Putting us to ignorance again

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Thermodynamics: Foundations and Applications. By Elias P. Gyftopoulos and Gian Paolo Beretta. *Macmillan, Inc., New York: 1991. Pp. 658. $66.*

LET us take the view that the *basic* ideas to be taught in thermodynamics should be the same for all students, be they engineers, chemists or physicists, while the applications should differ so as to be most appropriate to the students' needs. What, then, should constitute the basic framework? My own answer would be: (1) a phase space in which points represent equilibrium states and curves represent quasistatic (that is, reversible) changes; (2) the ideal gas and some other simple sytems; and (3) a clear understanding of inexact and exact differentials.

The students at the Massachusetts Institute of Technology, who have attended at least part of the course presented in this book, are by no means all engineers. In fact, the authors do not seem to address themselves to any particular students. I would expect, however, that engineering students are the most suitable readers. But there is one caveat: they should not know the subject beforehand, because the ideal readers are, according to the authors, those "without much background in thermodynamics".

So reviewers are not really very suitable readers because they "know too much". The authors go on to explain that "experienced readers . . . may be appalled when they read that thermodynamics applies equally well to macroscopic and microscopic phenomena, that entropy is equally well defined for equilibrium and non-equilibrium states, and that temperature is . . . useful also for . . . a single particle . . . .The new perspective requires . . . a subtle and demanding reconsideration of basic premises . . .". Thus there is little in the book on the first two points of my desiderata, and almost nothing on the third. But there are some challenging new points of view. The emphasis is away from mathematical concepts. This is not because the authors do not like to touch mathematical physics — I need only refer to their research papers on "quantum thermodynamics" published in *Nuovo Cimento* and elsewhere in the mid-1980s. (Their proposed union of mechanics and thermodynamics even attracted a leading article in *Nature* back in 1985 (**316,** 11).)

The unusual nature of the authors' exposition is illustrated by the fact that the first and second laws of thermodynamics appear in chapters 1–4, whereas adiabatics and entropy are introduced only later (in chapters 5 and 7 respectively). It may be that beginners will take strongly to the book; and so they should, considering that the course on which it is based has been taught for 20 years. The authors have worked outstandingly hard: there are many tables and numerical data and plenty of problems. It seems churlish to hesitate to give the book a full-blooded recommendation.

But I do hesitate, in part because of details such as the definition of reversibility (page 59), the alleged achievement of perpetual motion in the laboratory (page 39) and the absence of a reason why the ideal gas cannot exist near $T = 0$ (page 325). More excusable for non-British authors is the description of Lord Kelvin as an English physicist, even though I fancied I saw him turn in his grave on being thus described. (He was born in Belfast of Scottish parents and held university chairs in Scotland.)

The length of the book (it seems occasionally verbose) seems to be due to the authors' desire to cover both graduate and undergraduate courses, both introductory and advanced. However admirable the book's concept, its lack of references to research papers of even the 1960s or 1970s means that a graduate course would require yet more material to be added to an already long exposition.

In fact, the atmosphere of the book gives the impression of thermodynamics being a closed rather than a continuing subject. Perhaps the authors could present their philosophy of the subject forward more clearly by putting it into a shorter book next? □

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