example, *Geologie, Zeitschrift für angewandte Geologie*, and *Hallesches Jahrbuch für mitteldeutsche Erdgeschichte* are not West German serials but East German. The *Geologische Rundschau* is not a society, but a journal published by the Geologische Vereinigung of West Germany, which happens to be shown on the next line in the listing. The very important geological map of southwestern Germany at the scale of 1 : 600,000, revised and published in 1954 by the Geologisches Landesamt Baden-Württemberg, is not mentioned. The geological map of Austria at the scale of 1 : 500,000, prepared by Vetters and published by the Geologische Bundesanstalt in 1923 and reportedly revised in 1968, is not cited.

In his preface, Rutten includes an engaging invitation to American geologists to visit Western Europe for geological field trips and other pleasures. He speaks of road maps, guidebooks, accommodations, and cost, and ends with reassurances concerning the quality of drinking water and bottled milk.

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Thermodynamics

The Computation of Chemical Equilibria. F. VAN ZEGGEREN and S. H. STOREY. Cambridge University Press, New York, 1970. xiv, 178 pp. $8.50.

This book deals with the following problem in thermodynamics: Consider a macroscopic system of one or more phases which (i) is free of external macroscopic fields of force, of anisotropic stress, and of the effects of curvature; (ii) is at all times closed; (iii) has at all times a composition defined by the mole numbers of a set of chemical species; (iv) is at all times in thermal and hydrostatic equilibrium; and (v) is initially not in chemical equilibrium. Now let this system reach chemical equilibrium at prescribed values of temperature and pressure (or, less often, of temperature and volume), imposed of course by suitable manipulation of external conditions. The problem then is: for any particular case, defined by numerical values of the initial mole numbers and of the final temperature and pressure (or volume), compute, from appropriate data, the numerical values of the final mole numbers. The needed data consist of the standard free energies, at the final temperature, of the species involved, or equivalent information in terms of equilibrium constants. To obtain the solution from these data alone one must neglect effects of pressure upon the chemical potentials of species present in condensed phases.

Awareness of this problem goes back more than half a century, and in the early 1940's a drive to solve it efficiently began in Germany, under the goad of rocket technology. Since then, this and other needs have led to impressive growth of the subject, mostly in the United States. Today the chief applications are to propellants and rocket motors, explosives, chemical processing, and biology, as in the study of cell chemistry, of the formation in nature of organic compounds from inorganic, and so of the origin of life. In all but the simplest cases the computations are impracticable manually. Their development could therefore not have occurred without the concomitant development of computers, and the authors even suggest that the latter development owes something to the former.

The authors group the techniques now available into two main types: (i) optimization methods, and (ii) methods based on the solution of nonlinear equations. Methods of type i proceed by finding the values of the mole numbers that make the value of the Gibbs (or in the temperature-volume case, the Helmholtz) free energy a minimum. Methods of type ii usually consist in solving the mass-action equations for the individual reaction-equilibria known or assumed to subsist. The boundary between the two types is not sharp, in that for instance a procedure starting out to minimize Gibbs free energy may lead to a set of nonlinear equations needing to be solved (this case is allocated to type ii). The two types are of course logically equivalent, and the authors give a proof confirming this.

In two central chapters the methods belonging to the respective types are individually discussed. This discussion is especially valuable for its running comparison of merits and defects of the various methods. The main conclusions from this comparison are usefully summarized in a table near the end of the book (p. 156). The discussion is valuable further for its copious and knowledgeable references to the literature. There is a bibliography of 154 items, of which 106 date from 1960 or later.

In their preface the authors express the hope that the book will be useful in three ways: as a guide to the available methods, for those who have specific problems to solve; as a graduate level text, particularly for students of chemical engineering; and as a summary of the current state of the field. This reviewer believes the authors have succeeded in the first and third objectives but not in the second. The main reason for the failure is that no specific examples are worked out in the text, and no problems are given for students to work. A further reason is, regrettably, the sloppiness of a good deal of the thermodynamic discussion, especially in chapter 1, entitled "Foundations." Thus the steps leading to the formula (1.2.26) for the chemical potential of a species in an ideal gas—a formula fundamental to most of the sequel—are specious.

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Sulfur Metabolism

The Biochemistry of Inorganic Compounds of Sulphur. A. B. ROY and P. A. TRUDINGER. Cambridge University Press, New York, 1970. xvi, 400 pp., illus. $18.50.

The appearance of this book at this time insures that a similar book written ten years hence will have answers, now lacking, to many problems in the biochemistry of inorganic sulfur compounds. The book is needed and well done. What is known, and not known, of the biochemistry of inorganic sulfur compounds is presented in a lucid, accurate, and well-organized manner. The coverage of the biochemical literature within the self-defined limits of the book appears essentially complete as judged from the sections within the ken of the reviewer. For the most part the authors are content with a direct reporting of the literature, and little attempt at synthesis is made. This is understandable in light of the primitive state of knowledge of many of the areas discussed. The authors are cautious in their conclusions and gentle, perhaps sometimes too gentle, in their criticisms.

The book starts with a brief consideration of the nomenclature of sulfur-containing compounds which not only is

helpful but also is adequate to convince the microbiologist that he has company in his nomenclatural miseries. Chapters on the chemistry, preparation, and analysis of inorganic and selected organic sulfur compounds follow. These accomplish the intent of warning the neophyte and initiated alike of the pitfalls to be avoided in exploring sulfur biochemistry and of providing usable introductions to methodology.

The biochemical coverage encompasses more than the title of the book might suggest. The sulfotransferases and sulfatases which catalyze reactions of sulfate esters are discussed in the same detail as rhodanese and the sulfate activation enzymes. Likewise, cysteine oxidation is included in considering the metabolism of inorganic sulfur compounds by animals. Apart from these, the reader can expect only incidental mention of organic sulfur metabolism but relatively complete coverage of the oxidation and reduction of inorganic sulfur compounds by microorganisms, plants, and animals. Two brief chapters on the clinical chemistry of inorganic sulfur compounds and economic aspects of inorganic sulfur metabolism are included in the interest of relevance. Both are short, the first probably of necessity and the second by choice.

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Mechanisms of Food Choice

Insect and Host Plant. Proceedings of the second international symposium, Wageningen, the Netherlands, June 1969. J. DE WILDE and L. M. SCHOONHOVEN, Eds. North-Holland, Amsterdam, 1969. Illus. Paper, $15. Reprinted from *Entomologia Experimentalis et Applicata*, vol. 12, pp. 471–810 (1969).

Probably all plant species are attacked by insects, at least to some extent, yet most phytophagous insect species exploit relatively narrow ranges of food plants in nature. Explanation for this specificity of feeding habits may be sought at two levels. Ecologists are interested chiefly in understanding the ultimate factors (nutrition, energy, habitat, competition, counteradaptations to plant defenses, and so on) that determine the evolution and maintenance of particular feeding strategies. Ethologists and many physiologists, on the other hand, are concerned primarily with the various proximate behavioral mechanisms by which an insect has come to be able to recognize the particular range of plants to which it is adapted. This symposium volume, containing 28 articles, is devoted largely to the second level of enquiry and serves as an admirable review of the very considerable recent advances in our understanding of the behavioral and electrophysiological mechanisms whereby insects are able to recognize their food plants.

Although there is general agreement that olfactory and gustatory responses to various plant chemicals play a major role in food-plant selection, there remains a lingering controversy (reflected and substantially resolved in this book) about the relative importance as "sign stimuli" of nutrient chemicals and the diverse "secondary substances." G. Fraenkel, a pioneer in this subject, here reviews the evidence for believing that secondary substances, acting as attractants or repellents, are of paramount importance. Articles by H. L. House and J. L. Auclair, however, emphasize the vital significance to insects of an appropriate balance of nutrients and the ability of several species to recognize nutritionally superior diets without reference to secondary substances. The most valuable feature of this symposium is a series of articles (V. G. Dethier and L. M. Schoonhoven; P. T. Haskell and A. J. Mordue; T. H. Hsiao; S. Ishikawa, T. Hirao, and N. Arai; C. J. C. Rees; L. M. Schoonhoven; W.-C. Ma) which provide a broad view of insect chemoreception and demonstrate beyond doubt that host-plant recognition involves responses to both nutrients and secondary substances. Many different chemoreceptor cells are now known, in a variety of insect species. Some are highly specific, some are "generalists"; some respond to nutrients, others to secondary chemicals. A single cell may respond in a variety of ways to different chemical stimuli or to different concentrations of the same chemical. The overall pattern of responses is modified by synergism or antagonism at the peripheral level and final integration in the central nervous system, and an insect thus obtains considerable information about the chemical composition of a plant from a relatively small number of chemoreceptors. The sensitivity of some receptors has been shown to change after prolonged stimulation (Schoonhoven), a phenomenon that may account for "larval conditioning" such as that reviewed here for *Pieris* caterpillars (Hovanitz).

Other topics discussed in this volume include anemotaxis in locusts (Kennedy and Moorhouse), a termite pheromone-food-attractant (Ritter and Coenen-Saraber), artificial diets (Vanderzant), hormone analogs in plants (Sláma), influence of nutrition on aphid polymorphism (Mittler and Sutherland), a phenol-phenolase system secreted by sucking bugs (Miles), and the pattern of interactions leading to susceptibility or resistance of plants to the red cotton bug (Saxena). This book is diverse, informative, and up to date. Though by no means comprehensive it can nevertheless be strongly recommended to all who are interested in the feeding diversity of phytophagous insects and the more general problems of ecology, behavior, physiology, and biochemistry upon which this sort of research is shedding so much light.

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Reptilian Anatomy

Traité de Zoologie. Anatomie, Systématique, Biologie. Published under the direction of PIERRE-P. GRASSÉ. Tome 14, Reptiles: Caractères Généraux et Anatomie. Fascicule 2. Masson, Paris, 1970, xii, 712 pp., illus., + plates. 225 F.

Biology of the Reptilia. CARL GANS, Ed. Vol. 1, Morphology A. ANGUS D'A. BELLAIRS and THOMAS S. PARSONS, Ed. xvi, 376 pp., illus. $11.50. Vol. 2, Morphology B. THOMAS S. PARSONS, Ed. xiv, 374 pp., illus. $16.50. Academic Press, New York, 1969-70.

These two encyclopedic works on reptilian anatomy are the products of distinctly different objectives. The *Traité de Zoologie* provides a general survey of reptilian anatomy, whereas *Biology of the Reptilia* treats the subject in detail. Because of these different goals, the *Traité* volume suffers from contrast with the first two volumes of *Biology of the Reptilia.*

The *Traité* chapters follow the classical anatomical divisions. This broad approach and the obvious space restrictions placed upon the authors result in a superficial coverage of many of the