

senting his modest refinement of Hamilton's remarkable edifice (page 58): "I therefore do not know why Hamilton . . . requires the introduction of a function S of $6n + 1$ variables . . . while, as we have seen, it is completely sufficient to . . ." Does not that blend of pride and false innocence recall innumerable referee's reports, replies to referee's reports, and now *Physical Review* comments and countercomments that we have all read and (alas) written? Compare the dignity of Hamilton on Lagrange (page 44): "Lagrange has perhaps done more than any other analyst, to give extent and harmony to such deductive researches, by showing that the most varied consequences respecting the motions of systems of bodies may be derived from one radical formula; the beauty of the method so suiting the dignity of the results as to make his great work a kind of scientific poem."

Would that we were all in dread of being remembered as much for our prose as our theories and experiments; it might well benefit all three.

Not the least of the pleasures offered by Mandelstam and Yourgrau is the abundance of nuggets like the two cited above. A few more examples:

Whittaker on Hilbert's variational formulation of Einstein's law of gravitation: "Gravitation simply represents a continual effort of the universe to straighten itself out."

Poisson on the principle of least action (1837): "... only a useless rule."

Planck on the principle of least action (1915): "... that [general law] which . . . may claim to come nearest to that ideal final aim of theoretical research."

My complaints are few. Several philosophical axes are ground at regular intervals throughout the text, which process I personally found of little interest. Furthermore (and I offer this comment with the greatest reluctance in this day when scientific prose has completed its evolution into a medium with the vibrancy and resilience of wet cotton) I was continually disconcerted by a prose style I can only describe as baroque (Example: "Almost overbearingly did he postulate . . .") and a staggering lack of humor. Two examples of the latter:

Could not Planck have been joking when he viewed "as a variational principle Leibniz's maxim that our world is the best of all possible worlds!"

Could Voltaire (of all people), speaking of Maupertuis, not have been joking when he "dubbed him 'Sir Isaac Maupertuis,' so elevating him to the lofty rank of Newton," especially in view of the fact that he "later inveighed against his former idol with uncontrolled invective."

If not, your reviewer stands convicted of a most unseemly frivolity and irreverence. Be that as it may. The book as a whole should be a delight to the-educated and a most valuable supplementary text for the student.

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The Tides: Pulse of the Earth

By Edward P. Clancy

228 pp. Doubleday, New York, 1968. \$4.95

Written in a colloquial style, with rhetorical digressions into poetical and surrealistic imprecision, this book can be read as a novel without expecting too much hard factual information. It is said to be directed to students as well as to the general public, but to the former it will hardly be very useful except if they are familiar with the subject.

Even the general reader will be often disappointed by the author's failure to offer simple figures or explanations, for he covers them up by verbiage like this: (about the output of volcanoes) "... you may object that . . . volcanoes spew forth little material. But ask a geologist to make a rough estimate. . . . Double the figure he gives. . . . Multiply the result by 4.5 billion years." and so forth. Yet the figure is not given, so that the reader is unable to perform the calculation. It would have been simpler to say that the present output of volcanoes is about one km^3 per year and omit all the empty rhetoric. Cases like this are numberless and characteristic of the entire book.

Serious misstatements also abound. On page 199 the author remakes celestial mechanics by saying that "the moon's revolution about the earth is becoming faster and faster." Later, it is maintained that "If the moon is speeding up in its orbit, it is gaining kinetic energy" and then that "the

earth's loss of rotational kinetic energy goes . . . partly into increased kinetic and potential energy associated with the moon's orbit." Actually, in the tidal transfer of momentum, the kinetic energy of the moon decreases, and only the potential energy and angular momentum are increasing. Nowhere is it mentioned that tidal interaction leads to a steady increase in the moon's distance, accompanied by a lengthening of the month or slowing down of its orbital revolution. This complete misunderstanding of tidal evolution annuls whatever the author, in so much verbiage, is subsequently saying about the history of the earth-moon system and the paleontological clues (corals) to the variation in the length of the day.

The illustrations are below standard and noninformative. Any reader is supposed to be able to read a map; yet the two maps of Passamaquoddy Bay, in their surrealistic presentation, are all but an insult to his intelligence. Everything else is similarly distorted.

If much of the meaningless verbiage were cut out and substituted by elementary factual information, still retaining the poetry, the book's value could be greatly increased. In my recent experience, I have repeatedly concluded that too many books are too lightly published nowadays: The present book is no exception.

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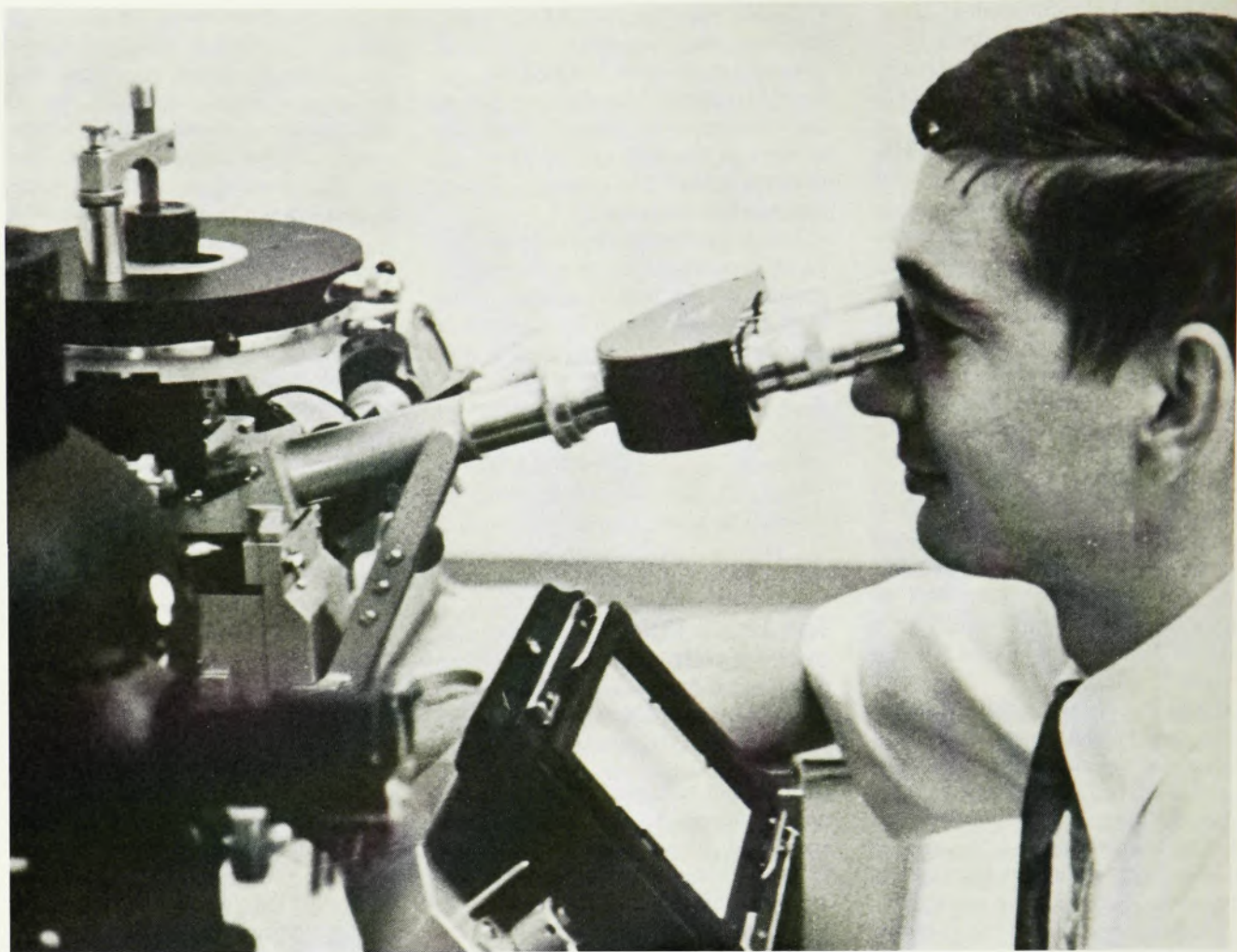
Reflexionsspektroskopie

By Gustav Kortüm

378 pp. Springer-Verlag, New York, 1969. \$21.50

In recent years methods of reflection spectroscopy have been extensively refined and developed and physical data not accessible to standard spectroscopic analysis are now being made available. Such data are optical constants (index of refraction and dielectric constant), parameters of crystal powders, properties of pigments, molecular structure, adsorption, catalysis on surfaces, kinetics of surface reactions, ligand structure and surface-photochemical processes.

This book's purpose is to indicate the capabilities of the two major reflection-spectroscopic approaches, namely diffuse reflection and attenuated total internal reflection. The lat-



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ter is dealt with briefly in the eighth and last chapter; diffuse methods are described thoroughly in the previous six chapters, the first chapter being a brief general discussion of reflection. The discussion on the method of diffuse reflection includes the role of grain size, regular specular reflexion, concentration of absorbing components, moisture content and influence of scattering interfaces on the results obtained.

A salient feature is the excellent presentation of Rayleigh scattering, Mie scattering and radiation-transport theory as foundation for a theoretical background of multiple scattering. The author points out that no complete theory of multiple scattering has yet been developed. The Schuster (1905) equations for isotropic-multiple scattering are presented in chapter 4 as the historical precursors of the Kubelka-Munk (1931) theory. Exponential and hyperbolic solutions of the latter theoretical equations are arrived at, and form the basis for tables of the Kubelka-Munk function given in an appendix. The derivation of that function and presentation of its tables makes this a useful and unique book. It marks the recent rapid progress of diffuse-reflection spectroscopy as an analytic science.

The one chapter on total-internal-reflection spectroscopic methods is relatively minor. The 29 pages barely hint at well established possibilities of internal-reflection procedures. Yet the book is highly commendable: Literature citations and illustrations are generous and there is a table of contents and subject index. The applied physicist and experimentalist will find food for thought along new spectroscopic lines.

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Relativity and Cosmology

By H. P. Robertson,
Thomas W. Noonan
456 pp. Saunders, Philadelphia, 1968.
\$17.85

Relativity and Cosmology is the joint effort of two authors, one of whom died before the book itself was written. Thomas Noonan was the last student of H. P. Robertson at Cal Tech. After Robertson's untimely death, he undertook the task of organizing Rob-

ertson's notes into book form. Much of the material in this book, then, is Robertson's, and the scientific community can be thankful to Noonan for making available the thoughts of one of the greatest cosmologists of this century. Noonan's contribution to this work, however, was more than just that of an editor. For the most part Robertson's notes were aides memoires, so that their publication required a considerable amount of reconstruction and expansion.

The book's main development follows along fairly standard lines and is quite similar to that found in a number of other texts on relativity. However, there are a number of discussions that are not standard and that make the book well worth owning. There is an extensive discussion of the Poynting-Robertson effect, of special-relativistic gravitational theories and automorphisms of the metric, to mention a few of these special topics. However, it is the last five chapters that make this book especially valuable. These last chapters are devoted to cosmology and are pure gold. They contain a considerable amount of material that can be found only with some difficulty (and some that can not be found at all) in other places. It is also in these chapters, I feel, that Robertson comes through most directly and where one can appreciate the beauty of his work. We can all be grateful that this material is finally available.

Nevertheless, and despite its many fine discussions, a number of serious omissions make it less than ideal as a text on relativity (if such a thing even exists). For one thing, there are no problems, which is admittedly a minor inconvenience for the teacher. Perhaps more serious is the almost complete lack of discussion on the important developments in relativity over the past ten years. Thus there is no discussion of gravitational radiation except in the linearized approximation, of the initial-value problem, nor of global properties of solutions of the gravitational equations that have played such an important role in modern cosmological thinking. A student would have to look elsewhere to find out what has happened in relativity in recent years.

Finally, there are several places in the text that require further clarification. Why, for instance, is the second postulate of special relativity taken to be the existence of the Fitzger-

ald contraction instead of the more common constancy of the velocity of light? Then there is a derivation of the Lienard-Wiechert potentials that proceeds by transforming the potential in the rest frame of the charge to an arbitrarily moving frame. One gets the right answers by this method, but one should at least explain why it only works for the potentials and not for the fields. I also feel that the underlying principles of general relativity need more discussion than is given in this book. Finally, there is a discussion of the role of the photon in special-relativistic gravitational theories that I find rather baffling and in particular the statement that no special-relativistic-gravitational theory can predict the gravitational red shift.

On the whole, I feel that *Relativity and Cosmology* is a valuable addition to the literature and will be of interest to both specialists and nonspecialists alike, although perhaps more so to the former than the latter. The fact that it is based on the notes of Robertson will also make it valuable to those who are interested in the history of the development of cosmology up to the time of his death.

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Cours De Physique: Mechanique Ondes

By Julien Bok, Pierre Morel
316 pp. Hermann, Paris, 1968. 42 F

This book is the first of a series intended for the new courses in the mathematics-physics and physics-chemistry programs in French universities, consequent on higher educational reforms introduced in 1966. Its level is about equivalent to junior-senior texts in American universities.

The authors are alumni of the Ecole Normale Supérieure and are presently professors in the Faculty of Sciences of the University of Paris. In their preface they comment on the relatively recent interest in the restructuring of physics education in many countries, and they especially praise new experiments along this line, particularly those at the University of California at Berkeley, Cal Tech and the Massachusetts Institute of Technology.

From the American point of view there is little novelty in the work. As