chemical characterization techniques are discussed. These include electrochemical techniques, radioisotope techniques, and x-ray fluorescence and photoelectron spectroscopy.

All of the chapters are by experts actively working in the field. Their contributions reflect the present state of the art. Even readers who do not intend to use the techniques can find valuable information in this book.

It is useful to have the various techniques of surface science gathered in one volume, and the book should find easy acceptance among surface scientists. Although it may not be useful to students, the book is a welcome addition to the libraries of most workers in the field.

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Chemosystematics of Plants

Chemistry in Botanical Classification. Proceedings of a symposium, Lidingo, Sweden, Aug. 1973. GERD BENDZ, JOHAN SANTESSON, and VERA RUNNSTROM-REIO, Eds. Nobel Foundation, Stockholm, and Academic Press, New York, 1974. 320 pp., illus. $27.50. Nobel Symposium No. 25. Medicine and Natural Sciences.

During the last 18 years we have seen a number of important developments in systematics. There have been philosophical and conceptual challenges to the classical assumptions and concepts, and there have been changes in methodology as a result of new tools such as the computer and the scanning electron microscope. A very important advance has been the widespread and systematic use of chemical characteristics in classification. This development was particularly important in botany because of the rich spectrum of chemical substances possessed by plants. It also marked the entry into the field of botanical taxonomy of scientists trained outside biology, largely in organic chemistry or biochemistry.

The present volume records the proceedings of a symposium which, according to the introduction, started "an important and useful dialogue between chemists and systematists." Although the dialogue has been in progress since chemosystematics began and the subdiscipline of chemotaxonomy has been noted in its brief life by the publication of at least one "synthetic" volume a year, the papers in the volume demonstrate that chemists and botanists are still not quite comfortable working together.

All but three papers are by active practitioners of chemosystematics, many of them trained as chemists. Two of the papers by nonchemosystematicists are by A. Takhtajan and A. Cronquist, who present the response of the traditional taxonomist to chemosystematics. They regard chemical compounds as an additional set of characters, to be treated in the way morphological and anatomical characters always have been treated. Both writers appear to be impressed by the possibilities offered by nucleic acid sequencing of proteins such as cytochrome c, but they seem to be less impressed by the information offered by the distribution of the betalins, in part, one suspects, because the former do and the latter do not fit in with classical schemes of classification.

The third paper by a nonchemosystematist, V. H. Heywood's "Chemosystematics—an artificial discipline," presents a critical, well-documented assessment of the subdiscipline of chemosystematics. Heywood points out that the taxonomic component of chemosystematics lacks the rigor of the chemical methodology. He also points out, however, that there have been a number of recent attempts to clarify the principles and concepts of systematics and that it is incumbent on chemists working in this field to familiarize themselves with these developments. He further points out that because the process of selecting, processing, and arranging data to produce a classification is still imprecise and subjective, it nullifies the rigor and precision with which the data are obtained. He thinks that the main service of systematics to biology and chemistry is in providing an "effective information system based on the taxonomically circumscribed classes." This allows all kinds of data (not merely chemical ones) to be stored, so that all kinds of relationships can be extracted when needed.

All the other papers are to a greater or lesser degree specialized reports on the distribution of special classes of compounds in the plant kingdom and their use in creating phylogenies. Most of them—notably T. Swain's "Flavonoids as evolutionary markers in primitive tracheophytes," J. B. Harborne's "Flavonoids as systematic markers in the angiosperms," W. Herz's "Pseudoguaianolides in Compositae," and D. Boulter's "The use of amino acid sequence data in the classification of higher plants"—are welcome updatings. The edited transcripts of the discussion following each paper are for the most part uninteresting, but the final discussion session is illuminating and one of the best parts of the book.

Symposium volumes are usually uneven, and this one is no exception. However, in view of the claim this volume makes to represent a dialogue between systematists and chemists it is important to note what is missing. Absent are spokespersons for the body of doctrine that has been called "numerical taxonomy." Only Heywood mentions this crucial aspect of systematics. Absent are presentations of new philosophical trends, particularly the phylogenetic theories of the Hennig-Brundin school. Absent are also spokespersons for population biologists and chemists working with isozyme distribution in populations, applications of chemistry that have revolutionized population genetics. Absent (except for a brief paper by Kullenberg and Bergström on pollination in the orchid *Orphrys*) is the entire body of information on the possible role of secondary compounds in the evolution of plants.

In his essay, Heywood writes, "For reasons which I do not entirely comprehend, the work of many chemical or biochemical contributors to systematics seem to be aimed at assisting in the elucidation of phylogenetic relationships within the angiosperms." This volume is an example of this preoccupation. However, as Heywood notes, "angiosperm phylogeny is not a major concern" to most biologists in the world. This is the main drawback I find with this volume: although entitled *Chemistry in Botanical Classification*, it is preoccupied almost exclusively with phylogenetic relationships at the family or suprafamily level. Moreover, even in this narrow area, the symposium fails to come to grips with the logical and philosophical problems that are involved in this approach, and does so at a time when they are being explored and debated in the literature. On the other hand, for the biologist interested in knowing what the latest contributions of chemistry and biochemistry to plant phylogeny are, it is an excellent review.

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