

# Book news

## 1. Book review

● *Technology of metal powders — recent developments*, edited by L. H. Yaverbaum. New Jersey, Noyes Data Corporation, 1980. 400 pp.

(Reviewer: B. K. Loveday)

This book is the product of a data-based compilation of information related to metal-powder technology that appeared in the patent literature in the U.S.A. from March 1974. It is a useful reference volume for those involved in projects involving powder metallurgy. The information is presented in an easily assimilated style, and essential diagrams are included. Precious metals, magnetic powders, copper, nickel, refractory materials, and iron and steel all receive detailed attention. Some specific topics that may be of interest to the South African reader include the development of ferrosilicon powders with improved corrosion resistance, the production of cobalt powders from the oxide and the carbonate, and the reclamation and recycling of cemented tungsten carbide. Spray drying and related processes feature among the many newly developed techniques outlined.

## 2. New books

● *The use of microprocessors*, by M. Aumiaux. New York, Wiley, 1980. 176 pp. \$25,50.

A basic textbook describing the microprocessor system and its philosophy of use. Each chapter discusses, from the user's perspective, each of the main components: the microprocessor, memories, the programmable peripheral interface, and the programmable communication interface. Provides basic exercises and instruction sets for the Intel 8080A and the Motorola 6800, enabling the reader to program from a kit.

● *Aluminium smelter technology, a pure and applied approach*, by K. Grojtheim and B. J. Welch. Düsseldorf, Aluminium-Verlag GmbH (P.O. Box 1207, D-4000, Federal Republic of Germany). 146 pp. DM48.

Aluminium smelting has now become the most important non-ferrous metallurgical process, yet its extraction technology is seldom taught in sufficient depth to prepare people for professional employment in the industry. One of the reasons for this is the lack of a suitable modern text that bridges the gap between superficial treatment and the advanced views expressed in research-oriented publications. One of the aims of this book is to fill this void. A second aim of the book is to broaden the understanding of less professionally trained technologists who are employed in aluminium smelters. Most major aluminium-producing companies have had to prepare their own training manuals, and with time these have become oriented round their own technology and interpretations. This has made it difficult for them to be updated with the various advances that have been made elsewhere, and has led to an in-breeding in thoughts and concepts. This book can serve to overcome these limitations if it is used for training in the fundamentals.

● *Coal-bridge to the future*. New York, Harper & Row, 1980. \$35.

This is the final report of the World Coal Study. It

provides an extensive analysis of the world's coal prospects in the period from 1980 to 2000, based on detailed projections of coal use, production, and trade by country, region, and market sector. The Study assesses the role of coal in an economic perspective, describing coal markets, the interplay of costs and competition, and the role of governments and other economic factors that affect coal use. The Study describes how coal can be mined, moved, and used in ways that meet strict environmental, health, and safety standards; provides information on the type, amount, and distribution of world coal resources and reserves, and past, present, and projected production; describes maritime transportation needs; reviews current and developing coal-using technologies; and indicates the capital costs and investments required for coal chains from the mine to the consumer.

● *System modeling and response: theoretical and experimental approaches*, by O. Doebelin. New York, Wiley, 1980. 576 pp. \$26.

A clear, intermediate approach that shows the field's wider engineering applications. Includes transform methods for linear system response studies, frequency spectrum methods, the digital simulation approach to nonlinear system analysis and design, experimental test techniques for linear and nonlinear systems, and specific applications of modelling techniques to physical devices.

● *Environmental and climatic impact of coal utilization*, edited by J. J. Singh and A. Deepak. New York, Academic Press, 1980. 646 pp. \$39,50.

With world oil becoming increasingly scarce and costly, coal is once again a key fuel in fulfilling our energy demands. However, the utilization of coal and its liquid and gaseous derivative fuels creates unique environmental and climatic problems. Responding to the need for up-to-date, in-depth research in this field, nearly seventy scientists from university, industry, and government laboratories, gathered at the Symposium on Environmental and Climatic Impact of Coal Utilization, in Williamsburg, Virginia, on April 17-20, 1979. This book presents the proceedings of that symposium, where recognized experts reviewed our present knowledge and active researchers offered their latest findings. The entire spectrum of coal-related problems is dealt with here — atmospheric pollution (ground, tropospheric, and stratospheric), the environmental climatic impact of pollutants, and techniques for measuring pollutants and their impact.

● *Proceedings of the Third European Conference on Mixing, York, England, April 1979*, edited by H. S. Stephens and C. A. Stapleton. BHRA Fluid Engineering (Cranfield, Bedford MK43 OAJ, U.K.), 1980. 2 volumes. 500 pp. \$50.

The contributors are specialists in their own areas of research, and the proceedings provide an invaluable and indispensable contribution to research in this area.

● *Lignite technology*, edited by P. Nowacki. New Jersey, Noyes Data Corporation, 1980. 228 pp. \$42.

This book discusses the present and future use of

lignite for electric power generation, and the problems associated with the use of low-rank coals. Lignite and other sub-bituminous coals represent a large domestic, yet relatively unused, source of low-cost energy. The abundant deposits are located largely in the Northern Great Plains and Rock Mountain regions, as well as in Texas, and are near the surface. Lignite is a low-sulphur coal, but produces copious amounts of alkaline fly ash, and ash fouling of boiler tubes is the most serious operating problem when burning it. Yet lignite has high permeability and reactivity, which make it a superior feedstock for gasification and liquefaction.

● *The application of rock mechanics to cut-and-fill mining*. London, Institution of Mining and Metallurgy, 1980.

The papers presented at a conference at the University of Luleå, Sweden, in June 1980, present the state of the art in the application of rock mechanics to cut-and-fill mining both in Sweden, where cut-and-fill mining has a long tradition, and in other countries of the world. The results of the Näsliden project, which involved about 20 scientists from mining companies, universities, and research organizations in the Scandinavian countries are also given. In 1968 the Näsliden mine was fully instrumented for measuring pressure in the fill, convergence between hanging wall and foot wall, deflections of roofs, etc. Finite element codes for the simulation of stresses and displacements due to cut-and-fill mining were developed.

● *Papers presented at the Fifth International Symposium on Jet Cutting Technology, Hanover, Federal Republic of Germany, June 1980*, edited by H. S. Stephens and B. Jawis. BHRA Fluid Engineering (Cranfield, Bedford Mk 43 OAJ, U.K.), 1980. 438 pp. £38.

● *World coal resources: methods of assessment and results*, by G. Fettweis. Amsterdam, Elsevier, 1979. 425 pp. \$80,50.

Although there is general agreement that the world's coal resources are vast in relation to both present consumption and to other fossil fuel resources, there is widespread disagreement on the actual size of these resources, the quantity of useable coal, and the methods employed to measure the resources. In this book, the author deals with these questions from an interdisciplinary viewpoint, which ranges from geochemical considerations to mining engineering and mineral economics. He examines the different systems adopted by each country for the techno-economic assessment of mineral occurrences and puts forward suggestions for improvement and international standardization of classification methods. A discussion of the influence that types of mining can have on the assessment of coal reserves includes a chapter on the state of the art and problems of underground gasification. The book also gives a review of the results of international surveys on world coal resources since 1913 and of the national estimates in the major coal-producing countries. The conclusion reached is that there are in fact significantly fewer coal reserves that can be economically recovered than is generally believed.

● *Geophysical and geochemical techniques for exploration*

*of hydrocarbons and minerals*, edited by M. Sittig. New Jersey, Noyes Data Corporation, 1980. 300 pp. \$40.

Exploration for energy and minerals has entered a new age; in the United States especially, this type of exploration has become extremely active. Companies are opening exploration offices, and the demand for geoscientists and petroleum engineers versed in the pertinent prospecting techniques has climbed steeply. Practical knowledge fields most required are geophysics, stratigraphy, sedimentology, and the tectonics of the earth's formations and deformations. A short perusal of this book shows that all prospecting techniques are really interpretations within these fields, no matter whether hydrocarbons or rare metals have to be found and no matter how sophisticated the equipment and the techniques that facilitate the work of the modern geoscientist.

● *Financial Times mining international year book 1980*. Longman Group Ltd (Periodicals and Directories Division, Longman House, Burnt Mill, Harlow, Essex CM20 2JE, England). £24 surface, £34 airmail.

The Year Book lists details of companies involved in the mining of metals, minerals, and ores world-wide. It provides accurate company annual information essential for all those concerned with the mining industry. It covers 700 companies in 80 countries. Each entry is revised and updated every year and checked by the company concerned to ensure accuracy. The Company Index is cross-referenced with subsidiaries and associates. The Geographical Index lists, in country of operation, the mining, exploration, and development companies and/or their subsidiaries. The Metals/Minerals Index identifies the companies interested in a selected list of metals/minerals.

● *National Symposium on the Availability of Strategic Minerals*, edited by M. J. Jones. London, Institution of Mining and Metallurgy, 1980. 109 pp.

The papers presented at this joint meeting with the Fellowship of Engineering held in London in 1979 include: Definition of strategic materials and the means currently available to the United Kingdom Government to identify strategic sources and requirements: A United Kingdom minerals strategy — the role of Government: Availability of copper, nickel and cobalt: Availability of lead and zinc: Availability of tin and tungsten to British industry: Availability of chromium: Availability of molybdenum: Precious metals: Uranium resources, supply and demand: Considerations that affect the stockpiling of non-ferrous metals: Problems faced by traders: Problems faced by buyers: Chilean role in copper and molybdenum supplies — a supplying country's viewpoint: Approaches adopted by other countries.

### 3. NIM reports

The following reports are available free of charge from the National Institute for Metallurgy, Private Bag X3015, Randburg, 2125 South Africa.

#### Report No. 1941

*The recovery of chromite and platinum from the UG-2 Upper Chromitite Layer of the Bushveld Complex at the Pandora Mine* (first published 10th Mar., 1978).

This report records the results of an investigation into the

recovery of chromite and the platinum-group metals plus gold (i.e., the noble metals) from an adit sample of the UG-2 Upper Chromitite Layer of the Bushveld Complex. The investigation covered gravity concentration for the recovery of the chromite, flotation for the recovery of the noble metals from the whole ore and from the products of gravity concentration, flotation for the recovery of the chromite, and autogenous milling of the ore.

Gravity concentration using a two-stage spiral-concentration circuit with regrinding of the primary spiral tailings gave chromite concentrates assaying between 41 and 42 per cent  $\text{Cr}_2\text{O}_3$  at a recovery of over 80 per cent of the  $\text{Cr}_2\text{O}_3$  content of the ore. About 20 per cent of the noble-metal content of the ore was recovered with the gravity concentrate. Flotation of the whole ore by standard flotation procedures gave rougher concentrates assaying 50 p.p.m. of the noble metals. At that stage, the recoveries of the noble metals were between 78 and 86 per cent of the noble-metal content of the ore, the most important variable being the degree of grinding. Similar results were obtained on the gravity tailings. Flotation of the chromite concentrate resulted in a recovery of 90 per cent of the noble-metal content of the chromite concentrate at a noble-metal grade of 44 p.p.m.

Pilot-plant flotation tests showed that recoveries of up to 77 per cent of the noble-metal content of the flotation feed can be obtained at a concentrate grade of 52 p.p.m. of the noble metals.

Batch flotation tests for the chromite using a two-stage procedure in which the gangue is floated first showed that concentrates with grades of up to 42 per cent  $\text{Cr}_2\text{O}_3$  and recoveries of between 75 per cent and 80 per cent can be obtained. Only 5 per cent of the noble-metal content of the feed was recovered with the chromite concentrate.

Fully autogenous and semi-autogenous run-of-mine milling were shown to be feasible for the production of a feed material suitable for gravity concentration.

#### Report No. 1966

*A mineralogical investigation of ores from the Merensky Reef and their flotation products* (first published 31st Mar., 1978).

This report summarizes the mineralogical investigations that were conducted on ore from the Merensky Reef and its flotation products, in as far as the investigations relate to the beneficiation of this ore.

It was found that approximately 37 per cent of the platinum-group elements are harboured within the base-metal sulphides in these ores, either as minute inclusions or in solid solution, so that physical separation by conventional methods is impossible. This means that, whenever sulphides are lost in flotation tailings, some platinum-group elements are lost with them.

It is recommended that further effort should be devoted to the more effective flotation of the base-metal sulphides. Magnetic separation could be applied to the flotation tailings for the recovery of the magnetic sulphides and of the platinum-group elements they harbour.

#### Report No. 1971

*The effect of open- and closed-circuit operation in the*

*copper-cleaning flotation circuit of a complex sulphide ore* (first published 29th May, 1978).

The effect of open- and closed-circuit operation was investigated in the differential flotation of a complex sulphide ore containing copper, lead, and zinc. In open-circuit operation, copper losses are due to the slow flotation of the slimes. Closed-circuit operation improves the copper recovery by recycling the fines, but a secondary problem can arise in that the grades of the other elements in the concentrate become excessive. This is particularly true of lead, and is due in part to the high ratio of galena to chalcopyrite in the ore. Modification of the regrind circuit while maintaining closed cleaner-tailing operation can reduce this problem.

#### Report No. 2012

*A mineralogical investigation of borehole cores from the Trompsburg Complex* (first published 6th Apr., 1979).

Borehole cores recovered from six boreholes drilled through the rocks of the Trompsburg Complex in 1949 have been examined mineralogically. Much of the core is unlabelled, but identifiable core from the boreholes contains a variety of sulphide minerals in the basic intrusive rocks and the underlying metamorphosed dolomite. The basic intrusive rocks usually contain the assemblage pyrrhotite - chalcopyrite - pentlandite and sometimes pyrite, but in places have suffered hydrothermal alteration and may, in addition, contain linnaeite, violarite, millerite, and pyrite. Small, non-economic concentrations of sulphide minerals are commonly present at the base of the cyclic units.

The metamorphosed dolomite underlying the complex contains a number of rare sulphide minerals including alabandite, tochilinite, djerfisherite, and an unnamed potassium-copper sulphide. These sulphides occur together in places with a spinel of unusual composition that is rich in titanium and manganese. Most of the sulphides present in the metamorphosed dolomites do not appear to have been produced by mineralization emanating from the basic rocks; instead, they are considered to be the result of high-temperature metamorphism of pre-existing sedimentary layers.

No platinum-group minerals were identified during the investigation. The economic potential of the Trompsburg Complex cannot be assessed adequately, since the available borehole cores do not provide sufficient information.

#### Report No. 2038

*The leaching of sphalerite in acidic ferric sulphate media in the absence of elemental oxygen.*

The mechanism of the dissolution of a sphalerite in acidic ferric sulphate media is described. Leaching experiments were conducted on sphalerite concentrate, and the effects of the following variables were investigated: agitation, surface area, temperature, and the concentrations of ferric ions, ferrous ions, and sulphuric acid. Close correlation was found between the rates of dissolution and the measured electrochemical potentials of the leaching solutions, and it was concluded that the reaction is electrochemical in nature.

An empirical mathematical model, consisting of two simultaneous differential equations expressing the leach-

ing rate, was set up and solved by use of a digital computer. The model did not fit all the experimental results, and the reasons for disagreement are discussed.

#### Report No. 2052

*An investigation of the impurities in native gold by neutron-activation analysis.*

Instrumental and radiochemical methods of neutron activation analysis, developed for the determination of major, minor, and trace impurities in native gold, are described. The gold was obtained from Witwatersrand reefs and from deposits in the Barberton area. It was extracted by decomposition of the ore in cold hydrofluoric acid.

Quantitative results are presented for 14 elements found in native gold, and the significance of these elements in relation to the distribution of gold is discussed. The results suggest that there are geochemical differences in native gold from various reefs and deposits.

#### Report No. 2056

*The mineralogy and geochemistry of the copper, lead, and zinc sulphides of the Otavi Mountainland.*

A study of 44 samples from the area revealed that the major primary sulphides, which constitute the bulk of the mineralization, are galena, sphalerite, chalcopyrite, and tennantite. The copper mineralization is concentrated in the Hüttenberg Formation of the Tsumeb Subgroup and in the Nosib Subgroup, and the lead and zinc mineralization mainly in the Berg Aukas, Gauss, Auros, Maieberg, and Elandshoek Formations of the Otavi Group.

Antimony, manganese, and silver were detected in all the samples of galena analysed, and selenium in four deposits. Silver, iron, and zinc were found within tennantite exsolutions in sphalerite. The concentrations of these minor and trace elements are probably too low to affect the economic potential of any of the deposits.

Manganese was also observed in samples of sphalerite, which were found to vary in colour according to their manganese content, being dark red when the manganese content is high and ranging through orange to yellow as the manganese content decreases.

The deposits of the Otavi Mountainland are similar in many ways to deposits of the Mississippi Valley type, and a similar genesis is proposed for the Mountainland. It is suggested that the genesis involved the deposition of sediments and chemical deposits in the Swakop Basin, the leaching of the contained metals from the clay particles by the fluid trapped in the sediments, and the transportation of these metals in brine solutions. Bacterial action resulted in the formation of hydrogen sulphide, which was then trapped in the carbonates and later released when the dolomitic rocks of the area were subjected to folding, faulting, and brecciation. On its release, the hydrogen sulphide reacted with the brine solutions to form sulphide deposits in the fault and breccia zones.

#### Report No. 2058

*An elementary introduction to image analysis - a new field of interest at the National Institute for Metallurgy.*

The Mineralogy Division of the National Institute for Metallurgy recently acquired a Leitz-T.A.S. image analyser. This report gives a simple description of the instrument (which is one of the most sophisticated television-based image-analysing systems available commercially), as well as of some relevant aspects of image analysis and stereology. The report is not directed at the specialist in the field, but at the potential user of the facility who would like to know something about image analysis and the information it can supply.

#### Report No. 2059

*Distributed computer control of industrial processes.*

A communication subnetwork, HYDRA, suitable for use in distributed process-control systems has been designed, and is described here in general terms with the emphasis mainly on how the user sees the system.

The HYDRA network consists of five nodes connected into a loop. The link between nodes is a single, bi-directional, twisted-pair cable, which operates in half-duplex synchronous mode at a speed of 38,4 K-bits per second. Each node contains a node processor and a communications processor. The processors are connected by a shared-memory technique.

Although further work is necessary before the HYDRA network can be used in the field, tests have indicated the following:

1. HYDRA provides secure, error-free communication between nodes;
2. HYDRA is extremely reliable, with a high degree of fault tolerance;
3. the interfacing to HYDRA is simple, involving minimal overheads;
4. the network can accommodate a large variation in system size, i.e., it is highly modular;
5. delays of messages through the network are very short, the average time for a response to be received from a remote node being little more than 200 ms, and
6. it exhibits these characteristics even in the harshest environment.

#### Report No. 2060

*The analysis, by atomic-absorption spectrophotometry, of activated charcoal.*

An account is given of the analysis of activated charcoal for silver, gold, calcium, cobalt, copper, iron, nickel, silicon, and zinc.

The method involves fusion of the sample with sodium perisoc, leaching of the fused material with acid, and determination of the analytes by atomic-absorption spectrophotometry and conventional flame atomization.

The range of determination varied between 40  $\mu\text{g/g}$  and 20 000  $\mu\text{g/g}$ , and the relative standard deviation between 0,002 and 0,09.