THIRD INTERNATIONAL WORKING-MEETING ON SOIL MICROMORPHOLOGY
WROCŁAW, 1969

ZESZYTY PROBLEMOWE POSTĘPÓW NAUK ROLNICZYCH 1972 z. 123

Micromorphological investigation of visible pores of soils from the surroundings of Drahnetice near Tábor

J. PALÁN

University of Agriculture, Prague, Czechoslovakia

INTRODUCTION

The soils of the hilly and mountain-foreland regions of Southern Bohemia have so far been investigated to the least extent. The question of their genesis and soil fertility was in recent years studied by Němeček [5]. In the present paper, I am concerned with the study of visible pores of the illimerized, weakly gleyed soil of clayey-loamy character, on pleistocenic high soil-forming substrates which develop under the influence of the variable intensity of cultivation.

METHOD

The height above sea-level of the described soils amounts to 480-510 m, the average of the yearly precipitations is 660 mm, the average yearly temperature amounts to 7.3°C. The geological base is formed by pleistocenic diluvial heavier sediments of 5-8 m in thickness. The vegetable cover on the 1st locality with arable land consists of cultivated plants, while the 2nd locality with afforested soil is covered by monocultures of pines. It is the aim of the present work to show how the vegetable cover and human activity influence the changes of the soil and the frequency of the occurrence of the cross-section width of visible pores. Soil probes on these two localities were therefore selected so as to attain on equal soil types the smallest possible spacing (about 30 m). The micromorphological investigation of large soil sections, of 4×6 cm, prepared from intact soil samples of 8×6×5 cm, was carried out according to the methods published by Beckmann [2], Geÿger [3], Kubiëna *et al.* [4], and in cooperation with the mentioned authors in the Bundesforschungsanstalt für Holz und Forstwirtschaft, Abt. Bodenkunde, Reinbek bei Hamburg.

The soil samples in the grown state were taken from the horizons of two soil types.

Soil type I: Illimerized soil, weakly gleyed, of loamy-clayey character, on pleistocenic diluvial substrates, cultivated, vegetable cover-wheat:

Denomination according to A. N. Sokolovský	V. Kosil	Depth in cm	Sample No.
hor.	A	2-10	1
E(g)	A_2	25-35	2
eg	A_2G	40-50	3
I_1g	B	60-70	4
I_2g	B	100-110	5
(i)P	B/C	195-200	6

Soil type II: Illimerized soil, weakly gleyed, of loamy-clayey character, on pleistocenic diluvial substrates, not cultivated, vegetable cover — monoculture of pines:

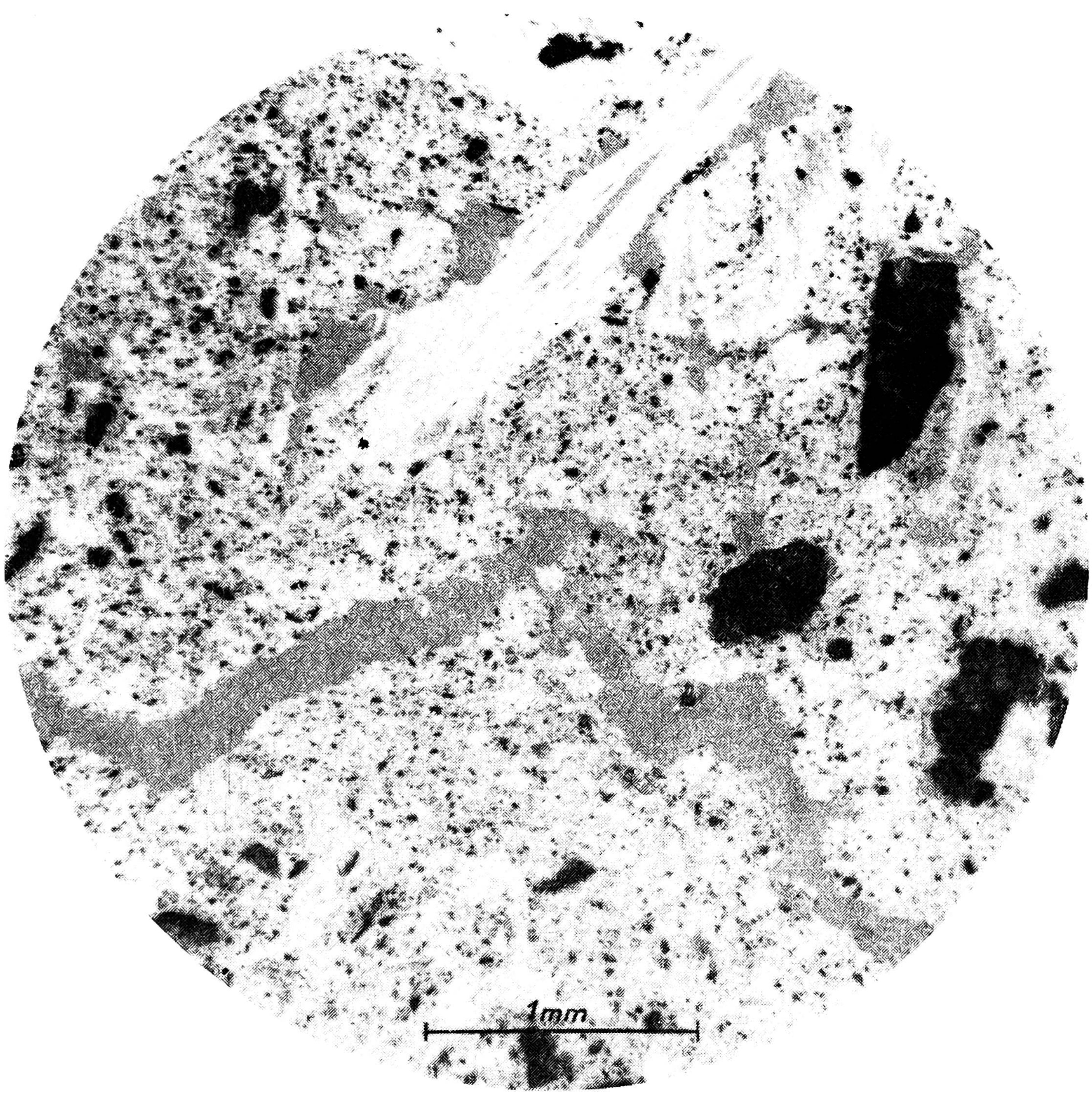

Fig. 1.

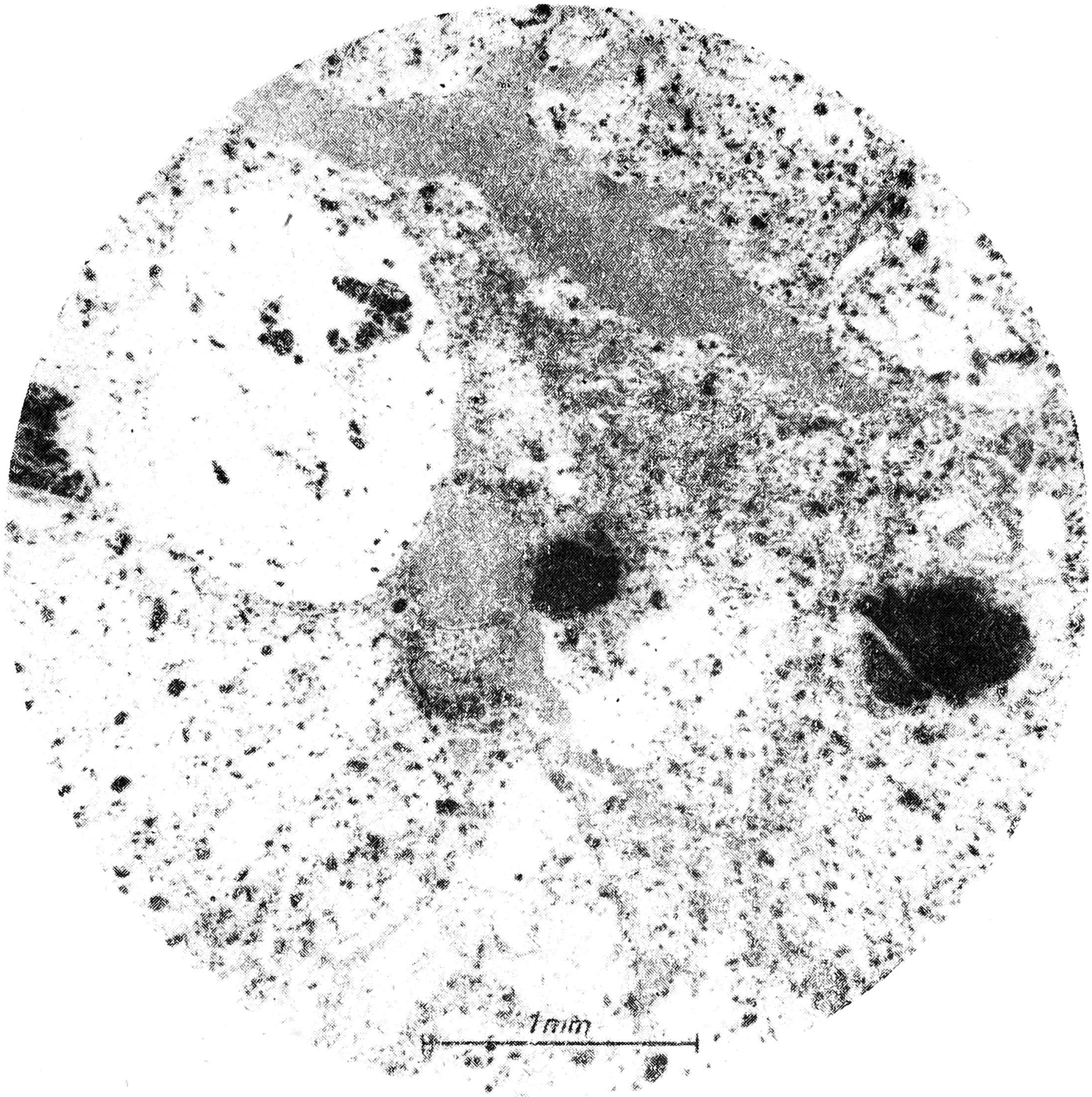

Fig. 2.

Denomination according to A. N. Sokolovský	V. Kosil	Depth in cm	Sample No.
Ho	A_0	2-5	7
E(g)	A_2	10-15	8
I_1g	B	30-45	9
I_2g	B	55-60	10
P	C	120-125	11

The preparation of the samples, their hardening and their sections were carried out according to the method of Altemüller [1]. For the quantitative investigation of large sections, we made a series of structural photograms by means of a Leitz table projector equipped with a holder for inserting photographic paper. This paper presented a structural image projected from the prepared section on the ground-glass screen of the table projector in such a way that the part of the soil phase not transmitting light appears white, cavities grey and minerals black. The evaluation of the structural photograms was performed by means of a grain-size analyser, which classifies the different widths of pore cross-sections into 48 groups. The measured values were entered into a table in which the cross-section widths of the pores are divided into groups according to Odén [6].

Classification of pores according to Odén [6] in μm:

non-capillary pores	semi-capillary pores	capilary pores
2,000-1,000	200-100	20-10
1,000-500	100-50	10-5
500-200	50-20	5-2

Evaluation of the results of the analyses of structural photograms. The measured values indicate the so-called frequency of the pore dia-

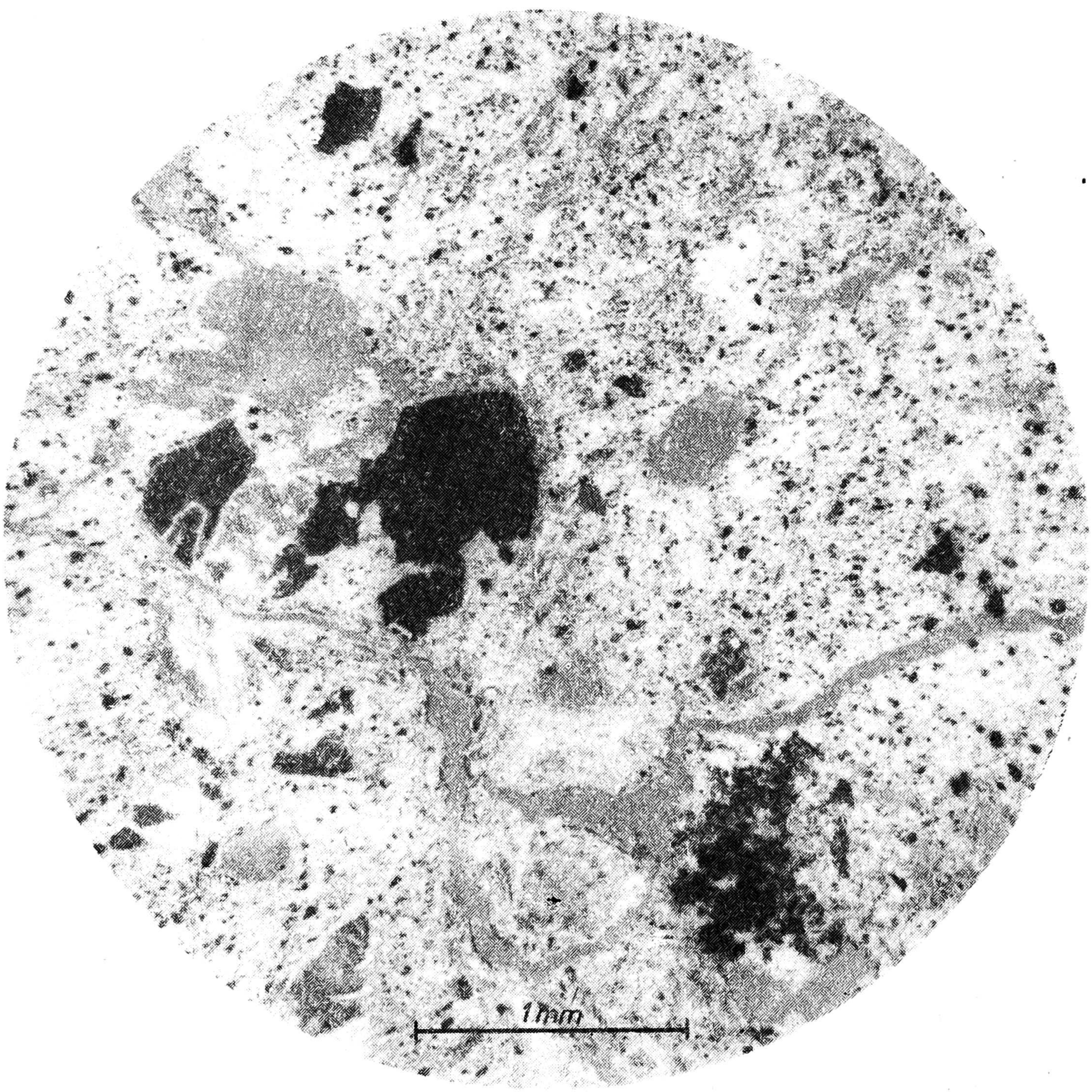

Fig. 3.

meters, which means the amounts of the most frequently occurring pore cross-sections. We ascertained the following quantities:

(1) frequency of occurrence of cross-section widths of visible pores in percent,

(2) the area of the cross-section widths of visible pores in percent.

We found that in the sample No. 1, representing the earth from the

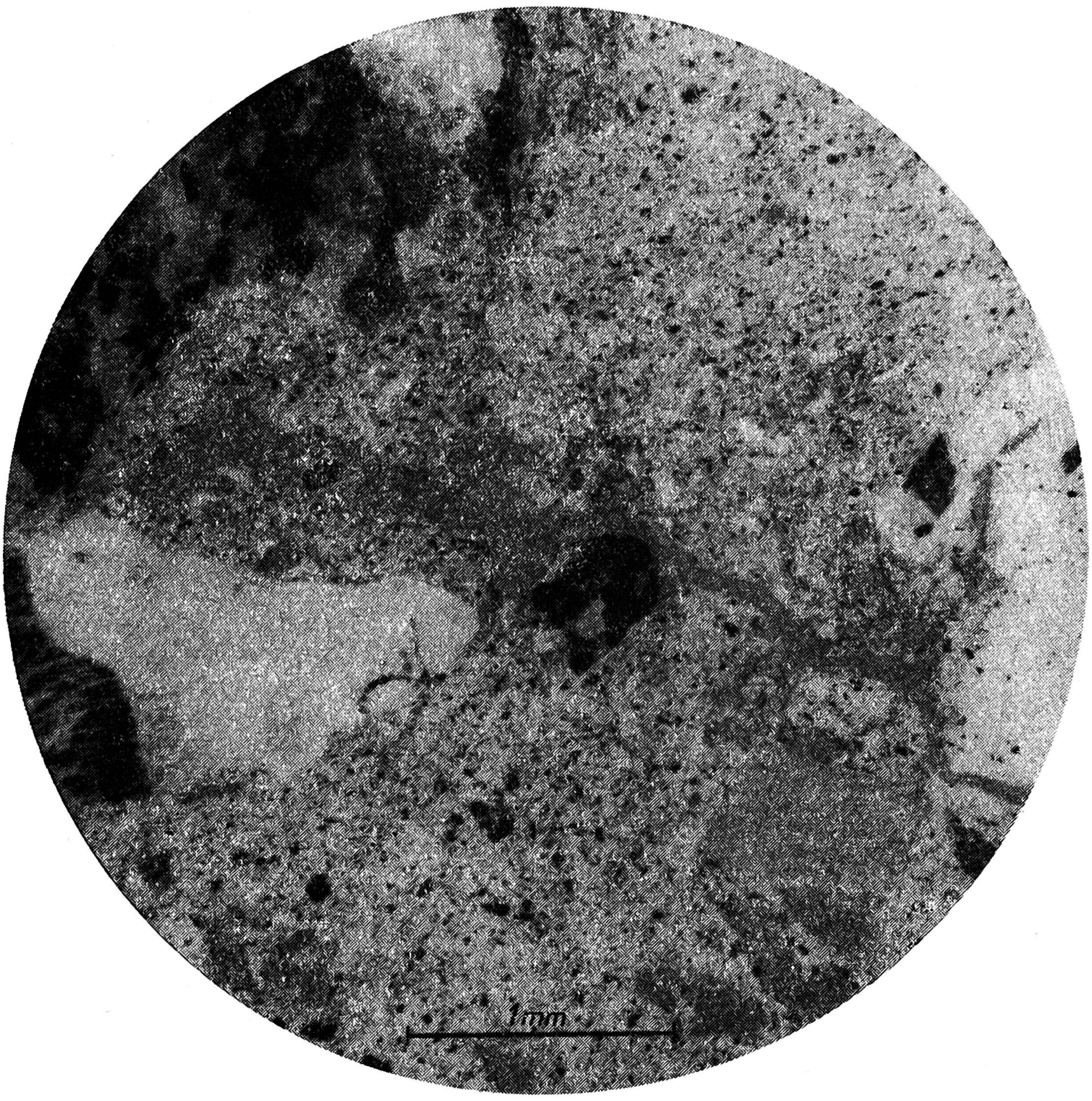

Fig. 4.

horizon of 2-10 cm in depth, 0.2% of all measured values of the frequency of the occurrence of cross-section widths of visible pores corresponded to 20-50 μm, 2.2% to 50-100 μm, 5.6% to 100-200 μm, 8.2% to 200-500 μm, and 0.9% to 500-1,000 μm. A comparison of the established values of the frequency of occurrence of cross-sections of visible pores of the soil type on the arable land with the soil type on the afforested area shows that the soil type on the arable land exhibits larger areas of the width of the cross-sections of visible pores than it is the case on the afforested soil, and this holds for all horizons except H_0. This fact is the consequence of the favourable vegetation of cultivated plants, which are deep-rooted and create a higher percentage of porosity. Moreover, the favourable composition of the humus leads to a higher percentage of the frequency of occurrence of cross-section widths of visible pores.

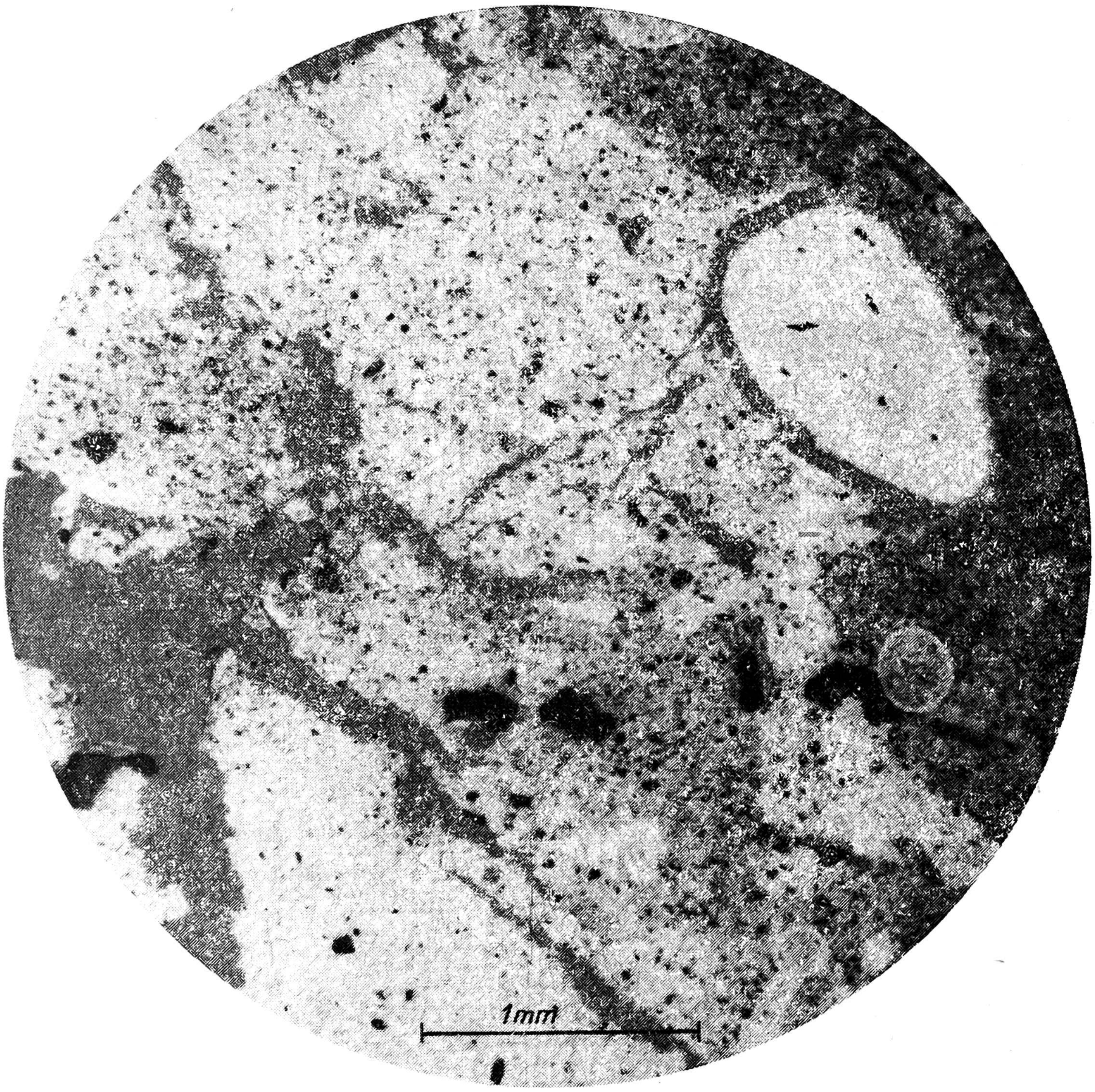

Fig. 5.

The humus-type horizon, characterized by sample No. 7, exhibits a higher percentage of the area of the diameter widths of visible pores and this phenomenon predominates in the humus-containing horizons of both types over the percentage of the frequency of non-capillary pores of a cross-section width of 200-500 μm. The frequency of the occurrence of the cross-section width of the pores is highest in the category of 50-100 μm in the E(g) horizon of the cultivated soil, amounting to 47.8% and in the E(g) horizon of the afforested soil, amounting to 58%.

A comparison of the frequency of occurrence of the diameter widths of visible pores of the category of 20-50 μm reveals a higher percentage

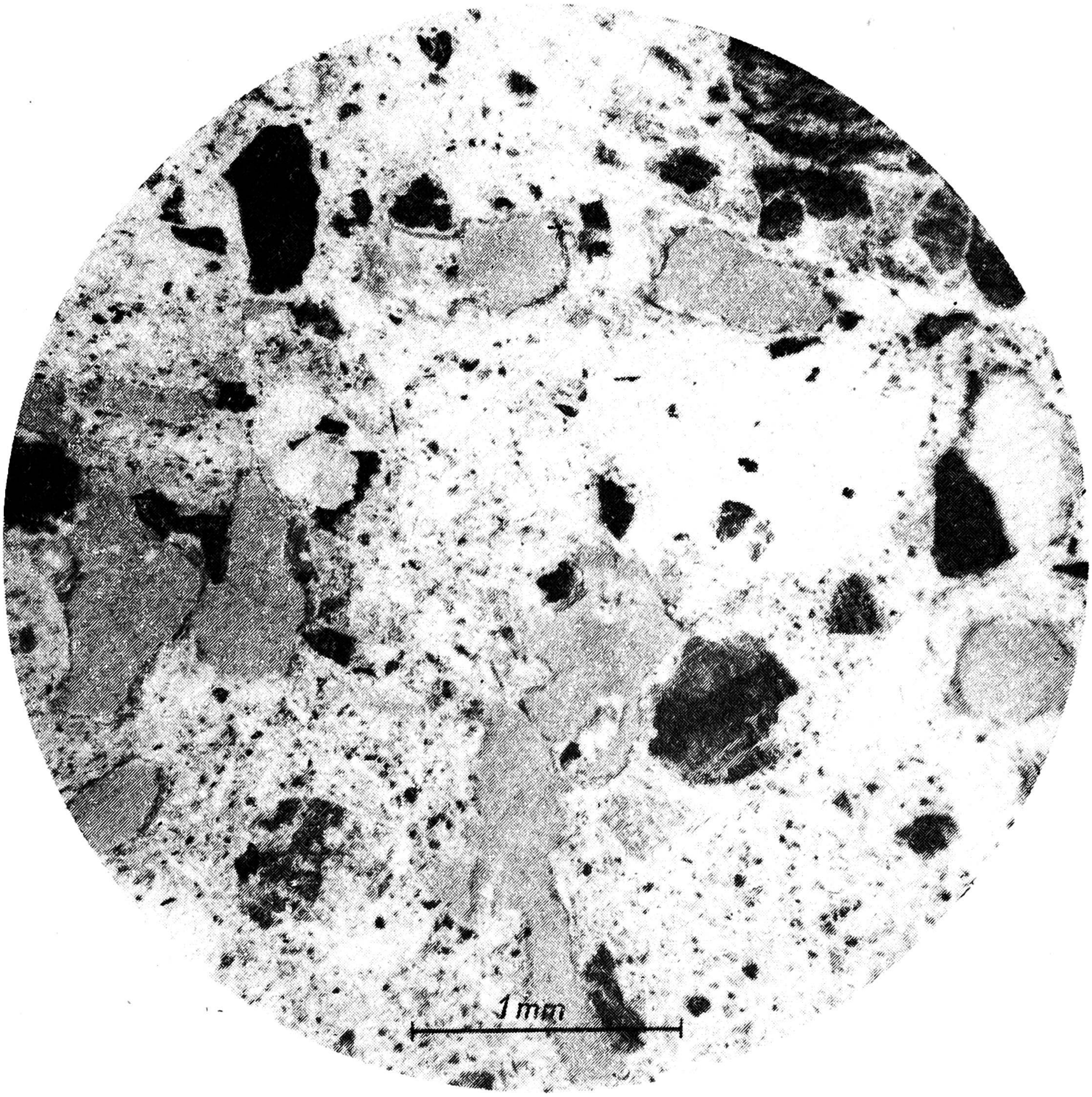

Fig. 6.

of the frequency of the width of visible pores of this cross-section in the cultivated soil type. A relatively high percentage of the frequency of occurrence of the cross-sections of visible pores of the category of 50-100 μm is encountered in the I_1g und I_2g horizons of both types, while the frequency of the occurrence of cross-sections of visible pores of the category of 50-1,000 μm is lower in these horizons. We prepared 30 structural photograms from each section. For illustration we present only one photogram from each horizon.

The structural photograms No. 1-6 represent the micromorphology of aggregates of the soil type on the cultivated area, while the structural photograms No. 7-11 show the micromorphology of aggregates of the soil type on the afforested area at an amplification of 50×. These photograms were made from the respective samples.

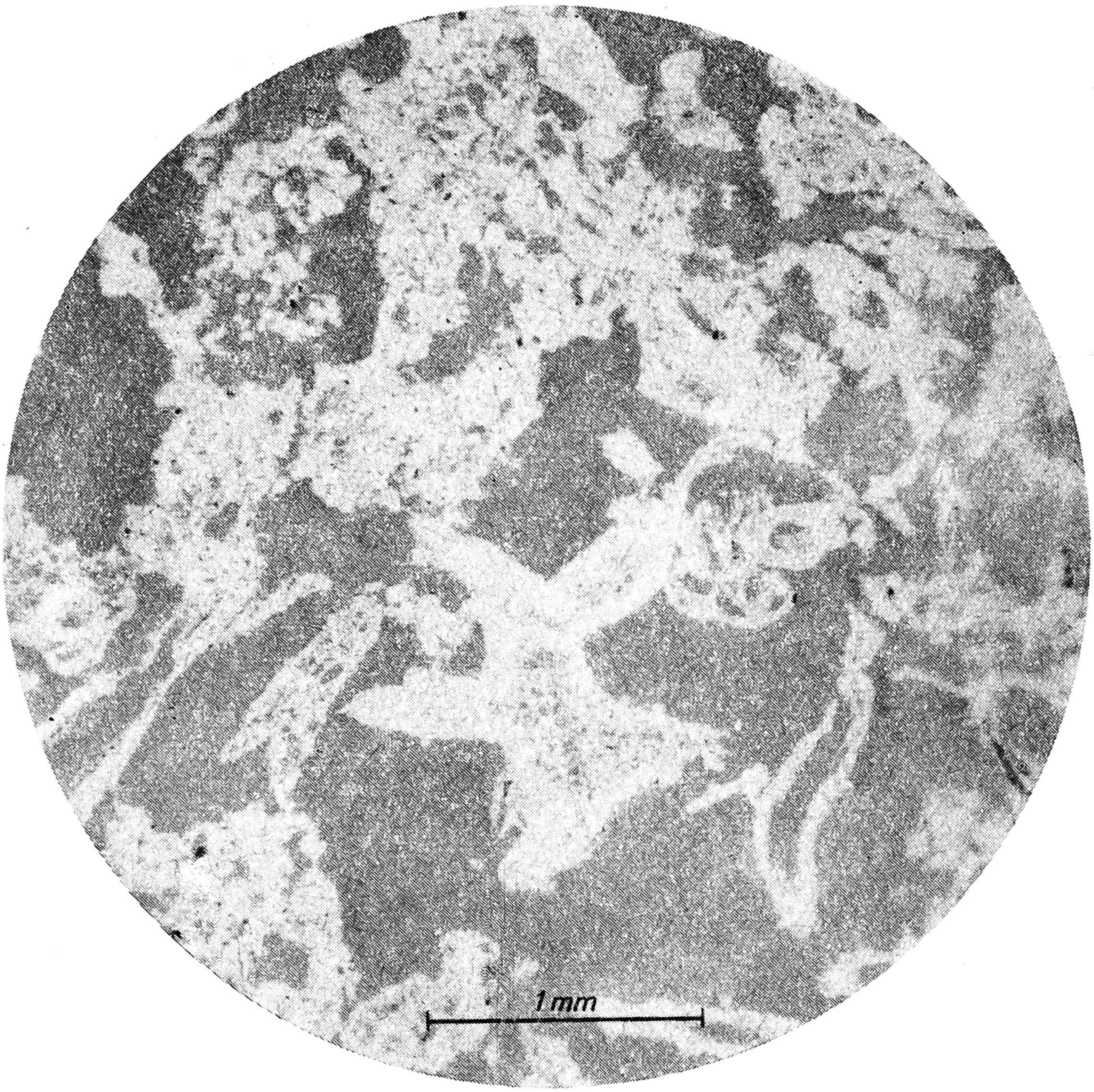

Fig. 7.

Structural photogram No. 1. Cross-sections of aggregates of rounded shape, filled up with semi-capillary and non-capillary pores in the lower half of the photogram. In the centre of the upper third there is the cross-section of an intact organic substance, with cross-sections of capillary pores.

Structural photogram No. 2. Cross-sections of aggregates of circular shape are ashy brown, the walls of the cross-sections of the pores, especially in the centre and in the lower third, are darker, of yellowish brown colour, in the polarization microscope with crossed Nicol prisms, colloid coatings were observed.

Structural photogram No. 3. The cross-sections of the aggregates are compact, of dark brown colour, with predominating semi-capillary pores.

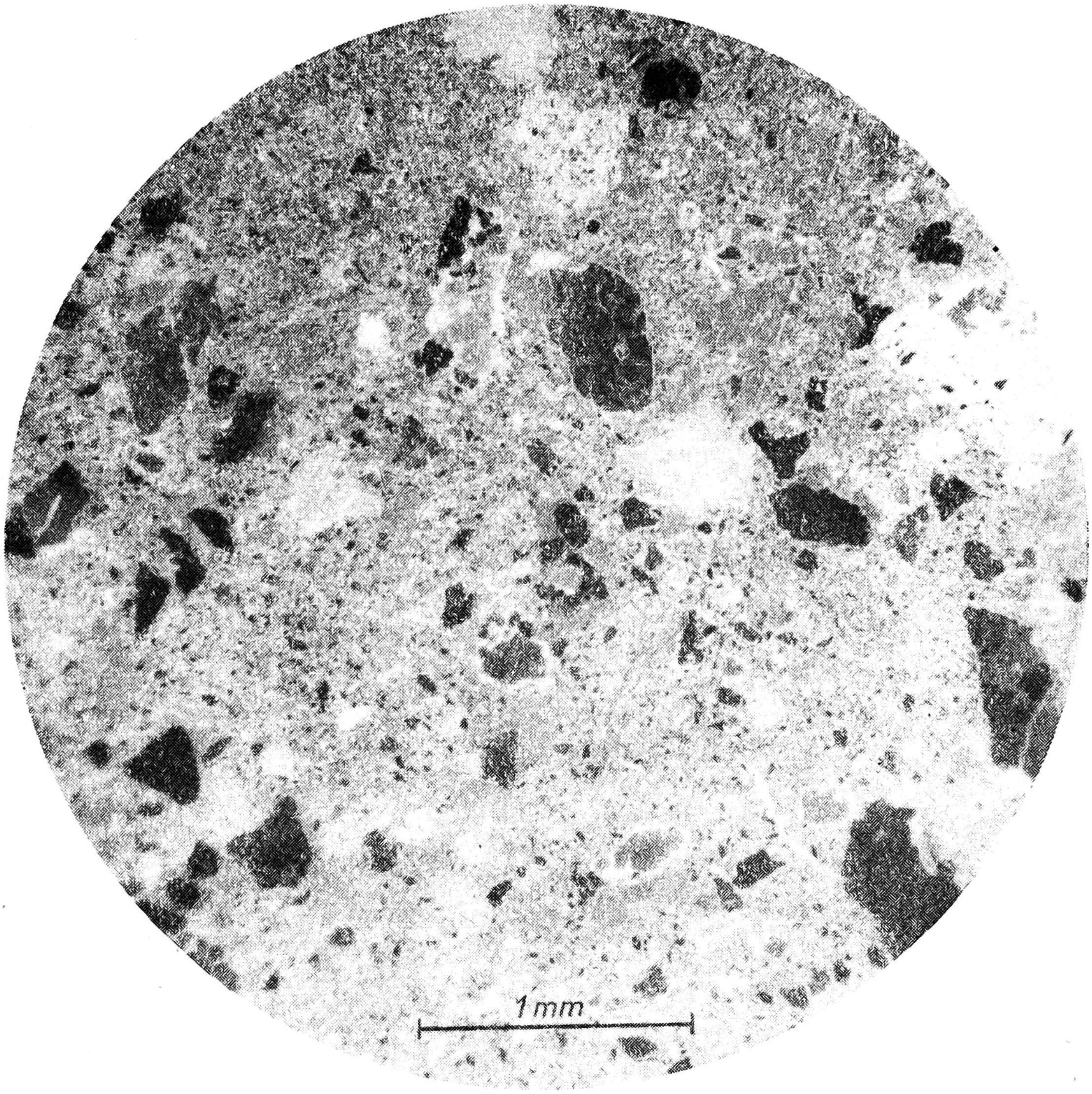

Fig. 8.

The walls of the cross-sections of the pores are darker in consequence of moderate illimerization.

Structural photogram No. 4. It represents the cross-section of a compact aggregate, divided in the centre of the photogram by the cross-section of pores, the walls of this cross-section are likewise darker, covered with yellowish brown coatings of colloids (when observed through the polarization microscope with crossed Nicol prisms).

Structural photogram No. 5 presents the cross-section of a compacted aggregate, which contains more microskeletons. The frequency of occurrence of the width of the cross-sections of visible pores amounts to 41.1%. Observation through the polarization microscope with crossed Nicol prisms revealed illimerization.

Structural photogram No. 6 illustrates the cross-section of part of the soil-forming substrate with microskeleton and pores on whose walls illimerization is visible.

Structural photogram No. 7. In comparison with the cross-sections

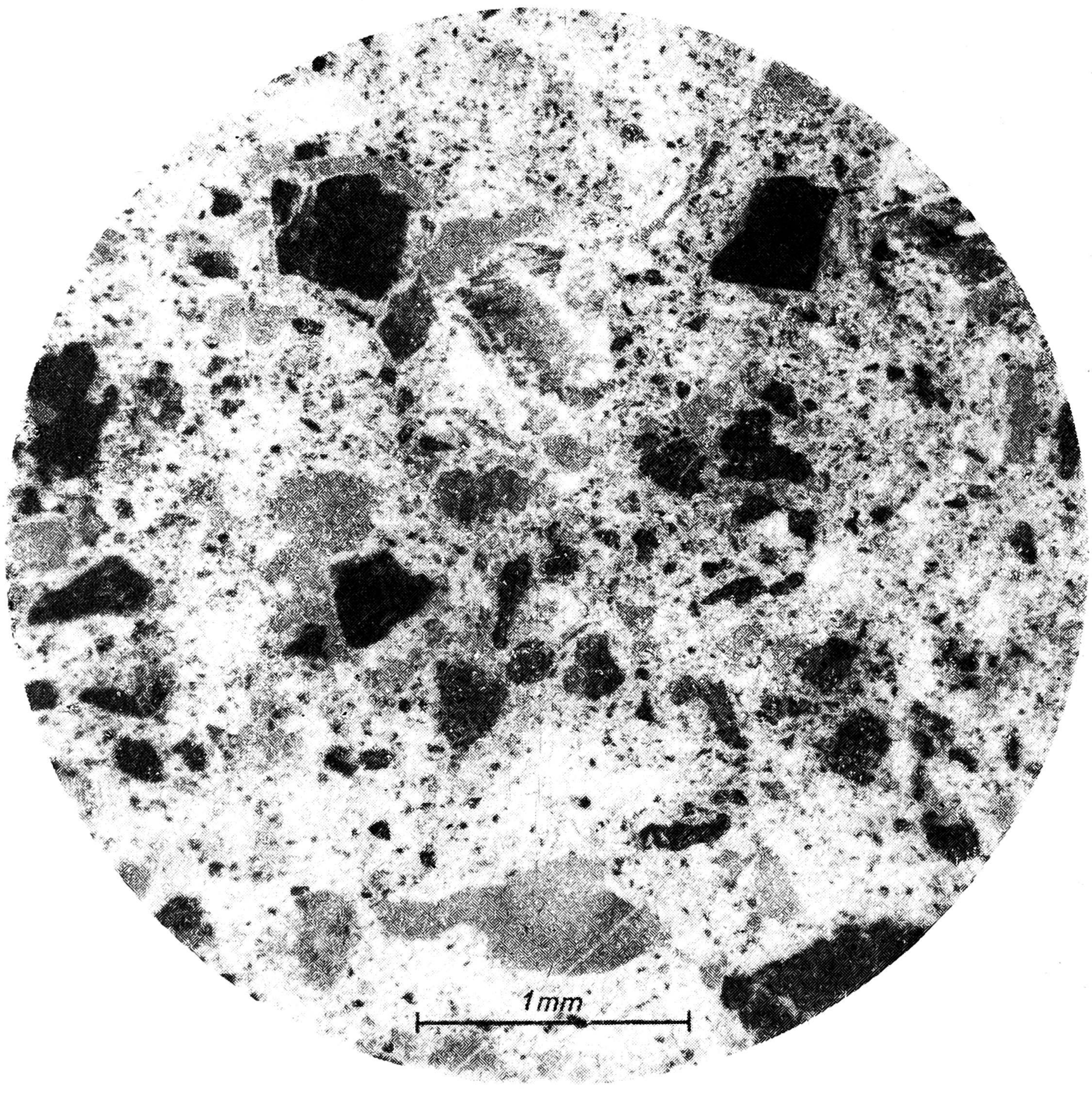

Fig. 9.

of the aggregates from the soil type I of the horizon, the cross-sections of the aggregates are distinctly developed. They consist of a large amount of so far not disintegrated organic substances. The walls of the cross-sections of the pores are predominantly formed by organic substance in various degrees of decomposition. The area of the cross-sections of the visible pores predominate over the solid substance.

Structural photogram No. 8. The aggregates are disintegrated, with a larger amount of the microskeleton in comparison with the photogram

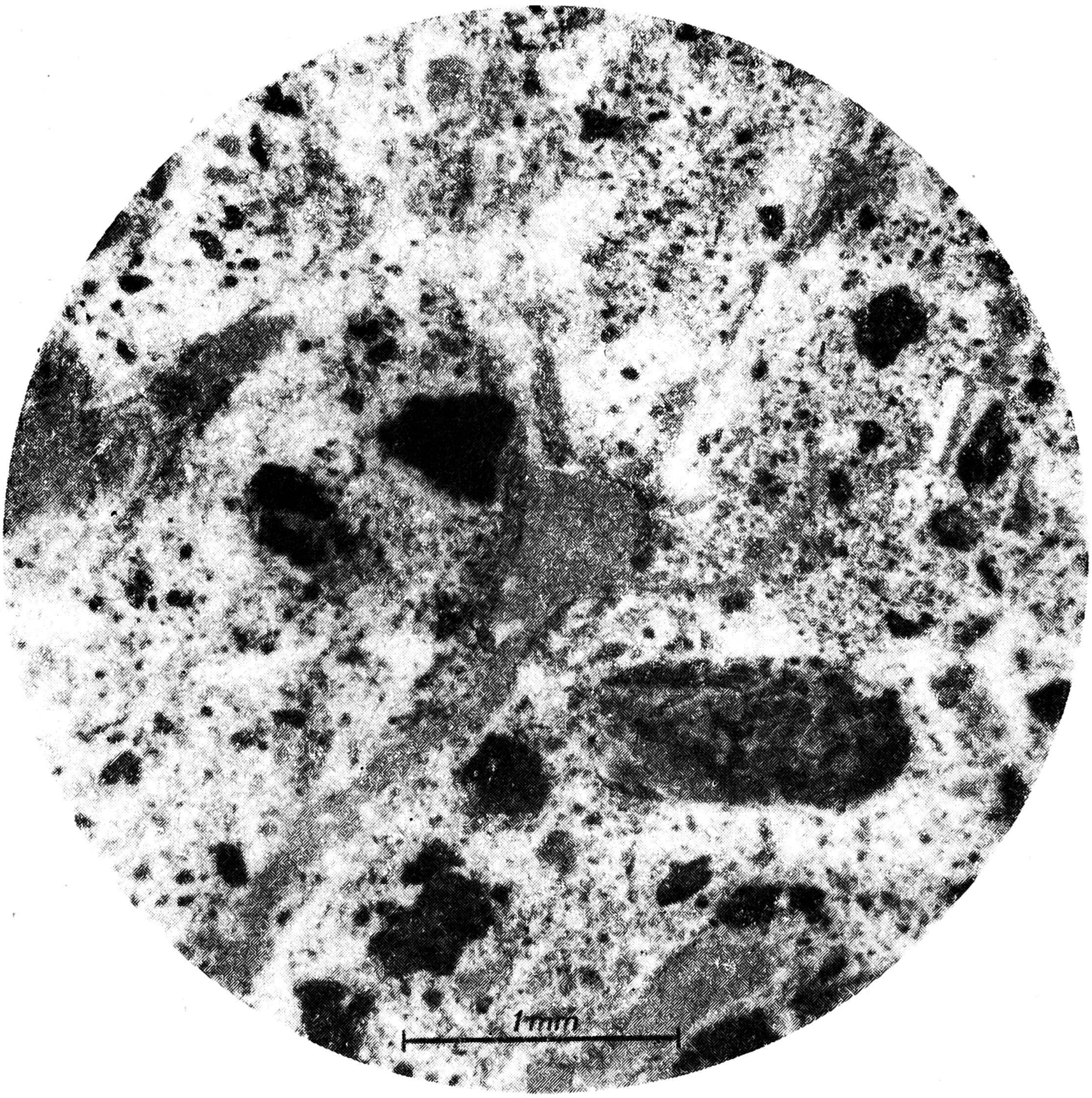

Fig. 10.

No. 2 from the E(g) horizon of the soil type I. The walls of the cross-sections of the pores have no coatings with characteristic double refraction.

Structural photogram No. 9 illustrates the cross-section of part of a compact aggregate interspersed with a microskeleton and darker soil conglomerates, with a double refraction characterizing an illimerization process (observed through the polarization microscope with crossed Nicol prisms).

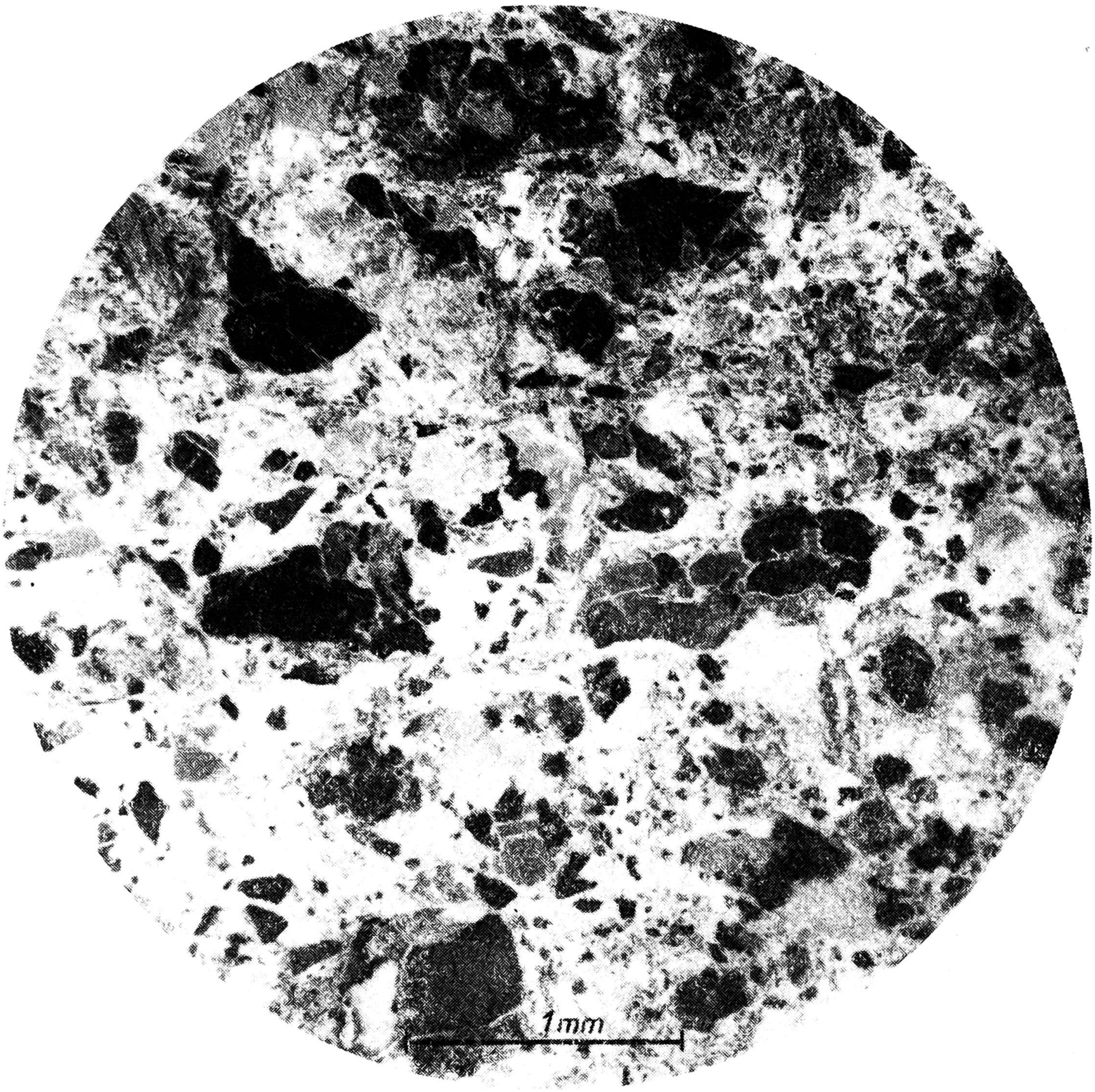

Fig. 11.

Structural photogram No. 10 shows part of the cross-section of an aggregate with a larger amount of darker conglomerates of colloids with characteristic double refraction and with dark coatings on the walls of the cross-sections of the pores.

Structural photogram No. 11 illustrates part of the soil-forming substrate with a high percent amount of cross-sections of the microskeleton and with a low percentage of pore cross-sections, 3.2%.

CONCLUSION

The study of visible pores of illimerized, weakly gleyed soil of loamy-clayey character on heavier pleistocenic layers from the surroundings of Tábor was carried out by means of the micromorphological method on the basic of structural photograms with the use of a particle-size classifier. A comparison of the ascertained values of the total percentage of visible pores of the soil type of arable land with that of an afforested area shows that the soil type covered with pines exhibits a lower percentage of pore cross-sections due to the influence of vegetation and the forms of the humus. The humus-type horizons of both types exhibit a predominating width of visible non-capillary pores of 200-500 μm. The frequency of the occurrence of pore cross-sections of the category of 20-50 μm is higher in the photograms from the arable soil. In the E(g), eg, I_2g horizons there is a high percentage of frequency of occurrence of visible pores in the category of 50-100 μm due to the influence of eluviation.

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