

through the experience gained in the exploitation of the great mineral deposits located in the Iberian Peninsula. Archaeological evidence shows that by the Third Millennium BC mining was in progress and that copper, tin, iron, silver and gold were valuable commodities which were being traded during the later Bronze Age. These metals formed an important component of the Phoenician economy and, no doubt, were a strategic consideration which led the Carthaginians, and later the Romans, to fight for the control of the Iberian Peninsula.

With the arrival of the Romans, organised mining on a large scale commenced, making use of all the technical knowledge than at the disposal of the Roman Empire. The two most famous areas in which mining activity was focused were the auriferous provinces of Leon and Asturias in north-western Spain and the Andevallo of south-western Spain. In the Andalusian district of Huelva at Rio Tinto, copper-bearing pyritic ores with gossanous cappings containing valuable concentrations of gold and silver provided the basis for an extensive mining operation by the Romans. A significant contribution to the knowledge of ancient mining and metallurgy in this region has been made by Beno Rothenberg and Antonio Blanco-Freijeiro in their work published in 1981.

Leonard Salkield had a long and intimate professional association with the metallurgical operations of the Rio Tinto Company where he worked from 1930 until 1962. The history which has been compiled as a result of his personal researches provides a particular insight into the technical developments in metallurgy at Rio Tinto since its re-discovery in the 16th Century, although the pre-Roman and Roman periods are not neglected. Certainly the most significant contribution has been made in the discussion of the metallurgical innovations which were made during the 19th Century and the way in which the ores were classified and treated both for the production of copper and, later, for the extraction of sulphur for the chemical industry. Both pyro-metallurgical and hydro-metallurgical processes are discussed and some of the environmental consequences which resulted from the large-scale smelting and leaching operations which were entailed. Aspects of technical development are supplemented by historical notes on the influence of German and Norwegian contributions to extractive metallurgy, including discussions of the Doetsch processes and the Orkla process. Chapters on the early mining operations of the Rio Tinto Company and the infrastructure which was established for the effective undertaking of the enterprise are also included.

Readers with an interest in the history of min-

ing technology and metallurgy in Spain will find Salkield's history a valuable reference which has taken shape, no doubt, due to the dedicated interest of the editor, Maurice Cahalan.

C. HALLS

Friedrich, G. H., Genkin, A. D., Naldrett, A. J., Ridge, J. D., Sillitoe, R. H. and Vokes, F. M., eds. *Geology and Metallurgy of Copper Deposits* (Special Publication No. 4 of the Society of Geology Applied to Mineral Deposits). Berlin, Heidelberg and New York (Springer-Verlag), 1986. xiv + 592 pp., 50 maps. Price DM 198.00.

This publication contains 40 papers which were presented at a symposium on copper deposits at the 27th International Geological Congress held in Moscow in 1984. Four major environments of copper mineralisation are covered: those in mafic and ultramafic igneous complexes (11 papers), porphyry copper-molybdenum deposits (9 papers), deposits of a volcanic-hydrothermal association (6 papers), and sediment-hosted deposits (14 papers) [M.A. 87M/5451, 5584, 5623].

Although exploration and research activity has tended to move away from copper deposits in recent years, this is still a useful publication, providing an up-to-date account of several aspects of copper mineralisation and describing several examples from the Soviet Union. Not surprisingly, the style and quality of the papers are variable. However there are some particularly informative reviews of the geology and genesis of several important deposits, including those at Kambalda, Sudbury, and in the Iberian pyrite belt. Although agreement amongst several authors is apparent in some areas, in others there are some interesting differences in opinion. Thus the majority of papers on sediment-hosted copper deposits suggest associated red beds as a plausible source for the copper and diagenesis as the key process influencing mineral precipitation. On the other hand the role of assimilation in the generation of sulphides in komatiites and layered igneous intrusions is not agreed and various lines of evidence are put forward to support or refute this mechanism of ore formation.

The book is well-produced and contains numerous diagrams; however a significant number of the maps have no scale. It is a pity that it has taken so long to appear but there is enough in this publication to make it an important source of information for those working in the field of copper mineralisation.

D. H. M. ALDERTON