

1848 (when Helmholtz made the first attempts at measurement) to the outbreak of the First World War. The chapter is preceded by a portrait of its author at work, complete with umbrella installed as a protection against floods from the laboratory above! Prof. Hill discusses some of the earlier work in the light of present-day knowledge and he includes reminiscences of research at Cambridge and of some of the people there and elsewhere who influenced him. It is good to know that this chapter will be the beginning of a future monograph.

This year's volume contains the usual chapters on the basic subjects, heart, peripheral circulation, respiration, digestion, kidney, water and electrolyte metabolism, the nervous system (four reviews) and reproduction. There are chapters on blood clotting, bone, transport through membranes, heat and cold, and chemical influences on cell division and development. Endocrinology this time covers the adeno-hypophysis and adrenal cortex, and the pancreas (insulin and glucagon).

The chapter on Russian physiology deals with metabolism and endocrinology. This is the last time that Soviet research will be treated separately. In future, reviewers will be encouraged to make use of the translations of Russian papers which are becoming increasingly available, and to discuss these papers along with the work from other countries. The final chapter, on comparative physiology, reviews work on the annual reproductive cycles of marine invertebrates.

The editorial committee pays its usual tribute to the authors (who write from six different countries) for undertaking the heavy task of preparing these surveys; all physiologists will wish to associate themselves with this tribute, and will wish the "Annual Review of Physiology" many further years of useful life.

D. C. HARRISON

## RUMINATION

### Metabolism in the Rumen

By E. F. Annison and D. Lewis. (Methuen's Monographs on Biological Subjects.) Pp. 184. (London: Methuen and Co., Ltd.; New York: John Wiley and Sons, Inc., 1959.) 15s. net.

THIS is an interesting, well-written and up-to-date account of the microbiology of digestion in the rumen and the resultant biochemical pathways of metabolism. In the rumen complex interactions take place which account for the importance of the ruminant in agriculture. Mammals do not secrete cellulases in their digestive juices, and the degradation of dietary cellulose in the rumen, its major function, is achieved by the cellulolytic activities of the microbial population. This releases potential substrates from refractory plant materials and permits the formation of metabolic end products in the rumen which are afterwards the main source of energy for the animal. This enables ruminants to live on coarse fibrous foods which would otherwise not be available. In other herbivora, such as the horse, there is a similar but more limited dependence on the activities of the micro-organisms of the caecum.

The production of certain essential amino-acids and vitamins and the conversion of some dietary constituents into microbial substance are other metabolic transformations. Symbiotic relationships of a remark-

able degree have thus been developed in the rumen. The separate metabolic pathways can seldom be adequately examined or controlled in isolation. The microbial activities are delicately poised between catabolic and anabolic processes. Thus, for example, in protein metabolism the microbial contributions may range from a rapid breakdown of excess ingested protein to ammonia and volatile fatty acids, to the extreme synthetic phase whereby urea from the circulating blood may diffuse into the rumen and be used for the growth of cellulose fermenting bacteria. The techniques now becoming available to the biochemist, physiologist and microbiologist are enhancing their ability to study rumen function, one of the most fascinating and rewarding fields for their attention.

It is hoped that this book will help to dispel the considerable ignorance of many biochemists, physiologists and bacteriologists concerning what happens in the ruminant. The study of such animals should have its place in the normal curriculum of these subjects. While some of the pioneer work was set in motion by Tappeiner in Germany and by Schalk and Amadon in North Dakota, workers in the United Kingdom have made remarkable advances in this fascinating field, and the names of Baker, Barcroft, Phillipson, Elsdon, Pearson, Smith, Oxford, McDonald, Syngé and Chalmers are to be listed among the pioneers. But Marston in Australia, Hungate, Bryant, Doetsch, Gall and Huhtanen in the United States, Balch, Blaxter and Hobson in Great Britain have, among many others, made their mark. The authors, too, have justified their position to be knowledgeable authorities in this field.

D. P. CUTHBERTSON

## DEVELOPMENTAL BIOLOGY

The Developmental Biology Conference Series, 1956

Cytodifferentiation. Edited by Dorothea Rudnick. Pp. xi+148. 28s. net. Environmental Influences on Prenatal Development. Edited by Beatrice Mintz. Pp. xiii+87. 22s. 6d. net. Regeneration in Vertebrates. Edited by Charles S. Thornton. Pp. xi+108. 52s. 6d. net. Embryonic Nutrition. Edited by Dorothea Rudnick. Pp. xi+113. 24s. net. Immunology and Development. Edited by M. V. Edds, Jr. Pp. xi+59. 19s. net. Dynamics of Proliferating Tissues. Edited by Dorothy Price. Pp. xv+96. 24s. net. Wound Healing and Tissue Repair. Edited by W. Bradford Patterson. Pp. xi+83. 21s. net. (The Developmental Biology Conference Series, 1956, held under the auspices of the National Academy of Sciences—National Research Council.) (Chicago: University of Chicago Press; London: Cambridge University Press, 1959.)

A LIVING organism has a present and two pasts, one evolutionary and the other ontogenetic. A study of any one of the three is ultimately comprehensive and will embrace the other two; any knowledge of one must be relevant to the others; and yet to each there is a distinctive biological approach.

The developmental biology conference series, a marathon of discussion meetings held in the United States with international participation in 1956, can be said to mark the end of a period during which the developmental approach to biology has been