

tions and expeditions, cathedrals and universities, roads and canals, books and instruments. Every society must make some investment for the future, and space exploration is certainly an exciting and promising item for investment. The difficulty in making allocations arises only because no man can foretell the future very accurately.

Nonetheless, in the desperate need to keep science and technology from alienating themselves from society, can one render some plausible connection between the potential of space science and our crying social needs? Here are two examples; the first was not anticipated, but currently attained, the second is the converse. "... Project Apollo developed techniques for directing the mass efforts of thousands of technical minds in a close-knit combination of government and industry. It may be possible to adapt these techniques to large social

and environmental undertakings such as control of earth's complex ecological system." (*Fortune*, July 1969) The second example is "Space communications ... may result in the disintegration of the cities and a great reduction in travel, as telecommunication and telecontrol will allow ... men ... to live wherever they please." (*The Promise of Space*, page 109)

The question then becomes "What portion of the nation's disposable income should be invested in the space program—civilian and military?" No man knows the proper balance point. But from Clarke's inventive mind has come this book that will entertain and inform the neutral inquirer, and that will render more difficult the task of the detractors of the space program.

* * *

The reviewer, a physicist and materials scientist at Michigan State University, spent some time in the space program.

Astronomical history

VISTAS IN ASTRONOMY, VOL. 9: NEW ASPECTS IN THE HISTORY AND PHILOSOPHY OF ASTRONOMY. (Conf. proc.) Arthur Beer, ed. (Univ. of Hamburg) 317 pp. Pergamon, New York, 1967. \$22.00

VISTAS IN ASTRONOMY, VOL. 10. Arthur Beer, ed. 214 pp. Pergamon, New York, 1968. \$16.00

by JOHN SUTTON

In this technological era, when historical studies are so often neglected, it is encouraging to find 1.5 books dealing with recent research into the history of astronomy.

Volume 9 of *Vistas in Astronomy* is devoted to the proceedings of a joint symposium of the International Astronomical Union and the Union Internationale d'Histoire et de Philosophie des Sciences held at Hamburg in 1964. It contains 32 contributions by scholars from 11 countries, and includes four in French and one in German. Many of the articles are concerned with the description and classification of manuscripts and astronomical devices such as sundials, astrolabes, armillary spheres and clocks. There are also studies of individual astronomers, observatories and astronomical movements in several countries, including Tibet.

The more interesting articles, particularly for the nonspecialist, are

those that go beyond description and classification. For example, Owen Gingerich demonstrates with an electronic computer that Kepler's crucial calculations of the orbit of Mars would have required much less effort had he not been plagued by numerical errors.

This profusely illustrated volume is not an encyclopedia, but it does present an overall picture of research in the field, at least as it was several years ago. Although it is primarily a book for specialists, it does contain much of interest for other scientists.

The flow of history continues in volume 10. O. Neugebauer has produced a fascinating and devastating exposé of the mathematical methods of Copernicus. He shows that, contrary to popular belief, the Copernican theory of the solar system is as complicated mathematically as the Ptolemaic theory and produces no better planetary positions.

Herman Zanstra's defence of the occult world, based on his personal preferences and the poorly established phenomenon of mental telepathy, is unconvincing and rather unscientific. The republication of 24 pages of ancient star positions in Gerald Hawkins's article on astroarchaeology is an unnecessary extravagance.

There is finally a return to conventional astronomy and the familiar for-

mat of this series. Of particular merit is Tibor Herczeg's thorough and systematic examination of theories of the origin of the planetary system.

Except for the objections mentioned, volume 10 is a worthwhile contribution to astronomy. Finally, radio astronomers will find it curious to note that *Vistas in Astronomy* has not contained an article on radio astronomy since volume one.

* * *

John Sutton is a research associate at the National Radio Astronomy Observatory.

Thermometry to date

PRECISION MEASUREMENT AND CALIBRATION, VOL. 2: SELECTED NBS PAPERS ON TEMPERATURE. NBS Special Publication 300. J. F. Swindells ed. 513 pp. National Bureau of Standards, Washington, DC, 1968. \$4.75

by JAMES B. KELLEY

When completed this series will contain twelve volumes, of which the present one on temperature is the first despite its designation as volume 2.

It has reprints of articles on temperature measurements made at the National Bureau of Standards through June 1967. Plus, there is a bibliography of temperature-measurement articles drawn from all over the world from January 1953 to December 1965. Hence, the total impact of this volume is to put in one place the most complete reference work on temperature in the English language.

The book is divided into seven sections: expression of uncertainties, temperature scales, resistance thermometry, thermoelectric thermometry, liquid-in-glass thermometry, optical pyrometry and spectroscopic thermometry.

Without meaning to be prejudiced, I found the section in resistance thermometry the most interesting. Here, the introductory paper by H. F. Stimson is of such basic importance that it could easily be made the basis for several lectures in an undergraduate thermodynamics course. Following this paper there are "Notes to Supplement Resistance Thermometer Reports" that go into some of the details, including the calibration of a Mueller bridge.

There are also interesting papers on low-temperature resistance thermometers going down to 2.1 K. Altogether

this entire section and the following one on thermocouples could compose a good part of an experimental-thermodynamics book. The section on the calibration and use of liquid-in-glass thermometers is invaluable to anyone who is engaged in standardization work.

The final two sections on optical pyrometry and spectroscopic thermometry cover each area very well. Both of these methods involve temperature considerably higher than those usually encountered in most laboratory work. However, with the increase of work in plasma physics, the spectroscopic methods are increasing in interest and value.

* * *

James B. Kelley has recently become vice-president for academic affairs at Adelphi University, New York. He has done research in thermometry, particularly resistance techniques.

Pocket encyclopedia

THEORIE DU MAGNETISME. By André Herpin. 882 pp. Presses Universitaires de France, Paris, 1968.

by DANIEL C. MATTIS

André Herpin has written the most complete textbook in magnetism, one that recommends itself to all physicists who are familiar with the French language. Some of the topics covered in rather substantial detail are local-field theory, domain theory and ferro-, ferri- and antiferromagnetism.

There is a chapter on the experimental methods of magnetism, that is, Mössbauer effects, nuclear-magnetic resonance and neutron diffraction. The author is particularly clear in correlating experimental parameters with theoretical analysis. He discusses atomic properties in some detail, including the rules of Hund, and then introduces the crystalline field and discusses its effects on ions of the transition series.

Also covered are thermodynamics, the exchange forces, anisotropy, dynamic phenomena and molecular-field theory. This last is perhaps the weakest feature of the book. The most recent theoretical developments define thermodynamic functions of magnetism, which often differ considerably from the molecular-field results.

It is, however, difficult to fault this book, which manages in addition to tell all about hysteresis, rare earths and many other miscellaneous aspects of the field. Perhaps it should not have been titled *Theory of Magnetism* but rather *Pocket Encyclopedia of Magnetism*. It is recommended for all students in this field.

* * *

The reviewer, professor of solid-state physics at Belfer Graduate School of Science, Yeshiva University, is the author of *Theory of Magnetism*, which is more theoretical and much less encyclopedic than Herpin's book.

Hot and fast

PHYSICS OF SHOCK WAVES AND HIGH-TEMPERATURE HYDRODYNAMIC PHENOMENA, VOL. 2. By Ya. B. Zel'dovich and Yu. P. Raizer. Wallace D. Hayes, Ronald F. Probstein, eds. (Trans. from Russian) 916 pp. Academic Press, New York, 1967. \$18.00

by ROLF LANDSHOFF

The existence of shock waves was predicted theoretically by Bernhard Riemann and proven experimentally by Ernst Mach, but for many years research in this field proceeded at a very slow speed. This situation changed quite drastically when the development of nuclear bombs and of missiles led to technical problems. The implosion of fissionable material, the expansion of and radiation from the nuclear fireball and the reentry of missiles could not be solved without a thorough understanding of these phenomena. Obvious interest also arose through astrophysical applications, such as the explosion of a supernova and the observed optical phenomena on the surface of certain stars.

Both authors have been active contributors in this field. They are members of the USSR Academy of Sciences, Ya B. Zel'dovich in the section designated as Astronomical Soviet and Yu P. Raizer in the Institute of Mechanical Problems. Among their numerous publications, one by Raizer once gave me a bit of a chuckle because of a not quite successful attempt to "declassify" the title of the English summary of the article. It was given as "The Formation of Nitrogen Oxides in the Shock Wave of a Strong Explosion in Air," and somehow the editor in charge of the clean up had overlooked the original Russian title just

above the English one, with the word "atomic" in place of the word "strong."

This book is the second of two volumes; the first is devoted to fundamental hydrodynamic, physical and chemical processes and the second one to details of the shock-wave structure and to numerous important applications. Discussion of the shock-wave structure deals with the role of various nonequilibrium type processes. In very strong explosions the most important of these is the radiative transfer of energy. Radiative transfer is also a major factor in determining the luminosity of a fireball. One of the phenomena observed is the so called "cooling wave" that moves toward the center of the fireball and whose theory was developed by the two authors together with A. S. Kompaneets.

Other applications include spark discharges and shock waves in solids at the surface of stars and in an inhomogeneous atmosphere with an exponential density distribution. Many of these problems can be successfully attacked by similarity transformations.

Altogether, these two volumes are required reading for anyone working in this field. The presentation is comprehensive, authoritative, and clear, and the translation reads very smoothly. Much of the credit for the latter must go to the US editors, who are themselves reputable scientists and authors. The books are also intended for graduate courses, and they will be useful for engineers who want to apply the results to specific problems.

* * *

A senior member of the Lockheed Palo Alto Research Laboratory, the reviewer is the editor of a recent book on excitation and nonequilibrium phenomena in air.

The cultivated reader

ANOTHER LOOK AT ATLANTIS AND FIFTEEN OTHER ESSAYS. By Willy Ley. 229 pp. Doubleday, New York, 1969. \$5.95

by JACQUES E. ROMAIN

Most of this book is not concerned with physics. However, any scientist will read with pleasure this refreshing series of essays on topics ranging from history through zoology and technology to cosmology and, of course, space science.

The first two subjects are unexpected