named spaces (which are connected with "positive" operators). The presentation is particularly adapted as an exact and clarifying foundation for the Hilbert-space techniques so common and necessary in present-day theoretical physics. The chapter on approximate solution of functional equations deserves special mention as providing an elegant, concise, and illuminating treatment of general approximate methods in the solution of integral and differential equations.

All in all, this book will repay the attention of any mathematically inclined physicist or engineer.

The Universe and Its Origin. H. Messel and S. T. Butler, eds. 147 pp. St. Martin's Press, New York, 1964. $3.75.
Reviewed by J. Allen Hynek, Northwestern University.

"When we see the Moon from close up it will be mostly very gentle slopes that we shall see and none, or extremely little, of the jagged steep mountains that have been the usual artist's conception of the lunar surface." So Tom Gold closes his chapter on the Moon in this pre-Ranger VII book which consists of lectures on cosmology, stellar evolution, and the origin of the solar system, prepared expressly for secondary-school science teachers in Australia.

Gold's prediction seems to have been strikingly confirmed by the epoch-making flight of Ranger VII, at least for the very limited region of the Moon examined. The jagged moonscape so ubiquitously pictured by science-fiction artists seems conspicuously absent.

It seems clear that erosion has been active on the moon to produce the Ranger-observed landscape but obviously not by the weathering processes so familiar on earth. Gold suggests an erosion that is possible only in a vacuum which permits bombardment by charged particles, hard radiation, and micrometeorites. "Vacuum erosion" (it might be called) is the mechanism that Gold feels has produced the surface texture of the moon.

The moon is perhaps our Rosetta Stone for an understanding of the origin of the solar system. There is strong reason to believe that "it was there in the beginning," and because the ravages of time have been much less on the moon than on the earth, detailed inspection of the Moon might be to astronomy what the opening of an age-old undisturbed tomb is to archaeology.

Origins is the theme of the entire small volume. The other contributors, George Gamow, Bart Bok, and C.B.A. McCusker, are concerned with the origin of the universe, of stars, and of cosmic radiation, respectively. Gamow also concerns himself briefly with the origin of life on earth.

Although the editors warn that the subjects treated by the authors "do not necessarily integrate with one another," in matter of fact, they do quite well. The problems of the origins of just about everything celestial, from the chemical elements which are in the stars to the stars themselves and to the galaxy, are outlined and treated in a coherent and in an as up-to-date manner as is possible in this rapidly growing field. What may particularly strike the American reader of this Australian volume, however, is the comment by the editors that the chapters were "written to cater for secondary school teachers". If so, then we must gather that secondary education in the sciences—and the education of the secondary science teacher—is more advanced in Australia than it is here.

Gamow leads off, and in five brief chapters reviews the distance and time scale of the universe, discusses the pros and cons of the evolutionary and steady-state theories, coming out strongly (as might be expected) for the evolutionary theory, and treats then of the origin of galaxies, stars, planets, and life. He gives a good account of the evolution of the cosmic distance scale, and extends the discussion to the curvature of space, the age of the earth, of the moon, of the stars, and of the galaxy. The editors failed to catch some simple but outlandish errors: the Hubble constant is given as 23 hours/sec/light year; obviously a million light years is meant. This would be a dynamic and cataclysmic universe indeed, if that figure were true! In addition, Gamow gives us a truly gigantic universe: the distance of the Corona Borealis cluster of galaxies is stated as 800 billion light years, a figure over-generous by more than two orders of magnitude. He gives the present rate of recession of the moon from the earth as 10 cm per lunation. At that rate, the earth and moon must have been close together a matter of 300 million years ago, and not 5 billion years, as he states.

Despite these slips, the chapters adequately present the over-all picture, always interestingly written. Gamow's section is by far the most quantitative—and if allowance is made for the obvious errors, the reader will learn much more than a secondary science teacher is expected to know in this country.

The other three sections are much more descriptive in nature, but at no sacrifice of accuracy of concept. Bok gives a fine and entirely adequate account of stellar evolution and the role this plays in the origin of elements.

Gold gives a fine presentation of the modern cold accretion hypothesis of the origin of the solar system, a hypothesis which appears to fit the facts much better than any previous theory. Finally McCusker, in the shortest section of the book, summarizes our present knowledge of the origin of cosmic radiation.

The book can be highly recommended as a good overview of the present picture of cosmic origins.

Elements of Astromechanics. By Peter van de Kamp. 140 pp. W. H. Freeman, San Francisco, 1964. Cloth $4.00, paper $2.00. *Reviewed by E. J. Öpik, University of Maryland and Armagh Observatory.*

The author is known for his outstanding investigations of double stars, crowned by the discovery of the truly planetary-size dark companion of Barnard's star.

The booklet is dedicated to an elementary two-dimensional presentation of the Newtonian two-body problem, except for a digression into double-star orbits and the perspective effects of stellar proper motions. Neither the elements of planetary orbits, nor the calculation of the positions of planets in space or on the celestial sphere are mentioned. The numerical applications, very limited in scope, refer to

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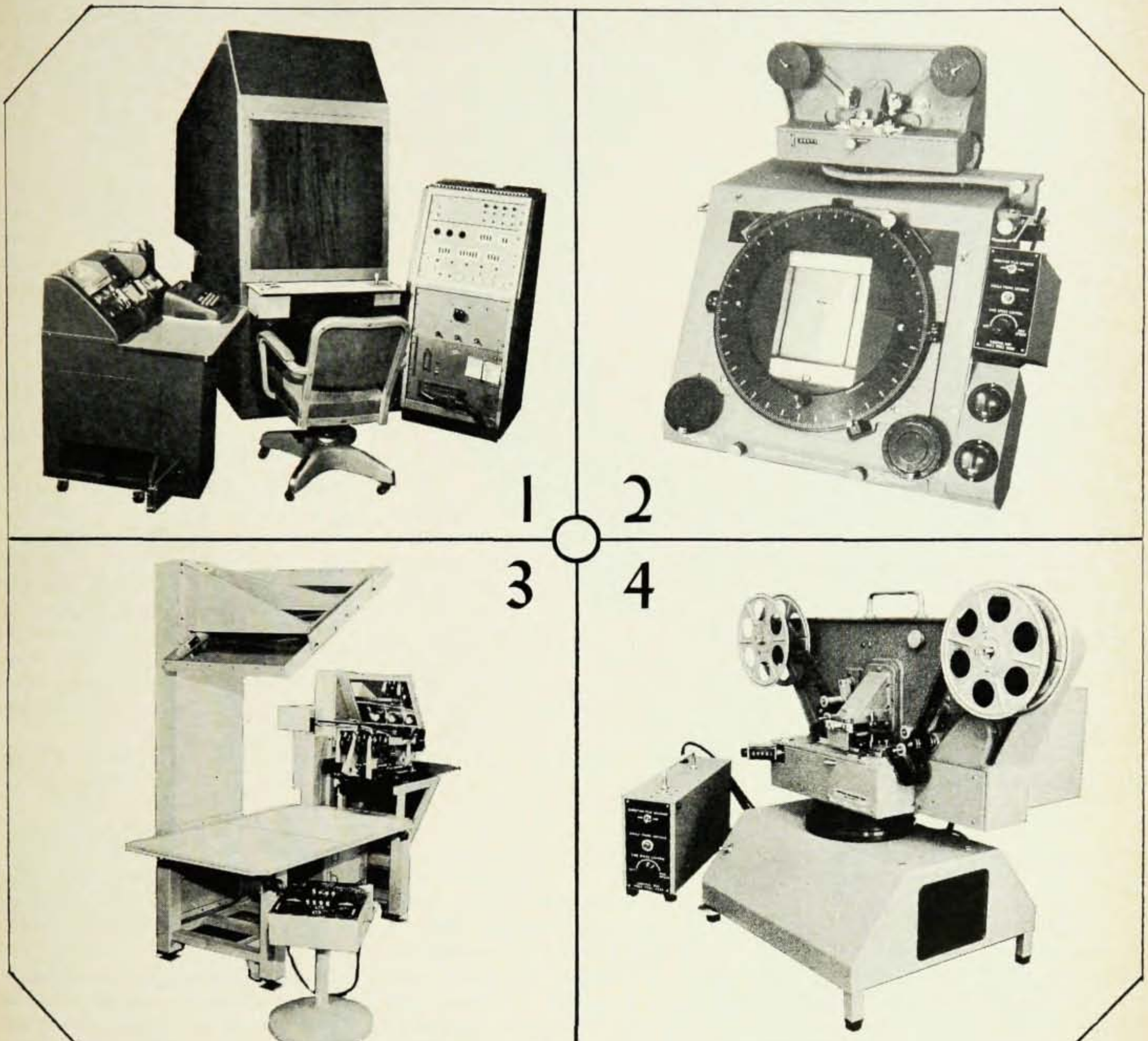

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the motion of vehicles within the sphere of action of the earth's gravitational field. Formulae for the mass ratio of an exponentially expended space rocket are given.

There are very few misprints, such as a superfluous minus sign in Eq. (8.4) which otherwise duplicates Eq. (3.27). Repetition and duplication of equations and text is practiced to a rather excessive extent [e.g. typically on page 66, Eqs. (4.20) and (4.22) occur twice]; with some systematization, the size and price of the booklet could have been cut very substantially without sacrificing anything of the contents.

On pages 29-32, the term "weightlessness" is used in the sense of the equality of gravitation and centrifugal force in a circular orbit; this may cause misunderstanding, as it has nothing to do with the problem of unconditional weightlessness on a space vehicle in free orbital flight.

As a two-body exercise of narrow scope, the work has been done very thoroughly, with detailed derivation of all the equations, beautiful and imaginative illustrations, and instructive tables. Its reading by a novice should be an easy matter.

Physics for Engineers. By G. F. Lewin. 310 pp. Butterworths, London, 1963. $9.95. *Reviewed by Robert L. Weber, The Pennsylvania State University.*

At a time when the most widely used American textbooks of physics for university students in science and engineering are pushing beyond a thousand pages in length and can be carried comfortably only in two-volume editions, it is interesting to see how well a British author can write a 310-page textbook which "provides a complete treatment of the theory of physics in a form which the engineer will understand without difficulty . . . and explains in detail the basic concepts and shows how these are related to the more advanced theoretical work of engineering".

The order of topics is somewhat unconventional. The text begins with five chapters on heat and kinetic theory of gases. There follow three chapters on light, two on wave properties and sound, and a chapter on the use of interference and diffraction in making accurate measurements. The text closes with chapters on electrical engineering and physics, mechanical engineering and physics, and nuclear and solid-state engineering and physics. The writing is terse. The reader is apparently assumed to be familiar with general physics and calculus. The mks system of units is usually employed. The student is offered some 67 exercises, with answers given, in contrast to the hundreds in a conventional American text.

Physics for Engineers is said to "cater for mechanical and electrical engineers in the first year of their Diploma in Technology courses". It is perhaps assumed that they will have had an introduction to mechanics and to electricity, for the one chapter on mechanics is chiefly concerned with simple properties of fluids, and contains also some remarks on accuracy of measurement, optical determination of stress, and flaw detection by radiography. There is a good but very compressed chapter on electrical principles including lumped circuits, transmission lines, and aerials.

The author has apparently been concerned with imparting a working knowledge of certain topics he deems important and not particularly with the most recent information, even in areas being stressed. The gas-thermometer scale is discussed at some length in terms of the older two-point calibration. The reference given for the International Temperature Scale is not the current one. Isotope masses are still referred to that of oxygen as 16. References to the literature are mostly to adequate standard books, some recent better ones being overlooked. A few statements might better have been omitted, such as, "the radiation pyrometer . . . may be used for measuring higher temperatures than the optical pyrometer, whose maximum is defined by the melting point of the lamp filament".

It is easy in criticizing any book, and especially a concise one, to differ with the author on the relative merits of topics included and excluded. Here one might suggest that it would have been better to include Newton's laws of motion instead of Newton's "law" of cooling, or third-order ray tracing theory, etc. However, some topics not often included in an introductory text which might appeal to users of this book are: a calculation for an achromatic model eye, instability of a fluid, Schrödinger's equation, radiation pressure, the color triangle, photometric data, vibrations sustained by an airstream, measurement of Poisson's ratio, the simple multivibrator and counter.

Physics for Engineers will probably be most used as a review and a reference book rather than as a complete textbook from which a student gains his initial understanding of physics.

The New World of Physics. By Arthur March and Ira M. Freeman. 195 pp. Random House, New York, 1962. $4.95. *Reviewed by Michael W. Friedlander, Washington University.*

Only two cultures? As many as two? Many of us have our own private prejudices on this subject, but are there any who will deny that the average nonphysicist has remarkably little knowledge or understanding of the structure we call physics? Unfortunately, too, so many who wish to educate themselves emerge from their labors with the most remarkably garbled ideas. Books which try to remedy this are to be welcomed, but perhaps they should be treated like drugs—given only under the direction of a doctor (of physics), and with a warning. This warning is essential: The reader must expect to exert himself intellectually to a degree to which he is probably normally unaccustomed. There is no easy way to an understanding of physics—hard (mental) work is needed. Even a popular book on physics should not be read like a novel, and if it can be, then I would suggest that it is not fulfilling its task. So much of physics involves unfamiliar ideas: abstractions, continuity and discreteness, precision in the use of a technical language, the use of mathematics to carry out quantitative calculations.

The danger of writing a popular book is that it might turn out to be too popular through the simple device of avoiding the important ideas of physics. Professors March and Freeman appear to have avoided this pit-