

Book reviews

● *Physical coal beneficiation and electricity costs*, by Hugh Mellenby-Lee. London, IEA Coal Research (14515 Lower Grosvenor Place, London SW1W 00EX), 1987.

Reviewer: D.W. Horsfall

If Mother Nature had been more forward looking whilst she tended the primaevial forests and ensured that diluent minerals did not get mixed up with the dying vegetation, the whole business of coal utilization would have been a good deal simpler. Instead of the coal user being confronted by a range of ash contents, he would have had to contend only with the problem of how best to get his ash-free organic-rich fuel into a furnace.

Upgrading of Coal

However, such was not the case, and beneficiation engineers, over the years, developed increasingly ingenious methods of stripping run-of-mine coal of some of its mineral constituents. The extent to which this has been necessary has generally been governed by market requirements, as well as by coal quality. The steady trend, with one exception, has been for the upgrading, or beneficiation, of coal to increase. The growth in the international coal trade has encouraged this trend. Importers look carefully at the cost of importing not only the coal but its incombustible mineral content, and paying freight charges on the latter.

Even in the inland coal trade, the greater the distance of the user from the market, the greater the potential for the upgrading of coal. However, the one exception, the one area of the market remaining relatively immune to the skills of the coal-washing specialist, has been the captive mine-power station complex. The mine is so close to the station that low-cost belt transport is used, and it is frequently thought to be cheaper to transport the coal's mineral content and let it go through the power station's mills and boilers. In South Africa, for example, only coal supplied to stations distant from the coalfields tends to be upgraded (or better grades are mined). Power stations sited at mines burn lower grades of coal, some of which, notably those in the Orange Free State, are the lowest-calorific coals currently being commercially consumed in the country. (Sasol in the Orange Free State also gasifies low-grade coals.)

Coal-based Generation of Electricity

However, as Mr Bob Dylan warned us, the 'times they are a' changin'', and there has been a good deal of comment and research effort on the extent to which the burning of uncleaned coals in power stations might actually incur costs greater than the cost of beneficiation. Not least of the factors causing revised thinking is the menace of acid rain, and beneficiation can reduce the sulphur content of coal. In Germany, for example, all power-station coal is washed. Although most of the debate is elsewhere, notably in Europe and the USA, South Africa's first de-stoning plant at a mine serving a pitsmouth power station was recently opened at New Vaal Colliery, and small-scale tests and studies are also under way. The arguments are complex and 'to be(neficiate) or not to be(neficiate)' tends to depend upon whether you are a preparation engineer or a combustion engineer. So many

and various are the studies that a simple answer to the question 'Does it pay to burn unbeneficiated power station coals?' is virtually impossible.

Onto a view generally consisting, therefore, of chasms and crags, Mr Hugh Mellenby-Lee sheds a neutral but illuminating beam. In his book, he has aimed to classify the studies that have been carried out on coal-based generating costs, the beneficiation approaches that are practicable, and the potential savings or cost increases (for it can work both ways) that result from the beneficiating of coal for power generation. The book is excellent in its objectivity, painstaking in its detailed approach, readable, and well set out. The author does not claim to be able to produce a single and definitive reply to the question; indeed, study of the book shows this to be impossible. However, his analysis of the studies, noting points of commonality and classifying the information, helps anyone seriously interested in the topic to formulate a logical plan of investigation.

In the summary preceding the main text, the general conclusions are as follows.

- (1) Although in some cases the lowest costs result from the burning of uncleaned coals, in most cases at least some degree of beneficiation is desirable.
- (2) It is preferable to design a power station to handle a specific coal of defined coal properties, whether beneficiated or unbeneficiated, and maintain coal within those limits.
- (3) Coal that is out of specification causes a sharp deterioration in performance, and beneficiation may then be necessary to maintain the specification.

Contents of the Book

After a short introduction, the various factors contributing to power-station costs are summarized, data from a number of sources being cited. The factors include transport, storage, handling, pulverized performance, steam generation, thermal efficiency, precipitator/baghouse performance, ash handling, and the cost of flue-gas desulphurization. In South Africa the main problem appears to be that the abrasiveness of the coal affects pulverizer costs; although this is mentioned, it receives less attention than the other factors. Studies relating these cost factors to coal quality are reviewed in the second part of the same chapter. Countries undertaking such investigation are Belgium, Germany, the UK, Australia, and the USA. The author concludes that there is no simple and general relationship between coal quality and costs, and the best way to establish a correlation is to build up a specific computer model.

The next chapter (3) covers the constitution of coal and the extent to which it can be beneficiated. Several types of coal (including South African) are described. Some liberation characteristics, with specific reference to pyrite, are included. Chapter 4 is an excellent summary of coal-preparation processes, with the emphasis on reporting efficiency and costs. Conventional and some developing processes are discussed and, as expected, fine-coal beneficiation (because of the emphasis on pyrite removal after liberation) is well covered. Useful cost figures from different sources are presented, covering plants ranging from

those which carry out simple crushing and screening to those which clean coal of the full size range present with middlings retreatment.

In Chapter 5, the cost analysis of power generation and cost analysis of coal preparation are combined, to give the overall economics. Australian, German, Indian, and US studies are quoted. The author stresses that the studies are specific to the situations described, some cases indicating an increase and others a decrease in costs resulting from the use of beneficiated coal. In the concluding chapter, the author comments that there is no doubt about better performance being obtained by the burning of cleaner coal, but the costs incurred in obtaining that cleaned coal are not necessarily lower than the saving in power-generation costs. Further to the author's conclusions, it might be added that the case for the beneficiating (as distinct from the de-stoning) of power-station coals in South Africa is not strong. The intergrown nature of the coal means that a fair proportion of low-grade coal must be discarded to give a meaningful improvement in calorific value. But the spread of opencast mining, with its potential for leading to the inclusion of stone bands with run-of-mine coal, may justify the removal of some deleterious non-combustible material.

Opportune Appearance

The appearance of this publication at this time is therefore opportune. It can be recommended to anyone engaged in beneficiation studies, especially for the logical way in which the approach to a suitable model is delineated. And logic in this case is important: some years ago, from a study based on the Escom annual report, I was able to prove (statistically) that Escom would be able to improve their thermal efficiency by burning pure stone. Perhaps, on reflection, Mr Mellenby-Lee has missed something?

● *Smelting and Refining Operators' Symposium*. The Australasian Institute of Mining and Metallurgy (P.O. Box 310, Carlton South, Victoria 3053, Australia), 1986. \$A 20.00.

Reviewer: R.D. Beck

This volume contains the papers presented at a symposium, which, as indicated in the title, was aimed at the practical metallurgist. This aim was met, since most of the papers describe practical work rather than fundamental studies. The papers deal with five metals and are arranged in four sections: nickel, lead and zinc, aluminium, and copper.

Each of the first three sections starts with a keynote address. D.R. Weir reviews the nickel market and concludes that the construction of plants for the treatment of lateritic ores has been beset by increasing energy and capital requirements, while at the same time the predicted increases in metal prices have not materialized. The formation of an institute to improve marketing and environmental research is one of the industry's answers to its troubles. D.H. Ward reviews the threats to the future of Australian lead-zinc smelters and refineries, concluding that it is now time to start to understand the very complex economics and technical environment in order to pose the right questions. Only then can appro-

priate technical responses be made. I.W. Reid provides an overview of aluminium production, outlining the major technical advances that have been made to improve the basic Hall-Heroult process.

Matters concerning energy usage form the subject of the greatest number of papers. The optimization of steam and energy usage and the technological innovations introduced to reduce costs are presented for two nickel refineries. Then, savings in energy, maintenance, and hydrogen are demonstrated up to pilot-plant scale for a process for the hydrogen reduction of nickel oxide in a vertical shaft reactor. Again, power savings are the theme of a paper describing the removal of arsenic from copper electrolytes by a solvent-extraction route. Improvements in the operation of a Herreshoff roaster for the reduction of lateritic nickel- and cobalt-containing ores are described in yet another presentation. In a paper that gives an assessment of copper tank-house technology, it is proposed that many widely accepted conventional practices require review. Other papers deal with energy conservation in a copper tank house through the insulation and covering of cells, and energy reduction in sinter plants through operation with pre-heated air and through changes in the design of cooling tables and the optimization of moisture content.

Process control is covered in several papers. One gives details of the hardware and software design for the control of potlines in the aluminium industry. Another, a general paper, reviews the decisions required and items to be considered in the selection of process-control computers and associated equipment. A similar paper describes distributed architecture with microprocessor-based controllers, data acquisition, and VDU operator stations.

Several papers deal with new processes. One paper covers a two-stage iron-precipitation process for zinc-plant solutions to remove increased levels of arsenic and antimony. Another describes the chemical enrichment of low-grade gold and silver concentrates. Highly intensive smelting techniques are covered in a paper describing the Siros melt Process and top-blown rotary concentrators for chemical optimization and flexibility. The Siros melt Process also features in an example of a process-evaluation technique that can rapidly advance the understanding of pyrometallurgical operations by the use of a team approach and a wide range of experiments.

The problems of corrosion and wear are covered in papers discussing the chloride problems associated with stainless steel and the use of new alloys in the non-ferrous metal industry. The type of failure and its influence on the operation of major wear parts in a continuous copper-rod plant are given with successful and proposed solutions.

Miscellaneous topics are covered in papers dealing with dewatering, firstly with the use of chemical aids for aluminium hydrate, and then with the Larox filter for lead-zinc concentrates. The debismuthizing of lead at the BHAS lead refinery in Port Pirie is also described.

The final paper is the Sir George Fisher Lecture, which was presented by Professor W.G. Davenport on direct copper smelting. This lecture gives the history and current status of the process, and provides reasons as to why it has not been adopted industrially.

In essence, this Symposium covered a wide variety of topics and would have been worth attending.

● *Aluminium-lithium alloys III*, edited by C. Baker, P.J. Gregson, S.J. Harris, and C.J. Peel. London, The Institute of Metals, 1986. 640 pp. US\$ 79.00 (Members: US\$ 63.20).

Reviewer: A.R. Harding

This volume records most of the 66 papers and 16 posters presented at the Third International Conference on Aluminium-Lithium Alloys, which was held in Oxford (England) in 1985. It gives a comprehensive and detailed view of progress in the development of a new family of aluminium alloys, and is usefully divided into two sections of approximately equal length. Book I assembles the application-oriented contributions, covering product objectives, fabrication, heat-treatment, and utilization properties, while Book II contains the supporting investigations of microstructure-property relationships.

Only one paper is concerned with the supply of raw materials. This reviews the reserves and resources of lithium in the Western World, and gives assurance that there is a massive surplus over current or any likely demands. However, there is no indication of whether it will be possible to meet the expectations for cheaper high-purity metal for the new alloys.

Aerospace Applications

Interest in aluminium-lithium alloys has been rekindled since the 1950s by airframe constructors seeking to reduce operating costs by the replacement of conventional alloys with new materials of similar strength, but greater stiffness and lower density. Aluminium-lithium alloys were seen to offer the prospect of achieving the replacement without the need to change well-established design and manufacturing techniques, which a move to composite materials would entail. This scene was set for the Conference by the first paper of Book I, which outlines the various interacting economic and technical factors involved in the choice of new materials for airframe manufacture: weight reduction, material cost and availability, material properties and their consistency, design opportunities and ease of modification, manufacturing cost, etc.

The identification of well-defined material objectives by the aerospace industry clearly served to unify and direct national development efforts so that material producers, manufacturers, government laboratories, and universities co-operated from an early stage. As a result, a few promising aluminium-lithium alloys were quickly selected, and now most of the work is concentrated on the development from these of semi-fabricated products to replace existing airframe components. The papers that follow, contributed from RAE Farnborough (UK), and from major material producers in France, the UK, and the USA, indicate the current status of each country's development programme, and reveal that the alloys chosen show great promise of meeting all the initial requirements. Already, the main problems of casting difficulty, oxidation, and embrittlement that inhibited the production and use of aluminium-lithium alloys in the past seem to have been largely overcome. Composition specifications have been registered, fabrication routes explored, and ingots fabricated on production equipment, and, in some cases at least, material has been supplied for the trial manufacture and evaluation of components.

Processing and Property Development

Subsequent papers in Book I are more specialized, dealing with particular aspects of processing or property development. Several of them centre on the achievement of working and heat-treatment practices, and the associated microstructure control, needed to obtain the combinations of strength and toughness to meet the target specifications. Occasional reference is made to the important contribution that the treatment and casting of molten metal have made to the progress of development programmes, but nothing is revealed of how a safe and economic casting practice has been established for the wrought alloys. Apart from one paper on grain refinement and one on a casting alloy, attention to cast structures is devoted to rapid solidification, the immediate interests being the possibilities of raising the lithium concentration or of introducing dispersoids in order to reduce the concentration of slip through coherent precipitates (a problem for the ductility or toughness of certain alloys noted by several contributors). There are also reports of mechanical alloying experiments with similar possibilities in mind for the modification of composition or microstructure. A comparison of three different techniques of producing more highly alloyed material (powder atomization, mechanical alloying, and melt spinning) could not be included in Book I and appears as an Appendix at the end of the volume. The remaining papers in Book I report on other end-use properties of the alloys: crack propagation in fatigue and fracture toughness tests, forming, super-plasticity, welding, adhesive bonding, surface treatments, oxidation, and corrosion.

Microstructural Features

Book II contains contributions that complement and extend those in Book I, since they are concerned with an understanding of the microstructural features of the alloys and the factors affecting their evolution. In this part, the purpose of the editors to arrange the papers into groups of related topics has proved particularly effective. The excellent summary provided as a Foreword compensates for the absence of an index, and enables the reader to scan the contents and, guided by page numbers, quickly identify and locate papers of immediate interest. The topics fall into two groups. The first covers the application of conventional microscopy, X-ray, electron-beam and thermal analysis, SIMS, and electron energy-loss spectroscopy to the study of the nucleation, development, composition, and structure of aging precipitates and of matrix and grain-boundary precipitates. The second group is concerned with compositional and microstructural factors that modify deformation characteristics, and contains studies of elastic moduli, strengthening mechanisms, recrystallization, texture formation, and elevated temperature properties.

An Interesting, Stimulating Volume

Unfortunately, there is no record of the discussion on the papers. However, again one of the editors has added a valuable item, in this instance by providing a summary of the conclusions of the Conference and the current status of aluminium-lithium alloy development. This has been done in the form of two pages of clear statements under the headings of 'basic studies', 'properties', and 'production', listing in each case where there is under-

standing and where there is need for more work.

Altogether, this publication has a clear, uniform format and a high standard of production and printing, although there are page-to-page variations in print density, and the now-common expedient of photographic reduction of the authors' typescripts results in very noticeable differences in the readability of the text of individual papers, depending on the particular typeface employed. The systematic reader intent on working steadily through Book I should be forewarned that, in order to avoid delays in production, difficulties with some of the illustrations were overcome by the incorporation of corrected and improved versions in an Appendix inserted between Books I and II.

No doubt, specialists in aluminium alloys will already have this volume at hand, and will experience no difficulty in finding immediately what they need by way of reminder and reference in the somewhat daunting mass of information in its many pages of text and illustrations. However, it is evident that the technical editors and the production staff have made considerable and commendable joint efforts to provide guidance for the more general reader who, with the assistance of the forewords, the list of papers, the author index, and the final summary, can pick a way through the 70-odd contributions, all of which have items of interest and stimulation to offer to anyone concerned with alloy development.

- *Carbon in pulp technology for the extraction of gold.* Kalgoorlie (Australia), Australasian Institute of Mining and Metallurgy.

Reviewer: R. Graham

This book consists of the papers that were presented at a seminar arranged by the Perth and Kalgoorlie Branches of the Institute from 13th to 15th July, 1982, and a symposium arranged by Murdoch University on 12th July, 1982.

The object of the seminars was to promote a forum in which operators could discuss the up-to-the-minute state of the technology. Further developments in this field have taken place in the past five years, and readers should bear this in mind when perusing the papers.

The volume is divided into six sections: an opening address, introduction, and sections on plant design, plant operations, other aspects of gold processing, and the Murdoch University Symposium.

In his opening address, Woodcock provided some history on the use of activated carbon for gold recovery, listed applications of the carbon-in-pulp (CIP) process, and mentioned current problems (these have been largely addressed and solutions found in recent years). He concluded by stating the potential of CIP in the treatment of gold ore owing to attractive operating and capital costs.

In the Introduction, Muir, Laxen, Filmer, and Gupta each presented a paper that described the chemistry and adsorption kinetics of the CIP process and included such aspects as the effects of foreign ions and pH on adsorption, various elution techniques, and electrowinning.

Six papers dealt with aspects of plant design. De Ment and King provided an economic study comparing CIP with zinc precipitation (an actual CIP plant and a hypothetical zinc plant). The results indicated an overall

economic advantage for CIP for five different gold-solution grades from 1,7 to 13,7 g/t. Couche examined economic aspects of CIP plant design, and demonstrated that economics favoured short retention time, high gold loadings, and mechanically agitated, draft-tube reactors. Lloyd and Sehic described test and flowsheet-development procedures for CIP evaluation and design. Griffin and Costello presented a patented process for the elution of metals from loaded activated carbon using methanol as the desorbing agent in a fractionating column. Hartzog described a method for establishing design criteria and translating them into a workable plant design. Shaw and McDonough discussed the design of agitators for CIP and the relative merits of an open-tank and a draft-tube circulator, the latter seeming more attractive.

Under the section heading 'Plant Operations', the first two papers (Davidson *et al.* and Greenhalgh *et al.*) relate respectively to the selection of activated carbon and process equipment for CIP applications. Significantly, they concluded that the first generation of high-tonnage CIP plants revealed definite shortcomings in equipment performance and materials of construction.

Two CIP operations in Western Australia were described by Sceresini and Webb. In a 500 kt per month CIP plant at Kambalda, the design production rates were achieved and maintained within three months of start-up. Flexibility was incorporated into the plant design, which had to cater for a high nickel content in the CIP feed and difficult clays in some areas. Australia Mining N.L. processes sand and slime tailings using CIP and Zadra elution. Interstage screening of coconut-shell carbon was a problem. The fine apertures became fouled up by vegetable matter in the pulp. Extruded carbon was therefore used with coarser screens. The use of activated carbon in heap-leaching operations was described by Geldard and O'Brien. At the Haveluck gold deposit (25 kt per month), ore crushed to minus 100 mm is screened at 0,8 mm, the coarse oversize is heap-leached (gold recovery by carbon-in-solution—CIS), and the fines are subjected to CIP. Coconut-shell carbon was used for the CIS.

Again, extruded carbon was used for the CIP because it proved to be harder and to have acceptable activity. O'Brien presented an agglomeration pre-treatment of ore in the heap leaching of gold and silver, used when the material contains critical amounts of fines or clay. An economic justification of agglomeration was presented.

Other aspects of gold processing were discussed in papers by Carr, Donald, and Freemantle. These included topical environmental issues such as clearing during gold prospecting, mine dewatering, and tailings disposal. The role of the Perth Mint was described, refining being carried out by the Miller Process. The financing of smaller resource projects was discussed related to their specific problems.

The Murdoch University Symposium consisted of four papers. Hosking reviewed analytical methods for the determination of trace amounts of gold in ores and process streams, and Avraamides reviewed prospects for alternative leaching systems for gold. While cyanide remained the main choice, likely alternatives were acid chlorine, acid thiourea, and ammoniacal thiosulphate. Ruane compared the Zadra, AARL, and organic procedures for the desorption of gold from activated carbon

in an elution column. He concluded that the AARL procedure was currently the most effective. Finally, Fleming described some aspects of the chemistry of CIP and resin-in-pulp processes, and a kinetic model that enables the number of stages in a CIP plant and the amount of carbon in each stage to be calculated.

In retrospect, the papers well reflect the state-of-the-art of CIP *at the time of presentation*. While the fundamental theory still holds, the process equipment and the process optimization have developed markedly.

- *Rock engineering and excavation in an urban environment. Review of proceedings of the conference held in Hong Kong from 24 to 27 February 1987 and published by The Institution of Mining and Metallurgy.* London, Institution of Mining and Metallurgy, 1987. £42.

Reviewer: T.R. Stacey

This book contains 38 papers, with associated discussions and contributions covering a variety of topics in the rock-engineering field. They are the work of authors from 14 different countries. In addition, there is an introductory keynote address, given by Dr E. Hoek, summarizing developments in practical rock mechanics over the previous 25 years.

It is somewhat unusual for the proceedings of a conference to include a wide range of technical rock-engineering aspects while at the same time maintaining a coherent common theme. This was achieved in the Hong Kong conference, the common theme being the urban environment, as given in the title. The variety of rock-engineering aspects dealt with includes rock-slope stability and stabilization, tunnels, underground caverns, foundations, shallow undermining, blasting, site investigation, and quarrying. The most common topic is slope stability, with no fewer than 13 of the papers concentrating on the subject. This is to be expected since Hong Kong, the venue for the conference, is renowned for the instability of its slopes. It is therefore rather disappointing to note that, although many of the slopes dealt with in the papers would be ideally amenable to stability evaluation using probabilistic techniques, only one paper, from South Africa, actually describes a case study in which this method was used. Nevertheless, it is interesting to see the scale of the rock cuts required in Hong Kong to provide platforms for the construction of high-density housing developments. These developments are often located very close to the toes of slopes, and this situation gave rise to two interesting papers—the potential effect of boulders moving on slope surfaces. One paper deals with the design of a boulder catch fence, and the other with the design of a rock trap at the toe of a cut. The latter was based on the physical release and trajectory monitoring of 13 000 boulders!

Papers dealing with remedial works to unstable slopes do not often appear in the literature, perhaps because they are related to a failure rather than a success. It is gratifying that the proceedings include several papers dealing with remedial work to unstable slopes. These deal with minor localized measures, as well as with major works to large slopes.

Blasting is often a sensitive issue in an urban environment, and it is not surprising that many of the papers

deal with this subject. Numerous permutations are included—the effect of surface blasting on existing tunnels, restriction on surface and underground blasting as a result of the proximity of surface structures, blast design considerations, and blast vibration monitoring. An interesting aspect is that the papers dealing with blasting vibrations and restrictions come from eight different countries.

Blasting restrictions have a significant effect on construction efficiency, which is particularly relevant in the restricted areas of Hong Kong, and there are several papers that include this topic in relation to underground and surface excavations.

Site investigation is dealt with in several papers, and it is interesting to observe the extent to which geophysical techniques were used.

In summary, the proceedings of this conference include a collection of papers that will be very useful to those involved in urban development. It is a worthy addition to any geotechnical library.

- *Uranium deposits of Canada*, edited by E.L. Evans. Quebec, The Canadian Institute of Mining and Metallurgy, Special Volume 33, 1986. 324 pp. Canadian \$40 members, \$50 non-members (plus \$3 for postage and packaging).

Reviewer: M.S. Toros

This special volume consists of twenty-nine contributions preceded by an introduction by D.S. Robertson relating uranium exploration and mining history in Canada, and grouped into six chapters: Early Aphebian conglomerate hosted deposits (5 papers); Proterozoic deposits hosted by folded, metamorphosed rocks (3); Hudsonian classical vein deposits (3); Saskatchewan unconformity-associated and sedimentary-hosted deposits of Helikian age (12); other Helikian unconformity-associated and sedimentary-hosted deposits (4); and Phanerozoic deposits (2).

The present knowledge of Canadian Proterozoic quartz-pebble conglomerate-type deposits is summarized in a review by J.A. Robertson that provides a regional background to the subsequent four papers dedicated to specific deposits of this type. In the second chapter, uranium deposits in pegmatites of the Bancroft area and in Early Proterozoic tuffaceous (Kitts) and rhyolitic (Michelin) rocks of the Allik Group are described, and their genesis is discussed. A volcanogenic origin is favoured for the uranium deposits in the Allik Group.

The papers dealing with the Beaverlodge complex veins point to a possible cogenetic origin of the mineralization with the unconformity-type deposits. Although the strong structural control is emphasized, the authors seem to favour a supergene origin. The next two chapters are dedicated to recognized unconformity-type deposits (named here unconformity-associated). Once more, the same major deposits are described (one paper is a reprint and two are reproduced from Special Volume 32 with insignificant modifications), and little interesting 'new' information is offered. Disappointingly, no editorial overview is offered, and no attempt is made to outline the generalized features of the deposits (a table like the one by L.S. Beck for the Beaverlodge District would have been appreciated). A brief description of the Rexpar fluorite and uranium deposits, believed to be of volcano-

genic origin, and a more consistent contribution by D.R. Boyle on basal-type uranium deposits in south-central British Columbia close the volume.

The carefully documented information and thoughtful interpretations provided mostly by professional geologists involved in the Canadian mining industry make this volume a valuable addition to the libraries of geologists engaged in uranium exploration in other parts of the world with similar geologic environment.

The editor states: 'Canada has been in the forefront in the exploration for and development of uranium deposits and it is appropriate that a volume dealing with all types of deposits found in Canada should be produced by the CIM'. Uranium explorationists will certainly endorse this statement, but Special Volumes 32 and 33 are marred by the number of repetitions they contain, for which it is difficult to see any necessity.

- *Iron control in hydrometallurgy*, edited by J.E. Dutrizac and A.J. Monhemius. Chichester (England), Ellis Horwood, 1986. 794 pp. £69,50.

Reviewer: C.J. van Niekerk

These 41 papers represent the proceedings of an international symposium on iron control in hydrometallurgy, which was held in Toronto during October 1986. The proceedings are produced as a hardbound book of a very high quality, and the same high standard of type is used in all the papers.

The book consists of seven parts:

- Part I (Chapters 1 to 5) on 'Process selection for iron control'
- Part II (Chapters 6 to 11) on the 'Chemistry of iron control'
- Part III (Chapters 12 to 17) on 'Solvent extraction processes for iron control'
- Part IV (Chapters 18 to 23) on 'Fundamentals of iron precipitation'
- Part V (Chapters 24 to 29) on 'Pickle liquor treatment'
- Part VI (Chapters 30 to 35) on 'Precipitation processes for iron'
- Part VII (Chapters 36 to 41) on 'Impurities, residues and the environment'

The book starts with a well-written paper that gives a mineralogical overview of iron control in hydrometallurgical processing. This paper covers 36 pages and lists 141 references. The other papers in Part I describe various industrial processes and a new approach for iron control in the roasting of zinc concentrate.

The papers that follow describe the chemistry of iron control in sulphate, as well as in chloride, solutions. Various solvent-extraction processes are also described for the separation of iron from base metals in these

solutions.

Papers on the fundamentals of iron precipitation deal with, among others, such topics as 'Factors that affect the kinetics on nucleation and growth and the purity of goethite precipitates produced from sulphate solutions', 'Precipitation of jarosite from manganese sulphate solutions', and 'Selective iron removal from process solutions by phosphate precipitation'.

The papers on the treatment of pickle liquors are restricted to specific processes, and include methods such as those using a fluidized-bed reactor or resin, and various papers describing the treatment of pickling liquors for stainless steel.

The last two parts contain papers describing iron-removal processes as applied at various plants. The book ends with 'A review of the environmental considerations of the disposal of residues from selected hydrometallurgical processes'.

This book can be regarded as a standard reference on the subject, and will be of benefit to metallurgists and industrial chemists in general and, more specifically, to those working in the field of base-metal hydrometallurgy.

- *Tunnelling into Colditz—a mining engineer in captivity*, by Jim Rogers. London, Robert Hale, 1986. £11.95.

Reviewer: J.D. Austin

This is not the usual book one is asked to review for a technical journal, but neither is Jim Rogers the usual author. He is a professional mining engineer who is a Fellow of this Institute and a Past President of the Institution of Mining and Metallurgy in London.

Jim Rogers qualified before the war and had mining experience in Yugoslavia and on the gold mines in South Africa. By some miracle, the army placed him in a unit where his skills could be used, but his active military career was cut short by his capture in France in May 1940.

This book covers the period from when he was captured until Colditz was relieved by the American forces in 1945. Initially he was sent to Laufen, where he was consulting mining engineer, mine manager, mine overseer, and miner for a 175 ft tunnel, which was discovered just 15 ft before freedom. As a result, he was sent to Colditz. This first tunnel was in loose ground and was driven by spiling. Most of it was still open in 1980, when it was exposed by building operations. At a later stage, he was transferred to Spangenberg, where he was involved in a hard-rock tunnel. For the second time he was sent to Colditz—hence the title of the book.

The technical description of the mining operations for the Laufen tunnel is very interesting, but the book is far more than that. It is a very readable account of life as a prisoner-of-war, covering the bad, the boring, the ingenious, and the humorous.