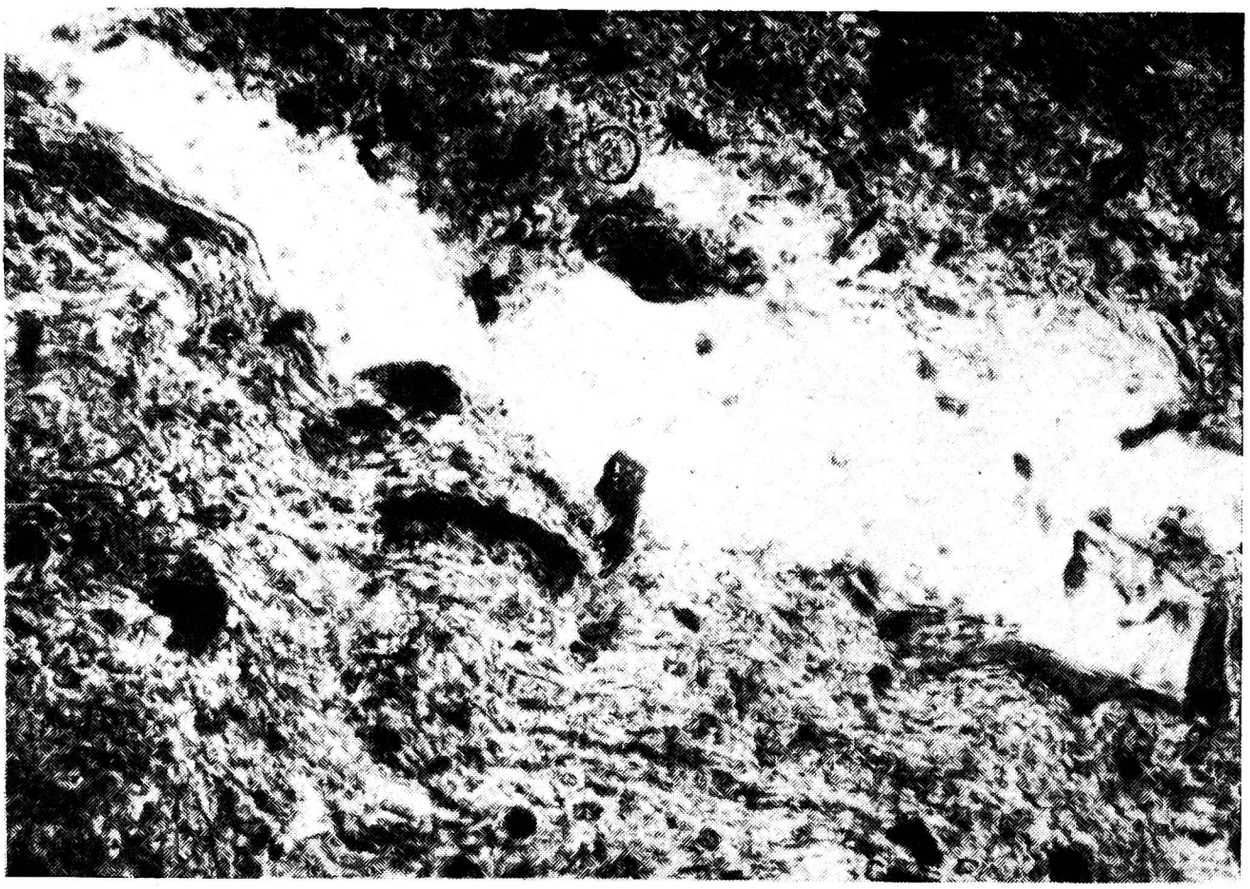

Fig. 1b. Ad M_1 horizon, magnif. ×600.

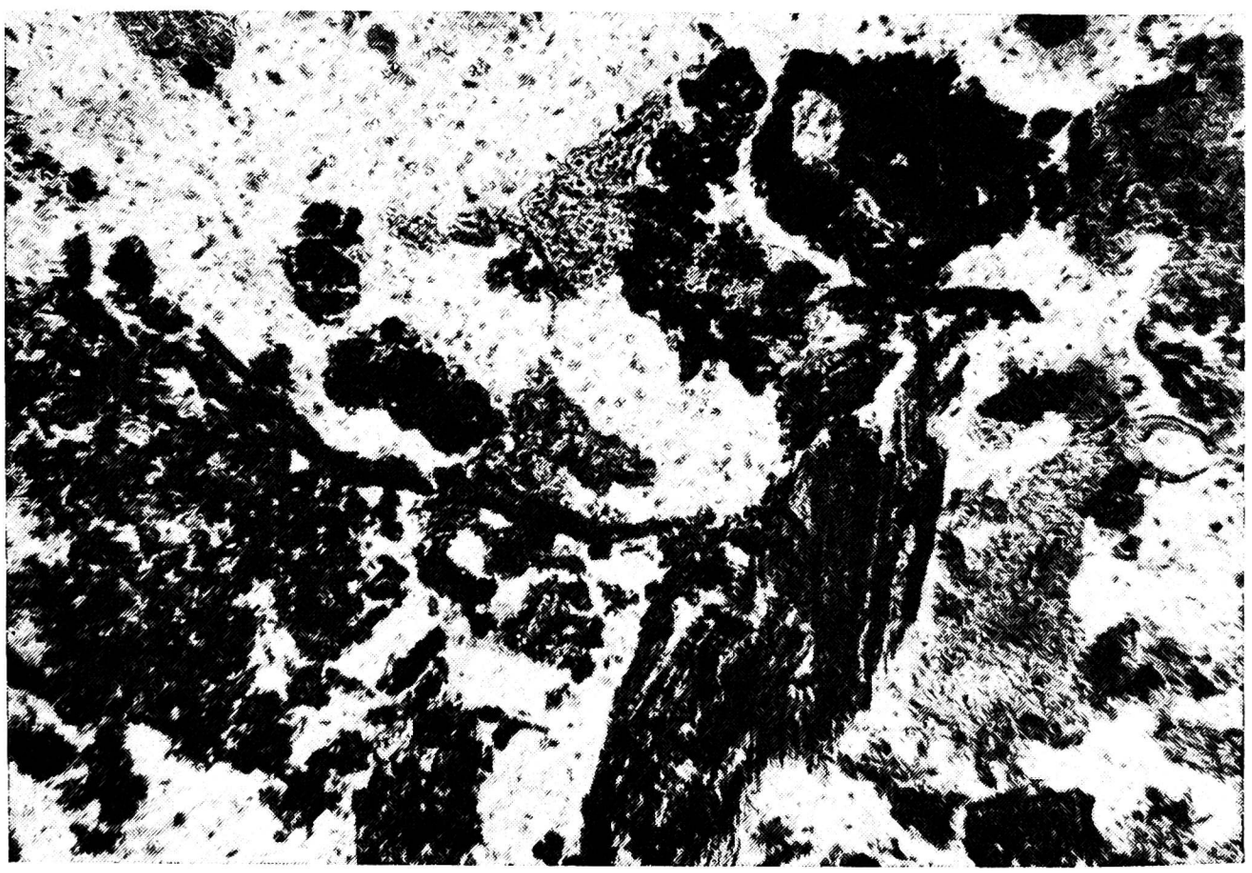

Fig. 2a. Substance of wedges; excrements of mezofauna are seen.

Fig. 2b. Substance of wedge, magnif. ×200.

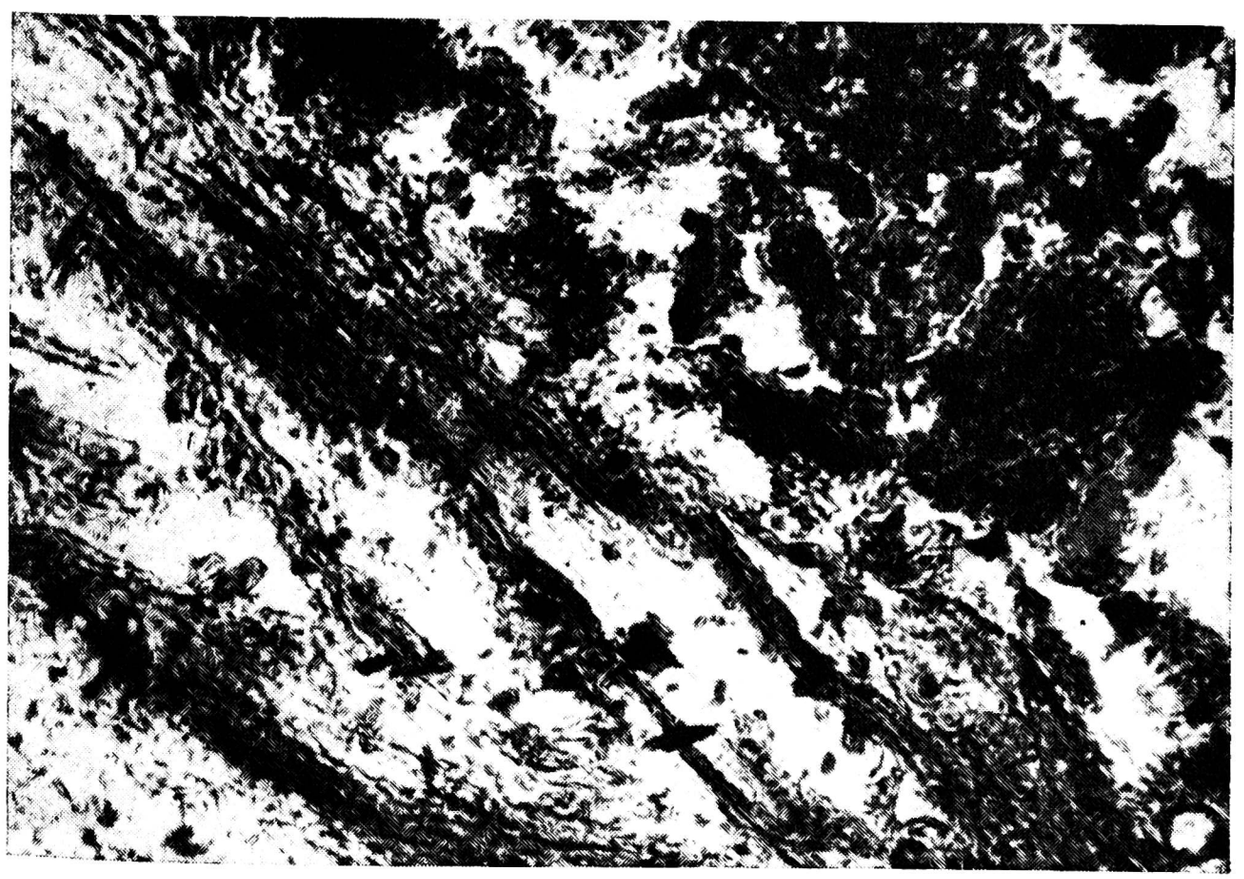

Fig. 2c. Substance of wedge, magnif. ×600.

and texture. Humification is a further feature of this process. Its intensity becomes weaker at the bottom of the profile. In the mucky processes the soil fauna has played an important role, crushing the "packets" of the gyttja and displacing them. Also the roots could play the same role since they were numerous in the sodmucky horizon-AdM_1. Particular attention should be given to the wedges which are filled with the gyttja-muck substance. The wedges occur between the micro rises of the ground. Their genesis is closely connected with the drying of the gyttja and the formation of the fissures. The fissures were then filled with the gyttja-muck substance from AdM_1 horizon.

The loose texture favored more intense action of the soil fauna and microorganisms and that farther led to the better humification of the gyttja. These observations were confirmed by earlier studies of the fractional composition of the humus from the analogical soil profiles, which were situated a few meters farther. So, for example it was stated, that the contents of humic acids were the highest in the AdM_1 horizon and in the wedges [4]. The optical density of humic acids show a decreasing tendency down the profile. In the lower horizons of the gyttja soil the signs of the mucky processes gradually disappear. Down the profile the "packets" become thicker and fissures between them are thinner and they finally disappear too. The layers of the gyttja of unidentified composition (even at 600× magnif.) are wavy and alternatively distributed with the thin laminae of the mineral soil plasma (Fig. 4b) which glare in the polarized light. This phenomenon may be interpreted by the period of sedimentation (in warmer periods organic particles were settled). Down the profile the content of the fine sand increases so clearly that the sediment may be classified as detritous-mineral gyttja. Below the depth of one meter the content of the sand decreases. The presence of such great amount of the sand may be explained by deflation, as a result of which the fine sandy particles were blown away from the small sandy island of old lake and were deposited on the bottom covered with the gyttja. Hereafter the island was probably overgrown by the plants and the deflation ceased. That is why the upper part of the soil profile contains hardly any sand.

As a result of an intensive drying of the gyttja, probably because of defective amelioration, the muck process was interrupted. Deep fissures and the formation of the laminated structure caused the disturbance of the air-water condition. The soil had been degraded and this caused its drying and development of the sod and plant cover.

To sum up, it may be stated, that the micromorphological studies of subaeral gyttja-muck soils completed the results of earlier investigations on the morphology and chemical and physical properties of these soils. They provide also some evidence about the course of (as yet not well explained) mucky processes in the detritous gyttja.

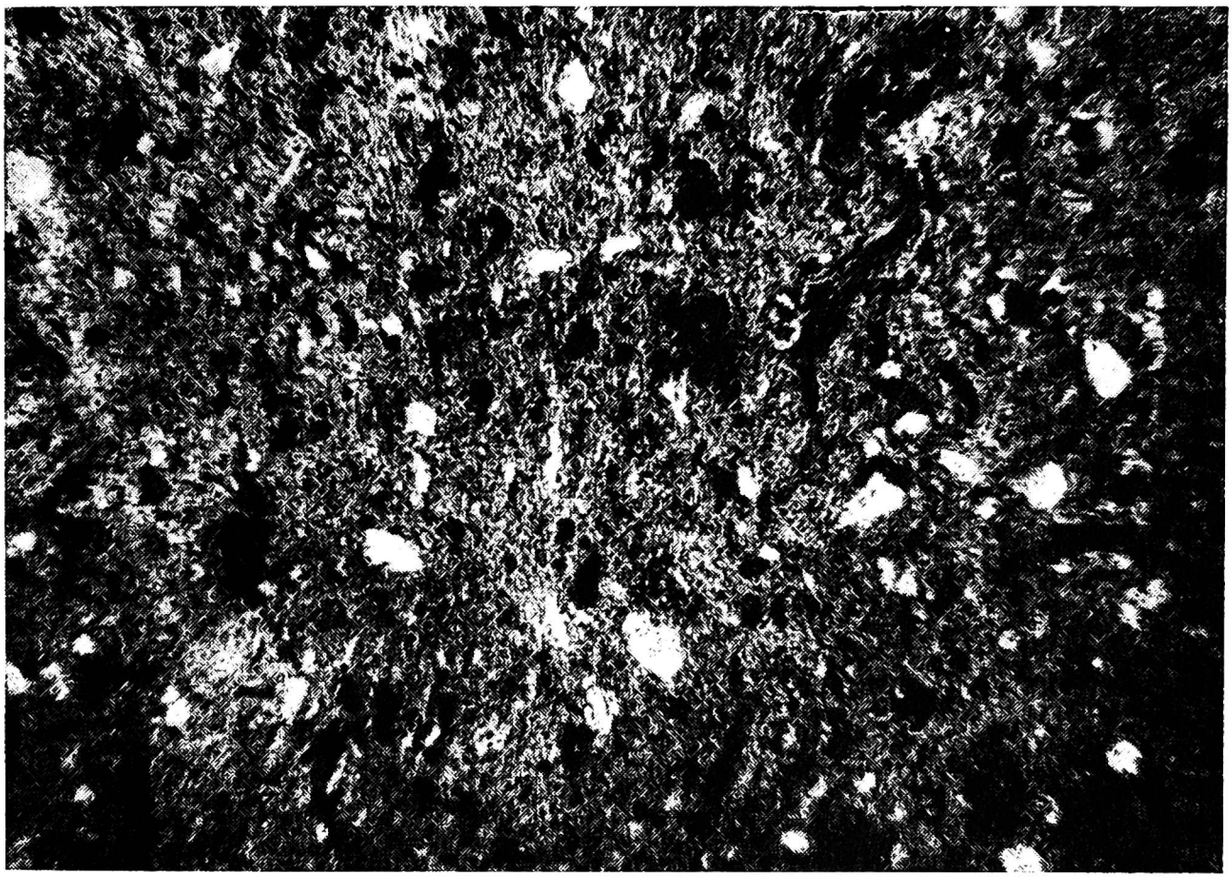

Fig. 3. M_2 horizon, magnif. ×100.

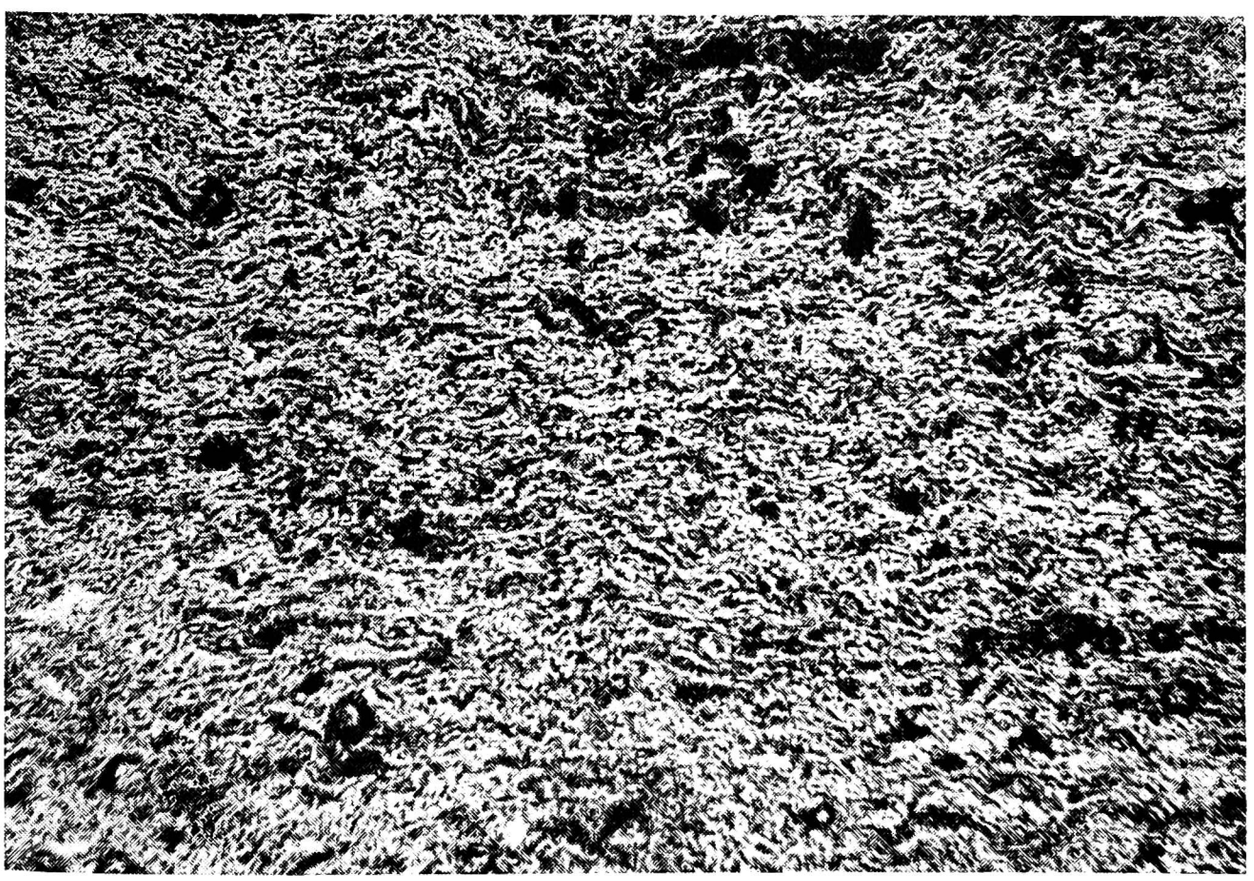

Fig. 4a. M_3 horizon, magnif. ×100.

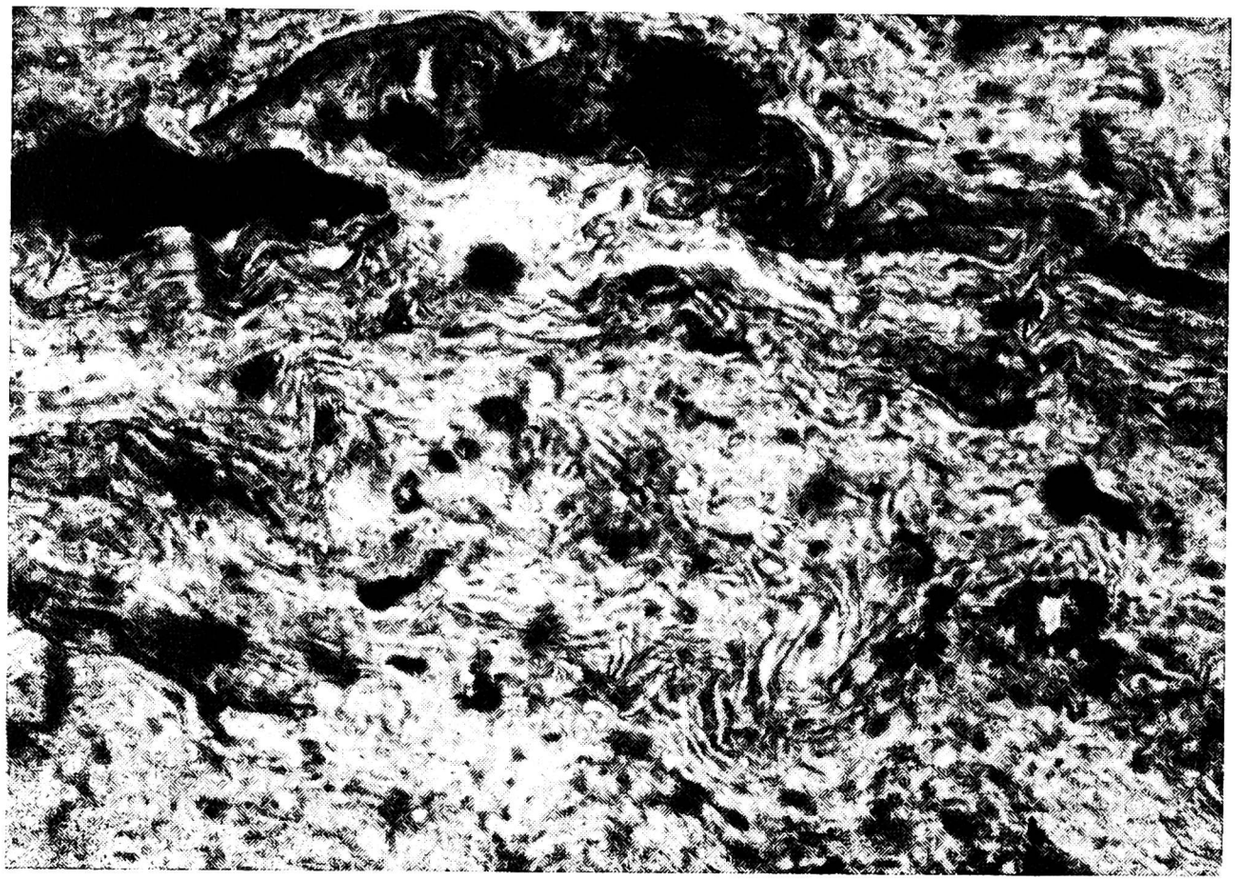

Fig. 4b. M_3 horizon, magnif. ×600.

SUMMARY

The micromorphology of muck soil developed from mineraldetritous gyttja has been studied. The profile of the studied soil has the following horizons: AM_1Gt — M_2Gt — M_3Gt — Gt. The surface of the examined area of gyttja sediments has a characteristic polygonal microrelief with the occurrence of wedges. It has been found that:

1. In whole of its mass the gyttja contains a remarkable amount of small mineral fractions.
2. Throughout the profile there can be seen a distinct layering of gyttja.
3. The mucky horizons M_2Gt and M_3Gt show numerous interstices going in the same direction as the layering.
4. In M_2Gt horizon, more fissures have been found than in M_3Gt horizon. The sod-gyttja horizon has a fine cloddy structure. In the particular aggregates, the lamination may be distinguished and the laminae have different directions.
5. The soil in the wedges has analogous structure and microstructure to that in AM_1Gt horizon.
6. The micromorphology of particular horizons seems to ascertain the fact that the mucky processes occurred not gradually, but because of too intensive drainage they were interrupted (sandy subsoil), and therefore the soil was strongly drained and degraded.

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