

the population (Ford, 1945). As a result, the geographical distribution of genes, and with them the resultant phenotypes, will be concordant.

While this concept of character concordance follows evolutionary theory well, the factual background from which it is drawn does not rightfully inspire the confidence taxonomists as a group place in it. Taxonomists seem to have forgotten the great complexities and disparities revealed in racial patterns by some really thorough analyses of geographical variation made in the past. Most of the prominent commentators on the theory of speciation have been careful to emphasize the inherently subjective and even arbitrary nature of racial limits. Here is a vastly unappreciated statement by Mayr (1942):

We have stated repeatedly that every one of the lower systematic categories grades without a break into the next one; the local population into the subspecies, the subspecies into the monotypic species, the monotypic species into the polytypic species, the polytypic species into the superspecies, the superspecies into the species group. This does not mean that we find the entire graded series within every species group. It simply means that in the absence of definite criteria it is, in many cases, equally justifiable to consider certain isolated forms as subspecies or as species, to consider a variable species monotypic or to subdivide it into two or more geographical races, to consider well-characterized forms as subspecies of a polytypic species or to call them representative species.

From our experience in the literature we are convinced that the subspecies concept is the most critical and disorderly area of modern systematic theory—more so than taxonomists have realized or theorists have admitted. Particular confusion surrounds the drawing of the lower limits of the subspecies category within that spectrum of classes recognized by Mayr as extending from “the local population into the subspecies.” The difficulties in this delimitation stem from four outstanding features of geographical variation: (1) the tendency for genetically independent characters to show independent geographical variation; (2) the capacity for

characters to recur in more than one geographical area, yielding polytopic races; (3) the common occurrence of the microgeographical race; (4) the necessary arbitrariness of any degree of population divergence chosen as the lowest formal racial level. It is our purpose now to illustrate these four features with the aim of re-evaluating the nature of geographical variation and of throwing new light on the subspecies concept as it is applied in taxonomy.

*Independent geographical variation.* Abundant examples of this phenomenon can be drawn from most careful analyses of geographical variation in a wide variety of animal groups. In his exceptionally complete work on “*Lymantria*” *dispar*, Goldschmidt (1940) finds eight characters which vary geographically (excluding chromosome size; cf. Makino and Yosida, 1949), none of which is in exact geographical concordance with any of the others. Several of the characters may be used by themselves to make striking racial divisions by cabinet standards, or they may be used in various combinations to achieve different results. Goldschmidt formally establishes five races by utilizing combinations of characters in size and coloration, while at the same time recognizing that “the number of subspecific types could be greatly increased by going into more and more intricate differences.” In fact, Goldschmidt’s data affirm that the number of races discernible increases as a function of the number of characters taken into consideration. This classic work is doubly important because it illustrates that physiological characters, such as degree of sexuality, rate of larval development, vary geographically just as do the more obvious adult morphological characters ordinarily used in lepidopteran taxonomy.

Moore (1944) surveys variation of the common leopard frog, *Rana pipiens* Schreber, in eastern North America, giving special attention to the characters stressed by authorities who had formerly divided the species into three geographical groups