Processes of Soil Formation and Development  
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THE INFLUENCE OF ENVIRONMENT ON SOIL FORMATION

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It is generally agreed that five factors of soil genesis and several processes, working together, account for the formation of practically all soils (3). The first four of the familiar five factors, viz., parent material, climate, biological activity, and relief, are definitely geographic in character; while the fifth factor, time, or age of the soil, is so closely related to the physiographic and geological status of the landscape that it also may well be included as a geographic factor.

Differences in soil formation, corresponding to differences in geographic environment, are of unequal rank and may be grouped in three orders as follows: First order, zonal differences, due to differences in climatic and associated biological activity; second order, local or intrazonal and azonal differences, corresponding to local differences in parent rock, relief, biological activity, and age of the soils; third order, regional and local differences, due to the activities of man.

SOIL DIFFERENCES OF THE FIRST ORDER  
CLIMATE AND LIVING ORGANISMS AS FACTORS  
in SOIL FORMATION

Soil differences of the first order correspond to differences in climate and accompanying differences in the types and activities of vegetative cover and animal population. Köppen’s system of climatic classification summarized by James (6), and Thornthwaite’s (14) system, are both attempts to classify climate on the basis of its relationships to the distribution of the broad zones of vegetation. Both systems are based mathematically on the available meteorological data of the world and so can be reproduced by independent workers. The maps produced by the two systems indicate that Thornthwaite’s system is of considerably more value to the pedologist because its values show closer correlations with the distribution of soils and vegetation than do those of Köppen.

Thornthwaite emphasizes “precipitation effectiveness” (P-E index) and “temperature efficiency” (T-E index) and recognizes the following classes of each: P-E, wet, humid, subhumid, semiarid; and T-E, tropical, mesothermal, microthermal, taiga, tundra, and frost. Distribution of precipitation by seasons also is indicated by appropriate symbols. Precipitation effectiveness in the production of soils and of soils is controlled in a general way by the rate of evaporation which, in turn, depends to a large degree on the temperature regime. Rainforests, grasslands, steppes, and tundras correspond to the more inclusive climatic groups and provide the broad background for the formation of various great groups of zonal soils and associated intrazonal and azonal soils. Table 1 illustrates more important relationships.

On most types of parent material, the zonal soils, especially in the B horizons, have stronger and stronger saturation with red as one passes from polar to hot equatorial climates. Among the most notable exceptions to this are the sandy Podzols of the microthermal humid climates with their strong-brown B horizons. Soils developed from strongly calcareous materials of subhumid and semiarid climates probably be classified as intrazonal rather than as zonal.

Locally, the proportion of red in soil colors is less where soil moisture is high, and, since soil moisture is influenced by atmospheric humidity it follows that the proportion of red in soils is less where relative atmospheric humidity is greater. For example, the relative humidity of much of Kweichow Province in China averages more than 90% for the entire year and at no time is it low. In neighboring Yunnan Province precipitation is slightly more, but the relative humidity is less (60% to 70%), especially during winter. Temperature differences between the two areas are slight. The dominance of Yellow Podzolic areas of New Mexico and Texas, and Maverick-Uvalde areas of Texas (17). These soils appear to be equivalents of the Rendzinas of the more humid climates.