Book Reviews

Insect Populations: The Central Question

The Ecology of Insect Populations in Theory and Practice. L. R. CLARK, P. W. GEIER, R. D. HUGHES, and R. F. MORRIS. Methuen, London; Barnes and Noble, New York, 1967. 246 pp., illus. $8.

One of the most important but least tractable problems of ecology is the identification of the mechanisms that control population density. In the search for laws governing abundance of organisms, ecologists have posed the central question: Is population density self-regulating? If it is, then abundance can be said to be stabilized and nature balanced in the strict sense. Entomologists have played a leading role in the development of the subject, and they have been responsible for the formation of two sharply opposed schools of thought. One group, which began with C. W. Woodsworth, L. O. Howard, and W. F. Fiske nearly 60 years ago and more recently has included H. S. Smith, A. J. Nicholson, and M. E. Solomon, has argued from deductions and fragments of empirical evidence that density *must* be self-regulating. If it is not self-regulating, that is, if "density-dependent" factors do not at some point or other come into play, then density-independent factors must force population numbers up and down in a random-walk pattern until they either become astronomically large or go to zero. In its extreme form—as exemplified by the recent "social conventions" theory of V. C. Wynne-Edwards—this interpretation assumes the occurrence of self-regulating mechanisms to be universal and to involve elaborate adaptations on the part of many species.

The opposing argument had its origin in the more recent "physical factor ecology" of F. S. Bodenheimer and B. P. Uvarov and has been most effectively advanced in some of the writings of H. G. Andrewartha and L. C. Birch. The latter authors have attacked the density-dependence argument as no more than a beguiling mental construction. They have cited cases in which most of the fluctuation in population can be accounted for by correlated fluctuation in weather variables, and they have assigned density-dependent factors to a minor, even trivial role in nature.

Meanwhile, data suitable for the resolution of the problem have been inconspicuously accumulating in long-term studies of insect populations. A majority of these studies concern pest species and have been conducted over a period of years by economic entomologists striving for practical results and with no theoretical axes to grind. The importance of the book under review is that it provides the first thorough, objective evaluation of enough of these results to begin to make some real sense of the matter. The truth as seen by Clark *et al.* is not at all simple, as of course one might have expected from the nature of the controversy. It might be very roughly summarized as follows: Density-dependent controls are widespread and possibly universal, but they vary immensely in kind and in the frequency and intensity of their operation from species to species. In some species these controls are paramount, holding numbers relatively steady or locked in predictable oscillations, whereas in others they are lax or even absent over long periods of time, with the result that weather gains nearly complete sway. The details are spelled out in intensive accounts of ten of the best-studied insect species. Objectivity is achieved by the regular use of original data and lengthy quotations from the original authors. Much of the material had previously been limited to entomological journals and agricultural house organs and was not well known, even to those population ecologists with the greatest stake in the matter. To select one example, I was especially interested in the account of the role of polymorphism in the oscillations of the Engadin Valley, Switzerland, populations of the gray larch budmoth. According to the authors' interpretation, at low densities a "strong" form gains the advantage by virtue of higher reproductive capacity and tendency to disperse; then, as high densities are reached, the "weak" form is favored because of its greater resistance to granulosis virus; next it begins to replace the "strong" form, only to be attacked by hymenopterous parasites which favor it differentially, thus starting the cycle back down again. Characteristically, nothing approaching this particular form of density-dependent control was found in the other nine species reviewed.

The book is at its best in its dispassionate review of earlier contending hypotheses and the small but growing set of case histories that are beginning to select among them. It also contains a good deal of practical advice for economic entomologists planning population studies. It is weak in its neglect of the mathematical theory of demography and competition, which to an extent seemingly unappreciated by the authors forms the conceptual basis for most of the current empirical research. The writing is also uneven and in spots distressingly pedantic or defensively vague—in other words, the mark of the committee is upon it. The weaknesses of the book are such that it will not be very suitable as a textbook, but it will make valuable extra reading for both graduate students and professionals. In sum, a notable contribution to the literature of ecology.

E. O. WILSON

Biological Laboratories, Harvard University, Cambridge, Massachusetts

Development of Optics

Historical Aspects of Microscopy. Papers read at a conference, Oxford, England, March 1966. S. BRADBURY and G. L'E. TURNER, Eds. Published for the Royal Microscopical Society. Heffer, Cambridge, England, 1967. 235 pp., illus. 42s.

A better title for this book would have been "Papers on the History of Optics and the Study of Vision," since only one-fourth of it is devoted specifically to the microscope. In particular, the entire first half is occupied by a long and fascinating paper on "The mechanistic hypothesis and the scientific study of vision" by A. C. Crombie which discusses ancient and medieval concepts of the mechanism of vision, and leads up, like a mystery story to its solution, to the discoveries