

steel plant refractories in the College of Mineral Studies at the Pennsylvania State University. The College has made many original contributions to this subject since the project started in 1949: this work has, in one sense, culminated in the publication of the book, *Phase Equilibria Among Oxides in Steelmaking*. The authors, Profs. Muan and Osborn, have aimed to bring together all available data on relevant oxide systems, and to apply this scientific information to process problems in the iron and steel industry. The presentation of the information has been designed for use by those meeting these problems as they assist in practising the art of operating the production plants.

The first three-quarters of the book gives data relating to equilibria in some sixty oxide systems of importance in iron and steel making, and sets out the basic principles underlying the information. This part of the book is excellent. No attempt is made to over-describe the basic science of the subject, references being given to many of the excellent texts already available: the essential principles are made clear by reference to the equilibria in the different types of system discussed. The special interest of the authors in this part of the work may be clearly discerned; more than three hundred original references are cited, and the subject is treated in an objective and critical manner. Whenever possible, the information is presented in a standard diagrammatic form, and the authors have redrawn many published diagrams in order to give a commendably uniform presentation. The diagrams are, in general, clear, but some of the more complex illustrations would benefit from the use of colour, a device which would, unfortunately, increase the price of an already expensive book.

The three final chapters of the book deal with the application of the equilibrium data to slags, oxide inclusions, and refractories. As in the preceding chapters, the information is handled in a clear and constructive manner; bearing in mind the audience at which the book is aimed, however, these sections do not maintain the high standard set by the earlier chapters. A few slag systems are discussed in reasonable detail, but more examples would have helped the average reader to extend the treatment to other systems. The validity of this criticism is emphasized by the authors themselves, when they point out that many simplifications and assumptions are necessary in order to discuss the chemistry of steel-making slags. Similarly, the logically presented information on oxide inclusions could have been extended, with benefit, to make more clear the ways in which the different phase relationships can affect the morphology of the precipitates.

Despite these criticisms, however, the book will be of undoubted value to those involved in the practical problems of iron and steel making. It should also find considerable use in providing examples for the amplification of university courses dealing with problems of high-temperature equilibria.

D. S. OLIVER

SKIN AND HAIR—A FORWARD-LOOKING PROSPECT

Biology of the Skin and Hair Growth

Edited by A. G. Lyne and B. F. Short. (Proceedings of a Symposium held at Canberra, Australia, August 1964.) Pp. xi+806. (Sydney: Angus and Robertson, Ltd., 1965.) A.210s.; 21 dollars.

BIOLGY of the *Skin and Hair Growth* is a large and wide-ranging book. Among the subjects covered are the skin structure of snakes and lizards; the development of feathers and hair; studies of hair growth waves and rhythms in cattle, sheep, rodents and seals; radiation effects on hair; the detailed biochemistry of keratin structure and fibre formation; endocrine effects on fibre

growth; and the cytology and morphology of hair follicles.

Inevitably, in a book of 46 chapters, many of which incorporate original work, the quality of papers varies. But the average standard is very high and the overall impression is that each subject is treated authoritatively. The emphasis of the book is on dynamic features of the skin-hair complex rather than on the classical aspects of anatomy and morphology. As with most symposia, complete coverage of the field was understandably not achieved. In this particular case, several important but specialized topics are virtually excluded; for example, the work of Bullough and his associates on the control of cell division in the hair follicle and the epidermis, and the subject of skin transplantation immunity. There has been no attempt to make a general synthesis, but in view of the variety of material presented this might well have proved an almost impossible task. The nearest approach to generalization comes in the opening paper by Billingham and Silvers which deals with some of the important remaining problems of skin biology.

Of the numerous sections deserving comment it may be permissible to sample a few. Papers by Straile and by Priestley and Rudall both suggest that the morphology and rate of growth of hair fibres may be controlled by a 'cellular shunt' mechanism determining which of the cells formed in the follicle bulb enter the hair fibre and which enter the follicle inner root sheath which invests it. Such a mechanism involves the spatial relationships between streams of newly divided cells moving distally from the follicle bulb matrix. These relationships may be determined by changes in the shape of the dermal papilla. This work and the studies of Fraser and of Short, Wilson and Schinckel on the proliferation rate of the follicle matrix cells may together hold the key to a complete understanding of the process of hair growth at the cellular level.

Cohen, by means of an audacious technique involving the transplantation of individual follicle papillae, has carried out a successful experimental attack on the fundamental problem of epigenetic specificity as between the dermal papilla and the epidermis. Chapman has constructed a highly ingenious theory which accounts for the formation of wool crimp by postulating periodic contractions of the follicle-attached pilomotor muscles. However, there still seems on this theory a difficulty in accounting for the situation in certain British breeds of hill sheep. Here the primary fibres (which are all associated with arrector pili muscles) may comprise a mixed population of loosely-crimped and uncrimped fibres, whereas adjacent secondary fibres (which lack associated muscles) are all clearly crimped. One hopes that Chapman will be able to direct his attention to this problem in the future. Different types of hair-growth rhythm and the factors controlling them in a variety of species are thoroughly dealt with in chapters by Chase, Lyne, Elizabeth Johnson, Ebling, Ling, Hutchinson and Hayman. Aspects of blood-flow to the skin are discussed in several papers, and here Molyneux revives, from a new point of view, the subject of arterio-venous anastomoses in the skin and their possible role in thermoregulation. Endocrine effects on hair growth are considered by Rougeot, by Houssay, Epper and Pazo, and by Downes and Wallace. A comprehensive paper by Ferguson, Wallace and Lindner indicates the bewildering complexity of present knowledge concerning hormonal influences on wool growth.

It should be evident, even from this selective discussion, that here is an essential reference book for all workers interested in the fields of skin and hair growth. Others on the fringe, such as endocrinologists, physiologists, pure zoologists, histochemists and biochemists, will find many chapters of value.

The book is very well produced, both editing and presentation being of an unusually high standard.

J. SLEE