

THE USE OF THE CLIMATIC FACTOR IN FRENCH SOIL
CLASSIFICATIONS

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Soil classifications have been developed in France since the twenties when ACAFONOFF⁽¹⁾ carried out his first studies on the soils of this country. Before world war II various other studies were carried out both in France and abroad. New soil classifications were proposed by OUDIN⁽²⁾ and DEMOLON⁽³⁾.

But, just after the war, considerable soil surveys were performed both in the metropolitan area and in French speaking countries in Africa, Madagascar, in the Far East, in various Pacific islands, and other places under the leadership of G. AUBERT. In North Africa, other teams of soil scientists were at work, many of them, such as BOULAINÉ, DURAND, GAUCHER, made valuable contributions to the knowledge of the soils of that part of the world.

Soon, soil classification projects were sketched out by AUBERT⁽⁴⁾. AUBERT AND DUCHAUFOUR⁽⁵⁾ proposed a joint one in the 1956 International Soil Congress held in Paris. In 1965, AUBERT presented a new system during Soil classification Symposium held in Ghent. From 1963 to 1967, various soil scientists met in Paris and proceeded to the restatement of a classification system known as the CPCS⁽⁶⁾ one. This system never received any official broadcast, but is however considered ever since as the official French Soil classification system. Indeed, it is used by French pedologists both at home and abroad.

Afterwards, various modifications were proposed by DUCHAUFOUR⁽⁷⁾, but the general idea was not modified. In all the systems referred to, the climatic factor, has been, from the very beginning, used as a differentiating criterion. The reference to climate in this paper refers only to the above mentioned systems. ACAFONOFF⁽⁸⁾ is probably one of the first to speak of climatic zones and to locate France in the weakly

(1) ACAFONOFF, 1927, 1936. (2) OUDIN, 1937. (3) DEMOLON, 1944.
 (4) AUBERT, 1954 à 1965. (5) AUBERT et DUCHAUFOUR, 1956. (6) CPCS, 1967. (7) DUCHAUFOUR, 1965, 1970. (8) ACAFONOFF, 1927.

podzolic zone. He divided the territory in an occidental strip with "a milder and more humid climate" and an oriental strip with a "more continental and less humid climate". A third soil zone, in the south-east is called mediterranean, which corresponds to the "subtropical mediterranean climate".

This first paper is quite meaningful in relation with climate. No figure, no reference with any climatic system are given; the wording is quite hazy.

In the DEMOLON⁽¹⁾ scheme, the reference to climate is made through such terms as "soils of cold regions" or "mediterranean soils". No definition is given.

In the 1956 "Projet de classification des sols" by AUBERT and DUCHAUFOR⁽²⁾, climatic conditions appear mainly at subclass level, as some of the factors responsible for the evolution of soils. But they appear also at other levels.

In raw mineral soils, in rankers, a division is provided for climatic and non climatic soils which means that the former are closely related to climatic conditions, whatever they are, and the latter are not. In calcimorphic soils, the "Steppe soils" subclass supposes a bioclimatic implication, a particular vegetation closely related to a particular climate. Ferruginous soils of hot climates are divided into "red mediterranean soils" and "ferruginous tropical soils". Climatic implications can also go further down to group level such as in "Black tropical soils" or "Brown temperate soils". But usually, the information given for groups and subgroups refers to morphology rather than to climate. As in the above mentioned systems, no definitions of climates are given.

(1) DEMOLON, 1944. (2) AUBERT et DUCHAUFOR, 1956

During the following years, various modifications are introduced in 1965 by G. AUBERT⁽¹⁾. During a symposium held in Ghent, he puts the French classification into a more elaborate shape. A new concept is introduced, the pedoclimate, which is considered as "difficult to specify, but bearing great influence on the evolution of soils". But this pedoclimate is followed by such hazy wording as "cool winters", "rather high mean temperatures", "cool but not cold, rainy season". In this paper, also, appears reference to "subtropical or mediterranean regions" by the means of "subtropical chestnut soils" and of "brown subtropical isohumic soils". In the class of soils rich in sesquioxides "pedoclimate is warm enough during the humid period". Reference is made here of "red and brown mediterranean soils". No real definition of any pedoclimate is given and no attempt is made to separate "mediterranean" of one class from "subtropical or mediterranean" of another.

In 1967, appears the CPC\$ system which again refers to pedoclimatic conditions. But no real definition is proposed. However, the importance of this concept is stressed upon as a "notion of temperature and soil humidity", in relation or not with local climate. A new expression is proposed as "physico-chemical surroundings" (ambiance physico-chimique), which is devised to show that "temperature, humidity, oxydation and reduction, cationic contents of soil solutions" are most important. Throughout the system, references are made to climatic conditions. For instance, in the "raw mineral class": cold desert or warm desert soils, in the andosol class soils of cold countries, and of warm countries. But pedoclimate is considered important especially in "isohumic soils" in the usual precision lacking terms. The Brunified soil class is divided into four subclasses based on climatic types: humid, temperate, continental temperate, boreal

(1) AUBERT, 1954 to 1965.

and tropical. No attempt is made to define them, and it is implied that this will be done later on. The podzolized class is divided into three subclasses, the first two are separated on climate basis; temperate and cold, the third on pedoclimatic. In the two following classes, the climatic factor appears no more and is replaced by morphological characteristics in one and physico-chemical criteria in another, where they are supposed to be closely related with the climatic factor.

In the various editions of his Pedology Handbook, DUCHAUFOR⁽¹⁾ and DUCHAUFOR and COLL⁽²⁾ have modified some of the units (such as andosols), but the reference to climates or pedoclimates is unchanged. In his project of Ecological classification, DUCHAUFOR⁽³⁾ proposes three main divisions; temperate or cold climate soils, warm climate soils, and other soils conditioned by other factors (such as salt or water).

To end this review, I should like to refer to a recent paper by BONNEAU⁽⁴⁾ in the second volume of DUCHAUFOR and SOUCHIER'S "Pedologie". The definition of pedoclimate reads as follows; "Temperature, water regime and oxygen content are the components of a climate peculiar to the soil; the pedoclimate". A table gives the main pedoclimate types, given in the same terms as in the classifications referred to hitherto.

It appears as a strong evidence to all soil scientists that soils depend on various factors among which the climatic one is most important. It has been felt absolutely necessary to many of them to introduce the climatic factor in the classification (see for instance DURAND⁽⁵⁾). After a careful scrutiny of the way it was used by French pedologists, one may reach various conclusions..

(1) DUCHAUFOR, 1965, 1970. (2) DUCHAUFOR et SOUCHIER, 1977. 1979. (3) DUCHAUFOR, 1976, (4) BONNEAU, 1979, (5) DURAND, 1954.

1. Two different approaches have been used. The first one is climate itself, in relation with broad geographical belts such as boreal, temperate, mediterranean, tropical etc. The second one is the notion of pedoclimate which appears in various schemes during the last decades.

2. The climatic factor usually appears at the subclass level but it can also do so at class or at group level. Reference to this factor is never an obligation and it can be replaced by some other factor.

3. The main characteristic of the climatic or pedoclimatic factor is that it is never accurately defined. Nobody can be satisfied by the lack of definitions of terms such as temperate, subtropical, tropical. There is still no progress if climate is replaced by pedoclimate referred to as "cold and humid all year long" or "moderately warm" and so on. A real effort of definition is necessary to overcome this obvious drawback.

4. In various publications, French pedologists feel it necessary to go further. For as BONNEAU writes: "For the time being, no pedoclimate classification has been set up".

So, at this moment, it appears that, in the French classification, reference to climatic factor (climatic type or pedoclimate) is not appropriate for at least two reasons.

1. The first is that its formulation lacks accuracy and should not be used in the terms proposed.

2. The second is that the climatic factor is always referred to with a genetic implication and not to make predictions for use; the soils we study are genetically related with the climate or pedoclimate we observe today. But nowadays, more and more pedologists are not so sure about that. They doubt that the soils we observe and the climate around them are so closely related.

So, some French pedologists think :

- that any reference to the climate as a genetic factor, at least in the higher levels of the classification, should be dropped, or pushed down to a low level, if use predictions are to be made.
- that the definition of climate and/or pedoclimate should be done with utmost care, using climate classification schemes, reliable climatic figures, avoiding vague adjectives.

However, we all know that soils are the product of a long history, that climatic factors and pedoclimate may have changed several times. So it appears more reasonable, when we are classifying soils, to take into account the soil characteristics resulting from climate and pedoclimate everybody can agree upon. But we must always refer to these climatic data whenever we are studying pedogenesis and or the best way to use the soil now.

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