AMANI MEMOIRS

COMPOSITE UNITS FOR THE MAPPING OF COMPLEX SOIL ASSOCIATIONS

BY

G. MILNE

EAST AFRICAN AGRICULTURAL RESEARCH STATION,
AMANI

CONTRIBUTION FROM
THE EAST AFRICAN AGRICULTURAL RESEARCH STATION

REPRINTED FROM
THE TRANSACTIONS OF THE
THIRD INTERNATIONAL CONGRESS
OF SOIL SCIENCE
VOL. I, 1935

LONDON
THOMAS MURBY & CO.
PRINTED IN GREAT BRITAIN

G D Anderson.

[*From the* TRANSACTIONS OF THE THIRD INTERNATIONAL CONGRESS OF SOIL SCIENCE, Vol. I., 1935. London : Thomas Murby & Co.]

COMPOSITE UNITS FOR THE MAPPING OF COMPLEX SOIL ASSOCIATIONS

G. MILNE

(*East African Agricultural Research Station, Amani*)

It often happens that two or more soil types, whose profiles and conditions of formation differ fundamentally, are found in association together, their boundaries forming a pattern which is repeated, with variations, over a considerable extent of country. It is, of course, possible, given the resources of an organised survey, to map such a piece of country in detail; but unless a large-scale map is the object in view, there still remains the problem of generalising the information thus laboriously obtained, for convenient and fair representation on a smaller scale. In the undeveloped countries of the tropics the method of detailed survey is rarely practicable, and the description of such an area must depend on the investigation of sample localities and the discovery of a key that will explain matters for the whole area. The problem is then, not the mapping of soil types individually, but the schematic rendering of an *association* or *physiographic complex* of soils, defined in general terms in relation to a set of conditions.

The units of ordinary classification (even the more inclusive ones, the great soil groups) will not serve this purpose, for they are, by definition, too homogeneous to accommodate complexes of soils whose members differ from each other in the important classifying properties. To select one particular soil group as the zonal type for the region, and in small-scale mapping to suppress the others as intrazonal or atypical, subtracts from our information instead of expressing it, and must be judged too arbitrary a solution except when the " atypical " soils cover an insignificant proportion of the total area. What is required is a composite summarising unit, the use of which, whether in verbal descriptions or on maps, shall denote a specified kind of complex of differing soils.

These complexes are a major element in the soil geography of East Africa. Throughout a district characterised by a particular type of hummocky or undulating topography, or rather by a given set of physiographic conditions *including* the necessary topography, a certain sequence of changing soil profiles is found repeated. A typical example, met with over a large part of the dissected peneplain of Uganda, is described (from the text of W. S. Martin and G. Griffith) in another communication to this volume (1). Here the complex comprises the soils encountered between the crest of a low hill and the floor of the adjacent swamp. A somewhat similar sequence, lacking the top member of the Uganda complex owing to a difference in the physiographic history of the district, is found in the foothills of the Usambara Mountains, in Tanganyika. In landscape different from these in many respects, but still with a repeated change of level from crest to hollow, complexes essentially of the same type, though with different member-soils, form the surface of large parts of the high inland plateaux. Even in the plains, where the changes of level are hardly perceptible, the soils alter, often fundamentally, between a slight watershed and a slight depression, and an over-simple description may misrepresent matters. The soils found in these complexes thus differ in different divisions of the country, but the type of association is recognisably the same: always the distribution of the soils is a function of differences of level.

For this common type of association I have elsewhere (2) (1935) proposed the name *catena*, a generic term which can be made specific by prefixing a locality-name. Thus the Usambara foothills complex is called *the Tengeni catena*, from the name of a former sub-station of Amani where the sequence of profiles has been studied. The word is intended by its derivation to serve as a mnemonic, the various soils included in a catena corresponding to the links in a hanging chain.

A convenient means of representing catenary complexes on a map is to colour the area in question in vertical stripes, using the colours that stand for the two, three or four principal types. The relative width of the stripes expresses approximately the proportionate importance, as regards the area they occupy, of the several types. Thus broad stripes of red alternating with narrow stripes of blue may indicate that throughout the area so coloured, red earths and black clays occur according to the lie of the land, the red earths occupying the greater extent of ground. This method has been adopted in drafting the East African Soil Map.

Since the first recognition of these catenary associations, it has become apparent that we have to deal with two different classes of them. In one, the parent material does not vary, the topography having been modelled out of a single type of rock at both the higher and the lower levels. In this case the soil differences are brought about by differences of drainage conditions, combined with some differential reassortment of eroded material and the accumulation at lower levels of soil constituents chemically leached from higher up the slope. Such is the Tengeni catena mentioned above, and the complexes of the plains. In the other kind, the topography has been carved out of two superposed formations, so that the upper one now forms the capping of the hills or ridges, and the lower one is exposed further down the slopes. Here a geological factor is added to the other conditions that make for soil differences. In such circumstances we may have as the top member of a catena an old soil or its denuded remnants (on formation A); younger soils below (on formation B, with some admixture of secondary material); and an accumulation of the erosion-products of both in the bottom-lands. To this type of complex belong some of the occurrences of the Uganda catena, where the perched " murram " beds, now carrying only a thin remnant soil with accumulated quartz fragments, form a capping on the flat-topped hills. Another example has been previously described (*loc. cit.* (2)) from central Tanganyika, where granite is overlaid by a thick crust belonging to a former cycle of weathering and both crust and granite are now being cut into by current erosion. On a more striking scale is a soil complex described by E. O. Teale (3) (1929) in the Kibondo district of western Tanganyika. Here the foundation of the country is lava, and from this a rich heavy chocolate-coloured soil is derived. The hill-top and plateau areas carry a grey light stony loam derived from a mantle of shale and chert which once completely buried the lava. In the bottom-lands are ironstone beds or grey clays. The whole is a catenary complex of the second kind.

It may be desirable ultimately to distinguish the two kinds of catena by different generic names, or possibly to reserve the term for the first and simpler kind only. At present, however, the same notation is used for both.

Two kinds of non-catenary complex have had to be recognised during the preparation of the East African map. They are illustrated

by one example each from Tanganyika. (1) On the flood-plain of the Kilombero River the ruling soil type is a heavy black clay, but there are known to be localised occurrences of other types such as true alluvial fans of current formation, or accumulations of loose sand. The extent and exact location of the subsidiary types is not known, but their existence should not go unmentioned when mapping the district. For this irregular type of complex the notation used is small discs of the colours for the subsidiary soils on a background of that for the ruling soil. (2) An association depending in great measure on the pattern of the geological outcrops appears to occur along the Indian Ocean coast, extending as far inland as the limit of the sedimentary rocks. Here the position allotted to a soil in classification is strongly influenced by whether it has developed on a loose sand, a sandstone, a limestone, or a clay, whose properties were determined in a previous cycle of weathering. The complex of soils that results is sometimes catenary, but usually the outcrops are not related in a simple manner to differences of level. For a long time to come such a region can only be described in general terms and mapped diagrammatically, though the various soil types that occur are known from the investigation of sample localities. The notation used is scattered discs of the colours for the recorded soil types, on an uncoloured background.

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[1] MILNE, *et al.* *This volume*, p. 271.
[2] MILNE, G., *Soil Research*, 1935.
[3] TEALE, E. O., "The Soil and Agricultural Development in Relation to the Geology of portions of the Northern Kigoma and Southern Bukoba Provinces." *Geological Survey, Tanganyika*, Short Paper No. 4, 1929.