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REVIEWS

Mechanical Properties of Solids and Fluids. By R. C. STANLEY. Butterworths, 1972. 240 pp. £3.90.

The author has set himself a difficult task. His declared aim is to cover the whole field of the mechanical properties of solids and fluids demonstrating the relations between motions at the atomic level and bulk mechanical properties. There are separate sections on elasticity, plasticity and viscosity and (surprising in a book with this title) a large section on vacuum physics. The structures of solids are briefly described in the chapter on plasticity. There is no treatment at all of fracture, nor of yield criteria or plasticity theory. In particular the author wishes to emphasize technological examples and applications. The book is intended for the first year of an undergraduate course in physics or engineering.

Such a broad treatment could make a useful book provided that the necessarily brief coverage of each topic were clear and accurate, provided that the book as a whole presented a balanced and coherent view of the field, and provided that the technological examples were up to date and carefully chosen. A. H. Cottrell's "The Mechanical Properties of Matter" shows what can be achieved in this direction, although it is true that it has only passing references to technological applications.

Unfortunately the present book is not nearly so successful. Some sections are clear and well presented, notably the section on strain, but others are superficial, incomplete and misleading. In a first-year undergraduate text this is a particularly heinous fault as the book cannot reliably be used as a basis for further work. One wonders what a budding technologist would make of such statements as (referring to mild steel) "Again, as the [compressive] stress is increased, the elastic limit and a yield point is reached, followed usually by some plastic flow up to the *crushing limit* when the material completely breaks down", or, in a description of the precipitation process, "Again the excess energy in the crystal may be reduced if [interstitial atoms] coalesce, and this time they will form a *precipitate*. If large enough, they may constitute a new phase; a different phase can be a different material or the same material in a different form, like ice and water."

It is particularly important in a short book where a statement is made that is not going to be elaborated on any further that that statement should be both clear and correct. Other examples of doubtful statements that appear are "... but it is known that the viscosity of all liquids, with the exception of water, increases rapidly with pressure"; "At higher flow rates the flow becomes less dependent on viscosity and more dependent on density ... At even greater flow rates the dependency on the density changes to a dependency on the square root of the pressure"; "many gases have very similar densities".

As a metallurgist I am distressed by the discussion of "the effect of dislocations on mechanical properties", where the following sentence appears: "The consequently vast number of variables, making every grain different from every other grain, again makes it virtually impossible to give any exact numerical agreement with the plastic properties of real materials". This seems to me a nihilist approach. Metallurgists do calculate things and have achieved in my view a very fair degree of success at relating structure and mechanical properties. It is no encouragement to the next generation of metallurgists to tell them that the problems are too complicated to be treated.

But perhaps the most serious criticism is the total lack of coherency and balance that the book possesses. In many cases an argument is left incomplete when by extending it a little further what has gone before might be properly qualified. For instance in the discussion of Stokes's law there is no word of warning that this is applicable only for a very limited range of Reynolds number. Nor in the discussion of Bernoulli's theorem is there any mention of the fact that it only applies for steady flow. In other cases topics have been covered which might very well have been excluded in a treatment at this level; for instance, the explanation of elastic compliance as a fourth-rank tensor, the explanation of Miller indices which is included in the short section on structure (they are never referred to again), and the description of Frenkel and Schottky defects in crystals which really have very little to do with mechanical properties. The book has no obvious overall framework or logic determining what is included and what is excluded. The selection appears almost random.

Nor is the author conspicuously successful in his attempt to include up-to-date technological examples and applications. His chapter on vacuum physics (primarily vacuum technology) is good, but not directly relevant to the general theme of mechanical properties. He has a full section on resistance strain gauges. Apart from these two examples most of the techniques he describes at length are rather antiquated. It is a long time since Searle's apparatus was used to measure the elastic modulus of any material. Nowadays rotating-cylinder viscometers measure stress on the outside cylinder, not the inner one, and the inner cylinder is rotated by an electric motor, not falling weights. Throughout the whole book I could not find a single specific example quoted of a modern technological material such as a high-strength steel, a creep-resistant alloy, an engineering ceramic or a polymer.

In conclusion there is a place for a book dealing with the mechanical properties of solids and fluids with a technological emphasis at first-year level but the present volume does not usefully fill that place.

P. B. Bowden

Gasdynamic Theory of Detonation. By D. Gruschka and F. Wecken. Gordon & Breach, 1971. 198 pp. £7.30 or $17.50.

The material contained in this monograph is well suited for the basis of a short, introductory course on detonations. The authors assume that the reader has some knowledge of thermodynamics and of compressible fluid flow. While the mathematical manipulations employed in the development are predominantly algebraic, partial differentials and ordinary differential equations often arise, though partial differential equations are avoided assiduously (in the entire book only two appear, these in connexion with blast waves). Thus, a high level of mathematical sophistication is not required. The presentation emphasizes basic principles, though recent research is often referenced and briefly reviewed. Although the citations are not exhaustive, numbering less than two hundred, they provide a good cross-section and at least one reference is cited for every topic covered, be it fundamental or advanced.

The first hundred pages of the text concern quasi-steady, planar, one-dimensional detonation waves, while the last three chapters treat two-dimensional and time-dependent effects. After summarizing and discussing first steady-state, one-dimensional conservation equations and then thermodynamic relations, the authors derive equations for the Rayleigh line and the Hugoniot curve under various sets of assumptions (Chapter I). Relaxation behind shock waves is discussed next (Chapter II), following which the Hugoniot curve for exothermic systems is derived and discussed, with major emphasis on the detonation branch but with some consideration also given to the deflagration branch (Chapter III). Detonation structure is viewed almost entirely in terms of the ZND model (Chapter IV). The current status of arguments for the attainment of Chapman–Jouguet conditions is appraised accurately (Chapter V). The last chapter of the first hundred pages concerns detonations in condensed explosives, the focus of the 1966–67 seminar at the German–French Research Institute, Saint Louis, France, on which the book is based. Equations of state and calculations of chemical equilibria are reviewed, with emphasis placed on simple approximations that have proved to be of practical utility (Chapter VI).

The departure from quasi-steady, one-dimensional flow begins with an elementary discussion of similarity and a presentation of Taylor's self-similar theory for plane, cylindrical and spherical shock waves (Chapter VII). Reflexion conditions at interfaces are treated in detail for one-dimensional, time-dependent waves and for two-dimensional steady-state waves (Chapter VIII). Inert bounding media ranging from vacuum to perfectly rigid materials are considered, and even detonable bounding media are discussed; nor is Mach reflexion overlooked. The effect of diameter on detonation velocity and on the structure of the wave is discussed for both condensed and gaseous explosives (Chapter IX), with some consideration given to detonability limits and to low-velocity detonations. Finally, detonation initiation is discussed from both practical and physical viewpoints. The authors close with a request for further research on multidimensional, transient detonation processes.

The scope of the volume is distinctive and, in retrospect, surprisingly coherent. Of course, a number of detonation topics are not included. The multidimensional structure of gaseous detonations is not discussed and there is no mention of spin heads. Chemical compositions of condensed explosives and of their detonation products are not reviewed thoroughly. The material that the authors do cover is remarkably up to date. Only very occasionally are obsolete statements found, as in the discussion of supersonic combustion, where it is implied that processes of this type have not been realized in the laboratory although in fact they have (as described, for example, by Edelman *et al.* *A.I.A.A. J.* 1971, **9**, 1357–64). Also, in discussing the theory of detonation initiation the authors state that direct initiation by an isobaric hot spot has not been analysed, but Zel'dovich and co-workers recently published an article on the subject (*Astronautica Acta* 1970, **15**, 313–21).

Although the choice of material is quite suitable for a short course, the standard of English used prevents me from recommending the book as a text. I cannot remember having read a book published in poorer English. Peculiarities range from spelling (e.g. "oxydation", p. 52) through phrase, sentence structure (e.g. 'Now assume we that...', p. 86), and paragraph structure, to arrangement of sections. I suspect that the lecture notes from which the book was prepared originally were written in French, because the style is typical of what I have seen in early attempts to translate French into English. It might have been better to publish the book in French, since the wording in English often will give an erroneous impression to a reader who does not know what the authors intend to say, though in every case it is possible to interpret meanings in such a way that the statements of the authors are correct. Despite this the equations contain very few errors, which attests to the high technical competence of the authors. However, it is a tedious task for anyone to read the book and I can recommend it only to those with a keen desire to be brought up to date on the subject.

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