was a static picture of vast scope and intricacy, catalogued systematically and described with the aid of a countless multitude of technical terms. As clues to this labyrinth there were and are an excellent classification of the chordates in the table of contents and a most full and useful index, the latter now filling fifty-seven pages of three columns each. But though these and similar features still make the book invaluable as a reference work, they must at the same time have contributed to the sense of continued frustration, especially to those students who persisted in asking such questions as: "By what steps did this particular anatomical complex attain its present state?" or, "Through what successive grades and branches did this animal evolve?"

The best of the additions to the old text are those in which the reviser and his nearer colleagues and friends have themselves made major contributions: especially in the sections dealing with the paleozoic ostracoderms, placoderms and fishes, the earlier amphibians, the origin and adaptive branching of the main divisions of the reptiles, the rise of the mammal-like reptiles and the diverse evolution of the ungulate mammals. These were all very inadequately treated in earlier editions but are now concisely set forth with the aid of many new figures, diagrams and charts; all of which fairly shine forth from the ample pages. In the newer parts of the work the reviser aims to outline the history of each major group in so far as it can be reliably reconstructed from paleontologic evidence and to indicate its probable relationships with other larger groups. This is most admirably done for the perissodactyls and some other groups of ungulates among the mammals and in varying degrees for other vertebrates.

From a work that already gives so much it may seem unreasonable to ask for more; but we hope that in the next edition the reviser may preface the general chapter on chordate morphology with a critical review of the principal theories of the origin of the vertebrates. It may then be noted that theories involving the transposition of the primary invertebrate nerve cord from the functionally ventral to the functionally dorsal surface are based on similar but apparently convergent adaptations to forward locomotion in bilateral animals of widely different phyla, as between *Limulus* of the Arthropoda and *Cephalaspis* of the Vertebrata. And it seems further that the factual material might have gained added significance if it had been suggested that the typical piscine chordate is essentially a swift-moving predaceous fish, which is already far advanced beyond the stage of the earliest known chordates. These were the Ordovician, Silurian and Devonian ostracoderms, which were relatively slow-moving, partly bottom-feeding forms, whose head and thorax were covered with a stiff dermal armor somewhat like dentine. Although these are well described and figured in the present work, it might have been noted that the studies of Stensiö, Heintz and Kiaer have led them to infer that the more or less continuous thoracic armor later broke down into the more flexible armor of such relatively swift-moving forms as the anaspids.

The present edition adopts the conservative view that the ostracoderms as a whole were an early side branch of the vertebrate stock, ancestral to the existing lampreys and hagfishes but definitely not ancestral to the true jaw-bearing or gnathostome branch of the vertebrates. While this may well be true of almost any given ostracoderm, it seems to the present reviewer far more likely that the general characters of the ostracoderms are truly primitive and that the jaw-bearing vertebrates in adopting predatory habits arose by greatly enlarging the branchial pouches, which are already present in the ostracoderms, and by emancipating the gill bars from the chondrocranium and modifying the anterior ones into jaws, according to the stages recently suggested by Romer (1937). And in like manner, the placoderm stock, although giving rise to many side branches, seems in its basal characters to be structurally intermediate between the officially "jawless" ostracoderms and the typical gnathostomes.

In general the reviser seems to follow the current practice of assuming that the possession of any conspicuous specialization, such as the slightly movable joint across the skull roof of the Devonian rhipidistian fishes, debars its possessor from being ancestral to later forms which do not have this specialization. The reviewer, however, has seen many such cases in which it seems that earlier specializations become overshadowed by later ones and fade out of the hereditary pattern. However this may eventually prove to be, it seems safe to predict that in the publication of the sixth edition the second volume of Parker and Haswell enters upon a new and far wider career of popularity among advanced students and teachers of vertebrate zoology.

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SYMBOLIC LOGIC

Introduction to Logic (and to the methodology of deductive sciences). By ALFRED TARSKI. Enlarged and Revised Edition. New York: Oxford University Press. 1941. $2.75.

THE last thirty years have witnessed a rapid and intense development of the symbolic study of logic and of its profound applications in mathematics, in

philosophy and in other disciplines depending on deductive thinking. Some of this development has been difficult for outsiders to follow, both because of the precision of the analysis used, and because of the complexity of the symbolic formulations necessary. There has long been a need for a clear-cut introduction to the new logic, which would state in an elementary but precise language the fundamental problems studied, and which would at the same time be free from an undue dependence upon traditional logic or upon special and controversial doctrines. The need has now been admirably met by this book, written by a distinguished Polish mathematician and logician who is widely known for his own fundamental contributions to logic.

Tarski's book begins with an elementary discussion of the notion of a variable and of the sentential calculus, which treats the properties of the basic logical connectives "and," "or," "not" and "implies"; subsequent chapters deal with the properties of identity, with the analysis of classes and with the calculus of relations. The chapter on axiomatic methods gives a careful elucidation of such fundamental concepts as the completeness and the consistency of a formalized deductive theory. It includes a discussion of some of Tarski's own recent results on the completeness of the ordinary system of Euclidean geometry. Roughly speaking, these results mean that every problem of *elementary* high-school geometry can be resolved by using the ordinary procedures in a systematic manner. The second part of Tarski's book illustrates the previously developed concepts of logic and methodology by setting up two equivalent systems of axioms for the real numbers. These are the axioms which lie at the basis of calculus and higher mathematical analysis.

Throughout the book the symbolism is held to a minimum. The explanations are admirably clear and objective. The book itself is a considerably enlarged and improved version of a monograph previously published both in Polish and in German; the translation has been done by Olaf Helmer. This English edition contains much new material: many new and well-chosen exercises, some with hints and suggestions of further problems; some apt historical notes on the essential contributions of various logicians; a good critical bibliography; some eminently fair discussions of controversial issues, such as the distinction between the use and the mention of an expression and the divergent claims for "strict" and "material" implication. (On page 182 there is a disturbing misprint. In the second italicized statement, $z : x$ should be replaced by $z \cdot x$). All in all, this book is to be heartily recommended, both to the interested scientist who would like to discover what this logic business is all about and to the teacher searching for a dependable and accurate text for college courses in logic.

SAUNDERS MACLANE

HARVARD UNIVERSITY

REPORTS

THE ELLA SACHS PLOTZ FOUNDATION FOR THE ADVANCEMENT OF SCIENTIFIC INVESTIGATION

DURING the seventeenth year of the Ella Sachs Plotz Foundation for the Advancement of Scientific Investigation, eighty-one applications for grants were received by the trustees, fifty-one of which came from the United States, the other thirty coming from fifteen different countries in Europe, Asia, North and South America. The total number of grants made during this year was twenty-three, one of these being a continued annual grant.

In the seventeen years of its existence the foundation has made three hundred and ninety-four grants which have been distributed to investigators in Arabia, Argentina, Austria, Belgium, Brazil, Canada, Chile, China, Czecho-Slovakia, Denmark, Egypt, Estonia, Finland, France, Germany, Great Britain, Greece, Hungary, India, Iraq, Italy, Latvia, Lebanon, Netherlands, North Africa, Norway, Palestine, Poland, Portugal, Roumania, South Africa, Sweden, Switzerland, Syria, Venezuela, Yugoslavia and the United States.

The list of the investigators and the purposes of the research aided in the current year is as follows:

Professor William H. Adolph, Peiping, China, studies in calcium and oxalate metabolism.

Dr. Kenneth T. Bainbridge, Harvard University, biological research with radioactive isotopes.

Dr. Georg Barkan, Boston University School of Medicine, investigations in the field of hemoglobin determinations.

Dr. E. L. Borkon, Southern Illinois State Normal University, Carbondale, study of the compensatory hypertrophy occurring in a remaining kidney in hypothyroid, normal and hyperthyroid albino rats.

Dr. Siegbert Bornstein, Beth Israel Hospital, New York, continuation of investigations on the chemical constitution of the antigens within the Salmonella group.

Dr. Austin M. Brues, Collis P. Huntington Memorial Hospital, Boston, studies on regulation of growth in tissue cultures.

Professor D. R. Drury, University of Southern California School of Medicine, Los Angeles, continuation of work on the kidney and hypertension.

Professor Herbert Elias, New York Medical College, study of the influence of various ductless glands on the threshold of the kidney.