insulators and conductors, for use at cryogenic temperatures and methods of joining these materials is presented. All manufacturers and sources recommended are British, and information on modern materials in common laboratory use at low temperatures, such as epoxies and titanium, is minimal.

The author's treatment of the hazards inherent in the laboratory use of liquid hydrogen and liquid oxygen could easily receive more attention. Certainly, these liquids should not be rejected out of hand as coolants, but in a text for the uninitiated more emphasis should be placed on using caution.

F. R. Fickett
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Talking About Relativity

By J. L. Synge
193 pp. American Elsevier (North-Holland), New York, 1971. $5.75

Widening Horizons: Man's Quest to Understand the Structure of the Universe

By Z. Kopal
176 pp. Taplinger, New York, 1971. $6.95

The Stars in Their Courses

By I. Asimov
199 pp. Doubleday, Garden City, N.Y., 1971. $5.95

In his provocative treatment, J. L. Synge, the author of *Relativity, The General Theory* and *Relativity, The Special Theory*, undertakes to clarify relativity for the well informed layman. He feels he has written a book that should be on three different library shelves—physics, philosophy and philosophy of science. This reviewer agrees.

One is introduced to geometry, algebra, variables, events, curvature of space-time, tensors, the real world and the mathematical world. Although Synge displays talent in exposition, most of the content of this challenging little volume will be lost on the layman. Indeed, the reader should have had instruction in relativity and he should have had occasion to use relativistic formulas, but (as Synge says) in a puzzled way.

These lucid conversations will bring another perspective to such formulas, and provide insights into the complexities of the subject for the reader with specialized background.

Zdenek Kopal prefaces his brief, highly readable and popular book with a quote from Maimonides: "It is of great advantage that Man should know his station, and not erroneously imagine that the whole Universe exists only for him."

The author helps Man to know his station, for he devotes his book to a historical development of our knowledge of the scheme of the universe from the earliest slowly emerging understanding through the energetic, rapid-growth years of the 17th and 18th centuries to the 1970's. Along the way he provides rare insights into the motivations and achievements of many of the astronomer-philosophers who made giant strides along the way. Kopal provides ample arguments in support of his appraisals of Herschel (outstanding observer and a prime mover toward truth), of Galileo (careless as an observer and one who did not contribute nearly as much as the times and opportunities warranted), of Tycho Brahe, Kepler and Newton (all highly laudable).

Those versed in astronomy will find much here to give their subject perspective, for Kopal writes with authority, his work reflects deep research, his statements are the result of careful judgments. And he writes in a pleasant, relaxed style.

Layman who wish to read an informative, exciting story of exploration and discovery will find it here. They will be introduced to astronomy by a professional astronomer (chairman of the astronomy department at Manchester University) who has a talent for clear exposition and the ability to compress extensive research into a succinct fast-moving narrative.

Issac Asimov's book contains 17 essays on science dealing with astronomy, physics, chemistry and sociology, which appeared in 1969–70 in *The Magazine of Fantasy and Science Fiction*. Each is fresh, timeless and bears the indelible Asimov twists that lend fascination. For example, the earth is in free fall around the sun. It's weight is zero. One cannot weigh the earth; one "masses" it. Asimov presents convincing arguments about such matters as: the sin of the scientist, astrology today and yesterday, the features of the moon, solar activity and its effects upon you and me. Each essay is wrapped with ideas presented in an introductory personal vignette—the gift of a sweatshirt with Newton on the front and $F = ma$ on the back; the counter essays on the speed of light by Asimov and Arthur C. Clark, who, Asimov is quick to point out, is three years older than Asimov. And so it goes, in this delightful collection of pieces that scientists will get a chuckle and much information out of; and which presents aspects of science in a manner that laymen, no matter how ignorant of science, will enjoy thoroughly. Take this one to the beach, to bed,

to your local traffic jam, to the queue, wherever it may be—take it wherever you're apt to have a few moments to spare—each essay is self-contained, and each is a tidbit that can be read in a few minutes but savored considerably longer.

Franklin M. Branley
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Micromechanics of Flow in Solids

By J. J. Gilman
294 pp. McGraw-Hill, New York, 1969. $15.00

Plastic flow is a macroscopic result of the motion of dislocations. The author, who published many papers on this motion, gives a summary of his work (and of the related publications by other scientists) in chapters 5 to 9 of this book. The first four chapters form a kind of introduction; their titles are: Introduction, Review of Elastic Behavior, Crystal Plasticity and Dislocation Geometry (the longest in the book). Of necessity, they are rather condensed, and the justification for many equations has to be looked for elsewhere in the literature (indicated by the author).

Many idealized models are considered and a great many equations given. The comparison with experimental data is not extensive; thus, of the 67 figures of chapter 4 only one presents an observed phenomenon, and two of the nine figures of chapter 5 refer to experimental results. In this respect, the volume is not greatly different from many other publications on solid-state physics and would be a very valuable survey of the theory of dislocations that is so important for strength and plasticity.

Unfortunately, the publisher's work is not as good as the content would deserve. Again and again, symbols appear in equations without any definition; two different symbols mean one quantity on one page; a misprint mars the very earliest equation (page 9) and many more stop the reader later on.

J. J. Bikerman
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Variational Principles in Heat Transfer: A Unified Lagrangian Analysis of Dissipative Phenomena

By M. A. Biot
185 pp. Oxford U. P., New York, 1970. Cloth $12.80, paper $6.40

Except for isolated cases, few of the equations of mathematical physics can be solved in terms of known functions. And of the techniques available to generate approximate solutions, undoubtedly the most useful are based on applications of one or another variational principle. It is interesting that although variational principles for the description of dissipative processes were first proposed long ago by Hermann von Helmholtz and Lord Rayleigh, they have only recently become subject to active investigation. *Variational Principles in Heat Transfer*, by Maurice Biot, collects the author's work on a unified analysis of heat transfer, including convection and conduction. The key idea is a generalization of the virtual-work concept; one consequence is the generation of variational equations containing terms analogous to generalized forces as in the Lagrangian formulation of mechanics. As is to be expected, the structure of the equation is suggestive of approximations. Several of these are worked out and shown to be accurate. The ideas involved are extendable to the discussion of other dissipative phenomena.

This is a personal book, giving an account, primarily of the author's work. Although other variational principles are very briefly discussed (for example, those of Prigogine–Glansdorf and Galerkin) little effort is made to compare them with the author's approach. This is a pity, since some of the most interesting ideas in the theory of dissipative processes, for example the collection of phenomena labelled "dissipative structure," are aptly discussed in terms of variational principles. A description of that work, and its connection with the analysis presented, would have enriched the book.

This clearly written monograph will be of interest and value to all those fascinated by dissipative phenomena. I recommend it to them.

Stuart A. Rice
The James Franck Institute University of Chicago

Particles, Sources and Fields

By J. Schwinger
425 pp. Addison-Wesley, Reading, Mass., 1970. $14.95

Any book by Julian Schwinger must be regarded as something of an event. No active physicist has contributed more to a larger variety of fields of theoretical physics than he has, and no one has been at it longer. Schwinger began doing original calculations with the Dirac equation while still a teenager in high school.

Schwinger's book is a systematic presentation of source theory—the Cambridge locals seem to refer to it as "sorcery"—as it applies to particle physics. The main idea is to separate particle phenomenology from particle structure. From a phenomenological point of view, particle interactions involve the creation