

highly complex fossil history of the Proboscidea, the great order of mammals of which the modern Asiatic and African elephants are the sole survivors; and the third, with a brief survey of the relationships between elephants and Man. Each of these three sections presents a well-balanced treatment of a very large subject.

In a book such as this it is necessary for the author to condense the material a great deal, and Carrington has handled this difficult task in admirable fashion. It would have been nice if there could have been more illustrations, especially in the first two sections of the book, but considerations of space and economy obviously would not allow this. A good, selected bibliography at the end of the book supplies ample references for the reader who may wish to pursue the subject of elephants beyond this "basic" presentation.

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Handbuch der Physik. vol. 51. *Astrophysics*, II. Stellar structure. S. Flügge, Ed. Springer, Berlin, 1958. viii + 830 pp. Illus. DM. 175.

Though this book is prosaically subtitled "Stellar structure," it is concerned mainly with the latest theories and hypotheses of stellar evolution. Nothing like it could have been written 10 years ago, and most of its ideas would have been described a generation ago as the outpourings of a group of scientific cranks. I remember vividly an incident at the Yerkes Observatory when a distinguished professor of the University of Chicago—a man well known for his own scholarly research—assured me that it was a waste of time to read an article by A. S. Eddington which purported to show that the central temperature of the sun is 20 million degrees. I also remember an earlier occasion, in 1913, when two leading European astronomers argued that it would be hopeless to attempt to measure the gravitational displacements of star images during an eclipse of the sun because, in the first place, the effect predicted by Einstein probably did not exist, and, in the second place, even if it did, the amount of displacement would be too small to be ascertained.

Lulled by a century devoted to the painstaking accumulation of facts about the universe and the slow interpretation of these facts, we professional astronomers had become (with a few notable exceptions) unduly conservative and cautious in accepting new and revolutionary ideas. We enjoyed the books by Flammarion and Fournier d'Albe but rele-

gated to the domain of belles-lettres their flights of imagination. We recognized Arrhenius as a great chemist but smiled at his fanciful astronomical hypotheses. We failed to comprehend the enormous astronomical significance of cosmic rays, and we neglected to profit by Jansky's epochal discovery of cosmic radioradiation until the radio engineer Grote Reber had learned enough astronomy to show us the way.

All of this conservatism was wiped off the face of the earth in that flash of light which accompanied the first test explosion of the atomic bomb in New Mexico. Today we are no longer surprised when astrophysicists talk about billions of planets belonging to stars other than the sun, or when a radio astronomer seriously considers sending radio signals to a planet revolving around a star of solar type some 10 or 20 light-years away. We accept almost without protest a theory which predicts an internal stellar temperature (in giant stars) of several billion degrees or an average density (in a white dwarf) a million times greater than that of water. And we speculate about the formation of all chemical elements out of hydrogen in stellar interiors and even on the surfaces of many stars.

It may well be that a future historian will criticize us for having lost our balance between judicious conservatism and exuberant revolutionism. He may even paraphrase Martin Gardner's sentences [*Fads and Fallacies in the Name of Science* (Dover, New York, 1957), p. 3] and say: "One curious consequence of the current boom in science is the rise of the promoter of new and strange scientific theories. He is riding into prominence, so to speak, on the coattails of reputable investigators." If it should be true that we are riding on the coattails of our more conservative predecessors, one thing is certain: The ride is the most joyful and exhilarating experience that any scientist has ever had.

In a recent review of volume 50 of this *Handbuch* (*Astrophysik*, I. Sternoberflächen, Doppelsterne), I expressed the opinion that the purpose of an encyclopedia is to present a broad and comprehensive treatment of all fields of a particular discipline and of their interrelations, and that in this respect it should differ significantly from a series of unrelated summarizing articles. I felt that this particular purpose of the encyclopedia had perhaps not been fully achieved in volume 50, even though the quality of the individual contributions could, with very few exceptions be characterized as excellent [see *Z. Astrophys.* 45, 239 (1958)]. Volume 51 does not elicit this criticism. It is, without doubt, the most important book on general astrophysics that has ever been written, and it can be recommended to astronomers and physicists as the most authori-

tative account of observational and theoretical astrophysics.

The individual chapter headings are as follows: "Stellar interiors," by Marshal H. Wrubel (in English, pages 1-74); "The Hertzsprung-Russell diagram," by H. C. Arp (in English, pages 75-133); "Stellar evolution," by E. M. Burbidge and G. Burbidge (in English, pages 134-295); "The abundances of the elements in the planets and meteorites," by H. E. Suess and H. C. Urey (in German, pages 296-323); "The abundances of the elements in the sun and stars," by L. H. Aller (in English, pages 324-352); "Variable stars," by P. Ledoux and T. Walraven (in English, pages 353-604); "Stellar stability," by P. Ledoux (in English, pages 605-688); "Magnetic fields of stars," by A. J. Deutsch (in English, pages 689-722); "The theory of white dwarfs," by E. Schatzman (in French, pages 723-751); "The novae," by C. Payne-Gaposchkin (in English, pages 752-765); and "Supernovae," by F. Zwicky (in English, pages 766-785). The volume closes with a subject index in German-English, English-German, and French (the entries in French refer only to the article by Schatzman).

As an observational astrophysicist I was especially interested in the articles by Arp, Aller, Deutsch, and Zwicky, and by Walraven's section on the observational results on variable stars. But the "nucleus" of this volume is probably the magnificent chapter by the Burbidges. The theories of variable stars by Ledoux, of white dwarfs by Schatzman, and of magnetic stars by Deutsch will enable me (and probably many others) to interpret our observations in the light of modern physical theory. I believe that the chapter on "Stellar interiors" is somewhat too short to fully satisfy the reader. Perhaps the author was not given enough space to develop this field adequately.

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The Fearful Choice. A debate on nuclear policy conducted by Philip Toynbee, Wayne State University Press, Detroit, Mich., 1959. 112 pp. \$2.50.

Philip Toynbee has prepared an interesting debate on nuclear policy by throwing an almost-pacifist challenge to a wide assortment of his high-placed British friends and by collecting and commenting on the essays they sent in reply. He starts by recognizing the great changes that the nuclear scale of destruction has brought about, and most of his correspondents go along with him on that. To the ringing words, "It is inconceivable that the free peoples would sur-

render their liberties without a fight," he replies by describing the modern meaning of "a fight." He believes that there was justification for the last war but that there can be none for the next. The meaning of the word *war* has totally changed. He declares that our weapons are useless before an attack, when to use them would be folly, and that they would be useless after an attack, when to use them would be useless revenge. He fails to recognize at any point the usefulness of our weapons as a deterrent (the weapons exist with the hope that they will never be used but with the determination—this Toynbee considers immoral—that they *shall* be used after an attack, in the belief that such determination is likely to prevent the attack.) He is set straight on this point by Ayer, and when Toynbee concedes superior strength to the Russians, Ayer responds not only with doubt but with the "saturation" argument—that slight "disparity no longer greatly matters."

Toynbee is probably right in considering that the arms race, if it cannot somehow be limited, will almost certainly lead to disaster. However, he considers no half-way measures for ameliorating the situation. He despairs of our mincing diplomacy. What he proposes is unilateral disarmament—by the West if we Americans can be persuaded to go along, or failing that, by a neutral block in Europe, or by Britain alone. He believes that Russia, with the world as its dish, would probably recognize it to be indigestible and would not attempt complete occupation. He considers that occupation after unilateral disarmament is less likely than annihilation is if the arms race continues. He would rather risk occupation than face the race agony of annihilation. Some of his correspondents would rather risk annihilation than face occupation.

Perhaps the most remarkable feature of the debate is the small attention paid to the many-nuclear-nation problem and to the possibility of stopping nuclear tests as a means of controlling the development of nuclear weapons and of tapering off the arms race. One of the most plausible essays is that by Richard Löwenthal, who is prepared to risk "race suicide by accident" rather than accept "slavery by design," because the risk may be deliberately reduced: "We could negotiate steps to stop the spreading of weapons to further powers." In the first half of 1959 there is more reason for optimism concerning the negotiations than there was a year ago when these essays were written.

One often wonders how people react in their thoughts to the nuclear threat, and these essays provide a wide spectrum of interesting answers, ranging from, "Fear is a bad advisor" (Lord Portal of Hungerford) to the Archbishop

of Canterbury's, "Sufficient unto the day is the evil thereof," and "the spirit in which we negotiate must be . . . a general readiness to give more than we receive." Toynbee is remarkable in having a father who agrees with him completely; the senior Toynbee comments tersely: "Let us therefore put first things first, and make sure of preserving the human race at whatever the temporary price may be."

This little book is thought-provoking. It is much too brief to give a balanced view of the problem of avoiding thermonuclear war, and too few of the essays are keenly critical of Toynbee's position. None of it is to be swallowed without thorough mastication. It gives an interesting glimpse of America through English eyes. It provides a chance to examine the views of quite a variety of one's fellowmen and, through them, to be stimulated to broaden and strengthen one's own thoughts on the world's most important problem.

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The Age of Improvement. Asa Briggs.
Longmans, Green, New York, 1959.
xiii + 547 pp. \$7.

Certainly any historian faces a major challenge in endeavoring to chronicle and interpret a period of national life in a volume that will be enlightening to the scholar and the general reader alike. In *The Age of Improvement*, a history of England from 1784 to 1867, Asa Briggs has met this challenge most successfully. Recognizing that his chosen period "cuts into what are usually thought of as two contrasting centuries—the age of balance and the age of progress," Briggs explains his choice on the ground that the sense of change felt by all classes of the population gave a unity to these years. According to the author, "it was the 'march' of events which fascinated contemporaries and sometimes horrified them. They were divided about the merits of 'improvement,' but they were at one in admitting that it existed."

The book is truly national in scope. It recounts the events associated with kings and queens, politicians, and military leaders, and it describes the changing lives of the "lower orders"—the farm workers, the mill hands, and the tradesmen. Due attention is paid to the religious, scientific, educational, and labor movements of the period. As one would expect from the author of *Victorian People*, there are sharp characterizations of the leading personalities, from the days of Pitt to those of Disraeli. Besides numerous works of historical scholar-

ship, Briggs has drawn upon much contemporary writing, both serious and popular. He includes many apt quotations in prose and verse.

The Age of Improvement is part of a ten-volume history of England being published under the general editorship of W. N. Medlicott, whose own work will carry on the account from 1867 to the present. The excellence of the book by Briggs gives promise that the series will be an outstanding achievement in historical writing.

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Colorimetric Methods of Analysis. Including photometric methods. vol. 2A. Foster Dee Snell and Cornelia T. Snell. Van Nostrand, Princeton, N.J., 1959. \$15.

This book is a supplement to volume 2 of the third edition of Snell's *Colorimetric Methods of Analysis* and is primarily a compendium of significant developments in inorganic colorimetry in the 1946 to 1956 period. The authors have adopted the economical plan of periodically publishing supplements instead of continually revising and enlarging volume 2. In addition to colorimetric methods, fluorophotometric, nephelometric, turbidimetric, flame photometric, and ultraviolet spectrophotometric methods are included.

The 68 chapter titles in volume 2A are virtually identical to those in volume 2, and the chapters appear in the same sequence. Each chapter consists of (i) a brief introductory paragraph, (ii) procedures for treating a variety of samples, (iii) cogent discussions and detailed procedures for specific methods, and (iv) miscellaneous methods of limited applicability. Throughout the book the procedures are presented lucidly and concisely. Since the reader is frequently referred to volume 2 for the procedure to be followed in completing the analysis of a specific material or for relevant information, volume 2 should be available for maximum utilization of volume 2A.

In my opinion the methods and procedures presented in volume 2A have not been selected or evaluated critically. In many cases the probable utility and reliability of a specific method is indicated by the space allotted to the discussion. However, the extensiveness of treatment is often proportional to the extent of the original investigation. The reader should also be reminded that the inclusion of a method or procedure in volume 2A does not necessarily indicate superiority to methods and procedures found in volume 2.

It is a Herculean task to keep abreast