REVIEWS

A Course in Thermodynamics. By J. KESTIN. Blaisdell, 1966. 615 pp. $14.50.

The past 25 years has seen the publication of numerous books on thermodynamics, written principally for engineers. Certainly the literature of engineering thermodynamics was in a sorry state before first Zemansky and then Keenan published their text books and established the subject as a primary academic discipline for engineering students. The American engineering schools, led by M.I.T., followed Keenan's book in their courses and after Hawthorne had introduced Keenan's approach in Cambridge in the early fifties, British universities also came into line.

However, Keenan's presentation of the first and second laws is a difficult one for students to follow, and several writers, notably Rogers and Mayhew and Spalding and Cole in this country and Mooney in America, have successfully attempted to present the basic laws in a form more acceptable to engineering undergraduates. More recently, the reviewer has introduced several small text books (Gibbings, Montgomery, Haywood and Benson), each book covering a small part of the field, in an effort to persuade the British engineering undergraduate to use text books more frequently.

Two difficult problems at present face the teacher of engineering thermodynamics. Should he introduce statistical thermodynamics into his course (Reynolds has published a lively book attempting to integrate statistical and classical thermodynamics) and should he follow Keenan and Hatsopoulos in their integration of the first and second laws into a single axiom? Anyone who still teaches the engineering undergraduate fresh from school has considerable reservations about increasing the thermodynamics syllabus beyond its present extent.

Into this situation has come Kestin's book, published last year. In this volume, the first of two, Kestin avoids both the problems of the previous paragraph. He simply outlines some essential concepts of statistical thermodynamics (the microstate and the macrostate) and refers only briefly to the single axiom, presenting the first and second laws separately. In his introduction he states his purpose as frankly pedagogical and his conviction 'that the discipline of thermodynamics is a natural unifying basis for the scientific foundations of engineering'. The resulting book is a tremendously careful, comprehensive, scholarly treatise on classical thermodynamics.

There is little that one can fault with the material and the presentation: the zeroth law, temperature, the equation of state, work, the first law, the closed system and the open system, the pure substance and simple mixtures, discussion of a variety of thermodynamics systems, the second law (Claussius-Planck and Born–Carathéodory presentations), entropy, Maxwell's relations and what is usually termed advanced thermodynamics, and finally entropy production in irreversible processes.

The feature of the whole book is its thoroughness. Examples of this are the

comprehensive discussion of elementary processes using the first law, for both the closed and the open system, the discussion of properties (with the aid of some beautifully reproduced property diagrams), and the discussion of a number of interesting thermodynamic systems, covering surface tension, galvanic cells, stressing of solid rods and electrostatic and magnetic fields. The reviewer is also attracted by the early introduction of the perfect gas and the mathematical emphasis, particularly in the discussion of properties and the equation of state (interpreted as a scalar field) and in the Carathéodory presentation of the second law. If there is a part of the book which is not entirely satisfactory, it is the section on open systems. Here one looks for more integration with fluid mechanics, with greater emphasis on similar treatment of the continuity, momentum, first law and second law using control surfaces as in Shapiro's book on compressible flow. (The confusion of the student who meets the steady flow energy equation in his thermodynamics course and a Bernoulli equation with a somewhat similar form in a separate fluid mechanics course is very real.)

But this is a minor criticism of Kestin's very great achievement in writing what must surely be the 'source' book for classical thermodynamics. If one wishes to study a particular aspect of classical thermodynamics (say, a particular property diagram of the detailed thermodynamics of charging processes), one will find the details in Kestin's book. The book's length does not follow from woolliness on Kestin's part—his writing is mostly concise and clear—but more from the incredibly wide range of applications and examples that he gives.

Kestin's philosophy is clearly stated: 'I believe the modern tendency for shortening and compression has gone too far...I have decided to include more than can reasonably be covered in one course...a student will not be left with the erroneous impression that the subject can be fathomed in all its profundity in a single pass'. Yet the book leaves me with a feeling of uncertainty about the teaching of engineering thermodynamics. In Britain where we have a basic three years of formal undergraduate instruction, what time can we allocate for thermodynamics presented in this comprehensive fashion? If we are to introduce our engineering undergraduates to statistical mechanics (surely the electrical engineers must have such a course), what material must we leave out of the present course? Are we not spending too much time on philosophical discussion of the basic laws? Must not some students go on to the study of engine cycles, an equally worthy academic discipline, as Haywood has shown? While Kestin provides many solutions to thermodynamic problems in his excellent book, he poses several educational problems as well—at least for this reviewer.

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Vocabulary of Mechanics, in English/German/French/Polish/Russian. Volume 2, Mechanics of Fluids. Edited by A. T. Troskolanski. Pergamon Press, 1967. 452 pp. £7.

This second volume of the *Vocabulary of Mechanics in Five Languages* is part dictionary and part vocabulary in the sense that it has alphabetical lists or indexes of words. Such an arrangement is facilitated by the method of tabulation. Entries in the vocabulary are laid out as recommended by the International

Organization for Standardization. Compound words are entered doubly in the five language indexes and noun genders are given.

Contents of the dictionary section are divided into Hydromechanics and Aerodynamics. Rheology, in a series of over 70 entries, is included under Hydromechanics. The section on Aerodynamics has subjects such as aerofoils, propellers, rotors, dynamics of hypersonic flows, dynamics of rarified gases, magneto-fluid-dynamics and dynamical meterology. Illustrations are used where deemed necessary to aid understanding in the dictionary section.

Should the meaning of, for example, a German word be required, the relevant index from the five is used. Listed under this chosen word are to be found compound words or phrases all of which are closely connected with the word. Each of these German words or phrases has been given a 7-digit key number such as 15–55–160. Reference to the main part of the volume with the last 5 figures of the requisite key number is easy, and here is found, as in a dictionary, the exact English equivalent of the chosen (or compound) word, with its meaning given in detail in smaller print. In larger print, below, is given the translation of only the word into German, French, Polish and Russian. The dictionary part is therefore completely understandable only to a person with knowledge of English. Many of the nouns used in the English description of the meaning are of course available for translation. No verbs as such are listed.

The significance of the figure 15 is not easy to find. Volume I was given the group number 05 and each of the 23,000 or more entries in this book in the five indexes and dictionary section is prefixed by the figure representing Group 15. One has doubts about the economy and convenience of such a numbering system. Some of the various definitions and descriptions of terms in the dictionary section are not completely clear. Deficiencies here may be due to translation difficulties rather than lack of technical understanding.

Adequate lists of symbols are given where necessary to facilitate usage, including over 20 similarity numbers which are used in the main dictionary. Some examples of words and their definitions, chosen at random, are as follows: Prandtl mixing length, friction velocity, Lagrangian turbulence scale, enthalpy, shape number, hydraulic gradient, critical depth, hydraulic analogy, shock polar, Busemann bi-plane, Mach cone, shock tube, honeycomb straightener, whirling arm, Nikuradse diagram, streak line, astronautics. About 50 books are listed under 'references'. Misprints are almost non-existent.

Although there are about 2200 numbered entries in the dictionary section, well over 4300 references appear in the English index; the other four indexes are of similar size.

A translator requires, first and foremost, a good dictionary for the pair of languages involved. Languages change and the rate of technological advance is now so high that technical dictionaries are additional necessities for correct and speedy translation. This volume satisfies in an excellent way an international need. The reviewer is not able to say categorically that this vocabulary of fluid mechanics is the very best available; he is sure however that, both as a reference dictionary and as a vocabulary for translation, it will be a valuable addition to the library of authors, editors and students of fluid mechanics.

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