I. Methods of micromorphological soil analyses

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Schemes of soil fabric components

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The wide extent of micromorphological investigations of soil in different countries during the last decade allowed to obtain many experimental data. Some efforts in requiring their systematization were already made, and several classifications of the principal soil fabric constituents were proposed. These classifications are based on fundamental works of Prof. W. L. Kubiëna. The most detailed nomenclature and classification were developed in the monograph of Brewer [3]. The classifications of soil voids, aggregates and microstructures were elaborated by Beckmann and Geÿger [2]. Barratt's [1] classification is concerned with humus forms and micro-fabrics of temperate grass-lands. Laruelle was occupied with the unification of the nomenclature in order to make it available to the workers of different countries.

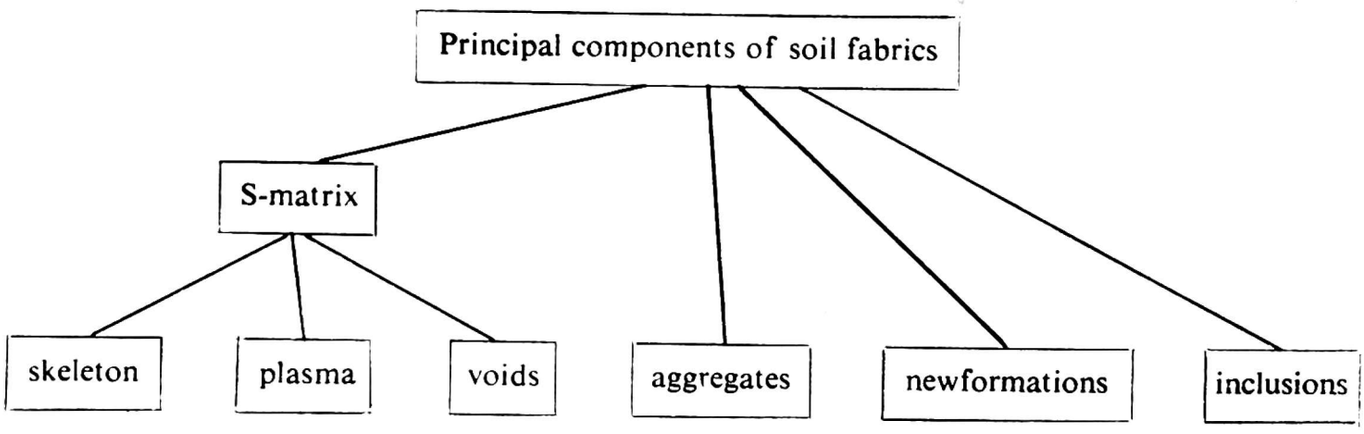
The classification schemes, which we are presenting to the 3rd International Working Meeting on Micromorphology of Soils have been compiled on the basis of the classifications mentioned above. We tried to make them applicable to the micromorphological study of geochemical landscapes. For this purpose the forms of different microfabric constituents are considered in a close relation with their substance; this is reflected in their subdivision into species and forms. Such a principle is especially important for the classification of new-formations since their composition and forms depend on chemical element migration capacities which are not equal in different environments [6]. In the presented schemes new-formations follow the order of chemical element decreasing migration capacites (gypsum, carbonates, ferruginous compounds and so on).

CLASSIFICATION SCHEMES OF SOIL FABRIC COMPONENTS

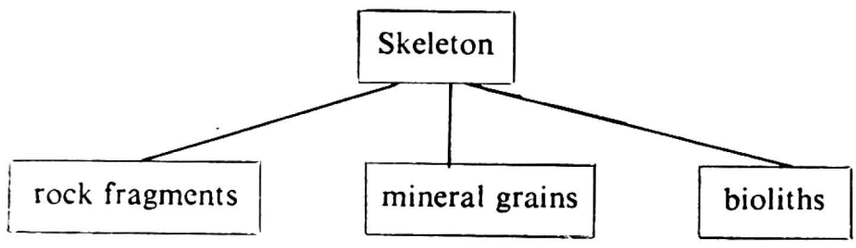
We group the soil fabric components into 9 schemes where they are presented as fabric and organization units in accordance with their forms, composition and mutual distribution. These schemes are the following:

Scheme 1. Principal components of soil fabrics.
Scheme 2. Skeleton.
Scheme 3. Species of soil plasma.
Scheme 3-a. Clayey plasmic fabric.
Scheme 3-b. Humus-clayey plasma.
Scheme 3-c. Carbonate-clayey plasma.
Scheme 3-d. Ferruginous-clayey plasma.
Scheme 4. Elementary fabric.
Scheme 4-a. Granular.
Scheme 4-b. Agglomeratic.
Scheme 4-c. Porphyric.
Scheme 4-d. Plasmic-silty.
Scheme 4-e. Silty-plasmic.
Scheme 4-f. Plasmic.
Scheme 5. Forms of soil voids.
Scheme 6. Soil aggregate species.
Scheme 6-a. Forms of humus aggregates.
Scheme 6-b. Forms of other aggregates (without humus aggregates).
Scheme 7. Forms of soil microstructures.
Scheme 8. New-formation species.
Scheme 8-a. Humus forms.
Scheme 8-b. Forms of gypsum.
Scheme 8-c. Forms of calcite.
Scheme 8-d. Forms of ferruginous new-formations.
Scheme 8-e. Forms and distribution of clay new-formations-polynite.
Scheme 8-f. Bioliths.
Scheme 9. Inclusions.

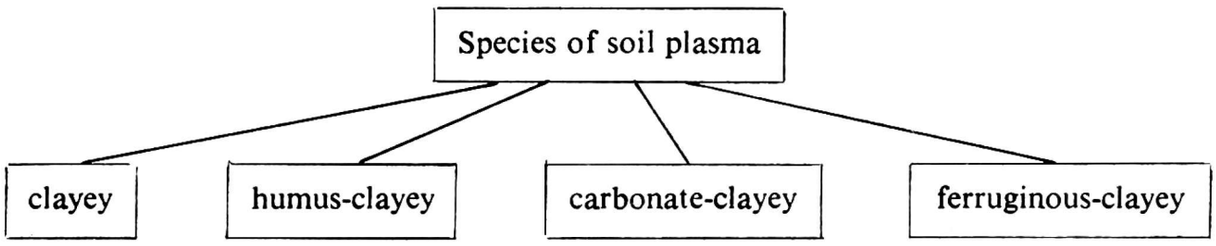
Scheme 1



Scheme 2

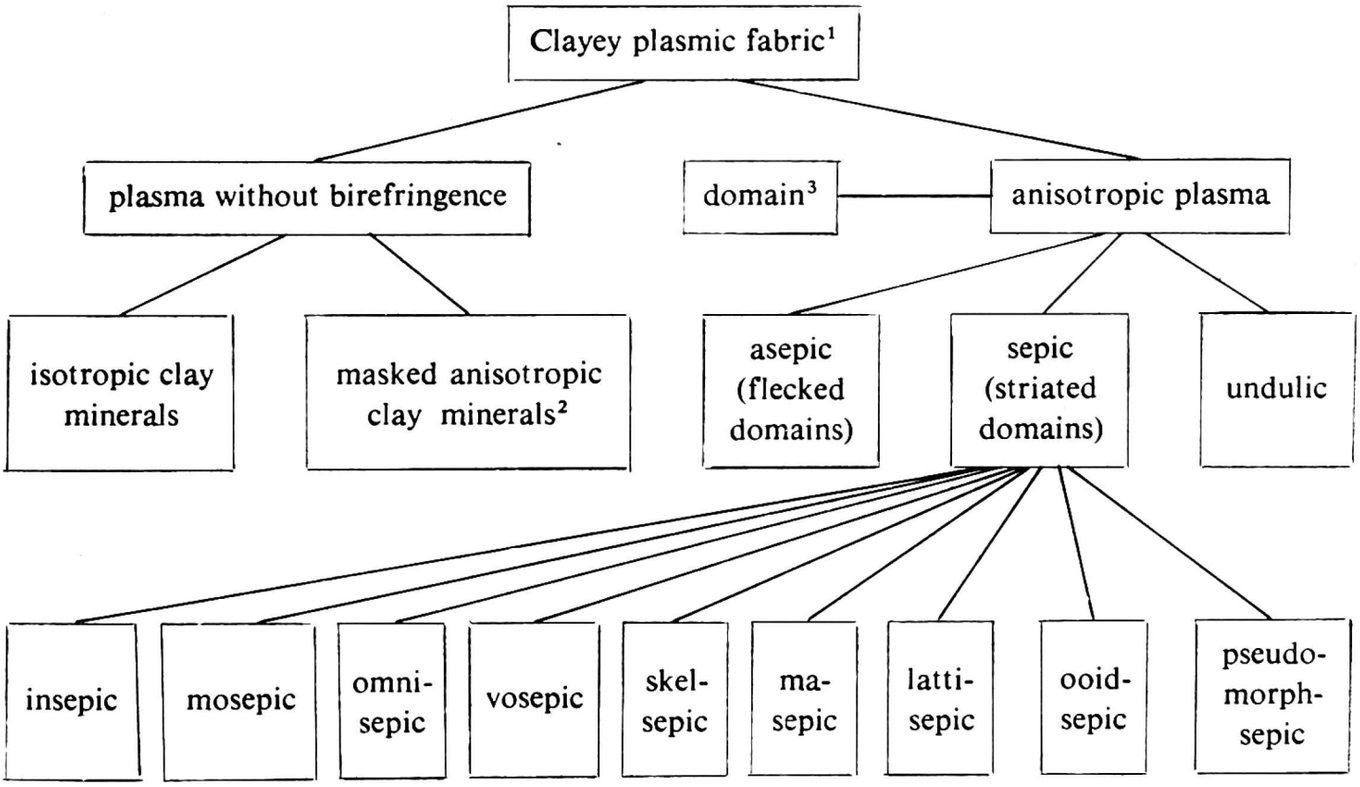


Scheme 3



Note: the plasma of each species is aggregated or dense.

Scheme 3-a

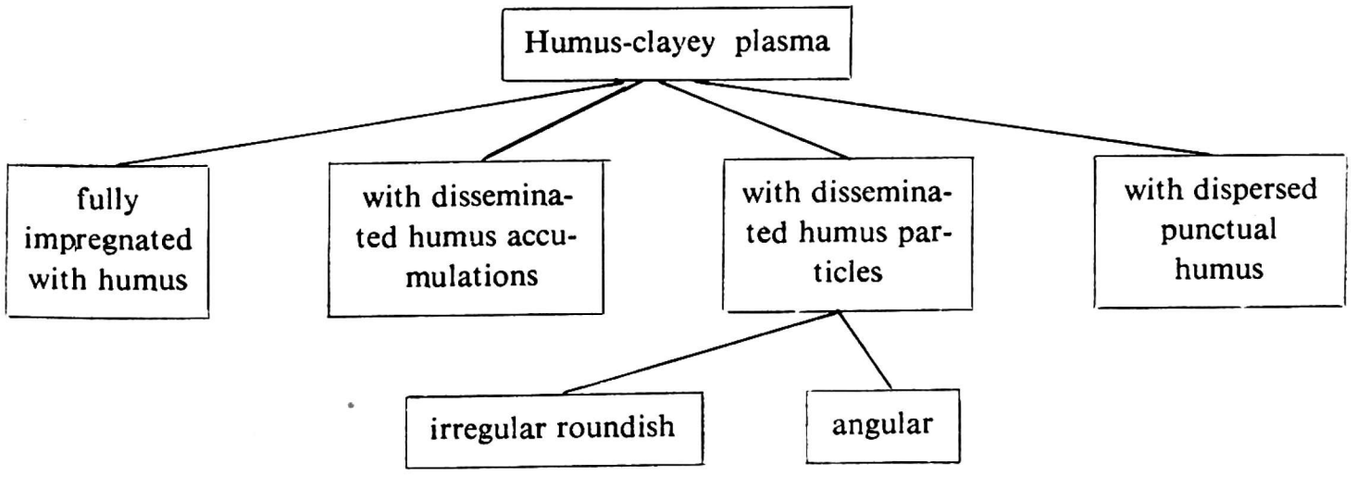


[1] Examined between cross nicols.

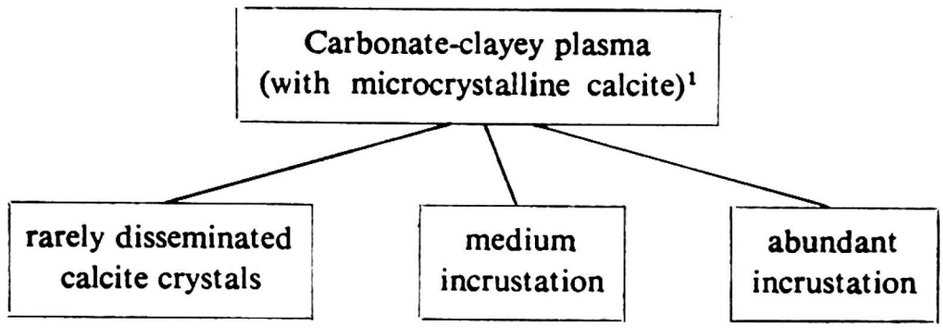
[2] With dark-coloured humus, iron hydroxides and others.

[3] Domain is the smallest clay aggregate, which can be distinguished under the polarizing microscope.

Scheme 3-b

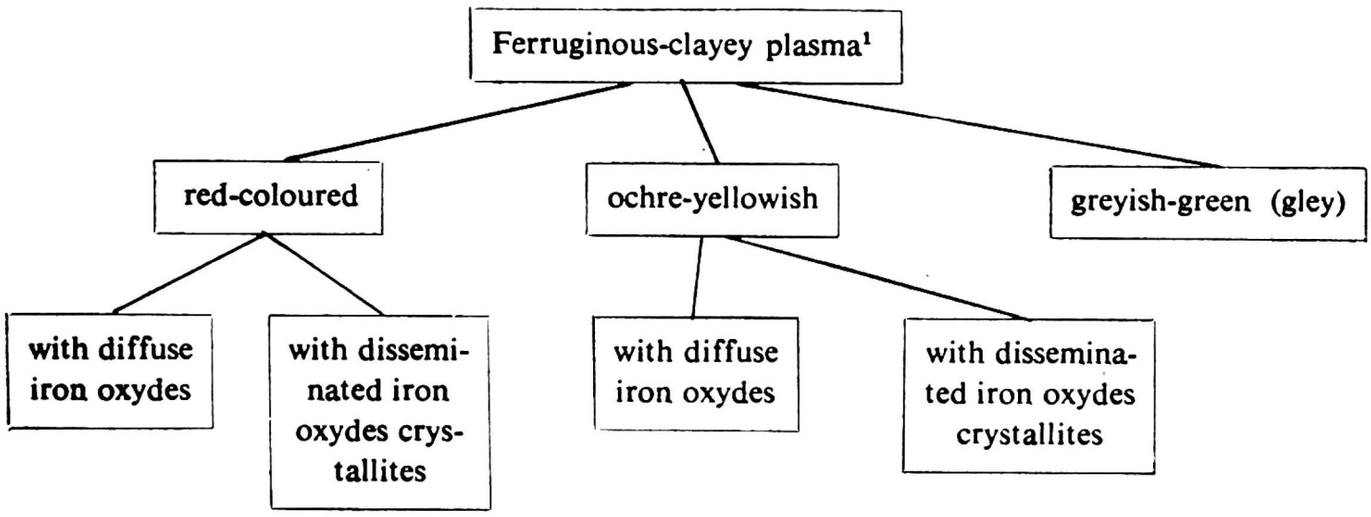


Scheme 3-c



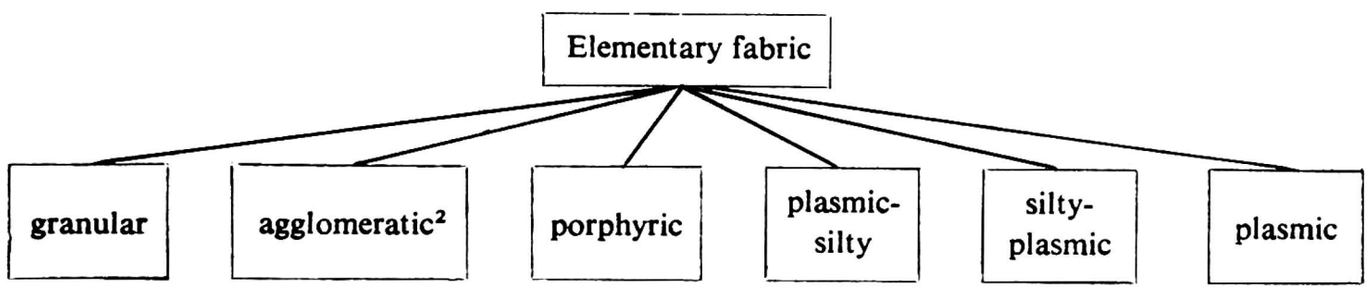
[1] Examined between cross nicols.

Scheme 3-d

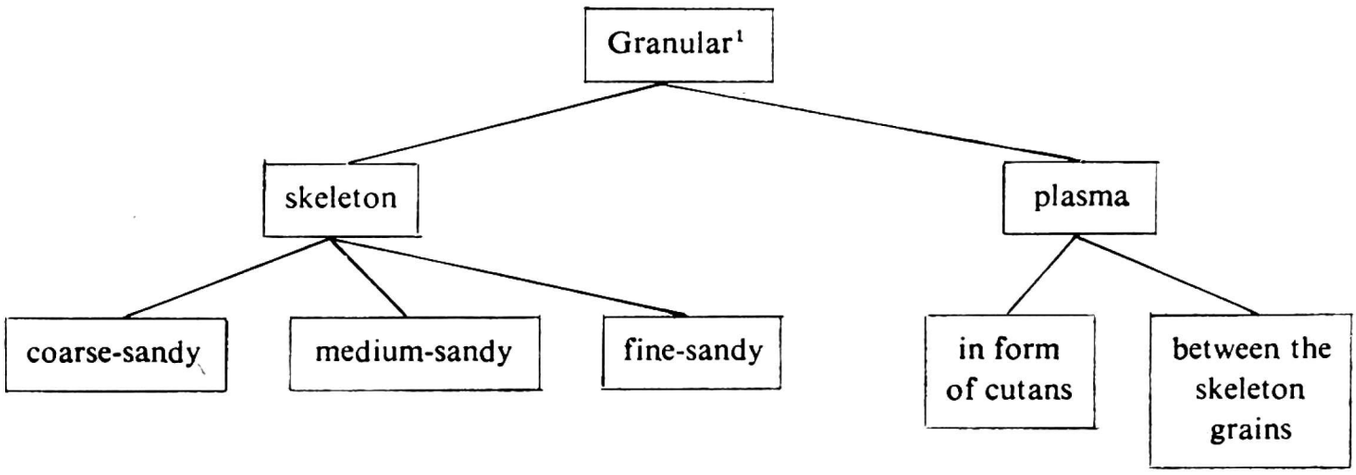


[1] The colour is observed in transmitted and reflected light.

Scheme 4

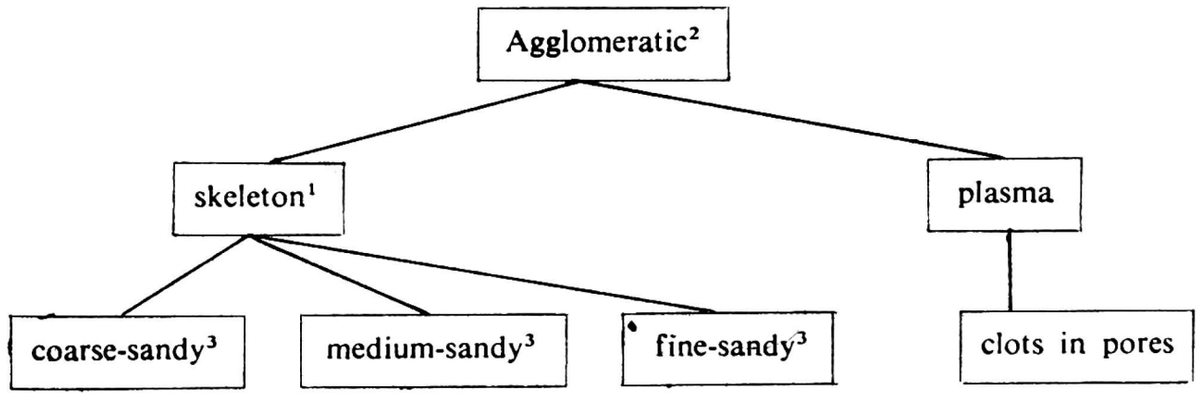


Scheme 4-a



[1] Granular-sandy grains with approximately equal sizes exceeding 0.1 mm (fine — medium — and coarse) touching each other or tightly situated predominate. A small admixture of silty particles is possible. The quantity of plasma is negligeable.

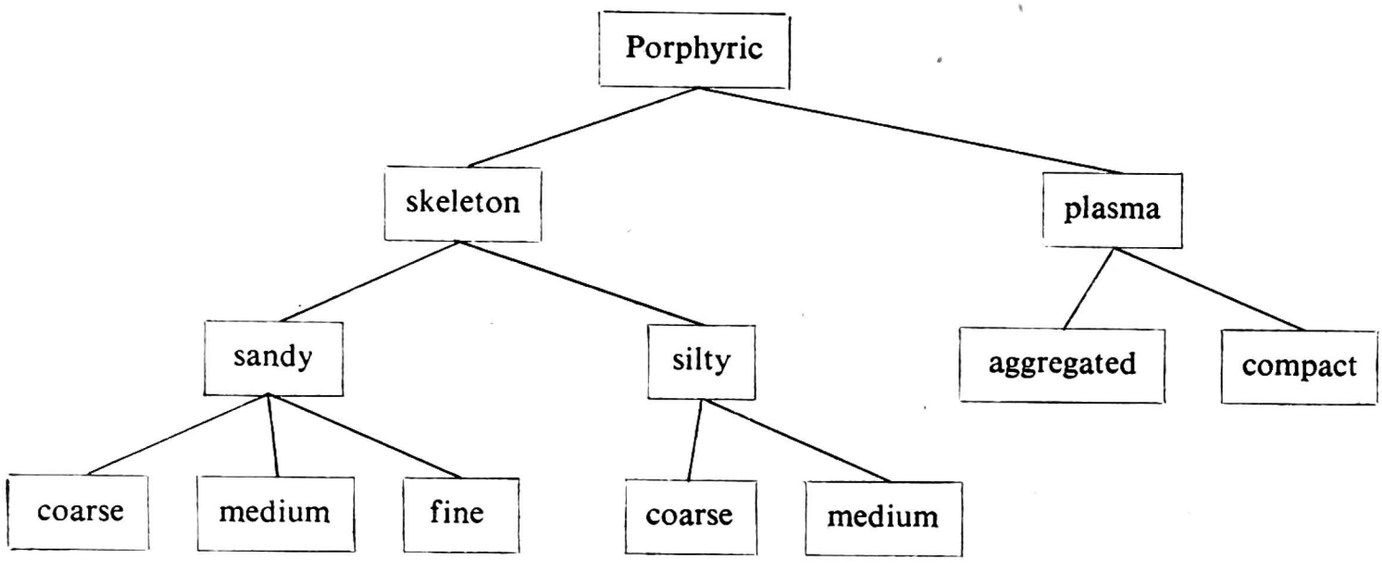
Scheme 4-b



[2] Agglomeratic — tightly situated sand grains of approximately equal sizes exceeding 0.1 mm (fine — medium — and coarse) predominate with plasma clots in pores. A small admixture of silty particles is possible.

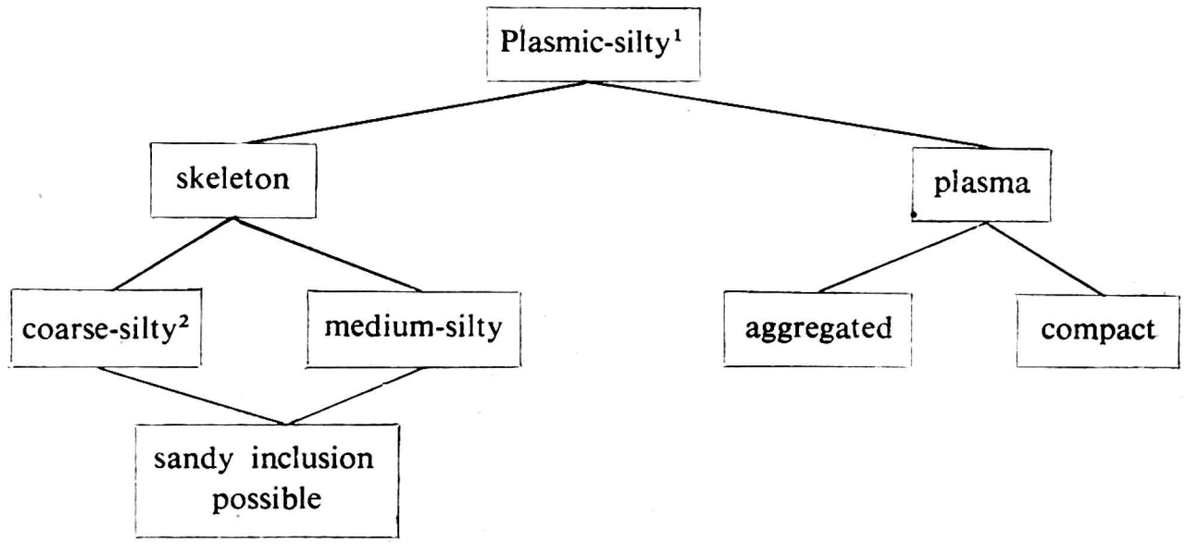
[3] Coarse-sandy -grain sizes 1.0 mm, medium-sandy -grain sizes 1.0-0.25 mm, fine-sandy -grain sizes 0.25-0.05 mm.

Scheme 4-c



Porphyric elementary fabric. Sandy grains > 0.10 mm are disseminated in the aggregated or compact plasma including more or less silty-sizes grains. The density of sand grains distribution is evaluated approximately (rare, medium, dense).

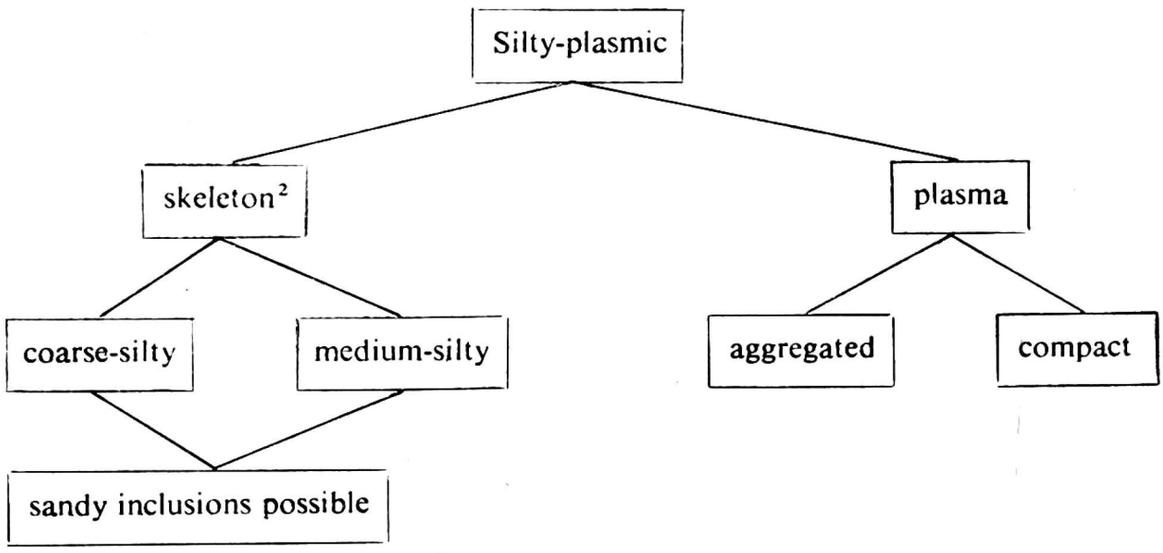
Scheme 4-d



[1] Plasmic-silty. Silty grains of predominating size 0.05-0.005 mm are densely distributed in the plasma.

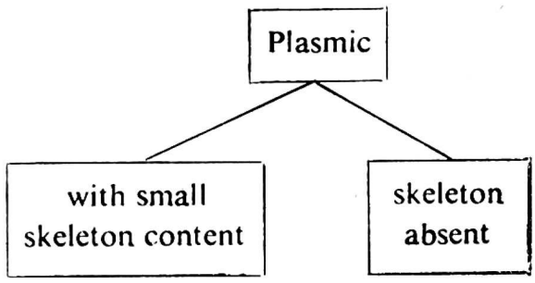
[2] Coarse-silty - grains | 0.05-0.01 mm predominate, medium-silty - grains | 0.01-0.005 mm predominate.

Scheme 4-e



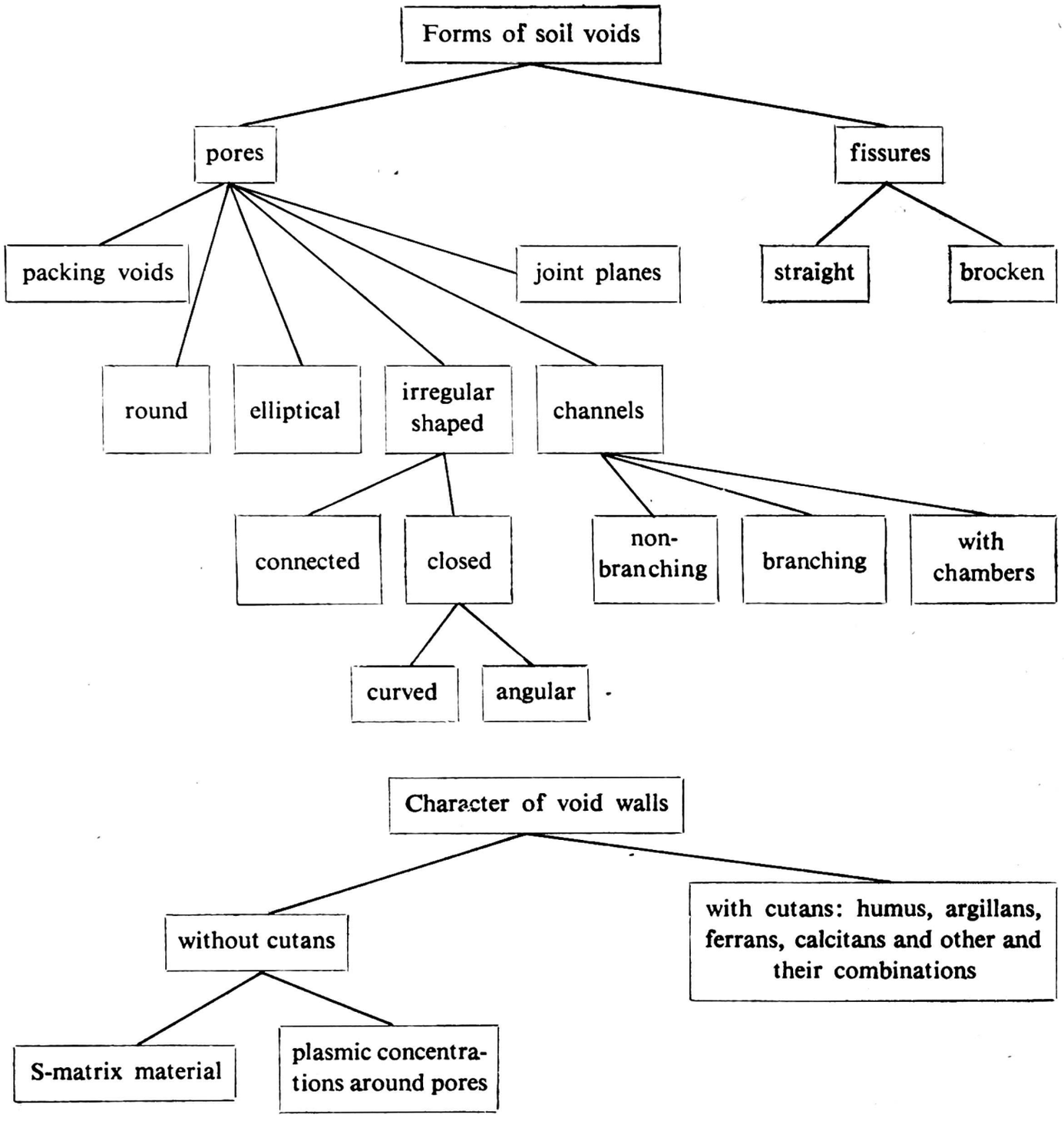
Silty-plasmic. Silty grains of predominant size 0.05-0.005 mm are disseminated in the plasma.

Scheme 4-f

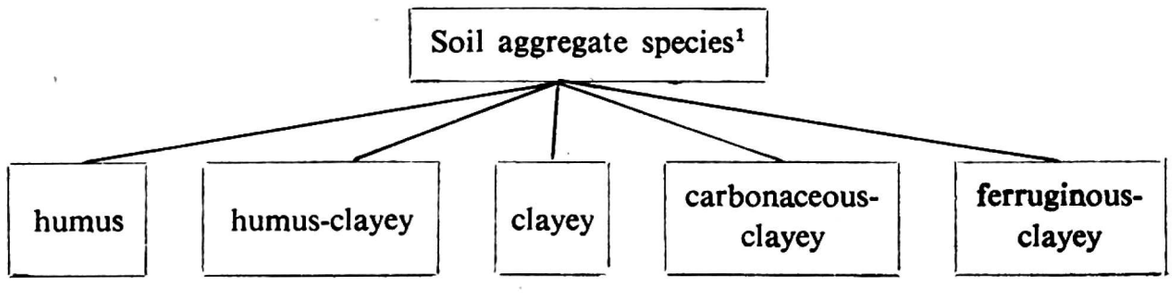


Plasmic. Plasma with small skeleton content or without it.

Scheme 5

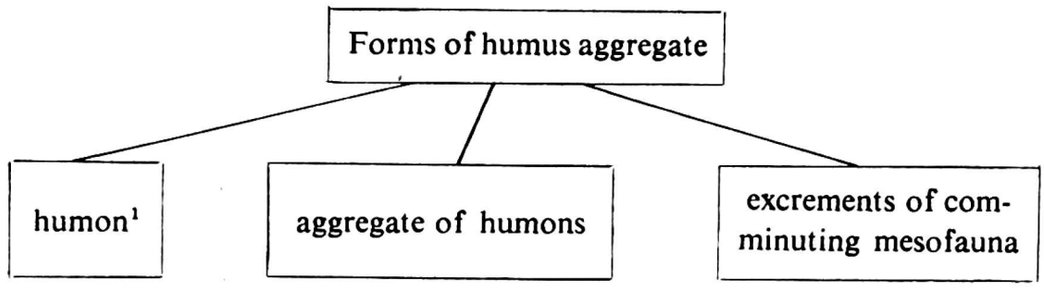


Scheme 6



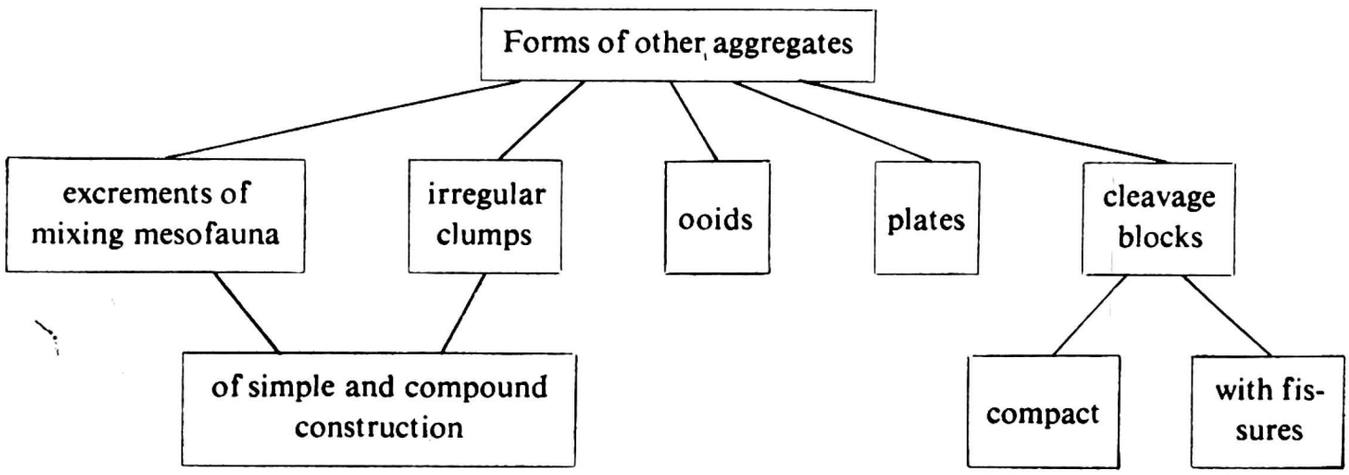
[1] All aggregates (except humus) include skeleton grains.

Scheme 6-a

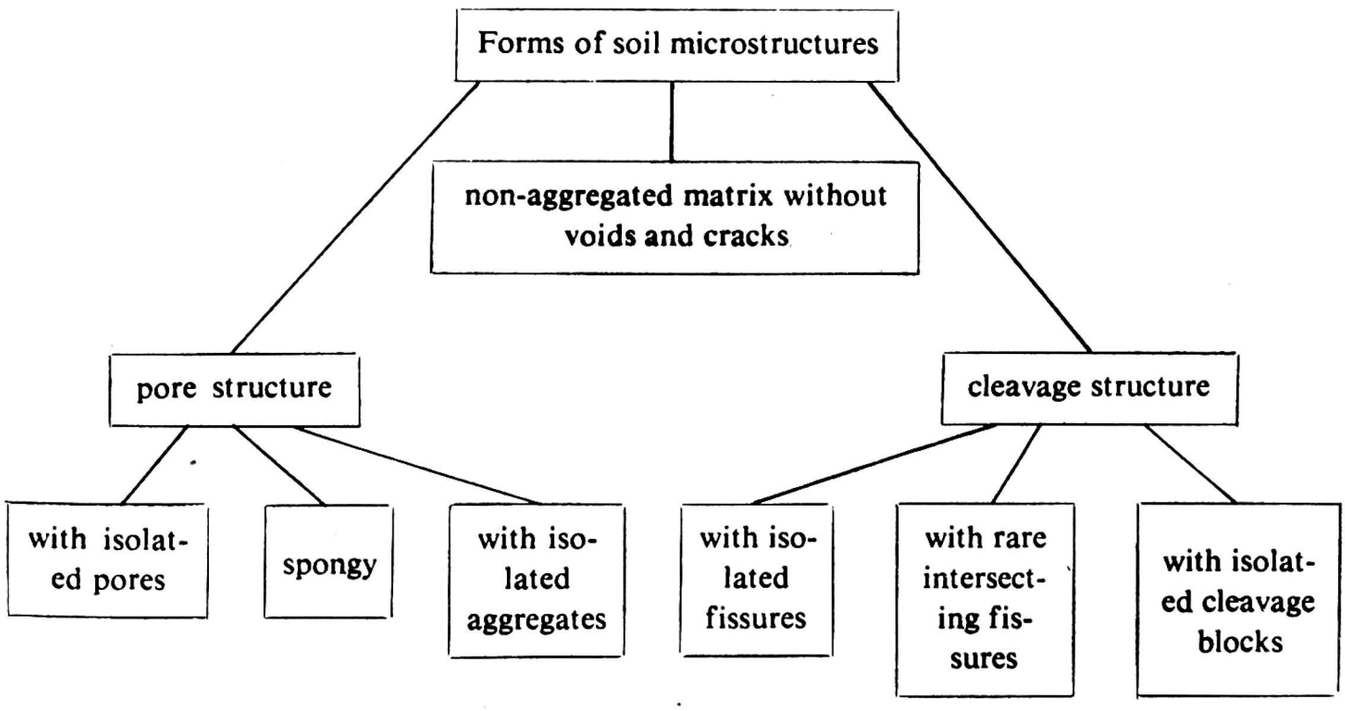


[1] Humon is the smallest (2-6μ) particle of dark-coloured humus.

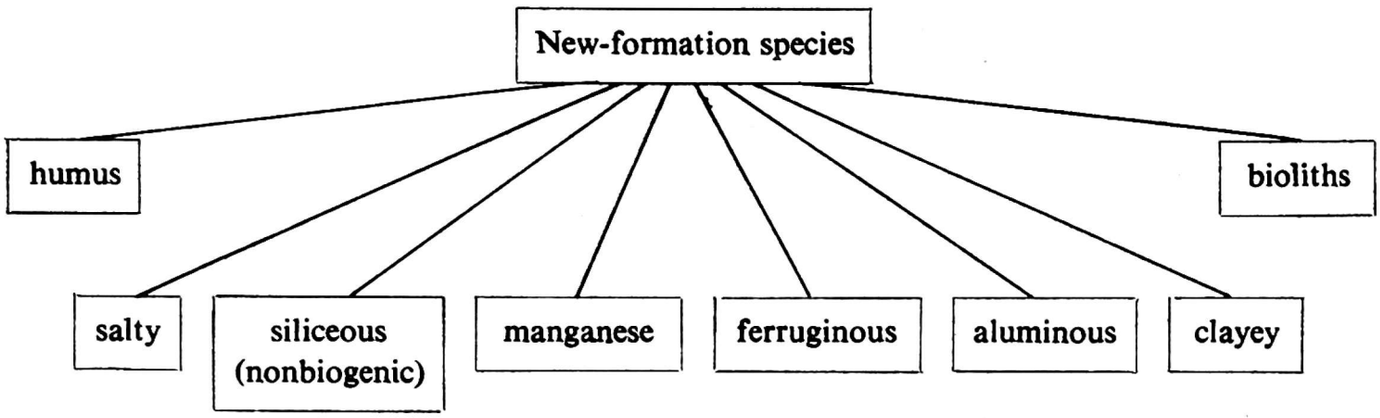
Scheme 6-b



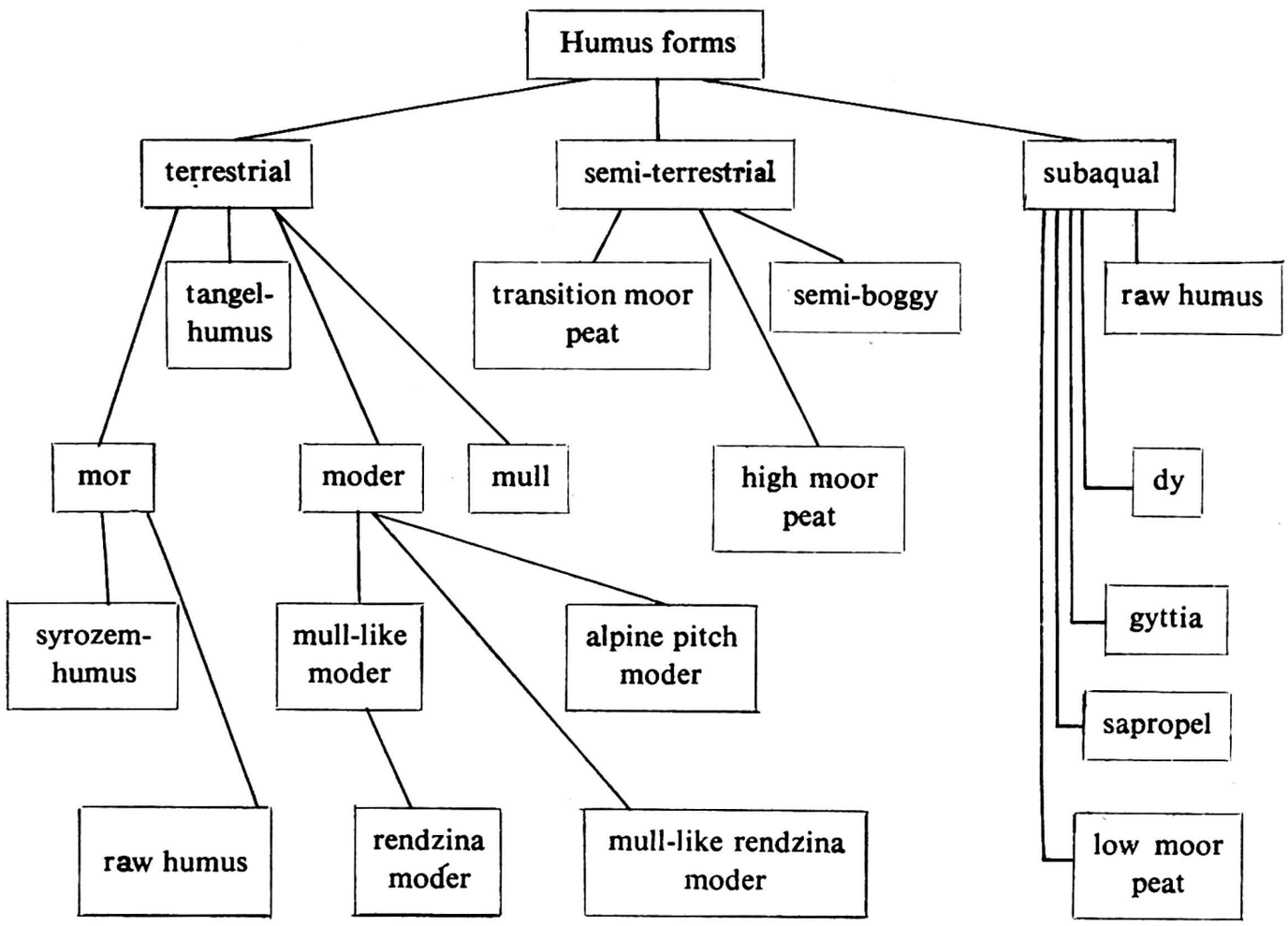
Scheme 7



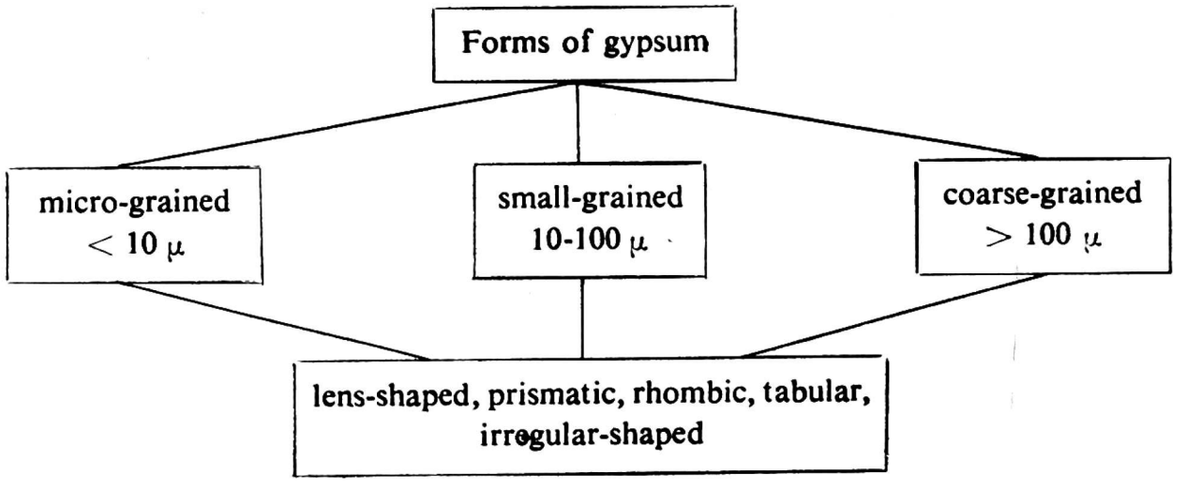
Scheme 8

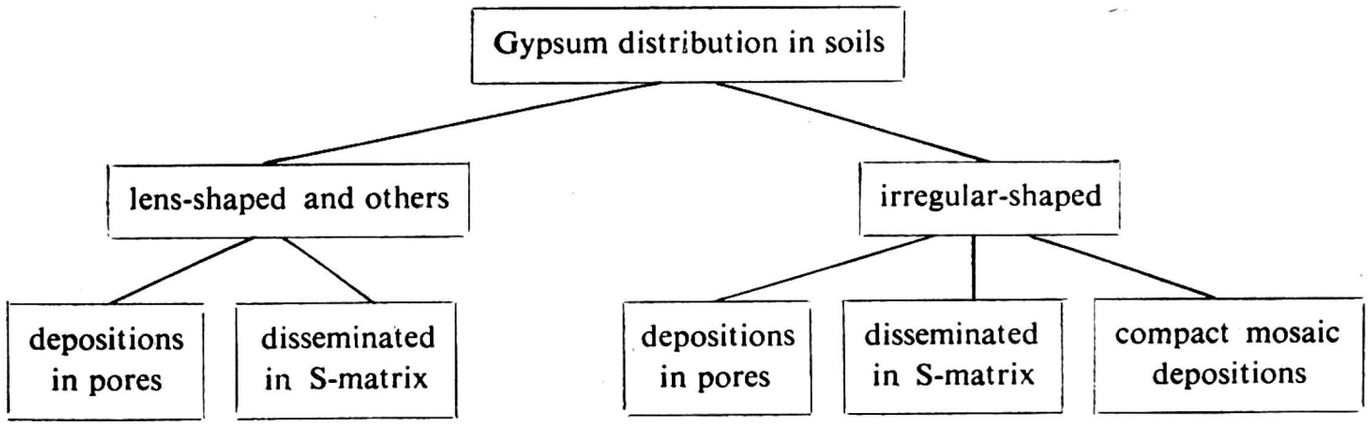


Scheme 8-a

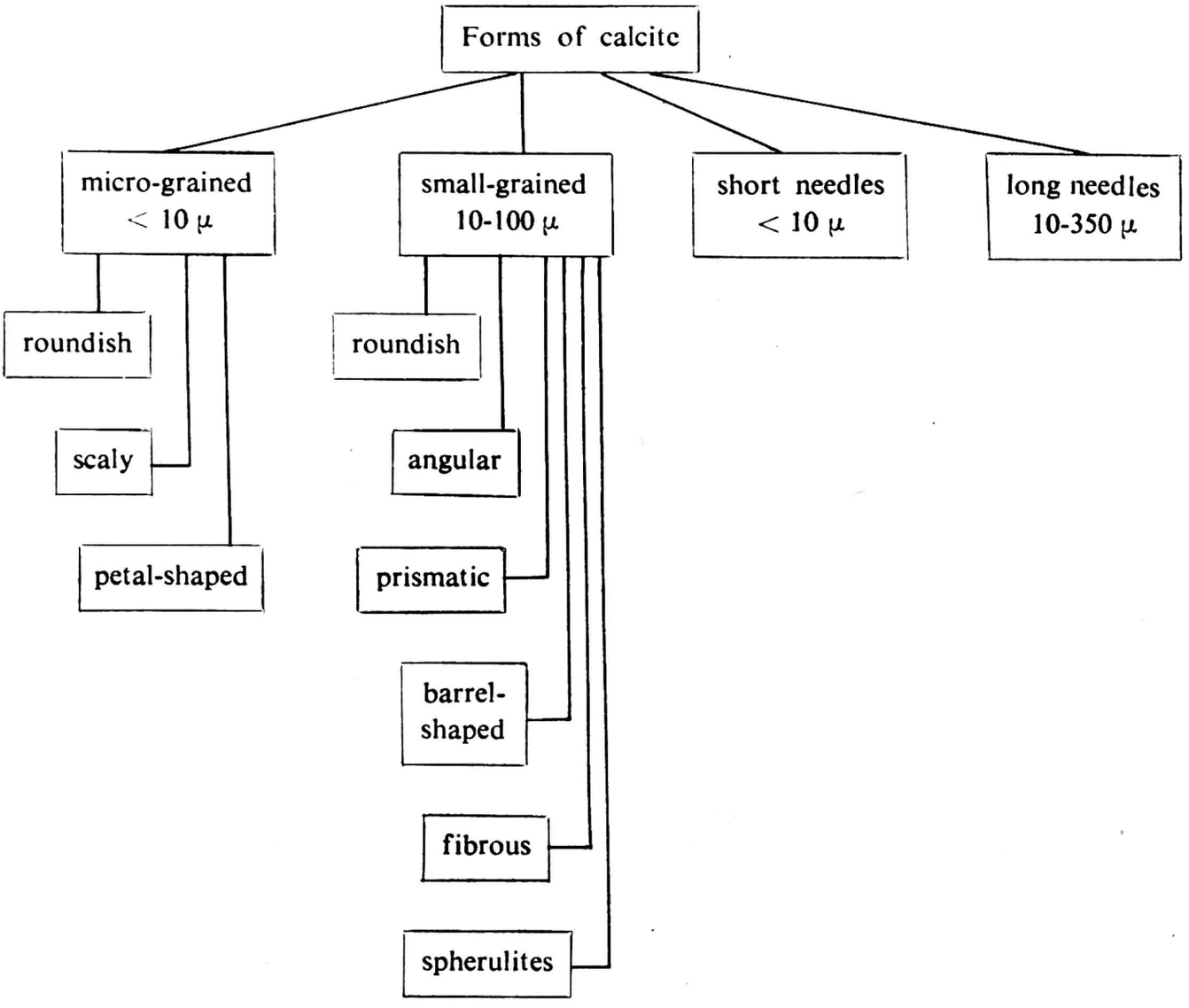


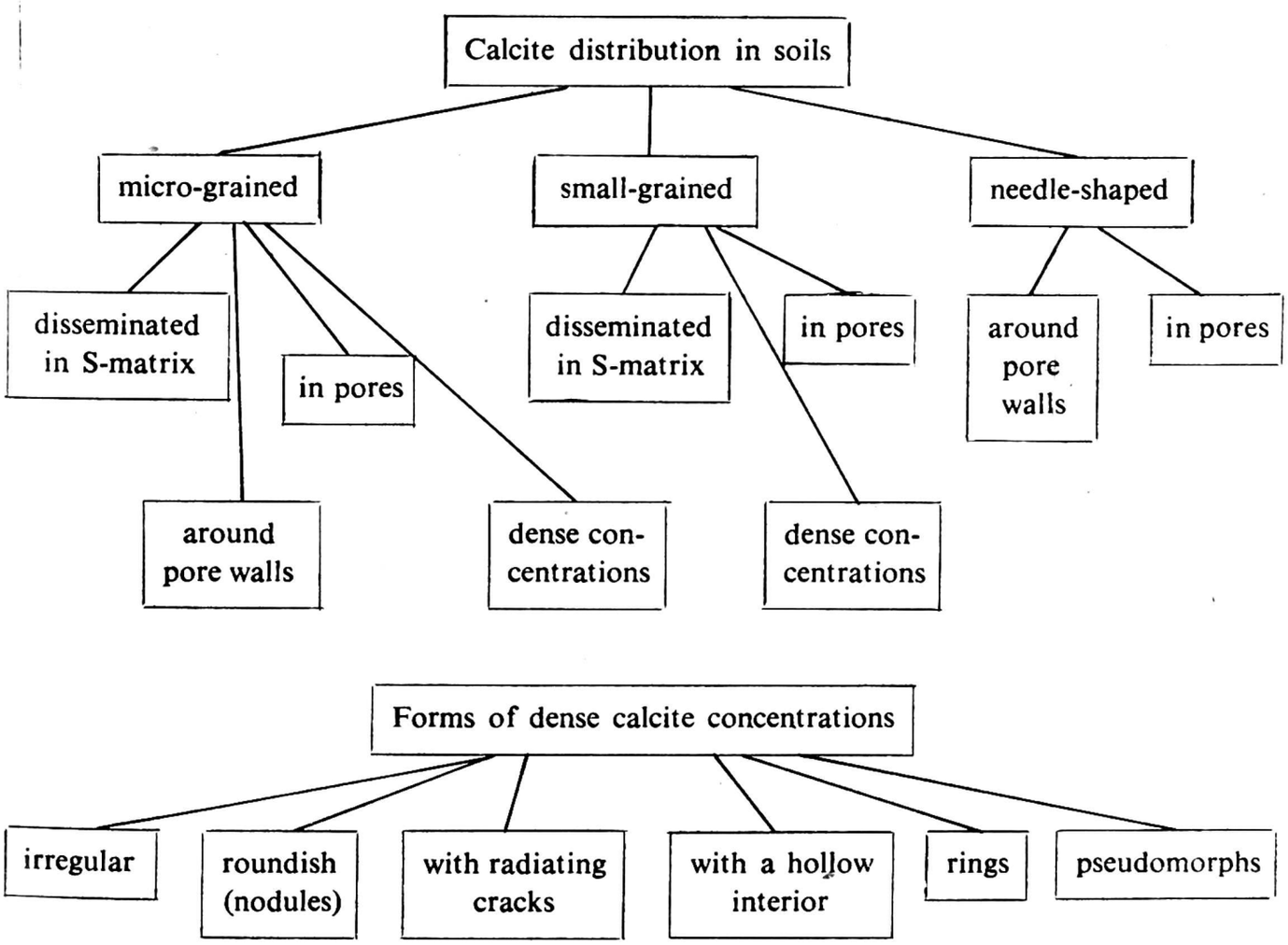
Scheme 8-b


Forms of gypsum
micro-grained
< 10 μ
small-grained
10-100 μ
coarse-grained
> 100 μ
lens-shaped, prismatic, rhombic, tabular,
irregular-shaped

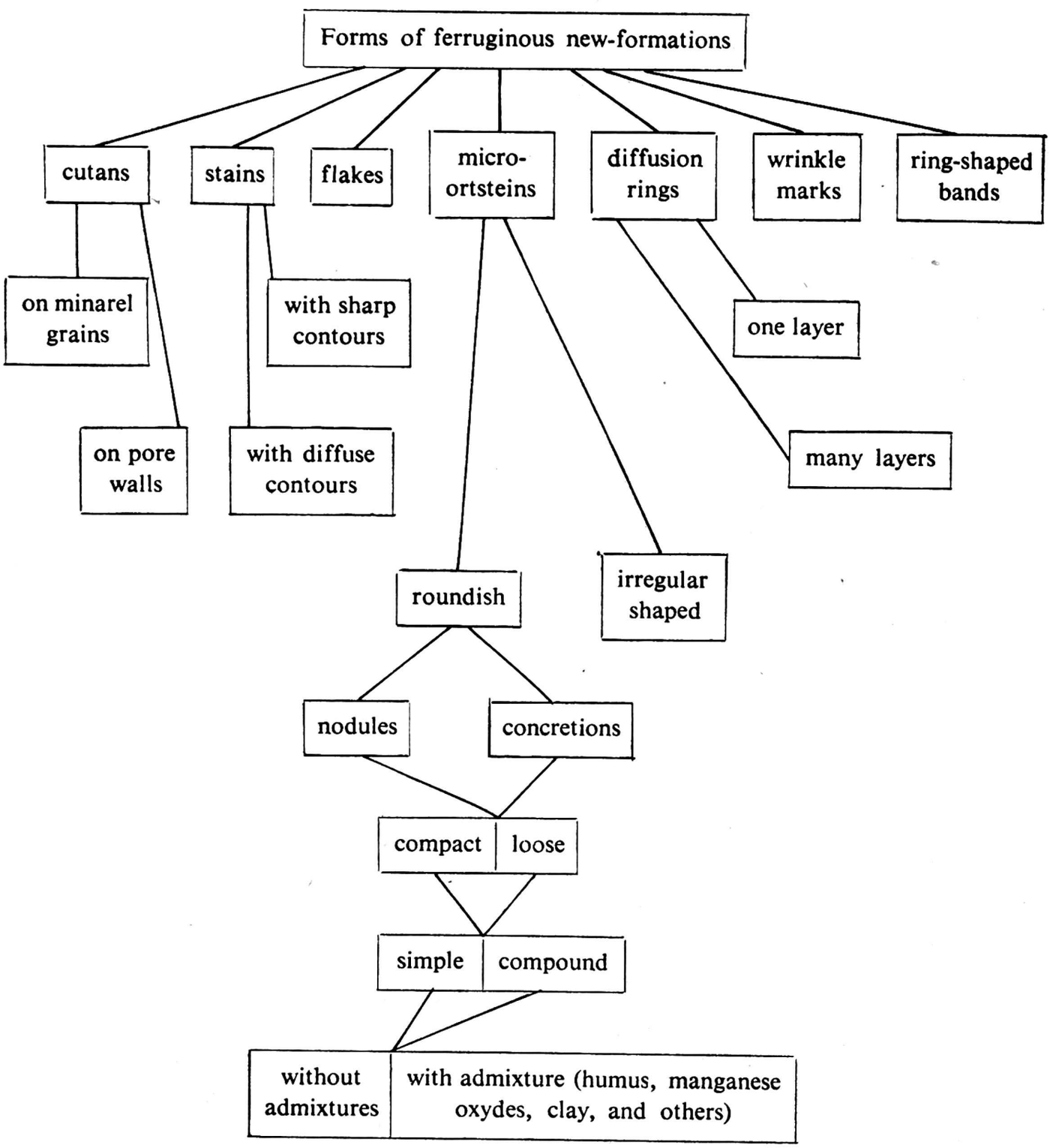

Gypsum distribution in soils
lens-shaped and others
irregular-shaped
depositions
in pores
disseminated
in S-matrix
depositions
in pores
disseminated
in S-matrix
compact mosaic
depositions

Schemat 8-c

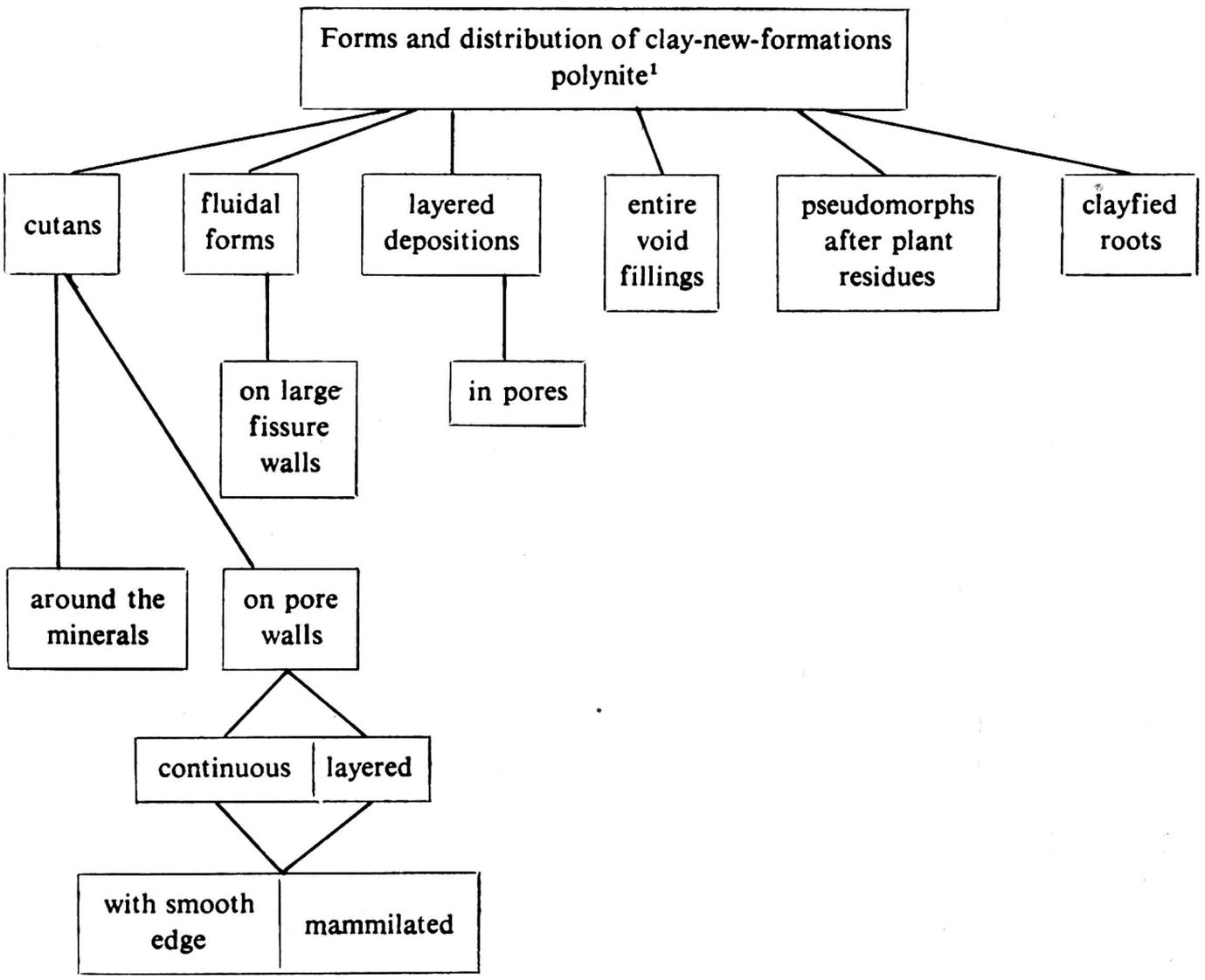

Forms of calcite
micro-grained
< 10 μ
small-grained
10-100 μ
short needles
< 10 μ
long needles
10-350 μ
roundish
scaly
petal-shaped
roundish
angular
prismatic
barrel-
shaped
fibrous
spherulites


Calcite distribution in soils
micro-grained
small-grained
needle-shaped
disseminated in S-matrix
in pores
around pore walls
dense con-centrations
disseminated in S-matrix
in pores
dense con-centrations
around pore walls
in pores
Forms of dense calcite concentrations
irregular
roundish (nodules)
with radiating cracks
with a hollow interior
rings
pseudomorphs

Scheme 8-d

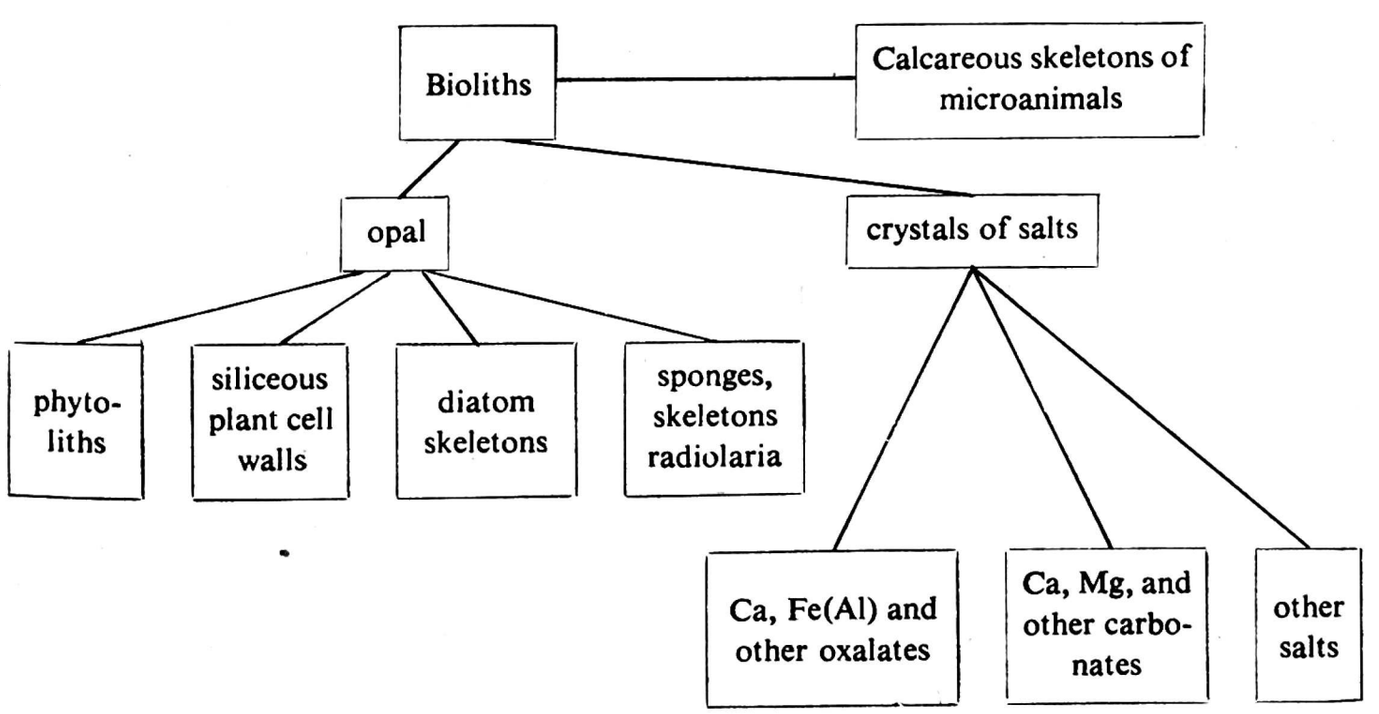

Forms of ferruginous new-formations
cutans
stains
flakes
micro-ortsteins
diffusion rings
wrinkle marks
ring-shaped bands
on minarel grains
on pore walls
with sharp contours
with diffuse contours
one layer
many layers
roundish
irregular shaped
nodules
concretions
compact
loose
simple
compound
without admixtures
with admixture (humus, manganese oxydes, clay, and others)

Scheme 8-e

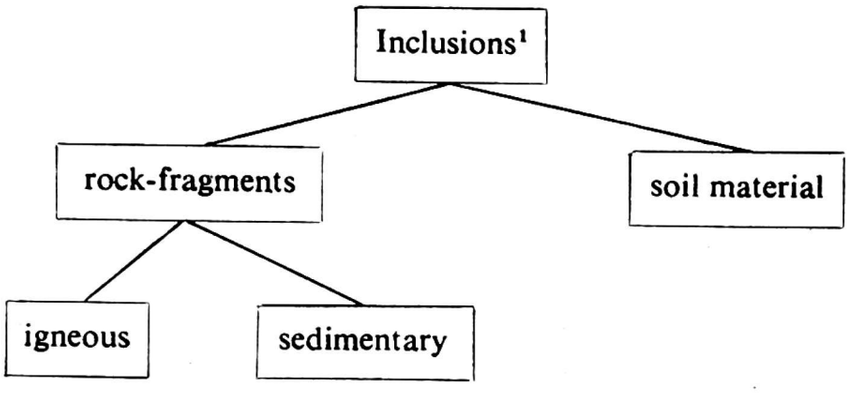


[1] Polynite — collophormic birefringing clay separations resulting from illuviation.

Scheme 8-f



Scheme 9



[1] Material foreign for the present horizon.

The schemes require some explanations which are given below:

Scheme 1. Shows the principal components of soils fabric.

Scheme 2. Mineral biogenic formations inherited from the parent rock — such as calcareous mollusc shells, radiolaria, sponge spicules, diatom skeletons — are considered as skeleton grains. Those which are found in the upper part of the soils (phytoliths, soil diatom skeletons and other) are included into the group of bioliths (scheme 8-f).

Scheme 3 is given in general after Brewer with addition of two forms of clayey plasma fabric: clay pseudomorphsepic and ooidsepic. The former represents clay pseudomorphs after primary minerals, the latter round and/or oval compact clay non-isolated ooids in a less dense plasma. Inside ooids the domains show a concentric or flecky-striated orientation. The crystic plasma is placed in the scheme 3-c as carbonate-clayey plasma and in scheme 8-c as a calcite new-formation.

Scheme 4. The elementary fabric is considered as combinations of plasma and skeleton grains of different size, and their mutual distribution.

Scheme 5. The first subdivision into voids and fissures is done after Beckmann and Geÿger, and Brewer. In the next subdivisions other classifications are taken into account.

Scheme 6-a and 6-b after Beckmann and Geÿger with a subdivision of humus aggregates.

Scheme 7. Forms of microstructures after Beckmann and Geÿger.

Scheme 8. Only main, widely occurring in soils, new-formations are considered.

Scheme 8-a. Humus forms are given after Kubiëna [5].

Scheme 8-c is compiled in general after Kubiëna [4]. The size limits of micro-grained and small-grained calcite are the same as adapted in sedimentary petrography.

Scheme 8-e. There is no special term for the collomorphic clay separations resulting from illuviation. Following terms of this clay are found in literature: (1) *oriented clay* — this term does not suit because domains are also oriented forming different plasma fabrics (insular, mosepic,

masepic etc.); (2) the term *mobile clay* is unfit because every clay orientation is called forth by its mobility; (3) the term *secondary clay* is invalid because all clays are of a secondary origin; (4) Brewer's *argillans* represent only the cutanic form of clays; (5) Kubiëna's term *Braunlehmteilplasma* can not be translated into Russian and besides it is characteristic of any kind of peptized clay. We have named illuviated collomorphic clay "polynite" because B. B. Polynov was the first who discovered it in soils.

Scheme 8-f. Only the most widely occurring and better known bioliths are considered.

The general schemes need undoubtedly further explanation. For the purpose of the study of geochemical landscapes it seems important to differentiate the components of soil fabric according to their species and forms peculiar to each elementary landscape (eluvial, superaqual and subaqual). Such a work must be done for different natural zones.

SUMMARY

Basing on several soil fabric classifications there were proposed a series of completed and modified schemes to be used for micromorphological descriptions of soils. The authors group the soil components into 9 schemes, which are presented as fabric and organization units in accordance with their forms, composition and mutual distribution. In the text the schemes are closely characterized.

REFERENCES

1. Barratt B. C., 1964. A classification of humus forms and microfabrics in temperate grassland. J. Soil Sci. 15, pp. 342-356.
2. Beckmann W., Geÿger E., 1967. Entwurf einer Ordnung der natürlichen Hohlraum-, Aggregat und Strukturformen im Boden. Die mikromorphometrische Bodenanalyse. Ferdinand Enke Verlag, Stuttgart.
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4. Kubiëna W. L., 1938. Micropedology. Ames, Iowa.
5. Kubiëna W. L., 1953. The Soils of Europe. London.
6. Polynov B. B., 1956. Selected works. U.S.S.R. Ac. Sci., p. 427.