THE SUB-GROUP ON ORGANIC MATTER

A Progress Report*

by P. Bullock, U. Babel, C. Jeanson and A. Jongerius

Introduction

The Sub-Group on Organic Matter was set up in 1972. It brought together specialists in moder and mull humus forms peats, agricultural topsoils and spodic horizons with a view to (i) appraising present systems of description and classification of soil organic matter in thin sections; and (ii) investigating the need for alternative systems. The original Sub-Group comprised Madame Dr. C. Jeanson (France) Dr. U. Babel (Germany), Dr. L. Bal (The Netherlands) Dr. P. Bullock (Great Britain) (Chairman/Convenor), Dr. F. de Coninck (Belgium), Dr. A. Jongerius (The Netherlands) and Dr. D. Righi (France). In 1975 Professor G. Lee (U.S.A.) and Dr. B.C. Barratt (New Zealand) joined as corresponding members. Recently, Drs. Bal and de Coninck resigned. Meetings have been held in Brunoy, France (1972, 1976), Wageningen (1973), Stuttgart (1974), and Poitiers (1975).

Selection of the Programme of Work

At the inaugural meeting at Brunoy (1972), there was extensive discussion on current description and classification systems for organic material in thin sections. These included the systems of Kubiena, Barratt and Brewer. While it was felt that all three systems had considerable merit, the Sub-Group felt that it would be impossible to take any single one and attempt to make it more comprehensive. Further, there seemed to be no way in which all three could be

*In addition to the listed authors, Drs. L. Bal (The Netherlands) F. de Coninck (Belgium) and Righi (France) have contributed to the scheme at earlier meetings.

combined into a single system. Consequently the decision was made to develop a separate system for the description and classification of organic material in thin sections which, because of the breadth of interest of the members, it was hoped would be widely accepted. It was decided to develop a system composed of a number of levels the lowest of which would contain only the basic building blocks of organic matter (termed basic components). The second level would deal with the organisation of the basic components into simple units and higher levels with further groupings of these units. The system would form the basis for micromorphological definitions of humus horizons and forms.

At the Wageningen meeting (1973) a scheme was developed for basic components but subsequent testing of it showed it to be too complicated. The following gives the progress made on the system at the last three meetings.

System of Description and Classification.

1. Introduction

The system is for use at magnifications up to about 250x in transmitted or incident light. To make the system initially applicable to all forms of light would raise too many difficulties. It may, however, be possible to add modifications to suit other forms of light at a later stage.

The question of whether a rigid or an open system should be developed has not been fully resolved yet. A rigid system has the advantage that similar descriptions would be made by different persons. An open system could be interpreted in more than one way.

The basis for the description is as far as possible morphographic, although it is appreciated that some genetic bias may be included.

2. Basic Components

Four main groups of basic components are recognised, of which emphasis has so far been on the first two.

a) Plant or animal residues recognisable by their internal structure or its contours.

b) Fine organic material without recognisable plant or animal structure.

c) Mineral grains recognisable by their optical properties.

d) Voids.

The basis for separation of a component is that it must differ from other components in at least two characte ristics (shape, size, colour, internal structure) unless there is no transition between the particular component and other components in which case only one characteristic need be different.

a) Plant or animal material recognisable by its internal structure or contours.

This material includes organs, tissues, cells and fungal hyphae and schlerotia, and where they are present in a thin section, whole organisms. The following definitions from a micromorphological point of view have been drawn up for these components.

Cell. A unit commonly 5–20 μm diameter consisting of a sur rounding wall enclosing an area which may or may not contain colourless to strongly coloured material. The enclosed material occurs as a thin layer on the inside of the wall or as a thick zone usually covering much of the wall or as a complete infilling. The cell wall is usually $\frac{1}{2}$ – 5 um thick and shows variable birefringence.

Cell fragments are more or less altered remmants of whole cells. They are more common than individual whole cells in most soils.

Tissue (or fragment of tissue). A unit consisting of a coherent group of cells broadly similar to each other in their morphology but which may differ from each other in lumen content.

Organ (or fragment of organ). A unit consisting of a coherent group of two or more different tissues.

It is recognised that there will be cases when absolute identification of a particular component is difficult and it may only be possible to consider it as an intergrade e.g. organ/tissue or tissue/cell.

b) Fine organic material without recognisable plant or animal structure.

Two different forms are recognised, polymorphic and monomorphic material, defined as follows:

Polymorphic material: Soil material which forms a discontinuous mass made up of small, more or less rounded, variously coloured, irregular patches which lack sharp boundaries.

Monomorphic material: Soil material which forms a continuous mass that is relatively uniform in colour or density or shows only very gradual transition in these two properties.

Polymorphic organic material is a common constituent of agricultural topsoils. Monomorphic material appears to occur in more specialised environments such as peats, F and H layers of acid humus forms and Bh horizons of podzols.

Several aspects of these two types of material require further discussion. The terms themselves are not satisfactory and suitable alternatives need to be found. Homomorphic and heteromorphic are possible alternatives but the past use of these and other terms requires further investigation.

There are cases when it is difficult to distinguish between the two types, particularly as polymorphic material appears often to be made up of monomorphic components.

For this reason, and because fine organic material has received little attention in previous micromorphological literature an investigation into this material is being undertaken by two of the Sub-Group members.

c) and d) Mineral Grains and Voids.

Neither of these groups has received much attention. Criteria for the recognition of mineral grains are well documented in petrological and mineralogical texts. Stages in the weathering of minerals are being considered by the Sub-Group on Weathering with which the Sub-Group on Organic Matter will liaise when considering criteria for describing mineral grains.

Voids within plant or animal material that arise during the alteration of such material are treated as voids rather than as part of the plant or animal structure. Only where the voids are part of the original structure e. g. intercellular voids are they treated as part of the plant or animal material. Like mineral grains there has been some good previous work on voids e. g. that of Beckmann and Geyger and Brewer, and this will be referred to when a scheme for voids is drawn up.

3. Description of the basic components

A tabular system for the listing and description of thin sections is proposed and the following has been tested on numerous photomicrographs and thin sections.

Each basic component can be subdivided for purposes of description in a number of ways, for example on the basis of size, where the same component occurs in two or more size classes or on the basis of internal structure, in cases where there is a difference in a certain basic component in terms of degree of preservation or alteration. In the description table, the criterion used to sub-divide a particular component is marked with an asterisk.

Some basic components are more restricted than others in the number of criteria by which they can be described. Monomorphic and polymorphic material have no size or shape and voids no internal structure or colour.

The final column 'Origin' in the table is for the listing of the origin of each basic component where this is certain or can be assumed e.g. tissue type, organ type, plant species etc.

4. Units of Second Level

A second level unit is the simplest recognisable unit in the thin section that results from the arrangement of one or more basic components. It differs from other second level units in at least two characteristics unless there is no transition between the particular unit and other second level units in which case only one characteristic need be different.

Second level units are described under the following headings :

(a) Basic components that occur in each unit and the relative amounts of each component in the unit.

(b) The distribution of the components in the unit.

(c) The size of the units.

(d) The shape and distinctness of the units.

An example of some types of second level unit is given in Fig. 1.

Of all the descriptive criteria used for second level units, that of related distribution is the least satisfactory and there is a need for a related distribution system pertinent to organic material.

5. Units of Higher Level

Third level units are ones arising from the arrangement of one or more units of second level together with, in

some cases, basic components not included in second level units. A Third level unit is distinguished from other third level units by at least two characteristics unless there is no transition between it and other third level units in which case only one characteristic is needed. Third level units are described by the same criteria as for second level units.

It is likely that only a limited number of types of second level units occur and still less types of third level and higher level units. As soon as the descriptive system has been worked out in more detail, names will be given to units of second and higher levels.

Future Work

A comprehensive Guide Book is planned in which the Basic Components and Levels of Organisation will be treated in detail, with emphasis on illustrations and worked examples.

The Chapters on Basic Components have been assigned as follows : (i) Organs, Tissues and Cells (including fungi) to Dr. U. Babel (Germany) and Madame Dr. C. Jeanson (France). In addition to definitions, these chapters will include schematic illustrations of the alteration stages of the main types; (ii) Polymorphic and monomorphic organic material to Dr. P. Bullock (Great Britain) and Dr. A. Jongerius (The Netherlands), including a consideration of sub-types.

In addition, members have been asked to prepare a series of papers, initially for internal use, on the microfabrics of peat, moder, raw humus, mull, anmoor, plough layer and spodic horizon. These will form a basis for the work of the subgroup on microfabrics.

2nd Level Unit (2. 3) Name : Oribatid mite dropping. Components: Polymorphic material (4), cell wall residues ?(1) Random basic distribution; unrelated referred distribution; 50–80 um in size; oval to circular, prominent.

3rd Level Unit: 3. 1 Name: Clusters of Oribatid mite droppings (1–5) Vughs (1–5). Clustered, rarely random basic distribution; unrelated referred distribution; 0. 5 x 0. 5 mm – 1x1mm; rounded to elongate; distinct.

3rd Level Unit : 3. 2 Name : Tissue fragments. Components: Unaltered tissue fragments (3); altered tissue fragments (2). Random basic distribution ; unrelated referred distribution ; about 2 x 1 mm; distinct.

4th Level Unit :

Components; Clusters of Oribatid mite droppings (1), Tissue fragments (3) Voids not included in 3. 1 or 3. 2 (1). random basic distribution ; unrelated referred distribution; porphyroskelic related distribution; size 3 x 2 mm.

Xeroranker (Plate Ib)

Basic components	2nd level	3rd level	4th level
1. 1 Organ residues	2. 1 (1. 2, 1. 3, 1. 4)	3. 1 (1.7,2.2,2. 3)	
1. 2 Tissue residues			
1. 3 Polymorphic material	2.2 (1. 2,1.3,1.4,1. 5)		4
1. 4 Quartz	2. 3	3. 2	(3.1,3.2)
1. 5 Mica	(1.1,1.2,1.3,1.4,1.5)	(1.7,2.1,2.2)	
1. 6 Vughs	2. 4		
1. 7 Compound packing voids	(1.1,1.2,1.3,1.4, 1. 5, 1. 6)		

2nd Level Unit 2.1 Name: Fine droppings
Components: polymorphic material (4), quartz and tissue residues (1).

Random basic distribution; unrelated referred distribution; porphyroskelic related distribution; about 40um diam.; irregular; distinct.

2nd Level Unit 2.2 Name: Coarse droppings.
Components: polymorphic material (3) tissue residues (1), quartz and mica (1). Distribution as for 2.1; 100-600 um diam., subangular; distinct.

2nd Level Unit 2.3 Name: Small aggregates.
Components: Polymorphic material (3), tissue residues (< 1) quartz (< 1) mica (< 1). Distribution as for 2.1; 600-2mm in size, subangular, distinct.

2nd Level Unit, 2.4 Name: Large Striotubulic aggregates.
Components: Polymorphic material (3); vughs (1); organ residues (< 1), tissue residues (< 1); quartz (< 1). Distribution as for 2.1; 1x1 mm in size, distinct.

There are two third level units which would be described in a similar manner to those in Plate Ia. One is a dense arrangement consisting of coarse droppings, small aggregates and compound packing voids, the other a loose arrangement consisting dominantly of coarse and fine droppings.

There is one fourth level unit covering the whole of the photomicrograph.

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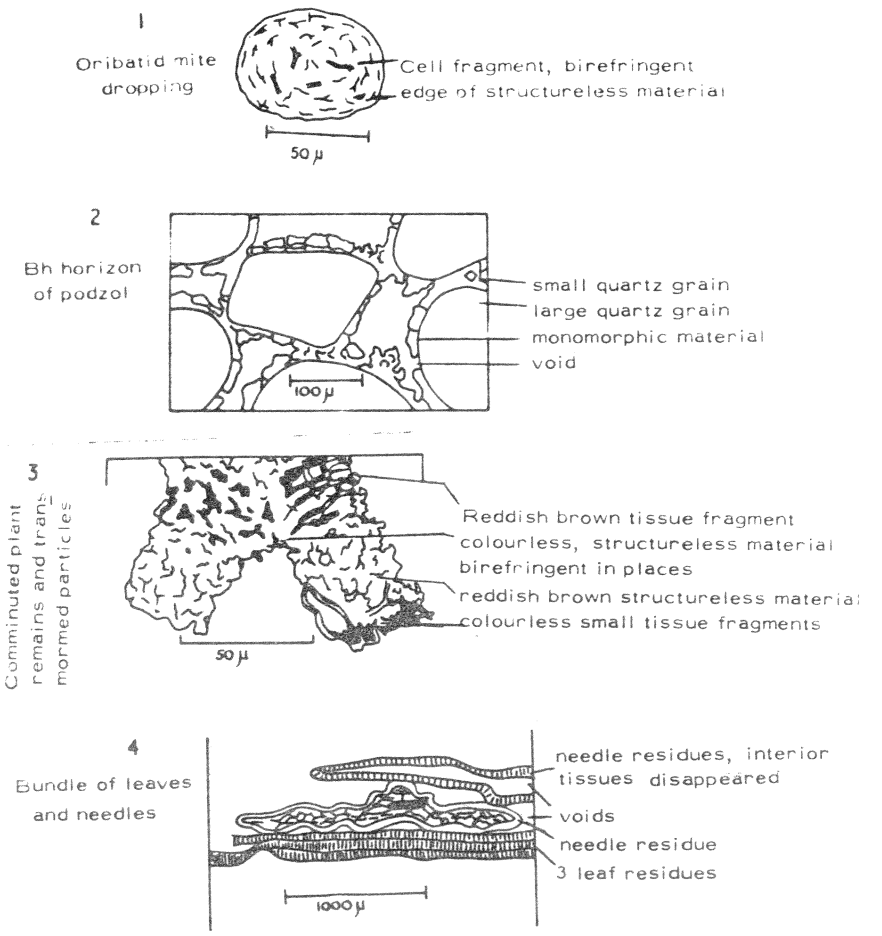

Fig. 1 Some examples of second level units.
1) Oribatid mite dropping; 2) Bh horizon of podzol; 3) Comminuted plant fragments and transformed particles; 4) Bundle of leaves and needles.

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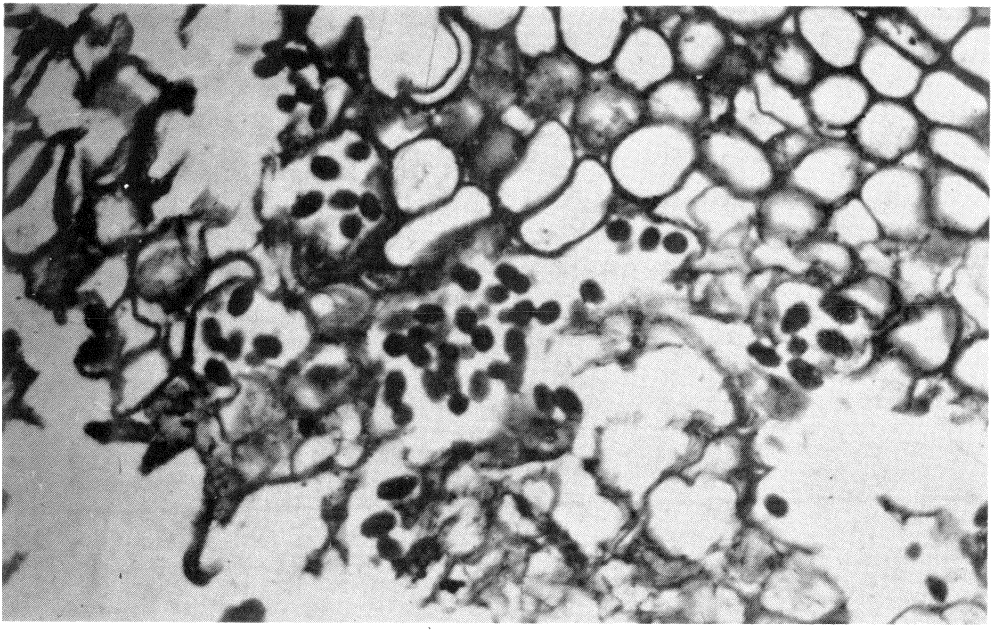
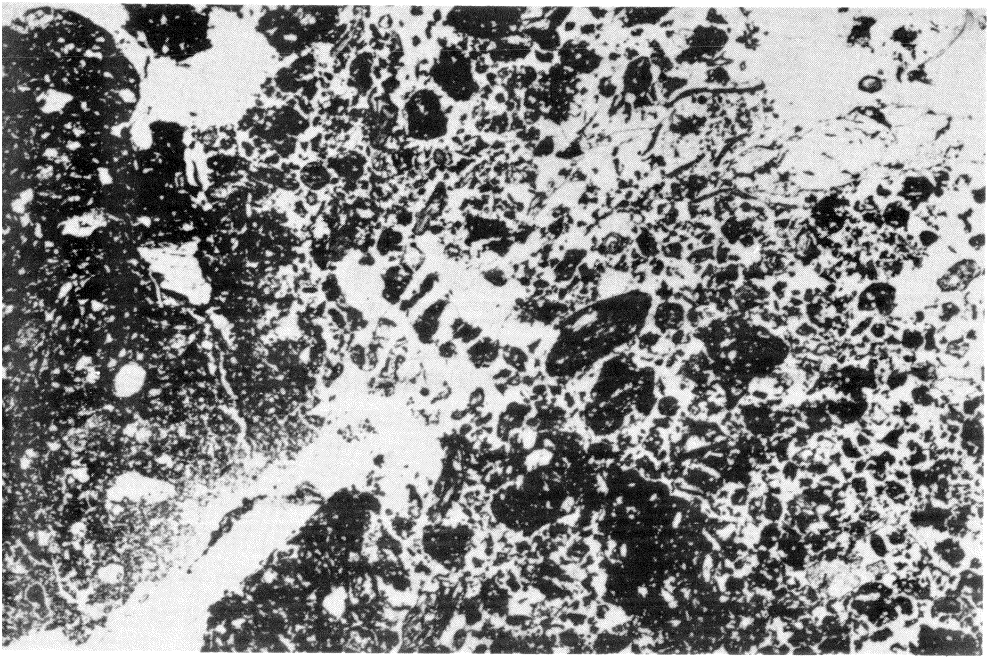
PLATE I



A L/F layer from podzol



B A Horizon of Xeraranker