

even more difficult. The authors have defined their purpose well: "The central theme of this book is the message that the unseen real world, revealed by science, is beautiful." In the pursuit of this they discuss classical mechanics, electromagnetism, conservation laws, atomic and nuclear physics and some statistical mechanics. The presentation is almost completely "in English." There are very few equations, few numbers, fewer graphs or tables, but a fair number of pictures illustrative of physical ideas. Interspersed between these sections containing "hard" physics are short biographies of famous scientists as well as essays on social aspects of science, a number of which are reflections by Pollard on his personal involvement in the war effort while a few others deal with the building of the atom bomb and its aftermath.

I am quite prepared to accept the selected physics topics as suitable to the avowed purpose; what bothers me most about this book is that it evinces so little spirit—it is not wrong, but rather flat and uninspired. Where one yearns for some enthusiasm, some excitement, some passion, one finds instead a rather pedestrian presentation of the great ideas or discoveries in physics. I find this particularly disappointing because physics, after all, is full of exciting and wonderful ideas, and replete with the most marvellous and quite unexpected intellectual surprises. Consider Maxwell's discovery that light is an electromagnetic phenomenon, for example. . .

This low-key presentation of physics is unfortunately further emphasized by a wordy and graceless style, which frequently borders on the awkward. Many paragraphs sounded to me as if they had been taken down verbatim from a classroom lecture and transcribed to the printed page with exceedingly little revision. A brief example may indicate what I mean: "Now we do have to discuss this kind of algebra a little bit. Mathematically it is dignified by a name which is higher in the categories of prestige: it is called 'analysis.' It contains two ideas." This kind of writing is not only graceless; it also represents a kind of "talking down" which at least I heartily resent and, I suspect, will be similarly responded to by most students.

I was also not terribly impressed by the selection of passages dealing with the relation of science to society. This happens to be a rather complex and significant area of study, and has attracted the attention of notable physicists, such as Albert Einstein and J. Robert Oppenheimer in recent times, but also of other seminal thinkers like Charles Darwin, Karl Marx, Lenin, Oswald Spengler and Bertrand Russell, just to mention a few. In this book, I find instead a set of rather humdrum and naive essays, illustrative of little intellectual significance.

Frankly, I think it would have been better to have omitted this topic altogether.

Having taught "poets" for three years now, I do believe that they deserve better.

A. BIERMANN
City College of
The City University of New York

Modulation Spectroscopy

Manuel Cardona
358 pp. Academic, New York,
1969. \$16.00

A more appropriate title for this volume would probably have been "Band-Structure Spectroscopy," a field in which relatively few texts exist. Approximately one-third of the book is devoted to the theory and analysis of the intrinsic optical spectra of solids. The remainder is concerned with the large contributions made by the application of modulation techniques to these spectra. Manuel Cardona of Brown University was a good choice as author, as he has been a prolific contributor to the understanding of the intrinsic spectra of solids for many years. His earlier work in conventional reflectivity spectra provided him an ideal background for the application of modulation techniques. Indeed, he and his coworkers at Brown performed measurements by most of the various modulation methods, instead of concentrating on all the ramifications of a single type of technique, as has been done by many other workers in this field.

This book has been written at a level such that it could well serve as one of the texts in a course in the band structure of solids. Theoretical and experimental work are interlaced throughout the book in such a way that the section on each type of modulation is complete in itself. The references are encyclopedic though, unfortunately, the data prevents reference to Bernhard O. Seraphin's reviews on electroreflectance. In all, the book presents experimental methods, data, theory and interpretation for electric field modulation, stress modulation, temperature modulation, and wavelength modulation, as well as a few other less prominent methods. The largest portion by far is taken up with electroreflectance and electroabsorption. These techniques have been used most extensively for obtaining qualitative information though, as pointed out in the book, the quantitative information that should be available is remarkably difficult to obtain. The discussions of wavelength modulation and temperature modulation are rather short and would lead one to believe that they would not likely be im-

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Foreword by Victor F. Weisskopf

These lectures covering topics basic to classical and modern physics were given by Pauli at the Zurich Federal Institute, where they were transcribed by his collaborators. They have now been translated and edited for English publication, and are introduced by Victor Weisskopf, who writes as follows:

"It is often said that scientific texts quickly become obsolete. Why are the Pauli lectures brought to the public today, when some of them were given as long as twenty years ago? The reason is simple: Pauli's way of presenting physics is never out of date. His famous article on the foundations of quantum mechanics appeared in 1933 in the German encyclopedia *Handbuch der Physik*. Twenty-five years later it reappeared practically unchanged in a new edition, whereas most other contributions to this encyclopedia had to be completely rewritten. The reason for this remarkable fact lies in Pauli's style, which is commensurate to the greatness of its subject in its clarity and impact.... Pauli's lectures show how physical ideas can be presented clearly and in good mathematical form, without being hidden in formalistic expertise."

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portant. As these techniques are more difficult experimentally, they naturally developed somewhat later, having been perfected after the book was written.

It is unfortunate that Cardona did not see fit to include in this volume the work that has been performed on defect centers in crystals. These same techniques have been applied with great success in the case of color centers, for example, and the extra chapter or two required would not have needed to be excessively long. A further criticism can be made as regards the presentation of experimental methods. Almost all of the techniques are described in a way that would lead one to believe modulation spectroscopy is an afternoon's work; there is, however, passing mention of some of the pitfalls.

An examination of the experimental data sections on electroreflectance and a comparison with current journals demonstrates amply the difficulty of obtaining good quantitative data; the easy experiments are the qualitative ones, but the step from qualitative to quantitative is a large one, both experimentally and theoretically, as Cardona well knows.

RICHARD A. FORMAN

National Bureau of Standards

Washington, DC

The Construction of Modern Science: Mechanisms and Mechanics

R. S. Westfall

171 pp. Wiley,

New York, 1971.

\$7.50, cloth; \$3.95, paper

The development in scientific thought that culminated in Newton's *Principia* in 1687—a development that Alfred North Whitehead once described as perhaps "the greatest single intellectual success which mankind has achieved"—constitutes the scientific revolution of the seventeenth century. This revolution in ideas is the subject matter of Richard S. Westfall's new book, written as one of a series that aims at bringing the results of recent scholarship in the history of science to a general audience. Writing a book for the general reader that deals effectively with such a richly diversified subject in a brief format may have been attempting the impossible. Westfall is certainly well qualified to try, however, because of his experience in teaching the history of science at Indiana University, and because of his previous writings—which include a book on science and religion in the seventeenth century, a series of papers on Newton's optical researches, and a major new

book on mechanical concepts in this period: *Force in Newton's Physics*.

Westfall sees the scientific revolution as the interweaving of two principal themes—the spread of the mechanical philosophy and the growing success of the search for mathematical order in the world. At the beginning of the century William Gilbert, for example, could still use the language of Renaissance naturalism to describe his experimental results on magnetism; he saw magnetic phenomena as the effects of an active principle that gave rise to sympathies and antipathies between bodies. The mechanical philosophy, expressed most powerfully by Descartes, decisively rejected such explanations in terms of active principles or occult virtues, and demanded that all natural phenomena be explained solely as the effects of matter in motion. Nature became a great machine. Westfall describes a variety of the hidden mechanisms proposed during the seventeenth century as causal explanations in fields as diverse as astronomy, chemistry, and embryology. These proposed mechanisms often strike us as fanciful or absurd, but Westfall emphasizes that they were very much a part of the thinking of a skillful experimenter like Robert Boyle, and that they deeply influenced even so profound and cautious a scientist as Christiaan Huygens.

The search for mathematical order proved most successful in the study of motion, both terrestrial motions and those of the heavenly bodies. Westfall traces some of the major steps in this search starting with Galileo's analysis of free fall and projectile motion, and Kepler's struggle with the orbit of Mars. He points out Descartes's statement of the principle of inertia and indicates the problem of understanding circular motion to which it led. Westfall properly emphasizes the central role of the problem of collisions in leading to Newton's formulation of the critical concept of force, and he sketches the development of Newton's mechanical ideas.

Despite the brevity of his book, Westfall has been able to suggest the variety of viewpoints from which the history of science can be treated. These range from studies of science as an organized social activity, through studies of the connections between scientific ideas and the general intellectual climate of opinion, particularly its philosophical aspects, to studies of the development of science as "determined partly by the intrinsic nature of the discipline, partly by the special role which that discipline's past always plays in its current evolution," as Thomas Kuhn recently put it.

Physicists will find Westfall's book to be a readable and interesting sketch of some of the main features of the