The principles of taxonomy*. During the last few years there has been a great upsurge of interest in the principles of classification—not only in biology, but in many other disciplines. The recent formation of an interdisciplinary classification society is tangible proof of this interest—and proof, also, of a realisation that there are many basically similar problems in the classification of such diverse 'objects' as, for example, living things, soils, languages, and diseases.

In the field of biological taxonomy two publications* of first-class importance have recently appeared, *Principles of Angiosperm Taxonomy*, by Davis & Heywood, and *Principles of Numerical Taxonomy*, by Sokal & Sneath. These two volumes bring together, admirably and comprehensively, a vast range of modern work on taxonomic theory and method, and the two pairs of authors are to be warmly congratulated on their labours—as are their fellow biologists on the opportunity to enjoy and profit by them.

First, let me outline briefly the plan and contents of each volume. Davis & Heywood, of course, cover the wider field. Their nearly six hundred pages are divided into an Introduction, followed by fourteen chapters, a section entitled "Conclusions", a most valuable combined Bibliography and Author Index of over forty pages, and an Index of subjects and organisms. The first four chapters deal with the theoretical basis of classification in general and of biological classification in particular, while chapters five, six, and seven review "the taxonomic evidence", morphological, cytological, and phytochemical. Chapters eight and nine describe taxonomic methods and techniques in "field, herbarium and library", and, in the remaining five chapters, the authors review in detail the taxonomic treatment of a wide range of "biosystematic" phenomena, such as phenotypic plasticity, apomixis, ecotypic differentiation, speciation, and hybridisation. The whole volume thus presents as comprehensive an account of modern angiosperm taxonomy as could be desired, and, as the bulk of the theory applies equally to other plants—and also to animals—the book should appeal to all biologists interested in classification.

Sokal & Sneath open their first chapter with that boon to reviewers—a summary of contents! The volume is divided broadly into three sections. The first section (chapters one to four), as they state, "provides a background to the field of taxonomy in general and an introduction to numerical taxonomy in particular", and so covers, to some extent, the same ground as the opening chapters of Davis & Heywood.

In the central section (chapters five to seven) are discussed the choice of characters, the estimation of taxonomic resemblance, and the grouping of organisms into taxa on the basis of this resemblance. The final section (chapters eight to ten) "deals with the implications of numerical taxonomy for systematic research", including its relation to phylogeny, nomenclature, and diagnostic keys, and is rounded off with a chapter on possible future developments in biology and on the application of mathematical techniques to fields other than the classification of living things. An Appendix describes, in detail, the mathematical methods used in numerical taxonomy, and will, I fear, appear rather formidable to the majority of biological readers! There is a sixteen page bibliography, and indexes to authors and to subjects. Sokal & Sneath's book is the first comprehensive introduction to their subject, by two pioneers of the mathematical approach to taxonomy, and henceforward there will be no excuse for ignorance of this young and rapidly developing field.

*Principles of Angiosperm Taxonomy by P. H. Davis and V. H. Heywood. Edinburgh, Oliver & Boyd, 1963. xx, 556 p., 42 figs. Price 95s. (or, as paperback, 75s.).
Principles of Numerical Taxonomy by R. R. Sokal and P. H. A. Sneath. San Francisco and London, W. H. Freeman & Co. 1963, xviii, 259 p., numerous figures. Price 60s.

So much—very briefly—for the scope of these two excellent volumes. What is the significance to biological taxonomy of their appearance at this time, and how may they affect the future development of the subject?

During the last thirty or forty years, two schools of thought on the aim and purpose of biological taxonomy have crystallised out. For the first, and still the more orthodox school, the primary aim of the classification of living things is to express their "phylogenetic relationship". For the second, it is to make a broad map of the diversity of the animal and vegetable kingdoms, based on overall resemblance, and serving as wide a range of purposes as possible; such a classification may be *interpreted* phylogenetically, but it cannot be regarded as *based on* phylogeny, least of all in those groups, such as the Angiosperms, where fossil evidence is very scanty. Although Davis & Heywood's volume is primarily a survey of present views—and a very fair survey—they do not hesitate to express their support for the second, less orthodox, of the above two schools of thought, and their advocacy will undoubtedly have considerable influence, especially among younger biologists, in whose hands lies the future of biological taxonomy. The authors' arguments supporting their views are scattered throughout the volume and, to the present reviewer, are convincing and conclusive. One word of complaint: it seems a pity that, in a volume of this size, space was not found, in the first chapter, for a fuller discussion of the basic philosophical principles of classification, as an understanding of these is essential for a proper appreciation of the problems of biological taxonomy. There is no mention, for example, of Mill, Whewell, or Venn—nor even of T. H. Huxley's opening chapter "On Classification in General" in his *Introduction to the Classification of Animals* (1869). Perhaps this can be remedied in a second edition —and also, incidentally (one of the very few errors), the attribution of "isophenes" to T. H. instead of his grandson, Sir Julian (pp. 318 and 509)!

Sokal & Sneath also, of course, take broadly the same view of the aim and purpose of biological classification, since numerical taxonomy may be said to represent its most acute form! There is no doubt that mathematical methods do give a more accurate and objective assessment of overall resemblance than does the qualitative approach of traditional taxonomy, but I cannot avoid a gnawing doubt, expressed more fully elsewhere, as to whether this increased accuracy is relevant to the purposes of taxonomy. There is no point in using a sharper knife than is necessary to cut the cake on one's plate, however fascinating one finds the process of sharpening the knife! But even if the mathematical approach may prove less widely useful than its advocates hope in the sphere of a general purpose, phenetic taxonomy, there are certainly special purposes, such as, perhaps, the measurement of comparative rates of evolutionary change in series of fossils, where it will provide an ideal tool.

These two volumes, then, are not only excellent in themselves, but are also notable as signs of the fundamental rethinking about taxonomy that is being undertaken at the present time.

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