

THE BENEFIT OF THE KNOWLEDGE ABOUT THE INTERTROPICAL SOILS TO THE DEVELOPMENT OF SOIL SCIENCE : contribution of French soils scientists

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The study of the intertropical soils, which has been conducted since about forty years by French scientists in collaboration with numerous scientists from the intertropical countries, has largely contributed to the evolution of the concepts, the methods and the knowledge of soil science in general.

There are four main contributions :

1 - The soil is defined first by its specific structures which are observed from the crystal and the cell to the drainage basin and the regional landscape. There can be, between the different types of structures of the soil mantle, some space and time relations which are revealed by the detailed analysis of the vertical and lateral distributions, of the constituents and structures, at the different levels. Some observations and dynamic measurements confirm that certain space and time relations exist and show that the structures which result particularly in porous systems, concentrations of certain constituents and horizon interfaces, etc., play, at all the levels, some essential roles in the physico-chemical, mechanical and biological soil dynamics.

The four dimensional organization of the soil mantle could often be revealed in the intertropical zone. The lessons which must be drawn are of two types :

— At all the levels, some soil features, types of horizons and soil types, which are generally considered as very different from each other, are, in fact, closely related :

- they are related in space, vertically and laterally, and often over great distances: lateral relations and lateral transfers of matter were observed over and over again within some soil mantles ;
- they are related in time, that is to say that they follow each other in time in the same zone, through the self development of the soil mantle or the variation of the external factors.

Space and time relations are obviously closely imbricated : the space distributions of the soil structures, namely of the various types of soil features, of voids, of aggregates, of horizons, of superposition of horizons and of toposequences, often reveal the various stages of the evolution in the same soil mantle. The similarity between the vertical, lateral and time structural distributions could even be revealed at the different organizational levels in some soil mantles.

— The organizational unit, "the soil as an individual", which must be known analysed and will be used for the mapping and the transfers of knowledge, can not be represented by a single model. This forces to reconsider the approaches to mapping, typology, taxonomy and classification.

2 - The soil evolution produce mineral concentrations. The pedological origin of high monomineral and subsurface concentrations of alumina, iron, manganese, kaolinite, smectites, carbonates, sulfates and chlorures, was demonstrated over and over again. The mechanisms of concentration are mainly processes of weathering, transfers, relative or absolute accumulations, epigenesis, of new minerals, all this within a structural system which is subjected to a constant evolution and which governs the concentration processes but also results from them.

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3 - The soil is active in the relief formation. The considerable phenomena, in the intertropical zone, of chemical weathering, of matter removals, of residual mineral concentrations, allowed to show that the role, in the relief formation, of the geochemical and differentiation processes of the soil mantle, is not limited only to the preparation of a material easier to erode. The reliefs are also rectified through the mineralogical transformation, the geochemical removal and the modification of the water circulation within the soils and at the top of them.

4 - Man has a great influence on the transformation of the soil. The disequilibrium caused by the clearings and by certain cultural techniques, often and rapidly lead to considerable morphological modifications, some of them being similar to the slower ones which have been characteristic of the soil history before the human intervention. Moreover, the soil mantles being highly structured, highly differentiated, vertically and laterally, being the sites of vertical and lateral transfers and of rapid and considerable structural modifications, all this forces to reconsider the approach to the soil fertility. The main lesson which must be drawn is that, when speaking of the soil fertility, of what it is today and of what one expects it to be tomorrow, one must be careful that :

1) Fertility is not defined only from the characteristics of a pedon, but by the characteristics of a more extensive soil assemblage whose vertical, lateral and time variations must be known ;

2) In order to know fertility, one must take account, with priority, of the detailed morphological features and of their relations with the other soil features, mainly the physico-chemical ones, as well as of their relations with the mechanisms of soil evolution and with the plants.

All this forces to reconsider the conception of the agronomic experimentation whose localizations and modalities must take account of the structures of the soil mantle.

All these results lead to reconsider how the soil mantles must be studied and used : structural analysis, mapping, classification, agronomic experimentation, diagnosis of the soil fertility, recommendations concerning the soil use.