

Book news

1. Book reviews

● *Perspectives in metallurgical development*. London, The Metals Society. 338 pp. £29.

Reviewer: John V. Bee

The city of Sheffield can justifiably be regarded as the birthplace of ferrous metallurgy as we know it, and the University of Sheffield has now been at the forefront of metallurgical teaching and research for a hundred years. Thus, this book which reproduces contributions to the Centenary Conference of the Department of Metallurgy, must be of special interest to all metallurgists.

This review cannot provide an adequate account of all the papers included in this volume, but attempts to convey something of their scope and tenor.

The session concerned with historical metallurgy presented not only the development of the Sheffield Metallurgy Department but of Sheffield itself. Reading these papers is like browsing through the 'Who's Who' of metallurgy. It is clear that Sheffield has made an incalculable contribution to the progress of metallurgy as a science and as an industry.

More-fundamental contributions were presented in the session committed to Extraction and Process Metallurgy. These included a review of the existing knowledge on some aspects of the physical chemistry of ferrous process metallurgy, the kinetics of the reduction of oxides from slags, the role of calcium, magnesium, and rare-earth additions in ferrous ladle metallurgy, the structure of fluxed sinter, and the process limitations of ESR and VAR for high-quality alloys. An important observation was made by Baker *et al.* in their paper on high-quality steelmaking: 'Steelmakers are being pressed to produce steels to meet more demanding requirements, not only to preserve traditional markets against competitive materials, but also to meet new engineering and technological demands'. This requires both tighter control of existing processes and procedures, and new processing steps. Former 'specials' must now be produced in bulk quantities, and the trend is to ever-increasingly stringent specifications.

In 'Solidification Processes', the contributions provide a good balance between theory and practice. The modelling of solidification processes is an increasingly important aspect of modern metallurgy, and this is considered in terms of the computer-aided design of castings. The application of heat-transfer models to continuous casting and a physical model for thick-section low-alloy steel welds are also described. On a more practical note, graphite-morphology control in cast iron is discussed in terms of the mechanisms of crystal growth, and the surface quality of continuously cast steel in terms of the heat-transfer characteristics of the casting powder. Of particular interest is the 'design and development of steel castings for off-shore applications'. While the use of steel castings has generally declined over the past thirty years owing to the improving technology and economic advantages of weld fabrication, the particular benefits of castings (such as cost and resistance to fatigue) have led to completely novel applications in hostile environments. This provides the foundry industry with exciting oppor-

tunities for the future. The new technology of 'Rapidly Solidified Alloys' is also presented with reference to both amorphous and micro-crystalline structures, with a further contribution on the structure of liquid metals.

'Microstructural Studies' reviews a broad range of materials. The transformation of austenite to ferrite is discussed in detail, together with the influence of structure on the properties of high-strength low-alloy (HSLA) steels. The kinetics of the growth of gamma precipitates in a nickel-aluminium alloy and the homogenization of single-crystal superalloys are also described. Returning to HSLA steels, their evolution is chronicled for several applications, and specific data are provided on the effect of titanium on controlled rolled-plate properties. A brief review is also presented on the principles of physical metallurgy that influence the structure and properties of different types of stainless steel.

'Working and Forming' again considers a broad range of processes from the computer modelling of hot working, through superplasticity and isostatic pressing, to metal cutting and one hundred years of tool material development.

The section 'Fracture and Fatigue Processes' includes an excellent review of the developments in the field of fracture mechanics. It is interesting to note the fundamental changes in the attitude of engineers, which has established quantitative design procedures to combat fracture and fatigue failures in service, and the early differences between the 'metal physics' and the 'metallurgical' schools in their approach to fracture and fatigue. Today 'mutual understanding and confidence between the engineer and the metallurgist are arguably greater in the field of fracture and fatigue than in any other'. Specific topics considered in detail include developments in fracture mechanics and NDT related to the assurance of the structural integrity of nuclear pressure vessels, ferritic steel-weld metal microstructures and toughness, fracture control in large-diameter pipelines, creep of stabilized stainless steel at low stresses, and plastic deformation and fracture of a two-phase alloy under compressive loading.

In 'Corrosion and Environmental Effects', both high-temperature oxidation and the stress-corrosion cracking of steels are reviewed. In addition, the potential and development of stainless-steel coatings for corrosion protection is discussed. It is concluded that ternary chromium-nickel-iron alloys, rather than a true stainless steel, would be used for thin deposited films, while stainless steel itself would be employed for thicker coatings produced by cladding or spraying.

'Future Developments in Metallurgy' addresses only alloy development in non-ferrous metals. Nevertheless, it is clear that there are widespread opportunities, particularly in the micro-electronics and communication industries. Special mention is made of magnetic alloys, amorphous metals, surface engineering, and ultra-fine filamentary composites. From this it is concluded that, 'industrialists need to seize the chance to exploit the often unique combination of properties in terms of marketable products'.

It is a pity that the contribution regarding developments in ferrous metallurgy is not included in this volume. In that presentation at the Conference, a fascinating scenario

was proposed for the steel industry in 2000. General integrated steelworks were seen as being replaced by specialized 'one product' integrated steelworks. In addition, raw materials for these plants would be semi-imported from low-cost primary steelmaking countries. Thus, we may see the emergence of truly international steel industries.

Although this review is necessarily superficial, with the more-detailed comment restricted to the papers reflecting the reviewer's own interests, it is hoped that some of the outstanding scope and breadth of the papers appearing in this volume have emerged from this review. This volume provides a fascinating insight into the past and an excellent summary of the state-of-the-art in many metallurgical fields, and points to many exciting possibilities in the future. I strongly recommend this book to all metallurgists, academic or industrial.

● *Mechanics of oil shale*, edited by K.P. Chong and J.W. Smith. London, Elsevier Applied Science Publishers Ltd, 1984. 603 pp. £75.

Reviewer: R.W.O. Kersten

Although this book may not be of interest to South African mining engineers, the manner in which the data are presented could be interesting and instructive in mining in South Africa and in other fields of prospecting.

The editors have collated the available data on oil-shale mining, since it appeared that different companies had investigated only portions of the entire process and, when confronted with an integrated operation, had found problems that they had not considered at all.

The first two chapters deal with the sedimentological environment and how this affects the recovery process, as well as giving a historical background of the work done over the past forty years.

A chapter on the continuum theory of rock mechanics by Chen presents a reasonable comprehensive introduction to the rock mechanics aspects that set the stage for the discussions in subsequent chapters.

The sampling of oil shale, some common types of analysis, the determination of fractures and joints, and their relationship to *in situ* stresses are discussed by Dana.

The next two chapters deal in detail with the mechanical characterization of oil shale, the influence of stratigraphy, and statistical analysis. Details are given of test techniques and methodology to determine the stiffness, tensile strength, creep behaviour, and compressive strength of the rock generally found in oil-shale deposits. General statistical and distributional characteristics, together with correlations between 29 engineering properties, are given by Chong and Bondurant.

The bulk of the book deals with fragmentation, which forms the subject matter of the next five chapters. The details discussed are the influence of stratigraphy on explosive fragmentation; model tests to show the process of fragmentation in hard rock; surface uplift blasting to facilitate *in situ* reporting; and the dependence of rock fracture and fragmentation on strain rate. One chapter deals with *in situ*, open pit, underground, and modified *in situ* mining, with reference to explosive, drilling, and blasting practices.

The static and dynamic mechanical properties of oil shale exhibit considerable temperature dependence, and

its strength and acoustical velocities decrease with increasing grade and increasing temperature. These and other aspects are discussed in the last chapter.

2. Recent publications

● **CANADIAN MINERAL POLICY SECTOR.** Metallurgical works in Canada. Primary iron and steel 1984. *Mineral Bulletin* MR 203. Ottawa, Canadian Government Publishing Centre, Supply and Services, 1985. \$6.00.

This publication lists in detail the facilities, productive capacities, products, and other data of companies that comprised the primary iron and steel industry in Canada at 1st January, 1984. There are also separate sections on the steel pipe and tube industry, and on the iron powder and ferrite industry.

● *Tin and its uses* no. 143. Greenford (England), International Tin Research Institute, 1985.

This issue contains articles on tinsplate aerosol containers, the Third International Tinsplate Conference (London, October 1984), the toxicology of tributyl/tin compounds, solder pastes for electronics, and the use of liquid tin as a solvent metal.

● *Mining 1985*, edited by Diana Russell. Harlow (England), Longman Group Ltd, 1985. 540 pp. £46.

This volume, a Financial Times International Yearbook, presents detailed information on the activities and financial performance of over 700 companies across the world involved in the mining, production, and processing of minerals and ores. In addition, the data supplied in its various tables and other sections offer the user a broad view of the industry. Three full indexes give easy access to the facts and figures.

The following books are available from CRC Press, Inc., 2000 Corporate Boulevard N.W., Boca Raton, Florida 33431, U.S.A.

● *Inorganic ion exchange materials*, edited by A. Clearfield. 304 pp. \$100.

The compounds described in this volume show promise for use as catalysts or catalyst-supports, solid electrolytes, membranes for desalination, separation of radioisotopes, radioactive waste-disposal sorbents for gas chromatography, and other special uses. This volume is a collection of the available pertinent information for scientists in the many diverse fields related to the potential applications of these materials. Included for each material or group of materials are synthetic procedures, characterization of products, structure, ion-exchange applications, and recommendations for future work.

● *Polyurethane foam sorbents in separation science*, by T. Braun. \$80.

The synthesis, properties, and applications of polyurethane foam and open-pore polyurethane foam are extensively reviewed. This volume is a broad overview on the preparation, effect of synthesis conditions on properties and compatibilities of the sorbents, analytical applications (gas and liquid chromatography and collection and concentration methods), and miscellaneous applications (removal and recovery of various organic compounds from waste water).

- *Advanced particulate morphology: theory and practice*, by J.K. Beddow and T.P. Melloy. 208 pp. \$79.

Principal developments in this new, rapidly evolving field are covered in detail, beginning with a description of how particle shape is transformed into a number set by Walsh or Fourier analysis of the particle silhouette data. Also discussed is how coefficients can be summarized to give an economical, position invariant, universal signature.

- *CRC handbook of atomic absorption analysis*, edited by A. Varma. 2 vols: vol. I \$114, vol II \$102.

This desk-top reference enables a scientist to find the most reliable and sensitive methods of atomic absorption for a given analytical problem. Each chapter is devoted to one element or similar group of elements. After a general description of standard solutions, instrumental parameters, and inferences, each chapter gives an exhaustive list of literature references. The scientist then locates references to his particular interest using the author and/or subject indexes. (Subject indexes are arranged by determination, determination in designated materials and solutions, general topics, and interferences.) The appendices include a glossary lists of manufacturers of equipment, accessories, and various types of cathode lamps; and a list of chemical suppliers.

- *CRC handbooks of inorganic electrochemistry*, edited by L. Meites, P. Zuman, E.B. Rupp, and A. Narayanan.

The electrochemical behaviour of inorganic substances, including the complexes of metal ions with organic ligands, are comprehensively covered in these volumes. Thirteen tables are used to present data on the elements in alphabetical order according to their chemical symbols.

Vol I (Ag-Co): The elements Ag, Al, As, Au, Ba, Be, Bi, Br, C, Ca, Cd, Ce, Cl, and Co are covered in this volume. Each table is preceded by a description of contents, its organization, and the manner in which the element can be used. 512 pp. \$92.

Vol II (Cr-Er): Provides ready access to information such as electro-chemical data, stripping, voltammetry, ligands, and constituents of supporting electrolytes for the elements Cr, Cs, Cu, Dy, and Er. Tables in this volume are in the same format as in volume I. 560 pp. \$92.

Vol III (Eu-Mg): Deals with the ions and compounds of the elements Eu, F, Fe, Ga, Gd, H, Hf, Hg, I, In, Ir, K, La, Li, Lu, and Mg. The tables include the same information for each element as the previous volumes: electrochemical data, structural formulas, courses and mechanisms of half-reactions, stability constants of complexes, substitution-inert compounds, nonmetallic compounds and elements, stripping voltammetry, ligands and constituents of supporting electrolytes, supporting electrolytes, solvents, techniques, indicator electrodes, key to literature citations, and an author index. 488 pp. \$90.

3. Mintek reports

The following reports are available free of charge from the Council for Mineral Technology, Private Bag X3015, Randburg, 2125 South Africa.

- **Report M169**

The preparation of three South African coals for use as reference materials.

This report describes the preparation, analysis, and certification of three South African coals as South African reference materials (SARMs). The materials are designated SARM 18, SARM 19, and SARM 20.

Approximately 150 kg of each coal was prepared. Certified values were assigned to 29 elements for SARM 18 and 35 elements for each of SARM 19 and SARM 20. The analytical data, which were obtained by a wide variety of analytical techniques, were supplied by 28 laboratories in 10 countries.

Report M190

The preparation and certification of a South African phosphate concentrate for use as a reference material.

This report describes the preparation, analysis, and certification of South African Reference Material (SARM) 32.

The material is a phosphate concentrate from the Phalaborwa deposit, and was supplied by the Phosphate Development Corporation Ltd (Foskor). Eighteen laboratories in eight countries used a variety of analytical techniques to provide the analytical results.

Report M191

The agglomeration of fine material for bacterial heap leaching.

The report details an investigation into the preparation of agglomerates that can withstand a bacterial heap-leaching environment.

Numerous organic and inorganic binding materials were assessed for their ability to generate agglomerates that retain their competence under conditions of high mass loading and low pH. Such requirements appear to be fulfilled when calcium hydroxide and dilute sulphuric acid are used in the preparation of the agglomerates to yield a reinforcing internal matrix of calcium sulphate.

● Report M197

A computer programme to monitor the performance of an X-ray-fluorescence spectrometer.

A BASIC computer programme has been developed that measures the long- and short-term stability of an X-ray spectrometer and operational errors (and compares them with the limits specified by the manufacturer) and the dead time of the associated detectors.

The programme also carries out checks on the spectrometer with regard to the performance of different combinations of the crystals, the detectors, the collimators, the $\sin 2\theta$ angles, the apertures, the tracking of the $\sin 2\theta$ amplifier, the operation of the second-order spectrum circuits, the operation of the automatic pulse-height analyser, the condition of the detectors, the condition of the X-ray tube, spectral contamination by the tube spectrum, and physical contamination by analytical specimens.

Although the measurements take 15 hours, there is no disruption to normal, routine laboratory work since the measurements can be made automatically after routine work has been completed. Only four sample positions are required for this monitoring programme.

Metallurgical award

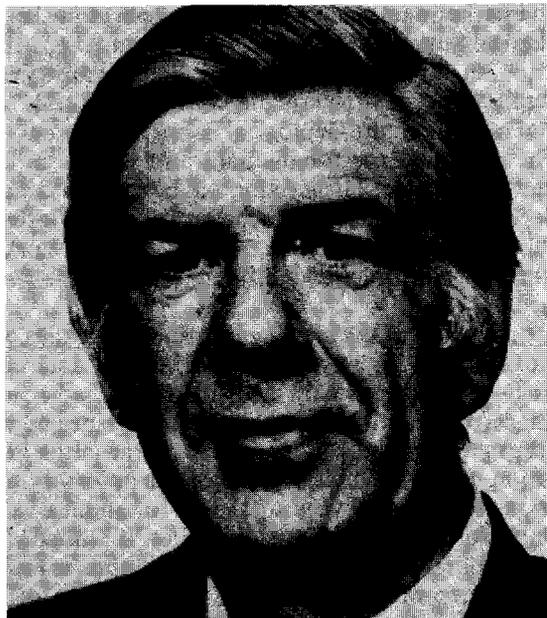
The 1984 Acta Metallurgica Gold Medal has been awarded to Professor John W. Christian of Oxford University. The medal is an international award that was established in 1974 to recognize outstanding ability and leadership in materials research.

Dr Christian is currently Professor of Physical Metallurgy at Oxford University. He graduated in physics at Oxford, and obtained his Ph.D in metallurgy there in 1949. At Oxford he was Pressed Steel Research Fellow (1951–55), Lecturer in Metallurgy (1955–58), and George Kelley Reader in Metallurgy (1958–67) before being appointed to his present position in 1967. He has been a Fellow of St. Edmund Hall, Oxford, since 1963. He was Republic Steel Distinguished Visiting Professor of Metallurgy at Case Institute of Technology in 1962–63 and has also held visiting professorships at M.I.T. (1971) and at the Universities of Illinois, Urbana (1959 and 1963), Pennsylvania (1970), Virginia (1972), and Stanford (1972), and visiting appointments at N.R.C., Ottawa (1956) and NBS, Washington, D.C. (1979).

Dr Christian is recognized internationally as one of the leading authorities in the field of martensitic transformations of metals and alloys, and his book *The Theory of Phase Transformations in Metals and Alloys* is a classic, regarded as the authoritative and standard treatise in this central field in metallurgy. Through his own original work, including *inter alia* the theory and experimental studies of the transformations of cobalt and indium-thallium alloys, and through his writings, he has contributed greatly to our understanding of the complex field of phase transformations, and martensitic transformations in particular.

In the field of mechanical properties, together with Basinski, he carried out pioneering experiments, which established the importance of the Peierls force in body-centred cubic metals at low temperatures. Since then, he and his group have made many important contributions to our knowledge and understanding of the fundamental plastic properties of body-centred cubic metals and alloys.

Professor Christian was elected a Fellow of the Royal Society in 1975 and is also a Fellow of the Institute of Physics and of the Institution of Metallurgists. He received the Rosenhain Medal of the Institute of Metals in 1969, and was the third Hume-Rothery Memorial Lecturer in 1974, and was awarded the Platinum Medal at the



Metals Society (now the Institute of Metals) in 1984. He was Robert F. Mehl Gold Medallist of AIME in 1981, and ASM's Campbell Memorial Lecturer in 1982. He has been an Editor of *Progress in Materials Science* since 1970, and Editor-in-Chief of the *Journal of the Less-Common Metals* since 1976. He was an Associate Editor of *Acta Metallurgica* and *Scripta Metallurgica* from 1967 to 1973.

The Acta Metallurgica Gold Medal is awarded annually by Acta Metallurgica, Inc. with financial support from Pergamon Press Ltd. Nominations for the award may be made by any of the twenty-five professional societies of seventeen countries that support Acta Metallurgica, Inc. in publishing the international journals *Acta Metallurgica*, *Scripta Metallurgica*, and *Materials and Society*. Professor Christian was nominated by both the Metallurgical Society of AIME and the American Society for Metals. He was selected for the award by a distinguished international panel of judges consisting of Dr John W. Cahn, U.S. National Bureau of Standards; Dr Charles Crussard, Pechiney Ugine Kuhlmann; and Professor Toru Imura, Nogoya University. The medal was presented to Professor Christian on 22nd May at the Annual Meeting of the Institute of Metals in London.

Proterozoic volcanic suites

An international symposium will be held at the British Geological Survey, Keyworth, Nottingham, U.K., from 2nd to 5th April, 1986. Entitled 'Geochemistry and Mineralisation of Proterozoic Volcanic Suites', this special meeting of the Geological Society will discuss the geochemical evidence for the nature of volcanism during the Proterozoic. The meeting will be co-sponsored by Project 217 (Proterozoic Geochemistry) of the International Geological Correlation Programme and Working Group 3 (Proterozoic) of the International Lithosphere Program.

The main aim of the meeting is to encourage the collation of a set of high-precision geochemical data comparable with those already available for volcanic suites of Phanerozoic and Archaean age. The absence of such a database at present is a major constraint in the interpretation of some 2 billion years of Earth history, and a serious anomaly in view of the vast amount of data available for Archaean greenstone suites. It is hoped that the proceedings of the meeting will be published as rapidly as possible, probably as a Special Publication of the Geological Society, so that the data can form the basis of subsequent work on IGCP Project 217.

The emphasis of the meeting will be on supracrustal volcanic suites, although contributions on magmatic suites (e.g. dyke swarms) that are demonstrably cogenetic with volcanic suites will be welcome.

Volcanic suites form the most significant loci for mineralization in the Proterozoic and are thus important

exploration targets. The meeting should therefore be of considerable interest to mining companies, and contributions from industrial speakers on the topic of volcanic geochemistry and mineralization will be especially welcome.

The themes of the Symposium will be as follows:

- Nature of the change in pattern of volcanism from the Archaean to the Proterozoic.
- Role of volcanism in Proterozoic crustal evolution.
- Applicability of Phanerozoic geochemical signatures (and discriminant diagrams based on them) to recognition of the tectonic environment of Proterozoic volcanism.
- Geochemical characteristics of supposed Proterozoic ophiolitic crust and comparison with Phanerozoic ophiolites.
- Geochemical criteria for Proterozoic volcanic-arc suites and evidence for the nature of subduction processes.
- Geochemistry of dyke swarms associated with volcanic suites.
- Metallogeny related to Proterozoic volcanism.
- Mantle evolution during the Proterozoic.
- Regional geochemical syntheses from each continent.

Further details are obtainable from Dr Tim Pharoah, Deep Geology Research Group, British Geological Survey, Keyworth, Nottingham NG12 5GG. Telephone: (06077) 6111.

Powder metallurgy

Every second year the International Powder Metallurgy Conference, the world's leading event in powder metallurgy, is organized and held alternately in North America and Europe. The next conference, PM '86, will be held in Düsseldorf, Federal Republic of Germany, from 7th to 11th July, 1986, and will be organized by the Ausschuss für Pulvermetallurgie on behalf of the European Powder Metallurgy Federation.

PM '86 is scheduled at a time when powder metallurgy is rapidly expanding both in the high-technology regions of the world and in the developing countries. This rapid expansion is explained by two major advantages that powder metallurgy can offer: unique material properties and economy in mass production.

PM '86 will consist essentially of three events:

- a scientific/technical conference
- an exhibition of powder-metallurgy equipment
- a state-of-the-art show of powder-metallurgy products.

The Conference will be held under the theme 'The Future of Powder Metallurgy', and will concentrate on the developmental work going on in universities, research organizations, and industry. Major topics will be new powders and material, and new shaping methods. New developments in engineering ceramics will be included in

this programme. An attendance of 1000 experts is expected.

The exhibition is planned on a much larger scale than at previous powder-metallurgy conferences. Full-size production equipment like presses and furnaces will be on display, and also auxiliary equipment like laboratory test devices and handling robots. A considerable portion of the exhibition will be reserved for powder producers. Two-hundred exhibitors are expected to demonstrate their most advanced products in the exhibition hall adjacent to the conference centre.

The state-of-the-art show will be a demonstration of powder-metallurgy products ranging from automotive, electronic, and aircraft to chemical applications. This show will be presented in neutral form, i.e. without company advertising but with a short technical description. The show will be supported by a discussion forum, in which users of powder-metallurgy products will summarize the advantages of such products.

Further details can be obtained from

Ausschuss für Pulvermetallurgie,
P.O. Box 9 21,
D-5800 Hagen 1,
Federal Republic of Germany.