papers are given. The book is well illustrated with clear figures, and there are numerous tables both for reference and to amplify the text.

Much of the material in the first part of the book is familiar from the standard textbooks on these subjects but, although the different topics are introduced at a very basic level, Dr Jayatilaka has fitted his presentation into a small space by selection rather than by simply condensing the standard treatment. This gives a much more interesting book, but does lead to some unevenness. Stress, for example, is minutely defined with the aid of a diagram, whereas shear strain gets only one line. On a larger scale, the chapter on fracture mechanics principles starts with several pages devoted to the theoretical strength of materials and ends with a description of COD (crack opening displacement) so brief as to be unintelligible. The book is generally strong on the practical side – so much so that not only are beam formulae given together with a quantitative discussion of the possible sources of error, but the chapter on testing includes a lengthy section on statistical analysis complete with 't' table.

The chapter on concrete is a little disappointing. Although the general treatment is correct and wide-ranging – the chapter starts with basic cement chemistry and works through to discuss (briefly) fibre- and

polymer-modified concretes – there are a number of minor points which are not in line with current thinking. For example, the threshold stress levels quoted from the 1965 reference for the onset of cracking in concrete would not now be accepted; recent work suggests that there is in fact no threshold.

Other points need rather more discussion to present a balanced view – for example, the controversy over the application of fracture mechanics to concrete is mentioned, but rather briefly, and no references given to the relevant papers. As a whole, this chapter has insufficient depth to be of real value to the concrete research worker, but Dr Jayatilaka has performed a very useful service in showing the student and the non-specialist not only that the behaviour of concrete can be understood (at least in part) by applying fundamental fracture theory to what we know of its structure, but also that concrete, the Cinderella of materials, is in fact one of the more interesting ones.

To sum up, the book is useful because of the unusual mixture of material gathered there. It does not, I think, succeed in being completely coherent in itself at the final-year student level at which it is aimed but, if used together with some of the standard references listed in the book, it will provide a valuable guide through the field.

J. H. BROWN

Concrete, timber and metals

The nature and behaviour of structural materials

J. M. Illston, J. M. Dinwoodie and A. A. Smith

London, Van Nostrand Reinhold Company, 1979. Type-set, illustrated. 235 × 155 mm. pp. xix, 663.
Clothbound: ISBN 0-442-30144-8. Price: £19.50. Paperback: ISBN 0-442-30145-6. Price: £9.75.

The reviewer has considered for many years that there should be a book for civil and structural engineers covering for the materials of especial interest to them and the basic principles of structure that govern the mechanical and other properties. This book almost meets that specification dealing, as the title implies, with the three broad fields of metals, timber and concrete. Although a separate author has been primarily responsible for each class of material, the book is well balanced in its coverage of each and refers to the broad similarities that exist between them.

A brief introductory chapter is followed by a long one that deals with the simple physical aspects of materials and gives a now traditional materials-science survey of atomic structure, interatomic bonding, states of aggregation, crystal structure. It also includes the derivations of the theoretical tensile and shear strengths of solids and shows how these are not

realized in practice, owing to the presence of cracks in brittle solids and dislocations in crystalline materials respectively. It concludes with discussion of surface effects, e.g. adsorption, which play such a large part in the behaviour of concrete and timber and of thermodynamic concepts including entropy and free energy.

Thereafter, the chapters on each material are dovetailed within sections covering particular performance topics. The book can be read in two ways, either as it has been written, covering each topic in turn or selecting the successive chapters on each class of material.

The first topic is structure, where in the case of concrete the constituents of cement are listed and the process of hydration is described. The structure of the cement gel and typical dimensions of features of hardened cement paste, e.g. gel pore size and gel body diameter, are given. The Powers model of the

hardening of cement is discussed in some detail. The effects of admixtures and of the properties of aggregates are considered. For timber, the structure is discussed at macroscopic, microscopic, cellular and molecular level. Metals are considered first at basic crystal structure level and then, after discussion of phase diagrams, grain structure and other microstructural features are examined.

The next four chapters cover aspects in which both timber and concrete differ significantly from metals. Both types of material are porous and contain water. The contained water can in part be lost causing shrinkage, isotropic in concrete but highly anisotropic in timber. Also water and other liquids can permeate into them, which can be dangerous if the liquid contains injurious chemicals or beneficial in the impregnation of timber with preservatives. Mathematical treatments of the diffusion equations governing these processes are given and practical results shown in diagrams.

The responses of the three classes of materials to stress, i.e. elastic behaviour, creep deformation and ultimately fracture are discussed in six long chapters. In the case of concrete the effects of water/cement ratio, age and aggregate upon these properties are considered. Descriptions of the methods for measuring the strength of concrete and the measurement of fracture toughness are given together with a discussion of the applicability of Weibull statistical theory of the failure of brittle materials. For timber, the emphasis is upon the anisotropy of the elastic properties and the influence of moisture content, particularly varying moisture content, and temperature upon creep and failure strength. For metals, dislocation movement is considered in some detail and ductile, brittle and fatigue failure are covered.

A chapter on metallurgical strengthening techniques considers not only the sub-microscopic and microscopic processes such as solid solution alloying,

precipitation hardening and heat treatment of steel, but also a numerical analysis of fibre reinforcement in metal matrices.

The durability of concrete and of timber and the corrosion of metals are each given a chapter. In the one on concrete, alkali-aggregate reactions, the ingress of aggressive agents, particularly their effects upon steel reinforcement, and the effects of low temperatures and fire are discussed. For timber, there are harmful biological agencies as well as physical and chemical. Metals are subject both to surface oxidation and to electrolytic corrosion; protection methods by surface coatings or cathodic protection are considered.

A final chapter covers the processing of timber.

The book is very readable and will make a good textbook for engineering students and for anyone concerned in teaching materials to engineers. It could also be a good starting point for any researcher into concrete or timber behaviour. Whilst there are many good books on metals there are no others, of which the reviewer is aware, at this level and so up to date on concrete or timber. As well as references within each chapter, there is a useful bibliography with comments on each work listed. The illustrations are clear and simple and SI units are used throughout. The only errors noted were two different and incorrect spellings of discrete on page 14, a wrong spelling of fare on page 586 and in the caption to Fig. 15.16 where Barker should be Gerber.

The book would be more complete for the would-be structural or civil engineer if there were also some treatment of stone, brick and fibre-reinforced polymeric composites. The treatment need only be brief, for most of the basic material is already covered. In particular, as stated above, the mathematical treatment of fibre composites is already given. Nevertheless, the authors are to be congratulated for producing a most acceptable text.

K. J. PASCOE

Polymers in concrete

International Symposium

Detroit, American Concrete Institute, 1978. Typewritten, illustrated, paperback. 228 × 152 mm. pp. vi, 420. ISBN not stated. Publication SP-58. Prices: US \$14.50 to ACI members, \$18.95 to non-members (shipping and handling fee: \$1.50 per book in the USA, \$3.00 per book elsewhere). Obtainable in the UK from the Cement and Concrete Association as publication 15.134, price: £9.00.

Since this symposium was held in Mexico City in 1976 a much larger international congress has been held in Austin, Texas (October 1978), and the proceedings of this more recent meeting are already available. It is therefore relevant to ask whether it is necessary to purchase all of the publications on polymer concrete, or which are the best buys.

This particular publication maintains the standards expected from the ACI and there are many valuable papers in the collection. Of the 22 papers, 8 are concerned with polymer concretes in which the aggregate is bound in a organic or polymer matrix and no inorganic, hydraulic cement is used. The topics covered in this category of materials include both