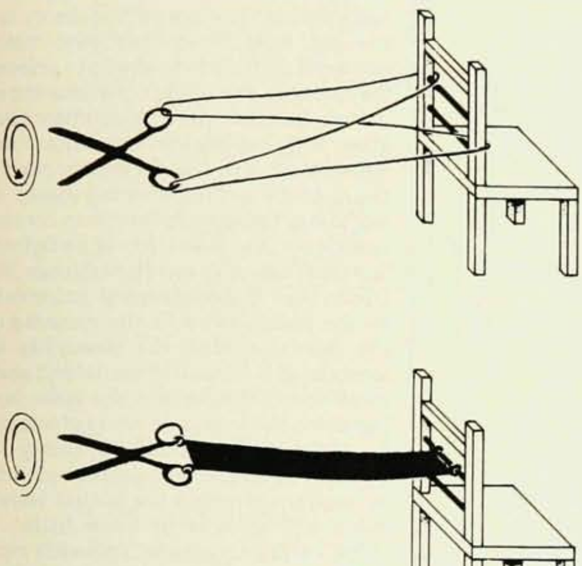
and that this book and, presumably, the succeeding volume will be foundation texts for a generation of physicists, as were the books by Luther P. Eisenhart and Schouten in their time. However, for those who would like a more physical introduction to the subject before studying this text, let me suggest the article by Penrose, "Structure of space–time," in *Battelle Rencontre, 1967 Lectures in Mathematical Physics*, edited by C. M. DeWitt and J. A. Wheeler (Benjamin, New York, 1968).

Finally, a comment on the appearance and formal structure of this volume is in order. Given the variety of symbols and the large number of indices, along with the need to identify indices with primes, carets or dots as well as to distinguish italic from boldface upright indices, the use of a larger typeface would have been helpful. A larger face would also have helped the editors to pick up the many typographical errors and broken letters. However, the organization of the book has been carefully thought out and the material is very well presented. In addition to the table of contents, the book has an excellent index, list of symbols and references section. It would have been useful had the authors also included the table of contents for volume II as well as perhaps its index.



Dirac's scissors problem. One can "undo" a 4π (but not a 2π) rotation of the scissors around its axis of symmetry—that is, one can untangle the string without moving the chair or rotating the scissors. This can also be demonstrated by replacing the string with a belt—a twist of 4π is undone by looping the belt once over the scissors. This figure, drawn by Roger Penrose, is reprinted from the book under review.

An Idiot's Fugitive Essays on Science

Clifford Truesdell

654 pp. Springer-Verlag, New York, 1984. \$58.00

Idiot, *idiōtēs*, a private citizen, a nonmember of everything—thus Clifford Truesdell specifies his position in the world. In this collection he has brought together reviews, addresses and historical essays from the past 35 years, some revised and most of them the fruit of long experience and much reading. Two themes run through the pages: that good scientific theory is based on rigorous mathematics and that the ancient theory of continuum mechanics (to which Truesdell has made his own substantial contribution) is good scientific theory. Because so many of the basic phenomena of flow, bending and plastic deformation have been studied from the beginning of modern mathematics, and because later discoveries have not changed the outlines of the subject, he can look back over a historical panorama that has no parallel in science except possibly for celestial mechanics. But that is a subject in which masses are often idealized as points, and it holds no interest for this practitioner of continuum mechanics, for whom the intrusion of the atomic hypothesis and of theories that emphasize it holds the same charm as the arrival of a busload of yelling schoolchildren in a sunswept pastoral landscape.

Possibly the most rewarding part of the book is an 87-page section, consisting of book reviews and a long biographical essay, on Leonhard Euler. Not only do we gain some idea of Euler's protean involvement in fields such as naval architecture, chemistry, optics, electricity, terrestrial magnetism, geography, mortality tables and the culture of mulberries and corn, we also see him in the intellectual milieu of the 18th century, in St Petersburg and during a 25-year interval at the court of Frederick the Great. There he was the statesman of science, answering every letter he received with encouragement, advice and helpful criticism, towering above the fields and swamps in which troops of academicians fought their squalid little campaigns of jealousy and revenge (a favorite theme of Truesdell's). But Truesdell focuses on Euler principally as the mathematician who invented the derivative as the limit of a quotient, who critically studied the convergence and divergence of series, who gave the modern definition of a function almost a century before Peter G. L. Dirichlet, who invented countless special methods still in use and who participated at every stage of the early development of the mechanics of rigid, elastic and fluid bodies. Truesdell writes that "only blind prejudice or special pleading could deny to Euler the rank of solely supreme in mathematics." I recommend these pages to physicists and mathematicians dissatisfied with the trivialities that passed for history in the texts they studied and to anyone seriously interested in the history of the Enlightenment.

The focus of contemporary physics on the invisible world is not to Truesdell's taste. It has perverted the teaching of classical dynamics by restricting it to the consideration of particles, rigid bodies and a few simple objects that oblige the student by vibrating harmonically. His indictment of the physics of elementary particles is general and explicit: The laws of the theory are not yet fully established, the mathematical difficulties are at present insuperable, the approximations are so uncertain that when calculation disagrees with experiment one cannot tell whose fault it is, and the theory cannot claim to be a fundamental theory of anything, because *"within any corpuscular view, the possibility of an infinite regress is logically inevitable"* (page 22). I fear that these sweeping judgments by the *idiōtēs* (what is the meaning of the assertion that the possibility of something is logically inevitable?) scattered freely throughout the book, laying down the law on matters of scientific taste, will weaken its ability to educate us and to change our opinions on matters of which the author knows much and most of us know little.

For obvious reasons Truesdell condemns mathematics that asserts but does not prove; he thinks catastrophe theory is ridiculous; he deplores computers for flooding the world with numbers of dubious provenance that obscure functional relations. I must point out, though, that the basic principles of mechanics are not theorems but began in experiment and observation, and that the computer, while it does not prove theorems on the behavior of dynamical systems, has in recent decades provided a phenomenology of chaotic systems (for example, Mitchell Feigenbaum's now-proved conjecture on period doubling in a large class of nonlinear recurrence relations) that will have profound consequences for dynamics.

But in addition to his scientific judgments, Truesdell's *obiter dicta* exert so much of the book's effort and occupy so much of its space that I must pause to mention them. "Was it necessary or desirable," he asks, for Derek T. Whiteside to translate the Latin in his great edition of Isaac Newton's mathematical papers? And he answers, "I doubt that they who cannot read the originals be in case to profit from the translations." The word "desirable" carries the main weight of the author's opinion. He is, I fear, Gulliver in Lilliput. To him, academic administrators are

SIDNEY HARRIS

"WHICH BERNOULLI DO YOU WISH TO SEE— 'HYDRODYNAMICS' BERNOULLI, 'CALCULUS' BERNOULLI, 'GEODESIC' BERNOULLI, 'LARGE NUMBERS' BERNOULLI OR 'PROBABILITY' BERNOULLI?"

"tumors," professors are pygmies standing "with crooked little legs" on giants' shoulders, preparing lessons for pygmylets, social scientists are charlatans and the "College of Liberal Arts," wherever and whatever it may be, is a fraud. Perhaps the intent is that many negatives should make a positive, but I fear they merely subtract from the authority of the historical essays on 18th-century mechanics that are the heart of the book. Even there, though, I found myself recalling Truesdell's earlier historical works, such as the *Essays on the History of Mechanics* (Springer-Verlag, New York, 1968) and the *Rational Mechanics of Flexible or Elastic Bodies, 1638–1788* (Introduction to *Leonhardi Euleri Opera Omnia*, $II.11_2$, Füssli, Zurich, 1960), in which his wide reading and mathematical acumen produced the kind of critical history that most historians of science cannot write. From the new book's excellent essays on Newton, the Bernoullis, Euler, Jean d'Alembert and the unhappy John James Waterston one learns what happened, but not as much as one would like of how it happened.

It is unpardonable for a reviewer to criticize an author for not having produced a different book, but in this one I would have preferred more claw marks and less vocalization.

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Molecular Semiconductors: Photoelectrical Properties and Solar Cells

Jacques Simon and Jean-Jacques André
288 pp. Springer-Verlag, New York, 1985. $59.00

For some 30 years chemists have been attempting to design organic molecular materials for various applications, such as metals, superconductors and semiconductors, by exploiting the wide range of possible modifications in composition and structure of organic compounds. A prime motivation for this activity is that the organic versions should be cheaper than the inorganic. In this book Jacques Simon and Jean-Jacques André focus on the quest for a molecular semiconductor, a material with a gap of 1–2 electron volts, reasonable mobility (larger than 1 cm^2/volt sec) for charge carriers and the possibility for forming good p–n junctions. They have in mind photovoltaic