as long as the chapter on Sweden and almost as long as the rest of the book. It also tends to intersperse within the main narrative sections of primarily local or historical interest. It is only in Finland, however, and mainly owing to the work of American and Russian geochronologists, that a sufficient number of radiometric ages are available to warrant the *raison d'être* offered for this book. Most of the dates based on rubidium-strontium or potassium-argon ratios cluster around 1.7 to 1.9 billion years, indicating a metamorphic event that reset the biotite clock throughout the Svecofennian and Karelian terranes. Lead-uranium and lead-lead ages give a greater spread, from 2.8 to 1.8 billion years. Russian geochronologists recognize three intervals of sedimentation, metamorphism, and magmatism in the Svecofennian and older rocks: (i) Katarchean, 3.6 to 2.8 billion years ago; (ii) Lower Archean, 2.7 to 2.2 billion years ago; and (iii) Upper Archean, 2.1 to 1.6 billion years ago. Post-Svecofennian rocks include the rapakivi-type of granites, 1.6 billion years old, and the (pre-sparagmitic) Jotnian sediments, 1.3 billion years old, including red quartz-sandstones. Above these are only Pleistocene sediments, except for sandstone "dikes" from one of which is reported a Cambrian brachiopod. A useful feature of this chapter is the chemical analyses of rocks, given as an appendix. Among other things this substantiates the contention, made at several places, that some of the very old Jatulian, Kalevian, and other orthoquartzites are indeed very pure quartz sediments.

Scattered through the book is considerable discussion of granites and granitization, the not-surprising concensus of which is that there are both magmatic and metamorphic granites—the magmatic mainly primorogenic or anorogenic, the granitized often migmatitic. Noe-Nygaard considers all of the Bornholm granites to result from granitization. The others see a range of types. Eskola presents the rapakivi granites as a classic example of a magmatic, anorogenic granite.

Although mention is made of various metals and ore deposits, economic geology is not stressed in this volume. One point of interest was the use of electromagnetic prospecting to locate copper deposits and graphitic zones beneath the Pleistocene cover.

The promised series will be a welcome one, for all the reasons so aptly summarized by Holmes. This first volume, however, is premature, in the sense that the numbers here cited are insufficient to meet in a really meaningful way Rankama's stated central aim—to "emphasize the classification, subdivision, and correlation of the Precambrian on the basis of exact ages" (p. vi). Future volumes would profit from a better balanced treatment of individual regions, a subordination of geographic boundaries, and a higher degree of focusing on the stated objectives. A treatise of this type also deserves bigger and better maps and a more comprehensive index.

## Biochemistry

**The Proteins**. Composition, structure, and function. vol. 1. Hans Neurath, Ed. Academic Press, New York, ed. 2, 1963. xiv + 655 pp. Illus. $22.

The welcome appearance of the second edition of *The Proteins* comes after a decade of unprecedented advances in the elucidation of the amino acid sequence and the three-dimensional structure of proteins. As the subtitle implies, the purpose is to relate the composition and structure of proteins to their function. This is the first of four volumes planned; it deals largely with experimental methods for amino acid analysis, peptide synthesis, and sequence analysis, and with the intramolecular bonds of proteins. Later volumes will cover the interactions and properties of proteins as macromolecules, their tertiary structure, and the characterization of protein systems of biological interest. Throughout, the focus will be on the interrelationship of the molecular structure and specific activity of proteins.

Although this is a multiauthored treatise, the content has been carefully selected and is well integrated. As evidence of the new viewpoint, none of the contributors to the first edition are represented in this volume with the exception of G. R. Tristram, who (together with R. H. Smith) has updated the tabular summary of the amino acid composition of proteins.

The first chapter, by Albert Light and Emil L. Smith, critically reviews methods of amino acid analysis, emphasizing preferred procedures and singling out special problems. The outstanding chapter by Klaus Hofman and P. G. Katsoyannis begins with an extensive critique of the methods and conceptual approaches to peptide synthesis; this is followed by examples of the synthesis and selective substitution of biologically active polypeptides to delineate the relationship of sequence and function. In an excellent chapter, R. E. Canfield and C. B. Anfinsen outline concepts and experimental approaches to the determination of the primary structure of proteins. Thereafter, intramolecular bonds are treated extensively, first from the chemical viewpoint by R. Cecil, who considers the role of sulfur in proteins, and then from the thermodynamic point of view by H. Scheraga, who evaluates the controversial subject of noncovalent bonds. The biological problems posed by the complexities of protein structure are presented in a historical review of protein synthesis by J. S. Fruton, who emphasizes the chemical aspects rather than the coding mechanism. Although extensive tables and many line drawings and formulas are included, pictorial illustration is sparse; only one colored and three halftone figures are included, and the structural formulas of proteins are set in too small type. This economy is more than compensated for by the wealth of material and the excellence of its presentation. Though wholly new in conception and execution, the second edition is a worthy successor to the first edition of this classic treatise. Because of its unified, critical, comprehensive approach, *The Proteins* will long provide invaluable stimulus and authoritative opinion in the rapidly developing field of protein structure.

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## Ion Propulsion Systems

**Ion Propulsion for Space Flight**. Ernst Stuhlinger. McGraw-Hill, New York, 1964. xviii + 373 pp. Illus. $17.50.

In this book Ernst Stuhlinger shows that electrostatic or ion propulsion systems can be practical for use in the vacuum of outer space for vehicle accelerations of the order of 1 mm/sec$^2$, and propulsion periods of months or years. Such vehicles will accommodate payloads of 40 to 50 percent on flights to nearer planets, and

their flight times will be considerably shorter than those of vehicles using chemical systems. The history, description, and dynamics of various propulsion systems—electrothermal, electrostatic, magnetofluid-mechanic, and photon propulsion systems—are considered in the first three chapters. Chapter 4 deals with the flight mechanics of these systems in terms of specific energy, maximum payload ratio, terminal velocity, initial acceleration, flight distance, and time. Optimization for maximum payload, maximum terminal velocity, and minimum transfer time are considered.

Chapter 5 deals specifically with the ion motor—its components, the production of ions, space-charge effect, beam formation, and its neutralization and heavy particle systems. Sources of electrical power in space—solar, nuclear, thermionic, and thermodynamic are covered in the next chapter. The navigation and missions of electrically propelled space vehicles are dealt with in chapters 7 and 8. Cesium is the most promising material for the ion motor, and its physics, chemistry, and metallurgy are given in chapter 9. In the last chapter the author gives his conclusions and appraises the future prospects of such systems. No ion engines have been tested in space, and the most serious problem is that of developing efficient and reliable nuclear-electric power sources in the kilowatt and megawatt ranges.

The material is illustrated with many figures and tables, and nearly 500 references are given. The book is timely, and my only criticism is that Stuhlinger is not selective in considering details. But that is, perhaps, unavoidable at this stage in the development of the subject.

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## Economic Entomology

**Entomologie appliquée à l'agriculture, Traité.** vol. 1, *Coléoptères.* Published under the direction of A. S. Balachowsky. Masson, Paris, 1962–1963. 2 parts, xxvii + 1391 pp. Illus. N.F. 162.

This is the first volume of a series on economic entomology, which will be composed of eight volumes in which some 60 contributors will treat the Coleoptera; the Lepidoptera; the Diptera and Hymenoptera; the Thysanoptera and Heteroptera; the Homoptera; Orthoptera, Dictyoptera, Dermaptera, and Isoptera; Lesser Insects, Mites, Myriapods, and Molluscs; and the Nematodes. Sixteen of the contributors helped with this volume. The area specifically covered is Europe (excluding the U.S.S.R.), North Africa, Asia Minor, and the Near East to the border of Pakistan and India. However, the European area of the U.S.S.R. is at least partially covered because much of the cited literature pertains to the U.S.S.R. This work reminds one of Balachowsky and Mesnil's huge work, *Les insectes nuisibles aux plantes cultivées* (1935–1936), in two volumes and 1921 pages. However, the *Traité*, because of its larger size and scope and its modernity, cannot be considered merely a revision of the older work. The new work is truly new. In the *Traité* only insects harmful to farm plants are considered. Thus, insects that affect farm animals are excluded; insects that are harmful to timber and ornamental trees are not included, but those that affect fruit trees are. Insects that attack stored products are discussed. The first volume, entirely on beetles except for a short introduction, is bound in two parts.

In the introduction, insects in relation to man and man's world are discussed. The contents are arranged according to the classification of beetles, beginning with the Carabidae and ending with the Platypodidae. A family is very briefly characterized and, when possible, generalizations on biologies of the family are given. Then each economically important species is discussed separately under the following headings: description (very brief, usually morphological but occasionally ecological, and often accompanied by an illustration of the adult); biology or life history (usually detailed, often with a picture of the larva or of damage caused by some stage of the beetle); and finally control measures. Then, extensive bibliographies, one general and one for each family discussed, are given. Finally, an index to insect taxa and a table of contents are provided at the end of the volume.

The literature cited (almost all of it quite recent) for each species is very helpful. Published information on the life histories of beetles is often hard to locate because it is scattered among various publications, often buried in articles, and usually not so well treated by abstracting journals as taxonomic information. The authors seem to have combed the Russian literature on beetle biologies.

The descriptions of the biologies of the species, based on information that the authors have brought together from many sources, will be the important contribution of these volumes. That different amounts of knowledge are available with respect to the various species has caused some treatments to be imbalanced, but this is to be expected. For example, 99 pages are devoted to the Colorado potato beetle alone, whereas all of the Elateridae are covered in 30 pages. Relative importance to agriculture has required that more than half of the total pages be given to the Curculionidae and Chrysomelidae; the Scarabaeidae rank third in the page allotment, with 21 other families ranged far behind. So much information is available on some species that subheadings are needed, such as oviposition, distribution, migration, and the like. Quite often life history, which occupies by far the most space, and damage are discussed under separate headings. The sections on control, which are placed at the end of the discussion of each species, seem very short and superficial for a book on economic insects. However, plans have been made to publish a separate series on control.

I saw few faults. One of the most exasperating, and important, is concerned with the literature citations. Far too often the author and year cited under the specific name is not accompanied by a full citation in the bibliographies at the end of the volume. Half the citations under some species of Tenebrionidae, for example, referred to nothing in the terminal bibliographies. These faults should be corrected, for the great amount of literature cited is one of the strong points of the book. I noted one error in the illustrations—the same photograph seems to have been used in Figs. 70 and 79 for two different species of scarab larvae. An index to host plants should have been provided, especially since the book is arranged according to beetle systematics. And finally, the American reader may have some difficulty with the scientific names used, especially those for the weevils. That usage of names should not be considered a fault, however; our differences of nomenclature are differences of interpretation, not of facts.

This is a fine start on an important series of books. Americans will find