Despite its occasional shortcomings, the book is well worthy of the attention of the uninitiated, who will derive from it much delightful instruction.

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NATURAL CONTROL OF ANIMAL POPULATIONS

The Distribution and Abundance of Animals

By H. G. Andrewartha and L. C. Birch. Pp. xv+782. (Chicago: University of Chicago Press; London: Cambridge University Press, 1954.) 112s. 6d. net.

THIS large monograph begins by rejecting the relevance of any study of whole animal communities or ecosystems to the understanding of distribution and numbers of animals. It then proceeds to take a firm stand against the general use of mathematical models and, in particular, of ideas connected with biotic relationships and density-dependent processes between populations, as explanations of events in Nature. The authors believe that the regulation of numbers does not exist in the sense hitherto examined in theoretical and laboratory population ecology. They believe that most fluctuations consist of the natural recovery of populations each time after minor or major catastrophes, or at any rate changes, which have reduced them, and that these are usually brought about by weather; that is, the system of control of numbers in Nature contains only one compensatory process—the innate capacity for increase, pitted against the chaos of outer Nature. This summary of their views is, of course, necessarily a simplification of a tome that contains an extremely large amount of hard intellectual work, valuable case-histories from a number of laboratory and field studies by various people, and a genuine attempt to reduce to logical order the very diffuse field of population ecology (though even here, it is chiefly terrestrial ecology and, within that, the ecology of insects that has provided the main material).

After about fifty pages of preliminary statements, and two chapters on diapause and on dispersal, taking the reader to p. 125, there are two hundred pages about the effects of temperature, moisture and light, which are interesting in their own right as source material, necessary to the later theory, but not in themselves conclusive as regards the latter. This central section, "Analysis of Environment", continues with about two hundred pages more about biotic relationships such as competition within and between species, predator-prey relationships, food, and so forth. Most of this section about population relationships is written in a highly critical, often polemical, manner, and it forms a sustained and oddly contemptuous attack on what the authors regard as the dogma of the regulation of numbers through varying density-dependent processes based proximately upon biotic links. It does not seem likely that the reader will be entirely impressed by the implication that nearly all previous research in the subject is irrelevant to the interpretation of field population changes, or that the study of simplified mathematical models and their testing in the laboratory is misleading. There is certainly a real dilemma, recognized by all sensible ecologists, between studying the complexity of naturally inter-

spersed populations with their ecological connexions, subject to variable outer conditions of climate and vegetation (and often the actions of man as a super-power), and the delimitation for study under controlled conditions of parts of this system at a level of precision that will satisfy scientific criteria.

Apart from the last fifty pages, which deal with some genetic matters in ecology, the rest of the book is an attempt to provide a new theory of the control of population density, illustrated by a few examples from the field. The latter include some of the authors' own research upon insects in South Australia. The facts adduced are most interesting, and should be studied dispassionately by ecologists. The trouble one has is that there are as yet practically no field measurements of populations of anything like the refinement possible in the laboratory. For all practical purposes at the present time, we know no more about the behaviour in the field of the innate capacity for increase than Malthus did. The notion of innate capacity for increase, with its stable age distribution, is really quite as highly theoretical and abstract a tool for study as the equation for the logistic curve, or Volterra's predator-prey theories. Apart from the human material originally used, it is so far based entirely upon laboratory work with populations living in supposedly defined conditions. The authors have, indeed, substituted for what they consider a dogma, another just as theoretical and with rather less common sense behind it. In spite of the air of certainty that pervades this large book, there are striking inconsistencies like this. These may not appear obvious at first reading. The style is lucid and the learning great, but the thoughts behind are not always illuminated. It is not clear why so large a part of the book deals with density-dependent processes studied in the laboratory, and yet rejects their application to field events. There are some strange remarks on important topics: for example, that something cannot be a general theory unless it describes a substantial body of empirical facts; that "one would not expect to come across a limiting density in any finite number of observations"; and that only individuals, not populations, can be said to have an environment.

There is, however, so much that is useful and provocative to thought, and it is so sincerely tackled and expounded, that one can forgive the authors a certain amount of word-splitting and special pleading. It is less easy to overlook their evident refusal to understand the way in which scientific thought has to advance in a complex field, by the proper use of abstractions and inductive reasoning. Perhaps it is a good moment for ecologists to try to assess how far our existing knowledge can take us in deciding the relative parts played in the regulation of numbers by self-limitation (though intra-specific competition), other biotic relations, and influences like varying weather, refuges and the like. But I cannot believe that the natural communities of the world will be found to have evolved solely "by guess and by chaos", or that the inter-relations of animal populations have not introduced a gradual order into the structure of animal communities.

The book is well produced, though it could have been half as large and had ten times as many readers; there are, however, some misprints in mathematical formulæ. All research ecologists are recommended to read it in order to try to decide whether, as the dust-cover announces, it provides "a new, satisfying and workman-like theory".

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