ments in time. Reference works such as these greatly facilitate such searches. Chemists everywhere would be profoundly grateful if a sharp reduction in the time lag between the appearance of a paper in the literature and its incorporation in the reference works were possible.

Sauerstoff treats the distribution of oxygen, ozone, and water. The geochemistry of the hydrosphere is reviewed. The technology of oxygen, ozone, and hydrogen peroxide manufacture is covered.

The volume on arsenic represents a complete treatment of the geology, chemistry, physics, and industrial utilization of arsenic and its compounds. As mentioned above, the regular appearance of such volumes covering the chemistry of each of the elements, with a delay of no more than five years, would tremendously simplify the time requirements for literature searches.

The magnesium volume deals with binary and ternary alloys of magnesium and is, therefore, of primary interest to metallurgists and engineers.

Titan is a comprehensive treatment of the chemistry of titanium and its compounds. The volume is particularly timely in view of the present active interest in titanium metal. It is of particular interest to American chemists to note that this volume is dedicated to Roger Adams for his assistance in the rehabilitation of the Gmelin Institute following World War II.

These volumes maintain the usual high standards of clarity, conciseness, and organization of previous volumes in the Gmelin series. They represent an essential part of the literature of inorganic chemistry and should be a required item in every library used by research chemists.

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The Biological Sciences

Evolution in the Genus Drosophila. J. T. Patterson and W. S. Stone. New York: Macmillan, 1952. 610 pp. Illus. $8.50.

An appreciation of the importance of this book is best gained by a brief survey of its historical background. During the early decades of the twentieth century little interest was taken by biologists in the subject of evolution as a field for active study and research. However, the new science of genetics was rapidly advancing, particularly owing to the brilliant researches of the Morgan school on the genetics of Drosophila.

By 1927 H. J. Muller, then at the University of Texas, had demonstrated the artificial induction of mutations in Drosophila by x-rays. A few years later, in the same laboratory, T. S. Painter, ably assisted by W. S. Stone, had demonstrated the significance of the constant banded pattern of the giant salivary gland chromosomes of Drosophila—not merely an advance in cytology, but rather an entirely new level of cytology. In the meantime A. H. Sturtevant had combined taxonomic and genetic studies of Drosophila species and demonstrated hybridization between two species of the genus. Genetic analysis of Drosophila populations by Sturtevant and Th. Dobzhansky, N. P. Dubinin and colleagues, and others had thoroughly disproved the old bromide of the irrelevance of "bottle mutations" in evolution studies.

About 1938 J. T. Patterson and his colleagues at the University of Texas, aided by a generous grant from the Rockefeller Foundation, turned their attention to the problems of speciation and evolution in the genus Drosophila. With a truck fully equipped for collecting and field studies, workers from this laboratory made many extensive collecting trips throughout the U. S. and Mexico, and brought back alive for taxonomic, genetic, and cytological study approximately 100 new species, and many previously described forms. A series of University of Texas bulletins, totaling over 1600 pages, many hundreds of tables, figures, and diagrams, with detailed figures of internal anatomy, colored plates of over 70 forms, and many salivary and metaphase chromosome plates, has been issued at intervals, reporting the progress of these researches on speciation and evolution in the genus.

This work, published and in progress, naturally forms much of the basic material for *Evolution in the Genus Drosophila.* The book, however, is a comprehensive review of the work on taxonomy, geographical distribution, hybridization, genetics, and cytology of the genus in many laboratories in this and other countries, with a synthesis and interpretation of this material as it bears on the subject of evolution. It is this reviewer's opinion that the authors have done an unusually thorough and unbiased job of evaluating the contributions of other laboratories, and of interpreting the findings of the many investigators in this field. In the bibliography of some 700 references, perhaps half the items have been published since 1938. The early literature has not been neglected, however, and those who have provided the background for the recent rapid advances have been given due credit.

A résumé of the taxonomy of the genus, with descriptions of 7 subgenera and 29 species groups to which 267 species are assigned, is followed by a section dealing with geographical distribution, possible phylogenetic relationships, and what is known of the ecology. In the chapter on chromosome evolution, figures of the metaphase chromosomes of over 120 species are shown, with illustrations and interpretations of many changes in chromosome configuration through translocations, fusions, and inversions.

Other sections deal with salivary chromosomes, gene variation, selection, and genic balance, and isolating mechanisms. Over 100 cases of hybridization, showing differing degrees of evolutionary divergence, are described. One chapter is devoted to the remarkable story of evolution in the *virilis* group, as revealed through a study of the geographical distribution, hybridization,

sexual isolating mechanisms, and cytology of the 10 species and subspecies of this group. A final chapter on comparisons and conclusions relates the Drosophila studies to those on other organisms and to the broad field of evolution.

The publishers are to be commended for and complimented on the excellent reproduction of the many figures, and the almost total absence of typographical errors. This book will serve as a necessary handbook for research students, a mine of material for the writers of texts and other treatises, and a fascinating and authoritative exposition of the Drosophila story for all those interested in animal evolution.

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The Tropical Rain Forest: An Ecological Study. P. W. Richards. New York: Cambridge Univ. Press, 1952. 450 pp. Illus. $12.50.

This comprehensive and scholarly study of the tropical rain forest has so great a variety of data that this review can do little more than whet the appetite of the botanist, plant ecologist, forester, geographer, tropical agriculturalist, and others. So far as this reviewer is aware, this volume is the first major contribution dealing with the botany and plant ecology of the rainy tropical forest since Schimper's *Plant Geography* (1898, 1903, 1935).

The rainy tropics are demanding increasing attention over much of the world. Our general ignorance of these areas has been colossal and inexcusable. Even the average educated person does not realize that this nonseasonal tropical rain forest comprises about half the world's forest area. Nor does he know that man has been so destructive of this forest that, unless he alters his ways very soon, he may destroy it within a lifetime. Most people believe that the tropical rain forest remains in its pristine condition and that as yet man has scarcely made a dent in it.

A few high spots that should prove interesting to anyone with intellectual curiosity about the wet tropics and their flora are:

1. There is no pure stand: if the traveler notices a particular species of tree and wishes to find more like it, he may often turn his eyes in vain in every direction.
2. The forest is often two- and three-storied.
3. It is not difficult to penetrate the forest except on riverbanks or clearings. (A photograph is used to show this.) It is the slippery clay soil and the abundance of fallen logs and branches which make progress in the forest slow and laborious, rather than the thickness of the vegetation.
4. The structure of the forest on a riverbank is always different from that in the interior.
5. When trees are being felled, a large tree is often so strongly bound to its neighbors by lianas that even when cut at the base it will not fall.
6. The common idea that a thick layer of litter is characteristic of the rainy tropical forest is completely fallacious.
7. The tropical rain forest is not important as a source of timber despite the fact that it is the *only* source of such woods as greenheart and several kinds of mahogany. This results from the fact that the greater part of the world demand for timber is for coniferous softwoods, which are usually absent in the tropical lowland.
8. In all probability the great "open" savannas of the world (e.g., the llanos of northern South America) represent biotic climaxes that are usually due to fire or edaphic climaxes caused by soil conditions unfavorable to trees. It is doubtful whether any tropical grassland is a true climatic climax.

This reviewer strongly recommends the book to all those with a scientific or economic interest in the rainy tropics. There are some omissions, to be sure; probably the most serious was the author's decision to skip over man's economic relation to the tropical rain forest. (He did not live up to his decision altogether, however.)

The author admits shortcomings, admits even that the science of ecology is not yet ripe for a rigid theoretical framework. Although criticizing the broad generalizations of Schimper, he states that, in the present state of our knowledge, it is impossible to put in their place any clear or definite conclusions.

The Tropical Rain Forest contains many photographs, which are not only clearly reproduced but tell their story well. There are also several good maps, a large number of drawings, charts, and tables. There are an excellent bibliography in many languages, an index to plant names, and a general index.

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Theoretische Biologie: Stoffwechsel, Wachstum, Vol. II. 2nd ed. Ludwig von Bertalanffy. Bern: A. Francke, 1951. 418 pp. 43.50 Sw. fr.; bound 47.50 Sw. fr.

Biologists generally will welcome this new edition of the volume on physiology and growth in von Bertalanffy's well-known treatise. Like the first edition, this one covers a truly prodigious amount of material. It can be compared only with such works as Needham's *Biochemistry and Morphogenesis,* or D'Arcy Thompson's *On Growth and Form.*

The section on physiology, which constitutes the first two thirds of the book, is heavily, and quite properly, biochemical in emphasis—although there are long chapters on physical and physico-chemical aspects of living things. The text has been brought up to date by the inclusion of new results in many different areas. The Cori enzymes, phosphorylation, and the Krebs cycle are discussed, as is the work of Caspersson and Brachet on nucleic acids, of Darlington, Wright, and others on plasmagenes, of Pauling on antibody formation, of Horowitz, Beadle, and others on gene-controlled biochemical syntheses in *Neurospora,* of numerous investigators on the mechanism of photosynthesis, and the clinical importance of ACTH—the list could be extended indefinitely.

As is inevitable in a single volume covering such a

vast field and written by a single man, it is not difficult to find omissions. For example, the work of Pollister and Mirsky appeared to be missing from the discussion of protein synthesis and chromosome constitution, and the work of Evans from the discussion of pituitary hormones and growth. The present reviewer would like to have seen a fuller discussion of the relationship of photosynthesis to respiration which, as it stands, is little more than a footnote. But the section as a whole is such a rich mine of facts and ideas that it would be an ungenerous reader indeed who was not glad to accept von Bertalanffy's overly modest apology, which takes the form of a quotation from Aldous Huxley: "The subject is vast and complex; this volume is short and the knowledge and abilities of the author narrowly limited."

The final third of the book, on growth, is primarily mathematical in approach, in the manner made familiar by Thompson, J. Huxley, and von Bertalanffy himself. It presents a masterly survey of the work of the thirties and forties that analyzed growth phenomena in individuals and in populations by exponential equations, calculus, and other mathematical devices.

No doubt some readers would have preferred a more extended treatment of the author's views on the problem of "organic wholeness." Presumably, such a treatment will be found in Volume III, on "Dynamic Morphology," which von Bertalanffy promises. Meanwhile, we shall have to be satisfied with the recently translated and extremely interesting *Problems of Life*, in which von Bertalanffy deals with this topic in nontechnical language.

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The Epigenetics of Birds. C. H. Waddington. New York: Cambridge Univ. Press, 1952. 272 pp. Illus. $7.00.

His central purpose in writing *The Epigenetics of Birds,* Waddington tells us, "has been to review the literature, mainly dating from the 1930's, which deals with the primary stages of morphogenesis [in the chick]." In fulfilling this purpose the author has assembled an invaluable compendium of experimental work on, roughly, the first 5 days of chick development. The significance of each case treated is extracted in a manner almost deceptively succinct and convincing, the effect being heightened by the ease and grace of Waddington's literary style.

The book opens with a brief consideration of technical methods and then surveys the earliest stages in the differentiation of the blastoderm. This chapter provides a thorough review of the newer work of Peter, Pasteels, Spratt, and others, although it is somewhat overweighted with the minutiae of map-making for the blastoderm. The third chapter is a stimulating if inconclusive attempt to interpret the derivation of the large-yolked sauropsidan egg from the small-yoked amphibian egg by comparing the distribution of the future germ layers in the blastula stages of the two. Chapter 4, on endoderm formation, establishes the "gradient-field" character of the hypoblast.

Chapters 5 and 6 deal with the attempts that have been made to determine the potentialities of portions of the blastoderm, including the primitive streak, by operative intervention. Here, Waddington addresses himself with marked success to one of the major aims of the book—that of reviewing the results of avian experimental embryology in relation to those of amphibian embryology. Although he brings out the close resemblances of epigenetic procedure in these two classes, he also considers carefully the technical limitations that have made the results of chick embryology somewhat the less conclusive.

The seventh chapter, dealing with biochemical studies of early stages, reveals principally the poverty of both ideas and results in this fundamental field. Chapter 8 is devoted to a rather superficial study of mosaic differentiation of organ systems in later stages, and Chapter 9 provides a useful review of plumage development. Chapter 10 summarizes the studies that have been made on genetic defects and their phenocopies in chick embryos; although thorough on the factual side, the treatment contributes less to our understanding of this intricate subject than Waddington's authority in the field of genetics might lead us to anticipate.

Critical discussion of the empirical data that comprise the bulk of the book is largely postponed to the last chapter, which, it must be regretfully admitted, is not the most successful part of the work. The chapter is brief (only 15 out of 239 text pages) and says little more than is revealed on the surface of the data themselves. The insights we might have expected are not here, nor is there any really cogent attempt to orient the results of experimental studies in avian epigenesis in relation to the frontiers of modern physiological research. On the other hand, the book is certainly not uncritical; and the emphasis on fact and analysis, rather than on theory and synthesis, has had the good effect of keeping the whole within conveniently small compass.

A minor and, one hopes, unintentional defect of the book is a disquieting nationalism. All embryology seems to be divided into three parts: a German "school" devoted to amphibian embryology, and rival English (largely Waddington) and American "schools" of chick embryology. This curious view of science leads to results both amusing and disturbing. So "Willier and his pupils" are made to share the blame for the limitations of Lillie's embryonic segregation hypothesis because they are Americans, whereas R. G. Harrison goes unmentioned, apparently because he is not German. The various French-speaking authors whose works are liberally dealt with are, perhaps from lack of common nationality, allowed to pass unschooled.

Whatever flaws one might find in the work, however, do not alter the fact that *The Epigenetics of Birds* represents a major contribution to the literature of experimental embryology. Without doubt it will become

a standard reference work for every practicing embryologist.

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Mammals of Utah: Taxonomy and Distribution. Univ. Kansas Pubs., Museum of Natural History, Vol. 6. Stephen D. Durrant. Lawrence: Univ. Kansas, 1952. 549 pp. Illus.

Mammals of Kansas. Univ. Kansas Pubs., Museum of Natural History, Vol. 7, No. 1. E. Lendell Cockrum. Lawrence: Univ. Kansas, 1952. 303 pp. Illus.

Utah and Kansas are now added to the scant dozen of the states having adequate systematic accounts of their respective mammalian faunas. These two books have much in common besides sponsoring institution, format, and general plan of treatment. Each author is a field-and-museum naturalist who is thoroughly familiar, not only with the kinds of mammals and how they differ from one another in structure and distribution, but also with the physiographic and climatic conditions of their environment in the specific area treated. Such a combination of knowledge is indispensable if zoogeographical problems are to be intelligently handled. Moreover, these authors have personally inspected many thousands of specimens and have studied the original field notes of numerous colleagues. Each of the resulting volumes, therefore, contains much new information and gives a well-balanced picture of the current state of knowledge in the field it covers.

The primary approach is systematic. Keys, descriptive statements, measurements, and distribution maps make the reports usable as manuals for identification. Comparatively little of the text will be attractive to the popular reader, but these books are certain to be used for background data and orientation by future writers of popular natural history. For serious students of mammalian systematics they will become standard works of reference.

The diverse and varied mammalian fauna of Utah is treated by Durrant only in regard to taxonomy and distribution. Analysis of intraspecific geographic variation occupies most of the author's attention. The accounts of rodents, which include about 52% of the total number of species in the state, occupy about 69% of the text. Carnivores, in contrast, are briefly treated; grizzly bears are disposed of in less than a page, whereas one species of rodent, the pocket gopher *Thomomys bottae,* receives 53 pages. A carefully thought-out terminal section discusses the general and theoretical matters of faunal areas and the apparent effects on speciation of physiographic features. The part played by Pleistocene Lake Bonneville in shaping the modern fauna is shown to be especially important.

For Kansas, with fewer kinds of mammals and less contrasting physiography, Cockrum has provided more inclusive species accounts. General statements on habitats, breeding, and economic importance are added to the systematic data. Most of the natural history material is compiled from the publications of other authors, and it is disappointing to find so little of the original observations that Cockrum and his co-workers have had opportunity to make in recent years.

A regional account of the fauna provides the ideal medium in which a mammalogist may combine his own observations with pre-existing knowledge to produce a comprehensive statement concerning the mammals of his favorite area. Such an account also provides the most readily accessible source of information for the student or researcher. It is to be hoped that books with titles beginning "Mammals of . . ." will continue to appear.

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Soil Microbiology. Selman A. Waksman. New York: Wiley; London: Chapman & Hall, 1952. 356 pp. Illus. $6.00.

Following an excellent historical introduction, this volume deals with the kinds and numbers of soil microorganisms and the methods for studying them. The important groups are briefly described, with a chapter devoted to their decomposition processes. The chemical equations for carbohydrate decomposition will probably mislead the student into regarding them as reactions and products which occur in the soil, whereas they are not actually representative of the metabolism of any known organism or group of organisms.

The chapter on humus is particularly good and is followed by a discussion of the various methods for determining the rate of decomposition of humus and other organic matter in the soil. Nitrogen transformations are introduced by a discussion of the decomposition of protein and other nitrogenous compounds and the resultant formation of ammonia, followed by a consideration of nitrification and denitrification. Separate chapters are devoted to symbiotic and nonsymbiotic nitrogen fixation, and a greater importance of symbiotic fixation in maintaining soil nitrogen levels is emphasized. Another chapter describes the transformations of sulfur, phosphorus, and other elements.

The interrelations of soil organisms are considered in a chapter on the relations between soil microorganisms and higher plants, a second one on "associative" and antagonistic effects between soil microorganisms, and a third on plant pathogens in which their control by nonpathogenic microorganisms, as well as by other treatments, is discussed. The final three chapters deal with (1) stable manures, composts, and green manures, (2) microorganisms and soil fertility, and (3) recent developments.

The book is designed as a short introductory text and is an excellent account for anyone desiring an acquaintance with the microbial activities in the soil.

The problems in soil microbiology, as well as the chief contributions, are emphasized. Most of the literature quoted is quite old. In some instances, this is desirable, because it gives credit to the investigators who discovered important processes and directs the student's attention to some of the classics. In other cases, recent significant work is not mentioned.

From the standpoint of the microbiologist, relatively little attention is paid to the nature and characteristics of the organism concerned with the various soil processes, but the significance of their activities in soil fertility receives excellent treatment. The author's long interest and activity in soil microbiology are reflected in the pages of the book.

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The Earth Sciences

Traité de Paléontologie. Vol. I, ***Les Stades Inférieurs d'Organisation du Regne Animal—Protistes, Spongiaires, Coelentérés, Bryozoaires;*** Vol. II, ***Problèmes d'Adaptation et de Phylogenèse—Brachiopodes, Chétognathes, Annélides, Géphyriens, Mollusques.*** Jean Piveteau, Ed. Paris: Masson, 1952. Vol. I: 782 pp. Illus. 8300 fr.; clothbound, 8900 fr. Vol. II: 790 pp. Illus. 9000 fr.; clothbound, 9700 fr.

These are the first two of seven volumes covering the field of fossil animals. ("Traité de Paléozoologie" would be a better title, as fossil plants are excluded.) The major phyla of invertebrates, except the arthropods and echinoderms, and some minor phyla are treated in these volumes, to which 16 collaborators, all French with the exception of one Belgian, have contributed. The remaining invertebrates are to be dealt with in the third volume, and four volumes are to be devoted to the vertebrates.

Volume I starts with a series of introductory chapters on the history of paleontology; fossilization; principles of systematics; paleontology, chronology, and ecology (very brief); and on phylogenesis of the animal kingdom.

The systematic part gets off to a good start with the most complete treatment of fossil protists in any one book. Of the 13 groups of protists in this volume, discussion of all except the foraminifera is the work of Georges Deflandre, who is responsible for much of the modern literature on the 12 groups.

Jacques Sigal wrote the useful chapter on the foraminifera, except the part on the fusulinids, which is by Raymond Ciry. Classification of the foraminifera is still in a state of flux. Sigal's classification is most like Glassner's 1945 arrangement, although Sigal recognizes 61 families and Glassner 33. The chapter closes with a lengthy and valuable account of the ecology and paleoecology of foraminifera.

Sponges are rather summarily treated by Léon Moret. The archaeocyathids are given only four pages. The coelenterates are taken up piecemeal, without any synthesis of the classification of the phylum. The important rock-forming stromatoporids are inadequately treated in the chapter on hydrozoans.

The corals take up a third of Volume I. The Paleozoic "madreporarians" (tetracorals, tabulates, and heliolitids) are admirably handled by Marius Lecompte. His adoption of English terminology for the vegetative forms of tetracorals, because it is the best available and for the sake of uniformity, is a significant indication of the breadth of treatment. He proposes a new superfamily classification of the tetracorals that emphasizes septal structure. At the outset, however, he serves warning of the possibly unevaluated hazards of deceptive homeomorphy. He also recognizes the difficulty of establishing phylogenetic relations in the tabulate corals.

The chapter on post-Paleozoic "madreporarians" (hexacorals or scleractinians of other authors), by J. Alloiteau, evidently aims at complete generic coverage, unlike other parts of the volume. Presumably, it is based on a thesis presented by Alloiteau at the Sorbonne in 1952 (p. 682, item 1). Although still unpublished, the thesis may be assumed to be the source for the numerous new generic names cited as "Alloiteau, 1951." Some of these are based on new, undescribed, and unfigured species, also cited as "Alloiteau, 1951." Page 542 promises a later discussion of the modes of colony formation, but through some inadvertence that important subject is not again mentioned. In the systematic part terms are used without any explanation to describe modes of colony formation. Alloiteau's classification is a modification of that proposed by Vaughan and Wells in 1943. Three new suborders and many new families and subfamilies, some of which are of faulty orthography, are added. The classification is based primarily on the concept that the surface aspect of the septa reveals the trabecular structure.

Volume I closes with a chapter on bryozoa, by Emile Buge, that does not come up to the standard set for the other phyla. The classification is essentially an abbreviated version of Bassler's 1934 classification in *Fossilium Catalogus.* The general discussion of morphology is brief, and the relatively few genera in the systematic part are too briefly diagnosed. A closing résumé of the ecology of bryozoa and their association with other animals is informative and stimulating.

Aside from 42 pages on worms and wormlike animals, Volume II is taken up by the brachiopods and mollusks. Many paleontologists and zoologists would disagree with class rank for bryozoa, brachiopods, annelids, and other wormlike animals under a phylum Vermidians (*"embranchement des vermidiens"*).

The lengthy chapter on brachiopods is a tour de force, as it appears to be Jean Roger's first contribution to brachiopod literature. He leaned on Schuchert's and LeVene's 1929 comprehensive listing of genera and higher categories in *Fossilium Catalogus*