more, it was Morley who suggested that the entire apparatus be floated on mercury with an annular trough and float system which he devised. These great improvements enabled Michelson and Morley to employ a multiple-path optical system for their interferometer which lengthened the paths of the light beams by a factor of ten. As a result the anticipated fringe shifts predicted by the aether theory from the motion of the earth in its orbit would be 0.4 of a fringe, an amount which could not possibly have failed to be detected. The stone and mercury support also had the great advantage that the interferometer could be rotated continuously and observations made at all azimuths. As is well known, this famous Michelson-Morley experiment was completed in July, 1887, and gave a conclusive null result, which made it imperative that the far-reaching revisions in electrodynamics made by Lorentz, Poincaré, and above all by Einstein in the Special Theory of Relativity, should follow.

Following their work on the Michelson-Morley experiment, Michelson and Morley continued their collaboration on work (1887–1889) which established the feasibility of using light waves as the ultimate standard of length. Professor Michelson completed this work at Paris several years later, but an exceedingly important biproduct of their search in Cleveland while looking for a very narrow spectrum line suitable for the wavelength standard was the discovery of both the fine structure and the hyperfine structure in many lines of atomic spectra.

Toward the end of his career at Western Reserve University, Professor Morley collaborated with Professor Dayton C. Miller of Case. After the rather general acceptance of the Fitzgerald-Lorentz contraction hypothesis to explain the null result of the Michelson-Morley experiment, Morley and Miller devised a larger and more versatile interferometer which they used in 1904 to show that the same null result was found when the optical parts are supported by either sandstone, wood, or steel.

Three Dimensional Dynamics: A Vectorial Treatment. By C. E. Easthope. 227 pp. (Butterworths, England) Academic Press Inc., New York, 1958. $7.80. *Reviewed by T. Teichmann, Lockheed Aircraft Corp.*

While the vectorial treatment of analytical mechanics has become preeminent in American and many European texts, it has tended to have rough going in the British Empire largely perhaps because of the influence of the many important Victorian and Edwardian expositions on this subject which studiously eschew the techniques of Gibbs and Heaviside. The publication of this book seems to indicate that this opposition to vectors is at last dying out and that it is now becoming respectable in England to write each equation once only instead of three times.

The treatment here is essentially an undergraduate treatment of standard Newtonian mechanics specifically excluding the more advanced concepts of Lagrange and Hamilton-Jacobi theory. Within these limitations, however, the author has presented an extremely clear and usable picture of the methods of analytical mechanics. The text contains examples to illustrate all phases of the various general theorems and methods described. The chapters are generally followed by problems which illuminate the methods and challenge the reader without plumbing the depth of old-fashioned Tripos problems. A useful and significant portion of the book is devoted to the behavior of rotating bodies (more than half the book concerns such problems). In view of the present increasing interest in guidance and celestial mechanics, it seems probable that a thorough knowledge of this type of material will become the sine qua non of engineers as well as physicists, and this book can be recommended particularly to those who wish to refresh their knowledge of the subject with special reference to its practical application in missiles and satellites.

Roots of Scientific Thought: A Cultural Perspective. Edited by Philip P. Wiener and Aaron Noland. 677 pp. Basic Books, Inc., New York, 1957. $8.00. *Reviewed by L. Marton, National Bureau of Standards.*

The title of this splendid anthology is more informative than it appears at first sight. It heads what may appear first as just another book on the history of science. Actually the book is considerably more. As the editors pointed out in one of their prefatory chapters, "The historian of ideas . . . is interested not only in the logical, cumulative development of scientific thought but also in the extralogical components and their historical affiliations with other cultural developments in the history of the arts, of social institutions, of religion, and of philosophy." It is in the light of this illuminating sentence that one has to look at and analyze this volume.

The anthology consists of 33 papers which appeared earlier in the *Journal of the History of Ideas*. They cover the development of scientific ideas from the earliest classical times until the most recent evolution in cosmology. However, the emphasis is more or less on the sixteenth and seventeenth centuries. The articles are divided into four groups: the first is called The Classical Heritage, the second From Rationalism to Experimentalism, followed by The Scientific Revolution and From the World-Machine to Cosmic Evolution. Each group is preceded by a summary review of the whole era. Three of these summaries are written by the editors themselves and one is written by Crombie. The authors of the papers are representatives of the best history-of-science tradition: Moody, Koyre, Crombie, Randall, and many others. Some of these papers are considered classics of their kind and constitute a very interesting discussion of the subjects which they are treating. It is hard to pick out the best ones in such a galaxy of splendid papers, but I like best John Herman Randall, Jr.'s "The Place of Leonardo da Vinci in the Emergence of Modern Science", Edgar Zilsel's "The Origins of Gilbert's Scientific Method", Francis R. Johnson's "Gresham College: Precursor of the Royal

NOTABLE ACHIEVEMENTS AT JPL . . .

THE ARMY'S NEW SERGEANT

JPL is proud to have the responsibility of designing and developing the U.S. Army's newest operational missile system—the Sergeant. This weapon is America's first truly "second generation" surface-to-surface tactical missile and, when placed in production will eventually succeed the Corporal which was also a JPL development.

The Sergeant, especially designed as an extremely mobile tactical weapon, utilizes a solid propellant rocket motor which provides better field handling and storage capabilities than those of many other weapon systems. It can deliver a nuclear blow deep into enemy territory and its highly accurate guidance system is invulnerable to any known means of enemy countermeasure.

All elements of the Sergeant are particularly designed for active field use with emphasis on reliability, mobility and the use of standard U.S. Army vehicles wherever possible. The erector-launcher, for example, is capable of rapid movement over rough terrain. These characteristics place in the hands of the U.S. Army an important new tactical element of extended range.

The basic activity at JPL continues to be—research into all scientific fields related to the development of weapons systems and space research vehicles.

CAREER OPPORTUNITIES NOW OPEN IN THESE FIELDS

ELECTRONIC, MECHANICAL, CHEMICAL AND AERONAUTICAL ENGINEERING • PHYSICS AND MATHEMATICS

jpl

JET PROPULSION LABORATORY

A DIVISION OF CALIFORNIA INSTITUTE OF TECHNOLOGY

PASADENA • CALIFORNIA

Society", and S. E. Toulmin's "Crucial Experiments: Priestly and Lavoisier". This admiration of only four papers out of 33 does not mean at all that the others are less good. It merely reflects the personal preference of one reader. The wide diversity of the subjects and viewpoints makes interesting reading, whichever part of the book you may open.

The individual contributions are handled with a great deal of originality. This may go so far that one contributor is accused by another of "Marxist leanings". My own knowledge of this aspect of the subject is not sufficiently developed to resolve the controversy; at least in the published excerpts of the accused writer's paper these "leanings" were not immediately apparent to me.

I would like to mention one more paper which is slightly different from all the others. It is the last paper of the series by I. Bernard Cohen, entitled: "Some Recent Books on the History of Science". I pick it out separately because it can be used as an excellent introduction to the reading material on the history of science. I don't know of any other introduction to that material which is as good as this particular one.

It is customary to include also some adverse critical material in the description of any book and here is a little bit of such criticism. In vain I looked several times for any indication about the date of the appearance of the papers in the original publication. I think it would have added to the value of the book if references had been given. Nevertheless, carping aside, this book can be very warmly recommended to anyone who is interested in the history of science and the history of ideas.

Progress in Nuclear Physics, Vol. 6. Edited by O. R. Frisch. 297 pp. Pergamon Press, London and New York, 1957. $14.00. *Reviewed by Kamal K. Seth, Duke University.*

The present volume of *Progress in Nuclear Physics* has admittedly a definite "reference book" bias and this may be said without implying that that in any manner compromises the objectives of this excellent review annual. Nearly half of the volume is devoted to isotopes. On isotope enrichment there is an elementary article on multistage methods by T. F. Johns, and after four intervening articles (162 pages later) a somewhat more elaborate article on electromagnetic methods by M. L. Smith. Similarly, on atomic masses there are two articles: H. E. Duckworth on masses of atoms of $A > 40$, and again, with about 100 intervening pages, an article by J. Mattauch and F. Everling on masses of atoms of $A < 40$. The merit of these articles, in spite of recent publication of more detailed surveys of the subject lies in the fact that they are much more readable and concise, and yet as complete and comprehensive as any others. After the masses come moments and spins, and K. F. Smith, in a very elegant article, reviews the up-to-date experimental knowledge of nuclear moments and spins as well as the basic theoretical concepts involved. G. N. Walton writes on the not-so-well-known subject of fission recoil and its effects and M. B. Stearns reviews the experimental status of the spectroscopy of mesonic atoms. R. J. Eden discusses nuclear models and, at a time when the multiplicity of nuclear models is beginning to be quite confusing, his excellent and clear and essentially nonmathematical review of the subject is most opportune and may be recommended to every experimental physicist. The concluding article of the book can hardly be called a review article because the subject of parity nonconservation is scarcely ripe enough for it; both experimental and theoretical developments are still continuing at too rapid a rate. Yet, O. R. Frisch and T. H. R. Skyrme have done a timely service in writing on parity nonconservation in weak interactions in a style which is lucid and easily understandable.

The articles in this volume, as in the preceding ones, are uniformly scholarly and readable and are provided with fairly complete bibliographies.

Nuclear Reactions I. Vol. 40 of Handbuch der Physik. Edited by S. Flügge. 553 pp. Springer-Verlag, Berlin, Germany, 1957. DM 128.00 (subscription price DM 102.40). *Reviewed by S. Gorodetzky, Université de Strasbourg.*

This volume, the first in a series on nuclear reactions, contains four articles, the first two of which treat the entire subject of low energies. All of the articles are directed to experimentalists, who are likely to find them of considerable interest.

In the article on light nuclei (202 pages), W. E. Burcham first briefly discusses nuclear energy, or rather, in his own terms, the nuclear forces which one expects to influence the structure of a nucleus in a manner susceptible to experimental study. He then discusses the nuclear models as well as the various transitions, and the characteristics of nuclear reactions, which introduce the study of the properties of excited levels.

An explanation of the experimental methods by which these properties can be obtained as well as the brief theory of each method is given. Beginning with reactions classified according to different types the author analyzes at length the experimental results achieved. Finally, the author arranges his results by groups of isobars.

In the article on heavy nuclei (170 pages), B. B. Kinsey first examines the theory of the compound nucleus and nuclear reactions. He indicates some experiments which enable verification of the different hypotheses of interactions. The author then develops the experimental methods with some selected examples and discusses the nuclear reactions, which are classed according to their types.

At the end of the article there is a systematic study of some low-lying energy levels, especially in the deformed nuclei and in the tight-layered nuclei.

In the third article (75 pages), J. Rainwater discusses neutron resonances. He explains the theory, of-