tive theory. Quasars were recognized too late to be discussed in this book.

More advanced chapters include a thoughtful one by R. Kippenhahn, containing more than is implied in its title, "Stars with Helium-Rich Cores"; it not only discusses problems associated with models of giant (class III) stars, but also gives some consideration to difficult questions relating to internal magnetic fields and internal circulation of matter (Figs. 15 and 17 in this article seem to have been interchanged). Experienced workers are likely also to find valuable reading in chapters by P. Ledoux, "Stellar Stability and Stellar Evolution"; by N. Baker, "Theoretical Models for the Pulsations of Cepheids"; and E. Schatzman, "The Early Stages of Stellar Evolution". M. M. Shapiro contributes "Notes on Cosmic Radiation", a brief summary of present knowledge with regard to mass and energy distributions among cosmic-ray particles, with some discussion of their origin and of the question of their confinement in the Galaxy.

There are varied contributions of a more observational nature by L. Gratton, E. M. Burbidge, L. Rosino, and M. Hack respectively, ranging over such subjects as stellar associations, *T* Tauri and related variable stars, observed abundance anomalies, the structure of galaxies and the evolution of close binaries. Without questioning the value of these contributions, what I missed was a thorough survey emphasizing the basic observational needs in this subject, for better and more stellar photometry, better distance determinations, better mass determinations, better chemical abundances (involving much laboratory measurement as well as observatory investigations), more proper motions, more radial velocities, etc. In the case of several of these, for example, distances and masses, there is a crying need for good technical innovation. Theory has outrun the observational checks, and without them is in danger of indulging in excessive speculation and of getting too far away from the real, physical, world. Unfortunately, the acquisition of reliable observational data involves a great deal of hard, unglamorous work that cannot be done by unskilled labour, that is useless if not done critically and conscientiously, and that at the present day gets no great thanks or recognition even when well done. Astronomy, indeed all physical science, owes more to the Puritans than it has ever cared to acknowledge, and the decay of Puritan ideals in the Western world makes it more and more difficult to find people to do unpopular work, however essential. I think it is specially important to bring such points to the notice of young research workers.

The book is rather heterogeneous, but contains some good reading. It is well printed but could have been better edited.

R. O. Redman

LOOKING AT DISLOCATIONS

The Direct Observation of Dislocations

By S. Amelinckx. (Solid State Physics: Advances in Research and Applications, Supplement 6.) Pp. x + 487. (New York: Academic Press, Inc.; London: Academic Press, Inc. (London), Ltd., 1964.) 121*s.* 6*d.*

IT is remarkable how the study of dislocations in crystals has transformed itself, over the past fifteen years, from a theoretical science into an experimental one. When the basic theory was laid down, during the period 1934–50, dislocations seemed to many people to be mere playthings of the theoretician, never seen except on blackboards and backs of envelopes. Admittedly, there were some early signs that the theory might be correct—for example, from the Bragg bubble model and from the observation of the formation and movement of low-angle tilt boundaries in bent crystals—but the essential experimental challenge of actually seeing dislocations in crystals still remained. Then, quite suddenly, everything changed and several direct methods of observation appeared. In accordance with F. C. Frank's theory, growth spirals were seen to emanate from points of emergence of dislocations on crystal faces. In transparent crystals the 'decoration' technique was developed for showing up dislocations by lines of precipitated particles, like tracks in a cloud chamber. X-ray methods were also developed. Most important of all, the thin-film transmission electron-microscope techniques were discovered, which allowed dislocations to be seen so easily inside crystals that films could be taken of their movements. More recently, the field–ion microscope has enabled the atomic structures of dislocations to be seen.

These developments have set off a world-wide activity in the experimental study of dislocations. Many Ph.D.s have been won and many beautiful photographs published in this enterprise. A whole new subject has grown up—the crystallography of imperfect crystals—with its own body of theory for interpreting the observations and for identifying and classifying the dislocations thus seen, with an exactitude equal to that of classical crystallography.

Prof. Amelinckx has played a leading part in this development, particularly in the decoration of dislocations in ionic crystals, and it is no surprise that he has written this excellent and authoritative book. The principal experimental methods are described in great detail, illustrated with many superb pictures of dislocations, and the theory necessary for the interpretation of the observations is developed fully. This book can be unreservedly recommended to solid-state physicists and metallurgists interested in the experimental study of dislocations. They will be encouraged to work in the field by the delightful combination of experiment and theory it offers and which is so well brought out in this book. They need have no fear that all the interesting work has now been done: the field is an immensely rich one, as yet almost untouched in some areas, and this book will be an invaluable guide for all expeditions into them.

A. H. Cottrell

PHYSICAL GEOLOGY UP-TO-DATE

Principles of Physical Geology

By Prof. Arthur Holmes. New and fully revised edition. Pp. xv + 1288. (London and Edinburgh: Thomas Nelson and Sons, Ltd., 1965.) 84*s.* net.

SINCE *Principles of Physical Geology* first appeared twenty years ago profound re-orientations have occurred in many branches of geology and especially in those where modern advances in physics and allied disciplines have been used to illuminate geological problems. A few examples will emphasize the wide range and great depth of these changes. Radiometric dating has brought order into cryptozoic chronology so that the fundamental events of the first three thousand million years of the history of the Earth can be arranged in a reasonable sequence. Large-scale exploration by novel methods, geophysical and engineering, has completely changed ideas on the form and structure of the ocean floors which, after all, constitute 70 per cent of the lithosphere. Determinations in the rocks of many ages of the attitude of the Earth's magnetic field at the times they were formed, combined with the investigations of ancient climates and even of ancient wind-directions, have transformed the former heresy of continental drift into a fairly respectable orthodoxy. New ideas on the behaviour of rocks under various stress conditions have changed the interpretation of many crustal structures and have profoundly modified speculations concerning happenings in the deeper shells of the Earth. Prof. Holmes has played a prominent part in many of these advances, and they, with countless others, are set forth with his customary clarity and sprightliness