Contributions to the Genetics, Taxonomy and Ecology of Drosophila pseudoobscura and Its Relatives. By TH. DOBZHANSKY AND CARL EPLING. Carnegie Institution of Washington Publication 554, 1944: i–vi, 1–183, pls. 1–4, 24 figs. $2.25 (paper), $2.75 (cloth).

THROUGH a series of recent researches, among which those of zoologist Dobzhansky and botanist Epling are outstanding, *Drosophila* has been elevated to a position of pre-eminence in speciation as well as in genetics. Such work is effectively filling in the chasms that long split biology into zoology and botany, and each into systematics and genetics, into morphology and physiology, into "closet biology" and "natural history," into observational and experimental subsciences. The way is now being cleared for more unified advances, with more penetrating and more secure attacks on such central problems as evolution.

A skillful combination of genetic experiment and of cytological observations on the giant salivary chromosomes has disclosed races of *Drosophila* that are characterized by different arrangements of the gene-file along one or more chromosomes. It is shown by a brilliant analysis (1) that the several arrangements can be attributed plausibly only to series of inversions and (2) that their phyletic sequences can be postulated with little doubt. This is something distinctly new in a phylogeny that is unsupported by a fossil record. The chromosomal type has been determined for an immense number of individuals representing many populations over western North America and in Mexico and Guatemala. As a consequence it has been possible to analyze the data along several west-east and north-south transects. These exhibit very definite clines, and permit reasonable inferences in regard to the origin and spread of the genetic types.

In two respects such chromosome races appear to have only a limited bearing on the speciation process as it is generally interpreted. In the first place the chromosome

types do not seem to involve other differences, such as might be employed in routine systematics. Secondly, since the chromosomal arrangements are indicated (by a clever statistical analysis) to have little or no selectional significance they are probably not involved in adaptive speciation, which presumably is the usual sort. Nevertheless the thorough analysis of these chromosome types proves very significant.

The chromosome races illustrate beautifully the genetic heterogeneity of species. They are so numerous as to be practically uncountable, occupy very restricted areas and are constantly changing. These and other races are interpreted as genetically open systems through which genes of other conspecific races are free to pass. They are defined in Dobzhanskian style as "populations characterized by different frequencies of the variable genes and chromosome structures."

There appears, however, to be some inconsistency in Dobzhansky's concept of races. After stating that different genes or gene arrangements may flow independently through a species, he asserts that "an individual may, in this sense, belong to two or more races at the same time." But if, as Dobzhansky writes, races are groups of individuals, not single individuals nor single genotypes, then each individual can belong to only one population, except in so far as that population may be split into smaller aggregates or lumped into larger ones. The evolutionary organization of races, by which the characters of each are rendered increasingly uniform and distinctive, appears to be somewhat slighted in studies, like the present one, which are focused on the genetic mechanisms.

With this background of race analysis (written by Dobzhansky) and of the studies on taxonomy, distribution, ecology, dispersal, seasonal cycles and general natural history (worked out by the two authors in collaboration), Epling speculates boldly and interestingly on the ancient history—we might say prehistory—of raciation

in *Drosophila pseudoobscura* and its allies. Leaving an area of solid ground where every concept rests on an abundance of fact, he steps out onto the bog of hypothetical phylogeny. He does not, however, sink wholly out of sight, as many have done on the same ground. Before postulating an historical basis for the present organized pattern of race distribution he plausibly disposes of alternative explanations: wide dispersal by winds, separate origins of each race, and natural selection of chromosome types. Reviewing data on the geological history of the west he abandons the opinion of Dobzhansky and Sturtevant (1938) that the present distribution of *Drosophila* races was determined in relatively recent, perhaps Pleistocene or post-Pleistocene time. Regarding the Glacial climate of the west as having been too much like that of the present to have permitted the establishment of the observed distributional patterns, he dates the origin of races differing only in chromosome arrangement from Miocene or earlier. This seems to me to be an inherently improbable estimate, and my studies of fish distribution in the Great Basin and elsewhere lead to the view that during late Glacial time the whole western region was sufficiently cold (not warm) and moist to allow the establishment then of the present distribution of the *Drosophila* races.