BOOK REVIEWS

Selection of books for review is based on the editors' opinions regarding possible reader interest and on the availability of the book to the editors. Occasional selections may include books on topics somewhat peripheral to the subject matter ordinarily considered acceptable.

THE WHEEL DOTH TURN

Title Science and the Modern World

Editor Jacinto Steinhardt

Publisher Plenum Press, 1966

Pages x + 225

Price $7.50

Reviewer David L. Hetrick

This collection of lectures is one of several series of lectures commemorating the 175th anniversary of Georgetown University. The original title for this series was *Science and Society*. The resulting book is a goulash of miscellaneous essays, some charming and stimulating, others not.

The topic is extremely broad, and it means many things to many people. If anyone has come near to unifying the many aspects of this topic into a single discipline, it is Eugene Rabinowitch, editor of the *Bulletin of the Atomic Scientists*. Unfortunately, a conference with this title usually calls forth a miscellaneous sampling of popular science, as represented by this book.

The series begins with a charming lecture on modern astronomy and cosmology by G. C. McVittie. This is followed by Theodosius Dobzhansky's excellent discussion of evolution and human equality, a rational and eloquent plea for the abandonment of myths and stereotypes in race relations.

Ernan McMullin's essay on the limitations of science is disappointing. It takes up more than its share of pages, and has less to say. It is always good to remind laymen that scientific theories are tentative, but this essay will strike most lay readers as rather wordy and obscure. The author commendably refrains from advancing mysticism as a cure to fill the gaps in science; nevertheless, one is left with a vague feeling that uncertainty is something to be viewed with alarm.

General McCormack gives us some statistics about the preponderance of government in research and development. He points to some problems and ignores others. For example, there is no discussion of the prevalent bureaucratic misuse of the word "research" nor of the resulting confusion about the boundary between science and technology. Some of the problems he does mention are discussed with special pleading: for example, the thorny problem of patent rights is far from settled, and it does not help to give only one side of the question. According to the General, the government is supposed to protect the patent rights of those who foot the bills for development work, taxpayers excepted. (Incidentally, General, it is Knolls Atomic Power Laboratory, not Knowles.)

Arthur Ruark summarizes the "practical uses of atomic energy." It is good to see that nuclear weapons are not mentioned in this listing of "practical" uses, and one hopes that the omission is intentional. Ansley J. Coale next presents a challenging discussion of population growth, and few who read it can escape the conclusion that this is probably the gravest of mankind's problems. Have we already delayed so long in making a realistic approach that disaster is inevitable?

E. R. Piore's title leads one to expect a discussion of the impact of new materials on future technology, but he devotes most of his pages to expounding the viewpoint that technology is really motivated by economic needs and not by science. To a certain extent, the point is valid, especially in understanding history. Yet, in the future, the shape of technology, however motivated, will more and more be dictated by science, and this is the essay that one would expect from the title.

In his usual delightful style, Philip Morse describes the already overwhelming present and the incredibly exciting future of computers. He wastes no time on silly questions like "do machines think?"—instead he shows some of the vistas that will open up once we learn to communicate efficiently with the insides of a computer.

The high point is Bentley Glass writing on the revolution in biology and medicine. After summarizing what the twentieth century has meant to biological science, he has much of value to say about society, education, and science in general. He produces the most quotable phrases in the book: "...every man in the street must learn what science truly is, and not just what scientific knowledge can bring about.... For, on the one hand, it is not safe for apes to play with atoms and, on the

other hand, neither can men who have relinquished their birthright of scientific knowledge expect to rule themselves." Aside from the global problems of nuclear war and population growth, we have recent and continuing nonsense episodes like the phoney fears of fish flour, of water fluoridation, and of nuclear power as more mundane examples of misinformed society vs science, and all scientists and engineers would do well to ask themselves "what contributions to education did you make today?"

The final lecture is about the unmasking of the masquerade by Martian oxides of nitrogen as ice caps, vegetation, and dust storms. It is a fascinating story, and Carl Kiess tells it well. It is, of course, a disappointment to us erstwhile fans of Sir Percival Lowell and Edgar Rice Burroughs to find that the atmosphere of Mars is pure smog. (Is that what happened to Martian civilization?)

The book begins and ends in the far reaches of outer space, and the wheel hath turned full cycle. Other than this, there is not much continuity from one essay to the next. More important are the omissions that would have made this collection more deserving of its title, such as science and religion, nuclear weapons and international affairs, food and water supplies, and modern psychology. Surely one misses a discussion of science and religion that might have graced an important lecture series at a Jesuit university. Nevertheless, the book is worth its price, if only for the beautiful essays of its three best-known contributors: Dobzhansky, Morse, and Glass.

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AN ADEQUATE SOVIET REVIEW

Title Complex Compounds of Uranium

Editor I. I. Chernyaev

Publisher Daniel Davey and Company, 1966

Pages xiv + 520

Price $21.50

Reviewer H. A. Droll

Complex compounds of Uranium is a translation from the original Russian work by L. Mandel and the staff of the Israel Program for Scientific Translations, Jerusalem. The book, a fairly complete review of the complexes of uranyl, UO_2^{+2} (18 chapters), and U^{+4} (6 chapters) ions, is the product of 13 contributors under the editorship of I. I. Chernyaev from the Kurnakov Institute of General and Inorganic Chemistry, USSR Academy of Sciences. In spite of the large number of contributors, there is no evidence of the disjointed presentation one would expect. The Western as well as the Soviet literature on the subject is reviewed up to 1963. Although there is no index, the nature of the Table of Contents diminishes this deficiency. The order in which the chapters appear is based on the order of decreasing stability of the complexes, which, in turn, reflects the displacement series of the complexing agents (ligands). Thus, for UO_2^{+2}, the order of presentation of complexes by chapters which include annotations ranges from carbonate and peroxide to amines and oxygen-containing ligands.

Chapter one considers briefly the general chemistry of UO_2^{+2} and U^{+4} and introduces the reader to the nomenclature of uranium complexes *à la russe*. This is followed by 14 chapters which describe the properties (thermal, crystallographic, solubility, to name a few) and preparation of over 300 UO_2^{+2} complexes. Chapters 16, 17, and 18 deal with the structure of the UO_2^{+2} unit and with the calculation of bond lengths and bond angles ("geometrical analysis") in UO_2^{+2} complexes. Chapter 16 reports the detailed crystal structures of over 30 UO_2^{+2} complexes, most of which contain inorganic ligands. These structural analyses demonstrate the four-, five-, and six-fold coordination of UO_2^{+2}. The general chemistry of U^{+4} including redox and hydrolytic stability is considered in Chapter 19. Magnetic susceptibility, x-ray diffraction, and electronic spectral data indicate eight-fold coordination and $5f^2$ electronic configuration for U^{+4}. The preparation and properties of 97 U^{+4} complexes are described in the five subsequent chapters. The final chapter reviews the role of complexation reactions in the technology of uranium. Topics dealt with are the dissolution of uranium ores (e.g., carbonate leaching) and of uranium metal, precipitation of uranium complexes in chemical analysis and in purification procedures, and liquid-liquid extraction methods. Two observations of this chapter can be made: ion-exchange methods are ignored and only four references are cited, all from the Soviet literature.

The thought which permeates the book is the utility of coordination theory in the preparation of uranium complexes and in the interpretation of their structures. For example, treatment of crystalline uranates as derivatives of the hypothetical uranic acid is debunked, and the solubility of $U(OH)_4$ in aqueous alkali is interpreted in terms of the formation of an hydroxo complex $U(OH)_5^-$ rather than of a salt of a polyprotic acid, $H_3UO_4^-$. The UO_2^{+2} moiety is shown to resemble a simple dipositive ion, its enormous stability being observed from chemical, infrared spectral, refractivity, and x-ray data and its existence being justified in terms of molecular-orbital theory.

No book of this size can possibly be absolutely free of inconsistencies and faulty interpretations, and Chernyaev's splendid review is no exception. The statement on page 255 concerning the inability of UO_2^{+2} to be complexed by more