populations rather than among individuals. This is especially true for species that make their living by colonization and rapid occupation of new habitats, only to be supplanted rapidly by a more stable community. I am suggesting that weedy species, because of their high rate of deme extinction, may undergo a reasonable amount of evolution at the population level, even though individual selection may be a sufficient explanation of their adaptations. Nature does not always operate by the simplest mechanism, and the principle of parsimony is only a methodological convention, not a fundamental revelation of the structure of the universe.

Occasionally Williams' argument turns against him. I think, for example, that his discussion of genetic assimilation misses the point. Certainly no one claims that genetic assimilation occurs by any means other than by Darwinian selection. It is simply that for some developmental systems organisms that give up developmental flexibility for the assurance of a particular morphology will leave more offspring and are, *ipso facto*, better adapted. Williams' argument that genetic assimilation of a previously facultative response must be a loss of adaptation smacks of the very viewpoint his book is intended to combat. It is not possible to react instantly to a change of environment and the delay may be painful or fatal, so it is sometimes better to build in the response even in the absence of the stimulus. Before the calluses come the blisters, as I discover anew each summer when I first row a boat.

Despite such reservations, however, I believe that Williams' book is excellent in its totality and that it is 95 percent correct. Most of the characteristics of organisms, including social behavior, must be the result of differential fitness at the level of individual genotypes. Only a small part of evolution, although perhaps its most intriguing aspect, has occurred as a response of groups to a higher level of differential fitness.

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Lattice Defects in Quenched Metals

At high temperatures, crystalline solids are literally riddled with holes: many lattice sites which ideally should be occupied by atoms are instead vacant. This phenomenon is in a sense the inverse of the vapor pressure of condensed matter, as if the vacuum were "evaporating" into the solid. Thus, the concentration of vacancies increases rapidly with increasing temperature, often approaching 0.1 percent near the melting point.

One of the more fruitful and interesting methods for studying lattice vacancies appeared in 1952, when J. Kauffman and J. Koehler showed that it was possible to retain most of the vacancies during very rapid cooling from a high temperature. By measuring the effects of quenched-in vacancies on various physical properties, primarily the electrical resistivity, and by observing the annealing out of the excess vacancies, information concerning the thermodynamic and dynamic properties of both isolated vacancies and associated pairs, called divacancies, can be obtained. Unfortunately, the interaction of vacancies with themselves, with impurity atoms, and with other defects often complicates the picture, so that different investigators have not always agreed on the experimental results or their interpretation.

Another aspect of the problem which has received considerable attention during the past eight years is the study of larger-scale defects produced by precipitation of the excess vacancies. Depending on the ambient conditions, the vacancies may aggregate to form voids, stacking fault tetrahedra, and various prismatic and faulted dislocation loops. All of these larger defects have been observed directly by means of transmission electron microscopy. In addition, their effects on the mechanical properties of quenched metals are readily demonstrated.

The present book, **Lattice Defects in Quenched Metals** (Academic Press, New York, 1965. 829 pp., $22), edited by R. M. J. Cotterill, M. Doyama, J. J. Jackson, and M. Meshii, consists of the papers and discussions offered at a conference devoted exclusively to defects in quenched metals. The conference was held at Argonne, Illinois, in June 1964. The book is a timely documentation of a field of investigation that is expanding. Some of the contributions give extensive surveys of experimental results, but there is little of the tutorial review that the nonspecialist would find desirable. Thus, this book is certainly not intended for the general or casual reader, but is frankly addressed to those physical scientists whose research deals with, or is affected by, lattice defects.

The overwhelming majority of the papers are concerned with face-centered cubic metals, and especially with aluminum and the noble metals. There is extensive treatment both of the experimental techniques and methods of analysis. The effects of specimen size and purity, of dislocation content, of quenching temperature and quenching rate, and of various post-quench treatments are analyzed to yield information concerning the energies and entropies of formation and of migration of single vacancies and of divacancies, as well as information on the interactions of vacancies with impurity atoms and dislocations. A wealth of electron micrographs illustrates a variety of larger defects formed by vacancy aggregation, and a number of models are proposed to account for the aggregation processes.

The problems attacked in this work involve really microscopic features of defects in metals, and it is perhaps not surprising that some questions remain unanswered and that the conference proceedings occasionally display a lack of unanimity. In some cases, such as the question of the binding energy of the divacancy in gold, one could almost say that there appears to be little uncertainty—only disagreement. This is, of course, the result of intense interest in a rather complicated problem. The really amazing thing is that we can now begin to zero in quantitatively on such elusive targets, and the detailed picture supplied by the manuscripts of this volume represents as complete an account as one could hope to find of this particular corner of solid state science.

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Earth Sciences

Textbooks on solid-earth geophysics tend to polarize between an elementary survey approach and a specialized advanced presentation. Among the former, there is a variety of available books on earthquake seismology, internal structure of the earth, and explora-