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astrometry and refrains from criticizing the subjects he treats. Some of what has come down to us through many centuries could surely be improved. Is it really still appropriate to reckon angles in a hexagesimal system, with two different units (hours and degrees), no less? Has the concept of the ecliptic—such as it is—not outlived its usefulness? On the other hand, he has indeed introduced new concepts (proper direction, natural direction) where there was a need for them.

No worker in the field will be able to ignore this book without risking damage to the quality of his or her own work. It is also indispensable for the serious student. It may well show some seasoned astrometrist that the time has passed when one can engage in much modern astrometry without knowing (or at least knowing how to use) relativity. The beginner, especially the undergraduate student, will do well to study relativity and, for example, Laurence Taff's excellent *Computational Spherical Astronomy* before attempting to read Murray's volume. No library of any astronomical research institute will be complete without this important work.

HEINRICH EICHHORN
University of Florida

Manifolds, Tensor Analysis, and Applications

R. Abraham, J. E. Marsden, T. Ratiu
 582 pp. Addison-Wesley, Reading, Mass.,
 1983. \$34.95

This book is the first basic text in a series of books on global analysis, pure and applied, which is planned by Ralph Abraham, Philip J. Holmes and Jerrold E. Marsden and comprises both advanced and basic texts. The series aims at giving the keys of global analysis to a wide audience of scientists and engineers. One of the advanced texts has already appeared: *Gauge Theory and Variational Principles* by David Bleeker (1981). A second basic text, on Riemannian geometry and Lie groups, is on the drawing board.

Two of the authors of this text have previously written an advanced classic on the subject, *Foundations of Mechanics* (Abraham and Marsden, 1978), and one is currently writing a popular series *The Visual Mathematics Library* (Abraham with Christopher Shaw). The present text is a good book. It offers some of the essence of the first with the quality of presentation of the second.

What does this text cover? Basics in topology, calculus on Banach spaces, vector bundles, vector fields and dynamical systems, tensors and differential forms, integration on manifolds, applications to Hamiltonian mechanics, flu-

id mechanics, Maxwell's equations, thermodynamics and five delightful appendices. Lie groups are not mentioned. Not everyone needs Lie groups, but the stage (and the titles of the series and the books) is so well set up for them that their absence is a pity. More important, the absence limits the definitions of other concepts. For instance, the basic definition of Killing-vector fields requires the concept of group action on a manifold. In this book Killing-vectors are defined in the limited context of Riemannian geometry (that is, isometries) as the vector fields X satisfying $L_X g = 0$. A later example tells us that the flow of X consists of isometries, and isometries are defined in a later exercise. The information is there, but the picture is broken up into three pieces. Similar remarks apply to other concepts. The usual definition of vector bundles includes a statement on the group action of the structural group on the typical fiber. Without it, the key notions of structural group and transition functions, the distinction between fibers at a point and typical fibers, between trivialisable and trivialisations, are either absent or obscured.

Lie groups will, I believe, be an important part of the second basic text, and in this sense the present book is only half a book. Comments on the choice of topics, and their division between the two books will be more pertinent after the second book is published. Depending on the audience, the first book alone—or the two books combined—could serve as a basis for an excellent course in mathematical physics.

CECILE DEWITT-MORETTE
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Relativity and Its Roots

B. Hoffmann
 176 pp. Freeman, New York, 1983. \$9.95

The greatest strength of this short and very readable book, written by an award-winning Einstein biographer, lies in its thorough treatment of the "roots," the history of ideas about the relativity of motion. Though its tone suits a lay audience, even a working physicist may find some surprises in this narrative.

Relativity, Banesh Hoffmann reminds us, is as old as Western philosophy itself. Most of us know of Aristarchus of Samos, but he begins from Philolaus, whose moving-Earth (but not heliocentric!) cosmology came two centuries earlier. He touches briefly on the contributions of Nicolaus Copernicus, Johannes Kepler, Galileo Galilei and René Descartes on the way to the most "interesting" case, that of Isaac Newton. Here he dwells on the curious fact that the very thinker who en-