

cussion. It is, of course, impossible that each topic be treated in any great detail, and there are some ludicrously skimpy discussions. The notion of a partially conserved axial-vector current (PCAC) is covered in only eight lines—in which a trained eye might or might not be able to find some hint of the consequent low-energy theorems for pion production.

It may be that topics such as PCAC simply defy explanation at an elementary level. In any case it is still fair to point out that Perkin's presentation does not go far beyond standard approaches in bringing advanced topics such as this within the reach of the beginning student. A mere mention of these topics is simply inadequate.

In summary, the book is one that merits the attention of anyone teaching an introductory course in high-energy physics. As a set of lectures, the book is noteworthy for its range and clarity, but as a book it lacks that spark of brilliance that distinguishes insight from orderliness.

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The Thermodynamics of Simple Materials with Fading Memory

William Alan Day
134 pp. Springer-Verlag, New York,
1972. \$13.70

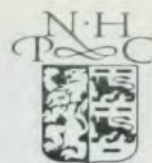
When we consider thermodynamics as a field theory of density, deformation and temperature, we must find out what the field equations are. Of course, they are based on the equations of balance of mass, momentum and energy, but these lead to field equations only when supplemented by constitutive equations that relate the constitutive quantities stress, heat flux and internal energy to the thermodynamic fields in a materially dependent manner. Therefore, the problem of finding the field equations for a given material becomes the problem of determining its constitutive relations. Traditionally, with few exceptions, only those materials have been considered whose constitutive quantities depend on the present values of the field and perhaps on their first gradients and time derivatives; exceptions include the classical theories of linear viscoelasticity with their monotonically decreasing relaxation functions. These theories were, in fact, describing materials with fading memory and their constitutive relations were functional relations of a simple kind.

Now, in the last decade or two, thermodynamicists have studied functional constitutive relations of greater generality or, more specifically, they have studied materials whose stress, heat flux and internal energy are dependent on the histories of deformation, temperature and temperature gradient. The form of the constitutive relations is subject to certain restrictions that can be derived from physical principles that are supposed to hold for a large class of materials. Such restricting principles are the entropy principle and the principle of fading memory, and to the formulation and evaluation of both Alan Day has made important contributions. It is therefore very appropriate that he should present a first comprehensive account of this recent field.

Day's book on *The Thermodynamics of Simple Materials with Fading Memory* essentially contains two parts; in the first one the author presents mostly his own ideas about thermodynamics and in the second part he describes a theory that goes back to Bernard Coleman's work. The basic inequality and the fading-memory principle are different in the two parts, but the resulting restrictions on constitutive relations are similar for many materials.

At the outset Day proposes an inequality that he assumes to hold in cyclic processes. For materials whose stress and internal energy are independent of the temperature gradient, this inequality states that the time integral over the reduced heat supplied to the body is non-positive in a cyclic process or, in Day's words: The Clausius integral is non-positive. The principle of fading memory is then stated as an assumption about the additivity of Clausius integrals in a composite process, which, roughly speaking, is a series of processes with intervals during which the body is given time to "forget." For the bodies under his consideration Day succeeds in proving that an entropy can be defined both in equilibrium and away from equilibrium, and he shows that this entropy is given by a constitutive functional. Using these general results Day derives restrictions for the constitutive functionals of thermoelastic bodies and of some viscoelastic bodies.

Entropy is no problem in the second part of the book; its existence and specific forms for its flux and supply are assumed, and the Clausius-Duhem inequality is postulated to hold for all processes. This inequality serves to derive restrictions on the constitutive functionals, and the principle of fading memory enters the theory as an assumption of continuity of the functionals with respect to a norm that characterizes histories in such a manner that their differences in the distant past become unimportant.



New Books from North-Holland

Fast Ion Transport in Solids, Solid State Batteries and Devices

Proceedings of the NATO Sponsored Advanced Study Institute, Belgirate, Italy, September 5-15, 1972

Edited by W. VAN GOOL, University of Utrecht, The Netherlands

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Fundamental Interactions and the Nucleus

By R. J. BLIN-STOYLE, University of Sussex, England

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The book concludes with a treatment of a linear viscoelastic material and lists some thermodynamic restrictions for the relaxation function.

Some of the proofs presented by Day are amazing in their ingenuity, and, although the book deals with a complex subject, it is so well written that every single argument can easily be followed by the careful reader.

The very fact that Day chose to present two different approaches to a thermodynamic constitutive theory makes it clear that that theory is not complete at the present day. And indeed, while the simple equations of state of classical thermodynamics have been replaced by functional relations of sophisticated generality, the second law in the form of various inequalities sticks out as what an archeologist would call a "typological relic" from the thermostatics of Clausius; but perhaps I am prejudiced on that subject, since in my research I have made it my concern to investigate the consequences of more general entropy inequalities.

INGO MÜLLER

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Introduction to Newton's 'Principia'

I. Bernard Cohen

380 pp. Harvard U.P.,
Cambridge, Mass., 1971. \$30.00

In the tribal folklore of physics, no saint has a bigger halo than Newton's. As it should be with true believers, physicists are loth to come to grips with the sweat and sin, the deviations from the path to Olympus, of their tutelary Herakles. Thus it is no surprise that while any interested person who seeks Augustine, Shakespeare, or Goethe need only go to any university library to find a complete, precise, and abundantly annotated edition containing every single word or figure set on paper by those authors and today preserved, until recently the scholar who would study the works of Newton was compelled to rely largely on the tiny fraction of his work that had been published, a fraction selected by a mixture of prejudice and caprice. Even now, those to whom Newton's native language in science, which was Latin, is inaccessible can consult his masterpiece, the *Principia*, only through a translation notorious for its blunders at critical passages.

This strange contrast results from the natural preference of the masses and the "educated" for great entertainers over great enlighteners. The ill

wind of abundant cheap publication, however, has blown good to Newtonian scholars by making possible the publication, now in progress, of *The Mathematical Papers of Isaac Newton*, Cambridge U. P., superbly edited by D. T. Whiteside, the four volumes going through 1684 now standing in print. In addition there are now four volumes of the *Correspondence of Isaac Newton*, through 1709, variously and irregularly edited by a committee, so that the responsibility for random spots of ignorance or national prejudice could be made anonymous. These eight massive volumes, difficult to penetrate, form today the best introduction for the serious student of Newton's thought.

The introduction presently under review is of a different kind. Of course, any introduction is made, not passively, but to someone. The quickest inspection of the work shows that I. Bernard Cohen makes no attempt to speak to any who would follow the brilliantly inventive, perplexing, lacunary, often fallacious and sometimes even contradictory mixture of guesswork and icy mathematics in Newton's treatise. Indeed, the content is mentioned only here and there, in passing.

Rather, this introduction, as the appearance of the late Alexander Koyré's name on the flyleaf might suggest, is a contribution to the "new" history of science: the story of the circumstances, rather than the content, of scientific discovery. As such, it is a work of great erudition. The reader is led through the preliminary manuscripts, the writing and publishing of the first text, and all the revisions, both those that did appear in the second and third editions and those that were withheld.

In the task Cohen set himself, he has succeeded perfectly, and the present volume will surely stand henceforth as the definitive textual criticism of the *Principia*.

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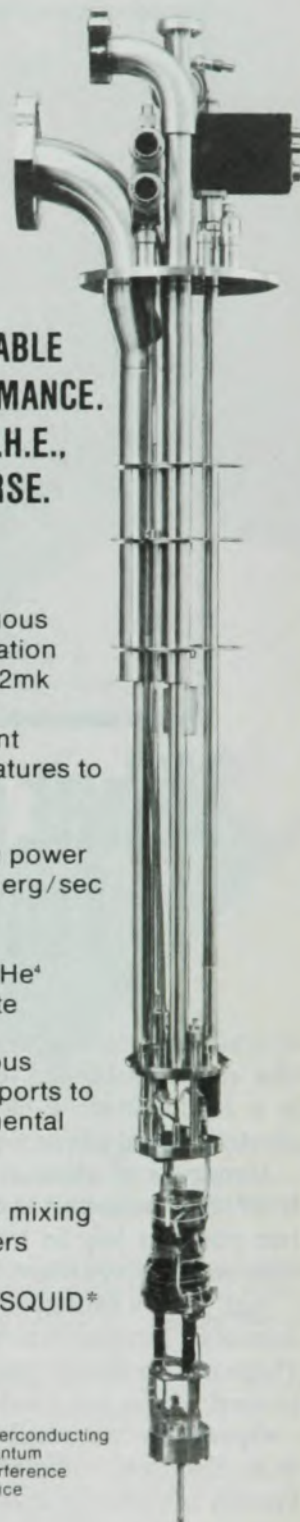
The Crystal Chemistry and Physics of Metals and Alloys

W. B. Pearson

806 pp. Wiley, New York, 1972. \$34.95

William Pearson is perhaps best known as the compiler of the *Handbook of Lattice Spacings and Structures of Metals and Alloys*. While engaged in this labor of Sisyphus, he has been conscious of the necessity to systematize the ever growing wealth of such in-

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