definitive and constructive account of the science of geological correlation.

The third and final section contains six papers dealing with individual aspects of the study of orogenic belts. The need for an independent tectonic terminology for orogenic belts is emphasized in a contribution which surveys the variety in orogenic belts. In another the rate of displacement, both vertical and horizontal, is considered. Three papers stressing the anomalous nature of the deeper crust within orogenic belts, both in physicochemical characteristics and in relation to its excessive thickness, suggest possible geophysical methods for determining meaningful models of the displacement within continents.

It is pleasing to see a section devoted to discussion, both that following the reading of the papers at the symposium and also that occurring later as written contributions. This section, which serves as a detailed criticism of individual papers, disappoints only in the paucity of points raised.

In such a collection of papers from a range of authors it is to be expected that not all the contributions rise to the level of the best. *Time and Place in Orogeny* is, however, a volume that few structural geologists and geotectonists can afford to be without, and all will anticipate with considerable interest the publication of the second volume of the trilogy: "Data for Orogenic Studies", the aims and organization of which are laid out at the end of this volume.

R. A. GAYER

ARCH PIONEERS

A Span of Bridges

An Illustrated History. By H. J. Hopkins. Pp. 288. (David and Charles: Newton Abbot, June 1970.) 70*s*.

THE building of bridges is still an exciting branch of engineering, because the challenges it presents never become stereotyped. No two bridges are exactly the same; each time the problems of wind and water, the lie of the land and the levels of the approaches have to be tackled afresh. Thus the Forth and Severn road bridges, finished within two years of one another, solve apparently identical problems in subtly different ways. The bridge designer also needs an eye for proportion and scale; the finished structure must not only do its job, but must be seen to be doing it. Form and function are, of course, closely related, and there are very few great bridges which do not "look" right, even to the untrained eye.

Professor Hopkins has written an excellent history of the art, the craft and finally the profession of building bridges. It is a story well provided with interesting characters, starting with Vitruvius, whose writings of the first century BC establish beyond doubt that the Romans fully understood the principle of the arch. Just before the French Revolution, Jean-Rodolphe Perronet brought this same principle to perfection with his daringly low arches and slim piers at the Pont de la Concorde in Paris. The doubters, of course, predicted instant collapse as soon as the centre supports were removed, but the bridge stands today.

After Perronet came the iron bridges of the nineteenth century—some were triumphs, like Robert Stephenson's recently damaged Britannia Bridge across the Menai Straits, or Telford's Mythe Bridge at Tewkesbury, and some were well remembered disasters, like the "wondrous bridge across the silvery Tay", as McGonigall just had time to call it in the brief space between completion and collapse. Today the suspension bridge, refined to remove dangerous oscillation and twisting, reigns supreme for large structures. Pre-stressed concrete has taken over for the smaller bridges, and it, too, has its masterpieces. Hopkins picks out for particular praise Robert Maillart's Schwandbach and Salgina bridges, both unbelievably light and elegant structures. He also has a good word for Waterloo Bridge across the Thames, whose designers had to cope not only with nature and the Blitz, but also Sir Giles Gilbert Scott, an eminent architect thrust on them. Londoners have reason to be grateful for their patience and determination, for one has to go upstream as far as I. K. Brunel's Maidenhead railway bridge for a Thames crossing of comparable distinction.

This book will be enjoyed by sixth-formers, undergraduates and armchair engineers everywhere. It is profusely illustrated and admirably written. My only complaints are the uneven quality of the printing and rather haphazard layout; but these are quibbles.

NIGEL HAWKES

DEFECTS IN CRYSTALS

Crystallography and Crystal Defects

By A. Kelly and G. W. Groves. Pp. xi + 428. (Longman: London, May 1970.) 100*s*.

THIS lucid and interesting book sets itself the somewhat ambitious task of combining the elements of crystallography, stereographic projection, tensor algebra and elasticity theory and of using these in a thorough study of crystal defects. Moreover, the book is aimed at students as widely separated as postgraduates and first year undergraduates. What is important is that it succeeds to a quite remarkable extent. The introduction takes up the first five chapters (part one plus chapter five), and is concisely and accurately presented. Then follows the development with chapters on glide, dislocations, point defects, twinning, martensitic transformation and crystal boundaries. It is necessarily selective, stressing consistently the crystallographic nature and importance of defects, and is refreshingly clear and direct. I liked particularly the discussion of Peierls force and grain boundaries and the chapters on twinning and martensitic transformation. I was disappointed that the discussion of dislocation core structure was not more closely related to crystallography. The book is particularly complete on subjects which the authors have pioneered (for example, independent slip systems).

This is essentially a text, not a reference book. It will certainly be of interest to postgraduates, though I feel that some undergraduates will find its style a little too brief and lacking in development. The book is excellently produced, has useful problems at the end of each chapter with answers at the back, and several valuable appendices. Wherever possible it avoids mathematical detail. In fact, my only criticism of substance is that it has tried to do too much. Our understanding of the importance of the crystallographic nature of defects in crystals is too incomplete at present to allow a full discussion. In many cases where the importance of crystallography is established, a proper discussion would involve prohibitive mathematical complexity, for example, anisotropic elasticity which is only hinted at in this text. We shall have to wait for an authoritative treatment of the subject. J. W. STEEDS

PARTICLE STATES

Elementary Particle Theory

By A. D. Martin and T. D. Spearman. Pp. xiii + 527. (North Holland: Amsterdam, 1970.) Hfl. 83; 193*s*; $22.

THE most useful theoretical concept for the analysis of the dynamics of strong interactions between elementary particles which is available to us at present is the scattering matrix (or S-matrix) element, which may be regarded as the quantum mechanical probability amplitude for scattering from an initial to a final state. The S-matrix element is a function of the external parameters in the process such as energy and angle of scattering, and the hope is that this