and underground), geochemistry, geobotany, geophysics, sampling, prospect evaluation, drilling and mining methods, project planning, and management, means that none can be discussed at length. Some criticism can be levelled for example at the presentation of the geological section (Part 1), which is perhaps too generalized and would have been improved by more individual 'case history' examples. The reader will find this an interesting book but unfortunately, not a particularly good reference source for factual data and literature relating to specific prospecting problems, as this reviewer found when seeking information on duricrust (caliche) geochemistry.

Despite these criticisms, Professor Peters's book provides a much needed introduction to the wide variety of subjects that comprise practical mineral exploration and mining geology. It is recommended to lecturers, students, and recent graduates working as geologists in the minerals industry.

J. McM. Moore

Habashi (F.). *Chalcopyrite: its Chemistry and Metallurgy.* New York (McGraw Hill) 1978. xi + 165 pp., 89 figs., 24 tables. Price £12·90.

As the title of this book indicates, the objectives of the author have been to review the chemical properties and metallurgical treatment of chalcopyrite, the most abundant copper-bearing mineral. Apart from an extremely brief discussion of the compositions and stabilities of bornite, cubanite, and idaite, no other ternary or binary compounds of the Cu–Fe–S system are dealt with in this text. The book is divided into twelve short chapters, most of which deal exclusively with the metallurgical treatment of chalcopyrite. These include discussions of the concentration of chalcopyrite by flotation methods and of metal extraction by thermal oxidation, reduction, aqueous oxidation, chlorination, and electrolytic treatment. One chapter reviews the structure and physical properties of chalcopyrite, and one deals with minor and trace elements in chalcopyrite and their effect on metallurgical processing. Only scant mention is made of the natural occurrence of this mineral. The concluding chapter is a statement of the author's view that the future of chalcopyrite metallurgy is in acid (probably HCl) pressure leaching of flotation concentrates at *c.* 110 °C in the presence of oxygen.

The book is written in a clear and concise style and the quality of presentation of text and figures is excellent. Each chapter is followed by an extensive reference list subdivided in terms of chapter subheadings. In reading the sections dealing with chalcopyrite metallurgy, one is struck by how many of the processes described seem only to be characterized empirically. Rarely have reaction rates and reaction mechanisms been properly investigated. Mineralogical studies in recent years have shown the complexities of the central portion of the Cu–Fe–S system, with such phases as talnakhite, mooihoekite, and haycockite being the result of different ordering processes during the breakdown of the high temperature 'intermediate solid solution'. It is a pity that the implications of this work have not yet been considered in relation to metallurgical processing; perhaps these aspects could be treated in a future edition of the book.

This book will be bought chiefly by metallurgists, but mineralogists and economic geologists working with copper sulphides will find it a useful review of the theory and practice of chalcopyrite metallurgy.

D. J. Vaughan

Navin (T. R.). *Copper Mining and Management.* Tucson (University of Arizona Press), 1978. 426 pp., 26 figs. Price $9.75 paper, $16.50 cloth.

Although this book by the Harvard Business School-trained Professor of Management at the University of Arizona adds little to knowledge of mineralogy, it is of interest to mineralogists in that it provides a conspectus of one of the greatest of mineral industries, evidently written with much inside knowledge. The year 1775 is chosen as the start of the modern era, dating from James Watt's agreement with Matthew Boulton to produce the former's patented steam engine. The dominant part played by the mines of Cornwall and Devon in the early Industrial Revolution is mentioned; about 100 were active, employing 60 000 men up to 1830, but with capacity for only about 15 000 tons of copper production per year. Of greater importance was the fact that Cornubia supplied talent, chiefly at foreman level, to every copper camp in the world up to World War I. Large-scale copper mining began, following Douglas Houghton's report, in Michigan about 1844, but for the USA the modern period began in 1881 with the discovery of Butte (Montana), Copper Queen and Morenci (Arizona), and the first look at Bingham Canyon, Utah, the last-named destined to become the prototype 'porphyry copper' deposit. Although British interests had developed mines in Chile and acquired Rio Tinto in Spain in the 1870s, by 1900 seven out of ten of the world's leading copper mines were in the USA. Today, Chuquicamata (Chile) leads the field, but it is believed that at Udokan (Siberia) Russia has the potential to develop the