

veteran in any field will make the effort to write down, let alone tidy up, the developments in his science throughout his lifetime.

He writes, understandably enough, with an intense sense of personal involvement. He evidently feels that his own contributions have been under-estimated and quotes with some bitterness "The publicity each theory has received has depended almost as much on the strength of personality of its protagonist as on its intrinsic merit".

Prof. Ernst's disputatious style, and his wide reading, combine to give a vivid historical picture of the way in which muscle physiology has developed. In addition, the experimental work for which he is best known—on the volume changes in muscle and on the osmotic activity of water in muscle—is presented in some detail; while numerous other aspects of muscle physiology are reviewed or discussed. Sometimes he does not give enough experimental detail to permit a firm answer to an important question, for example (p. 46), where he reports that isolated myofibrils are excitable electrically; and although some of his criticisms seem to me to be just—for example (p. 266), where he points to the confusion that surrounds the concept of muscular efficiency—he sometimes goes too far, or makes mistakes himself. Thus, in claiming priority over A. V. Hill for the discovery that when an active muscle is stretched it can absorb energy (pp. 11, 321), he seems unaware that his mechanical measurements alone, without heat measurement, cannot possibly solve this problem.

The book is well produced, but there is a cumbersome system of cross-referencing (to chapters and sections instead of to pages) that may have made it easier to write, but which certainly makes it more difficult to read. An infuriating example occurs on the last page (330), where it is implied that Hodgkin and Horowitz have failed to make proper reference to Prof. Ernst's work. To investigate this, a laborious search through the book is necessary, which ultimately arrives back on the self-same page from which it started, where it is found that the vital piece of evidence, by Laszlo, is still unpublished.

Nevertheless, it is Prof. Ernst's sincere interest in comprehending his subject that permeates and dominates his book. The fuel for his polemics seems to be the irritation that he feels because, after so many years work, by so many different people, the field still abounds in uncertainties, contradictions and misinterpretations.

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INORGANIC MICRONUTRIENTS IN PHYSIOLOGY AND AGRICULTURE

Trace Elements

Proceedings of the Conference held at the Ohio Agricultural Experiment Station, Wooster, Ohio, October 14–16, 1957. Edited by C. A. Lamb, O. G. Bentley and J. M. Beattie. Pp. xii+410. (New York: Academic Press, Inc.; London: Academic Books, Ltd., 1958.) 12 dollars.

THE volume under review comprises 23 chapters concerned with quite different aspects of trace-element nutrition, and a summary by Dr. C. A. Elvehjem given at a three-day symposium, which although rather unequal in treatment probably

present in some respects more informed accounts than could be achieved by a single author.

Provocative contributions by Arnon dealing with the requirements and roles of trace elements with special reference to vanadium, molybdenum and manganese in different plant organisms, and by Hutner and his collaborators describing a novel approach to methods for revealing nutrient requirements by increasing metabolic stress with some emphasis on cobalt, present what may be termed the philosophy of trace-element investigations.

The chapters on selenium in soils, plants and animals by Moxon, on cobalt requirements by Davis, and on cobalt in B₁₂ synthesis by Johnson and Bentley are both timely and informative. Iron is discussed by Granick, zinc by Hoch and Vallee, and copper mainly in relation to uricase by Mahler. Monoiodotyrosine metabolism is described by Serif and Kirkwood, but the use of bare references in place of certain details on methods and previous work are more akin to a paper of a series than a symposium contribution.

The specific role of boron in plant nutrition is still unknown. Skok, however, gives an excellently concise and detailed account of present knowledge regarding boron. Shorter papers by Sayre, and by McLean and Volk, deal with boron in corn and alfalfa.

Nason contributes a comprehensive statement regarding the roles of molybdenum and vanadium in plants and animals. The following paper by Keeler and Varner on molybdenum- and tungsten-protein fractions in *Azotobacter* approaches the problem of whether molybdenum fulfils a single or multiple role in *Azotobacter*.

The chapter by Pirson on manganese in photosynthesis reactions of higher plants and green algae is a welcome summary regarding the apparent role of manganese in this complex process. Shorter papers discuss manganese problems in soils and in soybeans (Hoff and Medersky), manganese in grape production (Beattie), and manganese toxicity in apple (Winter).

Two chapters by Brown, Eyster and Tanner deal comprehensively with the mineral nutrition of *Chlorella pyrenoidosa* and especially with the differential effects of manganese in heterotrophic and autotrophic growth, respiration and photosynthesis. These papers, with those of Pearson, Arnon, Nason, Hutner and collaborators, Johnson and Bentley, and Keeler and Varner, comprise a fairly comprehensive account of micronutrient metabolism in micro-organisms.

Some minor omissions are of references to both sodium and chlorine in the index in spite of allusions in the text and the indexing of rubidium and fluorine. Reference to work of Brown and Possingham (1957) on iron and cell division is omitted from the text, pp. 378–9 and the index, though it is included in the bibliography, and the main paragraphs on haemoglobin, pp. 368 and 370, are not indexed. The printing is excellent, and there are probably in all more than 1,000 different references conveniently distributed in relation to each chapter.

This book is recommended as a necessary part of any library used by students and teachers of plant physiology and of mineral nutrition in any field. Research workers will find therein much information on a wide range of trace-element problems and some stimulating or provocative points of view which may encourage further investigations.

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