Book Reviews

A Guide to the Practice of Modern Taxonomy

Principles of Systematic Zoology. ERNST MAYR. McGraw-Hill, New York, 1969. xiv + 434 pp., illus. $12.50.

This volume is in origin an extensively revised edition of the book on similar topics published in 1953 by Linsley, Mayr, and Usinger. Besides the advantages to be expected from any revision, the book has benefited by not attempting to deal at any length with subjects such as quantitative zoology or evolution theory which are adequately covered in other recent texts. As a result it is an extremely lucid account of all the topics, both theoretical and practical, which are necessary for the practice of modern taxonomy. The lucidity derives in part from the author's strongly held views, sometimes expressed in a slightly authoritarian manner; on the whole I find that the advantages of this method considerably outweigh the drawbacks. Even if at a few points one disagrees with the author one is at least certain what he means and what his objections are to other interpretations.

The author follows G. G. Simpson in distinguishing taxonomy (the theory and practice of classifying organisms) from systematics (the science of the diversity of organisms). It is advantageous that one of these two terms should not be wasted by making them, as in the recent past, synonyms, though one might argue as to which is which. One aspect of the scope of taxonomy is illustrated by the table on pages 11 and 12, in which the numbers of described species in the animal kingdom, estimated at 1.07 million, of which three-quarters are insects, are given. After the introductory chapter, the subject matter falls into three parts: the principles of zoological classification (chapters 2 through 5), the methods of classification (chapters 6 through 11), and zoological nomenclature (chapters 12 and 13). This is followed by a bibliography and a useful glossary.

The section on principles seems to me outstandingly successful, though I suppose it might also be regarded as the most controversial part of the book by those who held other views on some of the topics. I find myself agreeing with most of Mayr's suggestions and definitions, which in many cases express my own vague ideas better than I myself could have. The plan of the book is such that it is convenient to read chapter 2 (the species category) and chapter 3 (polytypic species and infraspecific categories) in conjunction with chapter 9, which deals with the more practical subject of taxonomic decisions on the species and subspecies level. According to the author's view, which I think nearly all biologists must share, the species is the only taxonomic category that has at least in more favorable examples a completely objective existence. Higher categories are all more or less a matter of opinion. The definition that "species are groups of interbreeding natural populations that are reproductively isolated from other such groups" is one that is often difficult to apply strictly in practice, but this is probably irrelevant. The definition sets out the aims of a taxonomist rather than his day-to-day activities; in particular it focuses attention on the idea that species include a more or less private gene pool. In groups such as the insects which are still in many families very imperfectly known, decisions must be made largely on the basis of experience and by analogy with the best-studied cases.

Opinions differ as to the utility of the naming of subspecies or geographical races. I am inclined to agree with Mayr that this is a useful device for supplying much essential information in a condensed form. The method is not invalidated by its misuse in the past. After all, a great deal of taxonomy suffers from past errors which, owing to the historico-legal aspect of zoological nomenclature, are difficult to dismiss as completely as one could wish. Doubtless subspecies are more useful in some groups than in others, but even this may largely be a matter of the extent of our knowledge of different kinds of animals.

The fourth chapter gives a short but very satisfactory account of the history of zoological classification, a somewhat more complex subject than one might at first suppose. A gradual liberation from a priori theories was finally accomplished by Darwin, who showed that the best classifications are always those that are founded on degrees of kinship or the extent of shared gene pool. There is, however, still possibility for disagreement, since the classification tends to serve two rather disparate purposes—the identification of specimens and the arrangement of taxa in a logical evolutionary scheme. It is desirable to keep these two aims as separate as possible, but if only for economy of space this cannot always be done in publications. Identification is usually facilitated by dichotomous keys, and the main virtue of these is that they can lead one quickly and easily to the right answer. A classification, on the other hand, may use many features that are difficult to detect in preserved material and may on the basis of characters that are weighted after study of the whole group associate forms that are superficially very different and that would not fall very near one another in a practical key. Mayr also has useful things to say about the "splitting" and "lumping" of taxa and the principles that should guide the taxonomist in making a rational compromise. Chapters 6, 7, and 8 deal with the practice of taxonomy, the forming of collections, the process of identification, the sort of characters that taxonomists have found useful, and the methods of analyzing variation. While many sound and useful ideas are presented, it is difficult to cover the field except in a rather general way because of the vast number of animal species and their great heterogeneity. In practice, the satisfactory study of each family (at least in insects) is apt to require a knowledge of certain tricks of the trade such as how to preserve specimens in a way that allows important characters to be visible and undamaged. In many groups it is desirable to have specimens preserved both dry and in some fluid, much as some of the older museums seem to dislike spirit collections. It is

particularly difficult to indicate what sort of characters are likely to be taxonomically valuable. New ones are being discovered all the time, and the only real criterion of a "good" character is that it leads to good results. The proof of the pudding is always in the eating.

Chapter 10, which deals with the procedure of classifying, is especially concerned with recognition and grouping of the higher taxa. It includes a discussion of Hennig's views. Mayr replaces Hennig's terms "plesiomorph" and "apomorph" by "ancestral" and "derived" as being more neutral and more self-explanatory. He does not follow Hennig in putting much more weight on the point where groups diverge than on the amount of change that has occurred since divergence. Thus he is happy to treat the birds as a class and to put the crocodiles from which they diverged with the reptiles. He also has a useful discussion of numerical taxonomy, which has become a bandwagon for taxonomists who cannot afford the Rolls Royce of molecular biology. His views, described very succinctly, are pessimistic about the value of the numerical work done so far but not altogether so about the future. The last chapter in this section deals, in a very practical way, with the publication of results and will be very useful to students.

Finally, the volume concludes with two chapters describing the code of zoological nomenclature and how to interpret it. This is essentially a dismal subject. All one can say in mitigation is that if we had no rules we should probably be worse off. It seems impossible for human beings to agree on these topics, and for that reason some code to which we can all refer appears to be essential. Mayr gives a brief history of the subject, sets out the whole code, and comments on a large number of points on which opinions often differ. These chapters also are very useful for a working taxonomist, though they will not attract workers in other branches of zoology.

It will be seen that I regard this book as a major contribution to general zoology, of special value not only to working taxonomists but also to the many zoologists with other interests who want to find out what the names of the animals they study really mean.

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Ordering the Phenomena of Ecology

Evolution in Changing Environments. Some Theoretical Explorations. RICHARD LEVINS. Princeton University Press, Princeton, N.J., 1968. x + 120 pp., illus. $6.50. Monographs in Population Biology, No. 2.

How much does the evolved complexity of life owe to its physical setting? Cracked, contorted continents; tidal oceans; a blanket of capricious vapors—were these the necessary cradle for life? Are they a continuing incentive? Is it perhaps no mere coincidence that Darwin found the physical grandeur of scenery as much an inspiration as its living mantle? In his old age Darwin wrote of his regret that age had diminished his once intense love of landscape; it seems that the mind which first saw clearly the process of evolution was a mind unusually laden with memories of rivers, islands, deserts, and mountains. These distilled, evidently, into the habitats and barriers of his theory. Since his time our estimate of the importance of the physical pattern has certainly not decreased, but many questions remain. Is physical heterogeneity as important for macroevolution as it is for speciation? Should dolphins look back to the birth of their intelligence on land as we should look back, perhaps, to the birth of ours in the canopy of the forest? Concerning that forest itself, did its mazy richness originate in the plains where it now stands or in the more broken and physically tougher world of bordering mountains and savannas?

These are some of the thoughts stimulated by reading *Evolution in Changing Environments*. They seem rather effusive for the severe pages of *Science*, but I record them as showing the breadth of relevance of this small book and as associations hovering indistinctly behind the seemingly dry concepts and technical problems of evolutionary theory which are discussed within. This is a very theoretical essay which pauses only briefly to point to possible illustrations of the new concepts or to data which may bear out predictions from the theory. The subtitle is "Some Theoretical Explorations," and the reader must be warned to expect more of "adaptive landscapes," "gene pools," and "pure white noise" than of mountains, lakes, and birdsong. I feel that the book could well have been less dry. For example, so little detail is given of the living complexity of real examples of a community that one is led to wonder what the author's idea of one actually is. From the book one might gain the impression that the animal communities of Caribbean islands consist almost entirely of species of *Drosophila*, which are sometimes eaten by lizards and a polymorphic spider—the last, in one table, floating in on an archipelago of quaint-named islands. However, this point is in passing; the book could have gained in more serious respects by being longer. First let me say what I found good.

It is stimulating and provocative. It begins with a persuasive defense of theoretical biology and with a particular plea for a theory which tries to reduce the manifold phenomena of ecology to some sort of order without waiting for the nearly impossible preliminary of descriptive precision in physical and chemical terms. The models of the book are to sacrifice "precision for generality and realism" —meaning especially the realism of environments that are spatially diverse, changing, and themselves partly made up of living systems. The author is more concerned with the general shape of phenomena as described in mathematical terms than with quantitative predictions. At the same time he sets out to discover formulas that will summarize the data of population and community ecology in much the same way that sample mean and variance summarize a variate. Quantities of this kind he calls "sufficient parameters," and they are to facilitate meaningful description and comparison of the entities to which they refer: species, communities, genetic systems, and so on.

This approach seems to me very promising, and the first of the new conceptional tools which Levins presents—the idea of the fitness set and adaptive function—raised my expectations high. This tool cuts a fair chip from the problem of his title, and will provide a useful way of visualizing an important problem. Already I see certain situations in the "classical" theory for unvarying environments in a new light. To give an example of its application, the idea gives us a basis for thought about a very diverse set of developmental polymorphisms differentiating cells, castes of social insects, migrant versus nonmigrant behavior in birds, immediate germination versus dormancy in seeds, and so on. Fitness set analysis, as the author calls it, is