## A First Course in the Mathematical Foundations of Thermodynamics

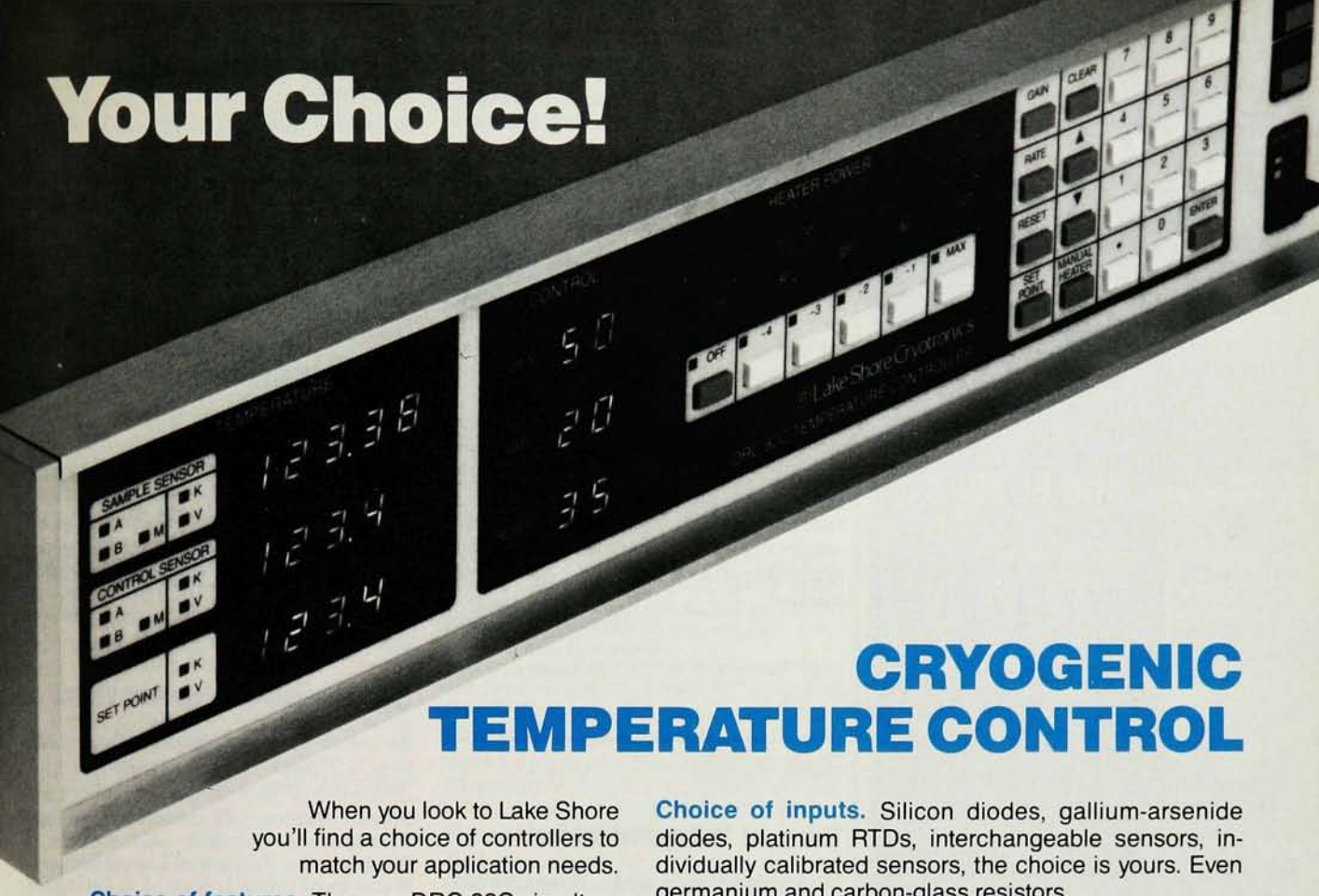
**David R. Owen**
134 pp. Springer-Verlag, New York, 1984. $26.00

Thermodynamics cuts across more disciplines than any subject except mathematics. One consequence of this is that the study of classical and modern thermodynamics is fragmented into poorly communicating and occasionally hostile camps. One camp of modern thermodynamics, which emerged from the study of nonlinear deformations of continuous media, has developed a new mathematical approach to the foundations of thermodynamics. David Owen, an applied mathematician who does research in the application of thermodynamics to elastic and plastic media, has written an excellent introduction to this development.

This book is part of the Springer-Verlag series of undergraduate texts in mathematics. As might be expected, the text concentrates on the mathematical development of the theory without much discussion of the physical meaning of the material. The book is divided into four parts. The first part uses homogeneous fluids to introduce the ideas that are developed in the remainder of the book; the next two parts present the first and second laws of thermodynamics; and the final part describes some applications.

Owen develops the first and second laws of thermodynamics in a different manner from most standard textbooks. In standard presentations, the first law is presented as the extension of conservation of energy from mechanical to nonmechanical processes. Heat is then introduced as the energy that enters a system to make up the difference between the internal energy and the work done on the system. Owen introduces heat, along with work, as a primitive notion, and derives the existence of the internal energy potential. A similar approach is found in Joseph H. Keenen's *Thermodynamics*. Owen's abstract introduction of the second law is based on the interesting work of James Serrin and provides a lucid exposition of the central ideas of Serrin's approach to the foundations of thermodynamics.

The last two chapters of the book provide applications to thermoelasticity and to homogeneous bodies with viscosity. In particular, they show how thermodynamics places limitations on the properties of materials. It is at this point that the efforts expended on the earlier chapters pay a nice dividend: This point is generally discussed in most texts under the heading of stability, but Owen's treatment is far

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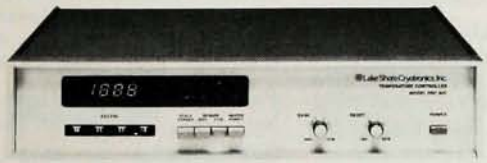

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The author has been successful in attaining his goal of making this book accessible to junior-level students who have completed the standard introductory calculus sequence. The text is a model of sound pedagogy, developing concepts in a repetitive fashion, starting with the ideal gas, progressing to more general and more abstract principles, and concluding with applications. At the back of the book there are a few problems for each chapter. However, I cannot recommend this as a text for an undergraduate course in introductory thermodynamics. I think such courses should contain more physics and give students a view of the vast scope of thermodynamics. I do emphatically recommend this book to all serious students and teachers of thermodynamics.

MORTON H. RUBIN
*University of Maryland*
*Baltimore County*

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