COMPARATIVE EVOLUTION AT THE LEVELS OF MOLECULES, ORGANISMS, AND POPULATIONS

G. L. STEBBINS
UNIVERSITY OF CALIFORNIA, DAVIS
R. C. LEWONTIN
UNIVERSITY OF CHICAGO

1. Introduction

Nearly all modern biologists who study evolution agree in believing that the rate and direction of evolution is determined by interactions between different processes, all of which are significant and none of which can be neglected. A synthetic theory of evolution, in some form or another, is here to stay. Five processes are recognized to be of basic significance. Two of these, mutation and gene recombination, contribute to the genetic variability that exists in all populations of higher organisms. The other three, selection, chance variations or gene fixations, and reproductive isolation, tend to reduce genetic variability, but are most significant as determiners of the rates and directions of evolution.

In spite of general agreement that all of these processes exist and may be significant at least under some conditions, great disagreement exists as to their relative importance. These differences may be due in part to the fact that the relative importance of different processes differs considerably from one group of organisms to another. Furthermore, even in the same evolutionary line great differences exist with respect to the relative importance of mutation, recombination, selection and the effects of chance when different molecules or even parts of molecules are compared with each other. Consequently, agreement and understanding are most likely to be reached by intensive studies of comparative evolution. Comparisons must be made both with respect to the evolution of entire organisms that belong to different evolutionary lines, as well as with respect to the evolution of different individual molecules or molecular systems in organisms belonging to the same evolutionary line. In accordance with the subject of the present conference, the comparisons to be made in this paper will be largely at the molecular level. Nevertheless, analogies to the evolution of molecular systems and of organs will be made when relevant.