

O.F.S. Branch

Proceedings of the Annual General Meeting on Wednesday, 30th July, 1975

The Annual General Meeting of the Branch was held at the St. Helena Club on Wednesday, 30th July, 1975 at 7.45 p.m.

Mr D. A. Smith (Chairman) was in the Chair. There was also present: Professor R. P. Plewman, President of the S.A. Institute of Mining and Metallurgy.

Six Fellows:

Messrs J. G. Cockburn, A. T. Lewis, Z. J. Lombard, A. N. Shand, L. J. Thorne, and E. T. Wilson.

Ten Members:

Messrs E. J. Dominy, B. J. Drysdale, A. H. Edwards, H. M. W. Eschenburg, A. M. P. Henderson, W. C. Mather, H. G. Mosenthal, D. I. Watson, P. R. Wheeler, and G. J. C. Young.

Six Associates:

Messrs A. J. Johansen, J. McLean, R. R. Perkin, C. F. K. Poulton, J. Scott, and C. P. Visser.

Four Graduates:

Messrs A. M. Jones, R. H. A. Plaistowe, P. S. Wentworth, and D. I. Whitewright.

One Student:

Mr A. P. S. Howard.

Six Visitors

Total Present: Thirty-five.

Numerous lady guests were present.

Apologies for non-attendance were received from Messrs M. G. Cullen, D. E. Couperthwaite, C. Straughan, and B. D. C. Watts.

The Chairman declared the Meeting open, and expressed the hope that everyone present would find the proceedings both interesting and informative.

He extended a special welcome to Professor R. P. Plewman, President of Council, who had flown down from Johannesburg to be present, and expressed appreciation, on behalf of the Branch, of the President's interest in local affairs.

Minutes of the Previous General Meeting

The Minutes of the General Meeting held on 12th February, 1975,

which had been published in the May 1975 issue of the *Journal* were taken as read. Their adoption was proposed by Mr G. J. C. Young and seconded by Mr E. T. Wilson.

Matters Arising from These Minutes

There were no matters arising from the Minutes.

Chairman's Annual Report for 1974/1975

The Chairman presented his report as follows.

1974/75 Committee

Mr D. A. Smith (Chairman), Mr G. J. C. Young (Vice-Chairman), Mr E. T. Wilson (Immediate Past Chairman), Mr R. R. Perkin (Honorary Secretary).

Committee Members

Messrs H. M. W. Eschenburg, A. F. Goetzsche, A. T. Lewis, H. G. Mosenthal, C. Mostert, and A. N. Shand.

Two Committee Members resigned during the year: Mr A. F. Goetzsche, early on, owing to his transfer out of the Free State, and, latterly, Mr C. Mostert, owing to his retirement. The vacancies that resulted were not filled.

General Meetings

Three General Meetings were held, and one visit was undertaken during the year:

Annual General Meeting, 31st July, 1974, present 32; General Meeting, 13th November, 1974, present 47; General Meeting, 12th February, 1975, present 34; Visit to Tugela-Vaal Water Scheme, 14/15th May, 1975, present 10.

Presentations

The following talk, demonstration, and film shows were presented during the year:

'Minerals in South Africa' — Mr P. W. J. van Rensburg.

'Rauföss Implosive Method of Compression Jointing of Cables and Bars with the Use of Detonating Cords' — Messrs G. Bowmer and N. Bennett (C.C.L. (SA) Pty Limited).

'South African Techniques in Shaft Sinking' — Film.

'Out of the Blue' — Film.

Visit

As has been mentioned, a visit was made to the Department of Water Affairs Tugela-Vaal Scheme on 14th and 15th May, 1975. The itinerary included trips to the Driel Barrage, Upper Tugela Canals, the Metz Tunnel Outlet, and the Sterkfontein Dam. The main branch of the Institute was invited to participate, and 14 of their members joined us on this visit. It was the consensus of opinion of the participants that this was one of the most interesting and informative visits undertaken by our Institute, and that it had given them a real insight into the complexity and magnitude of this scheme.

Committee Meetings

Three Committee Meetings were held during the year. I wish to place on record my appreciation of the assistance given me by members of the outgoing Committee.

Membership

The total membership of the O.F.S. Branch as at the 20th June, 1975 was 124 made up as follows:

Fellows	18
Members	35
Associate Members	1
Associates	41
Graduates	12
Students	17

This figure shows no change from that recorded last year. It is considered opportune again to appeal to all non-members present who are eligible to apply for membership of the Institute.

Finance

The Branch incurred no expenses during the year. A banking account is not operated locally.

Declaration of Office Bearers and Committee Members for the Year 1975/1976

The Chairman announced that, in terms of the Constitution, the outgoing Committee had elected the following Office Bearers for the ensuing year:

Mr G. J. C. Young (Chairman), Mr A. N. Shand (Vice-Chairman), Mr D. A. Smith (Immediate Past Chairman).

With regard to the incoming Committee, the Chairman announced that the appointed Scrutineers had reported that the number of nominees for election had equalled the number of vacancies on the Committee. Therefore, an election had not been necessary, and it was with pleasure that he announced that the following members would serve on the Committee during the 1975/1976 session:

Messrs E. J. Dominy, B. J. Drysdale, H. M. W. Eschenburg, A. T. Lewis, Z. J. Lombard, and E. T. Wilson.

The Chairman welcomed the new members to the Committee.

Induction of Chairman

Mr D. A. Smith introduced Mr G. J. C. Young by briefly outlining his past career and achievements and, in calling upon him to take the Chair, wished him a very successful year of office.

Mr Young thanked the Committee for having honoured him with the Chair for the coming year. He also thanked Mr Smith for his kind introduction and congratulated him on his successful term of office, saying that those members fortunate enough to have taken part in the Institute's visit to the Tugela-Vaal Scheme during May would agree

that Mr Smith's organization had been outstanding. The Chairman went on to congratulate Mr A. N. Shand on his election to the office of Vice-Chairman, and expressed the view that, with his assistance and that of the Committee, the coming session should be as successful as those in the past.

General Business

There was nothing raised under this heading.

Address by the President, Professor R. P. Plewman

The Chairman introduced Professor Plewman, saying it was especially fitting that he should address the gathering because he was one of the many sons of the Orange Free State who had won distinction in his field. He was well known on the Goldfields, having occupied a senior position at Harmony Gold Mining Co. Limited prior to accepting the Chair of Mining Engineering at the University of the Witwatersrand in 1963.

The President commenced his address by saying that it was always a particular pleasure for a President of Council to visit one of the Branches, and that this occasion was no exception.

Professor Plewman then went on

to give a most interesting talk on the training of mining engineers as provided by the universities and the industry. The subject was examined in the four relevant areas of the undergraduate programme, initial post-graduate training, post-graduate education, and the way in which the industry uses its engineers.

At the conclusion of this talk, Mr H. G. Mosenthal, in proposing a vote of thanks to Professor Plewman, said that the acute shortage of engineers at a time when increased mechanization was the order of the day was provoking much thought. He agreed that this shortage could well force a situation where the separation of the managerial and engineering responsibility would be the only possible way of administering the mining industry in this country.

Closure

Before declaring the Meeting closed, the Chairman thanked Professor Plewman for being present, and the members and visitors for their attendance.

The Meeting closed at 8.30 p.m. after which refreshments were served.

Conference on Vacuum Metallurgy

The Fifth International Conference on Vacuum Metallurgy is to be held in Munich from 11th to 15th October, 1976. The number of lectures will be limited to about

sixty so that there will be plenty of time for discussions. The language of the conference is English.

All inquiries should be directed

to Prof. Dr.-Ing. M. Wahlster, c/o Leybold-Heraeus GmbH Co. KG, D 6450 Hanau (Main), Postfach 549, Fed. Rep. of Germany.

Excavation and tunnelling

A conference on 'Rapid Excavation and Tunneling' is to be held in Las Vegas from 14th to 17th June, 1976. It is being sponsored by the American Institute of Mining,

Metallurgical, and Petroleum Engineers and by the American Society of Civil Engineers. The technical programme is being managed by the Society of Mining Engineers of

AIME. Further details are available from Darline D. Daley, SME-AIME, P.O. Box 8800, Salt Lake City, Utah 84108, U.S.A.

Book reviews

Mine filling. Queensland (Australia), Mt. Isa Mines, Limited, 1973. 293 pp. \$A20,00 incl. postage.

This volume represents the proceedings of the Jubilee Symposium of the N.W. Queensland Branch of the Australasian Institute of Mining and Metallurgy. The Symposium, organized to celebrate the jubilee of Mount Isa, attracted world-wide support — nearly 20 per cent of the delegates were from 13 overseas countries, which gave the meeting the flavour of an international conference rather than a local banquet. Thus it is fitting to note that this is already practically the standard text on mine filling, and, if you are at all interested in the topic, you should have a copy.

The 25 papers were broken down into various sessions as follows. First, there was a series of five plenary papers on the role and behaviour of fill, the development of cemented rockfill at Mt. Isa, the rational design of fill, the structural behaviour of fill, and sand filling. Next, there was a session on research on fill properties, broken down into seven papers on laboratory studies and three on field studies. Then there was a session on filling techniques, with three mining case studies and four distribution case studies. Finally, there were three 'additional' papers reviewing fill practice in Sweden, field studies of backfill in deep vein mines, and the prediction of hydraulic fill performance. Dickhout, of International Nickel, acted as rapporteur and closed the Symposium with a review of the technical papers.

Clearly, this represents a wealth of practical experience and theoretical advance, much of which had previously been tied up in internal company reports, and is thus available in this volume for the first time. At the moment, it must be admitted that mine fill is more of an art than a science — for instance, it was necessary to drop several hundred tons of various types of rock down a few hundred metres of ore

pass to prove that extensive breakage occurred. Nevertheless, some important advances were noted. The use of flocculants to reduce segregation effects in cemented fills is noteworthy. The horror story implicit in Fig. 7 of Aitchison, Kurzeme, and Willoughby's paper on the response of fill when used as a structural component should be noted by all who are working with saturated fill materials.

Occasionally there was a great feeling of disappointment that there was so little South African representation at the Symposium — perhaps statements such as the following would not have gone unquestioned had our local rock mechanics experts been present: 'uniaxial stress analyses . . . are misleading, particularly when coupled to such questionable concepts as "mine stiffness" and "energy release" that are postulated solely on assumed uniaxial and purely elastic behaviour of finite sized laboratory test specimens, concepts that have never been tested against independent mine measurements' (p. 218).

Further, if you seek answers to the question of filling large tabular excavations at shallow dips and great depths, you will seek in vain in this volume. Nevertheless, the principles that might guide you to a realistic solution to this problem are all there, though you have to read carefully and conscientiously.

Generally, the standard of production of the volume is good, although it is irritating to find the discussion of each paper at the end of the volume. The editing is usually good, although there were some strange metrications, e.g., KPa, K.P.A., and k.s.i. (for thousands of pounds per square inch!), a moderate amount of repetition of material, and typescripts of varying standards.

P.J.L.

Young, R. S. *Chemical phase analysis.* London, Charles Griffin, 1974. 126 pp. £4.50.

In the early history of inorganic analysis, much emphasis was placed

on the amounts of the substances or phases composing a mixture, rather than on the total amount of the element present. Thus, for ores, methods were sought for the various mineralogical forms or phases of the element. With the growth of inorganic analytical chemistry, this aim, which should be the ultimate aim of analysis, has tended to be lost sight of, and today it is rare to find this type of analysis described in textbooks of inorganic chemical analysis. The need for this information, however, still exists and, indeed, becomes more necessary as metallurgical operations become more refined and the grade of ore treated becomes lower. Thus, for example, copper occurs in both oxidized and sulphide forms in many ore deposits, and, because the methods of recovery differ, it is necessary to distinguish between these phases. For industrial and commercial purposes, the total calcium content of quicklime or hydrated lime is of less importance than the 'available' lime.

One reason for the neglect of this type of analysis is that the methods are often inaccurate and sometimes empirical. Many of the methods depend on the differences in the solubilities of the phases in solvents of one form or another, and the reproducibility of accuracy is therefore influenced by a number of factors such as the particle size, the degree of agitation of the suspension, and the surface properties of the particles, all of which are difficult to control. Moreover, the solubility of a mineral can be affected by the presence of another. Thus the well-known method for the determination of galena (a sulphide of lead) in the presence of the sulphates, carbonates, and oxides of lead, based on its insolubility in ammonium acetate solution, is inaccurate in the presence of pyrite, which increases the solubility of galena.

Physical methods such as X-ray diffraction, where possible, have tended to replace these chemical

methods in well-equipped laboratories, but the cost of the equipment and the specialized experience needed to interpret the data are usually beyond the means of the average industrial laboratory. The author of this book has therefore done a considerable service in assembling the various chemical methods, none of which requires anything other than the simplest equipment, from the widely scattered sources in the journal literature.

The elements of importance in phase analysis — a total of 34 — are reviewed in alphabetical order.

Full details of the methods in current use are given to enable the analyst to carry out the analysis without reference to the original literature. Older procedures are mentioned more briefly, but always with copious references to the literature. (Russian workers appear to have made the most substantial contributions to this literature.)

The author has a style that is admirably suited to the description of analytical methods; in fact, the book is a pleasure to read, and, because it avoids unnecessary detail, there is a very considerable amount

of compact information in this slim volume.

A more critical approach would have been welcomed. Where more than one method is described — for example, five methods are given for differentiating between aluminium oxide and metallic aluminium — there is little to guide the analyst in the choice of method. In spite of this shortcoming, the book should be welcomed by those concerned with mining, metallurgy, mineralogy, pharmacy, pollution, and the chemical industry in general.

T.W.S.

Company Affiliates

The following members have been admitted to the Institute as Company Affiliates.

- AE & CI Limited.
Afrox/Dowson and Dobson Limited.
Amalgamated Collieries of S.A. Limited.
Apex Mines Limited.
Associated Manganese Mines of S.A. Limited.
Blackwood Hodge (S.A.) Limited.
Blyvooruitzicht G.M. Co. Ltd.
Boart & Hard Metal Products S.A. Limited.
Bracken Mines Limited.
Buffelsfontein G.M. Co. Limited.
Cape Asbestos South Africa (Pty) Ltd.
Compair S.A. (Pty) Limited.
Consolidated Murchison (Tvl) Goldfields & Development Co. Limited.
Deelkraal Gold Mining Co. Ltd.
Doornfontein G.M. Co. Limited.
Durban Roodepoort Deep Limited.
East Driefontein G.M. Co. Limited.
East Rand Prop. Mines Limited.
Envirotech (Pty) Ltd.
Free State Saaiplaas G.M. Co. Limited.
Fraser & Chalmers S.A. (Pty) Limited.
Gardner-Denver Co. Africa (Pty) Ltd.
Goldfields of S.A. Limited.
The Grootvlei (Pty) Mines Limited.
Harmony Gold Mining Co. Limited.
Hartebeesfontein G.M. Co. Limited.
Highveld Steel and Vanadium Corporation Limited.
Hudemco (Pty) Limited.
Impala Platinum Limited.
Ingersoll Rand Co. S.A. (Pty) Ltd.
Kinross Mines Limited.
Kloof Gold Mining Co. Limited.
Lennings Holdings Limited.
Leslie G.M. Limited.
Libanon G.M. Co. Limited.
Lonrho S.A. Limited.
Lorraine Gold Mines Limited.
Marievale Consolidated Mines Limited.
Matte Smelters (Pty) Limited.
Northern Lime Co. Limited.
O'okiep Copper Company Limited.
Palabora Mining Co. Limited.
Placer Development S.A. (Pty) Ltd.
President Steyn G.M. Co. Limited.
Pretoria Portland Cement Co. Limited.
Prieska Copper Mines (Pty) Limited.
Rand Mines Limited.
Rooiberg Minerals Development Co. Limited.
Rustenburg Platinum Mines Limited (Union Section).
Rustenburg Platinum Mines Limited (Rustenburg Section).
St. Helena Gold Mines Limited.
Shaft Sinkers (Pty) Limited.
S.A. Land Exploration Co. Limited.
Stilfontein G.M. Co. Limited.
The Griqualand Exploration and Finance Co. Limited.
The Messina (Transvaal) Development Co. Limited.
The Steel Engineering Co. Ltd.
Trans-Natal Coal Corporation Limited.
Tvl Cons. Land & Exploration Co. Limited.
Tsumeb Corporation Limited.
Union Corporation Limited.
Vaal Reefs Exploration & Mining Co. Limited.
Venterspost G.M. Co. Limited.
Vergenoeg Mining Co. (Pty) Limited.
Vlakfontein G.M. Co. Limited.
Welkom Gold Mining Co. Limited.
West Driefontein G.M. Co. Limited.
Western Deep Levels Limited.
Western Holdings Limited.
Winkelhaak Mines Limited.

NIM reports

The following reports are available free of charge from the National Institute for Metallurgy, Private Bag 7, Auckland Park 2006.

Report no. 1714

The efficiency of the fire-assay procedure with nickel sulphide as the collector in the determination of platinum, silver, gold, and iridium.

The validity of the results from previous tests in which radio-isotopic tracer was added as a chlorocomplex has been proved by an examination of the nickel sulphide collection procedure using different anionic forms of the noble metals, and by another determination with radio-isotopic tracers of the efficiency of collection for gold and iridium. In addition, the behaviour of platinum and silver has been examined. The recovery at each stage of the collection has been related to the initial activity of the added isotope, indicating little or no loss due to volatilization on fusion.

The collection efficiencies that were obtained were 97,3 per cent for gold, 99,7 per cent for iridium, 97,7 per cent for platinum, and 96,6 per cent for silver. On the average, 2 per cent of the platinum, iridium, and silver remained in the slag, this loss increasing to 4 per cent for gold. More than 90 per cent of the silver was dissolved in the parting solution, and a further separation would be required to permit a determination of the silver.

Report no. 1721

A preliminary investigation into the mechanism of depression in the flotation of sulphide minerals at the Prieska Copper Mine.

The distribution of species present in solution was calculated for conditions close to those prevailing at the concentrator of the Prieska Copper Mine. At Prieska, the copper minerals are floated selectively by use of a depressant mixture of zinc sulphate and cyanide.

The calculations showed that, above certain pH values, both solid zinc cyanide and solid basic zinc sulphate are present. The observed

improvement in the depressing action of the mixture following an increase in the ratio of zinc sulphate to cyanide can apparently be correlated with the presence of basic zinc sulphate; however, sufficient plant data are not available at present to make this conclusion unequivocal.

Calculations made for conditions similar to those found in the lead-flotation circuit at the concentrator showed that no solids were present. The main solution species present is $Zn(CN)_4^{2-}$, which appears to depress the chalcopyrite, although the actual mechanism may involve the formation of a localized precipitate of zinc hydroxide at the mineral surface.

Report no. 1725

The determination of silica in fluor spar by 14 MeV neutron-activation analysis.

Silica has been determined down to a content of 0,3 per cent, with a coefficient of variation of 11 per cent. The coefficient of variation for a sample of 100 per cent silica, which was used for calibration purposes, was 0,70 per cent. This high level of precision was attained with a new sample-packing procedure, and the use of analogue stabilizers in the detection system.

Iron, magnesium, and aluminium give rise to small interferences in the determination, and corrections for these interferences have been determined. Phosphorus is a major source of interference since it readily produces the same radio-isotope as does silicon; a correction must therefore be made, based on the phosphorus content.

Results obtained on standard samples of fluor spar agree well with the recommended values, the precision of determination being 1 per cent relative for concentrations greater than 10 per cent.

Report no. 1736

The determination, by atomic-absorption spectrophotometry and liquid-liquid extraction, of antimony (parts per million) in ores and concentrates.

A rapid atomic-absorption pro-

cedure combined with liquid-liquid extraction for the determination of antimony in p.p.m. amounts in ores and concentrates is examined.

The sample is fused with sodium peroxide and leached in hydrochloric acid. The antimony is extracted into methyl isobutyl ketone (MIBK) from a solution of 6 M hydrochloric acid, after which co-extracted interfering elements are removed by back-washing, and the absorption of antimony is measured by atomic absorption, the organic phase being sprayed in the flame.

The precision of the proposed method is 3 per cent, and the lower limit of determination is less than 10 p.p.m. of antimony.

Report no. 1741

South African costs of equipment for the metallurgical industry (1975).

The average costs of the equipment used for metallurgical processing are shown in the form of graphs, which are based on costs prevailing during January 1975. Costs of materials of construction and an updated buyers' guide to firms that supply the equipment are also given.

A cost index for equipment, giving annual cost escalations from 1970 to 1975, is included.

Report no. 1744

The refining of the platinum-group metals.

The various separation schemes used for the refining of the platinum-group metals (PGM) are reviewed and compared on economic and technical grounds, in an attempt to ascertain whether any benefits can result from radical changes in the extraction process. The conventional process, solvent-extraction and ion-exchange processes, chromatographic separations, and an integrated solvent process are discussed, and a brief review of the chemistry of the PGM is given with regard to their nobility, oxidation states, complex formation, and kinetic effects.

Report no. 1746

The determination, by atomic-absorption spectrophotometry, of minor elements in zinc, lead, and copper sulphide concentrates.

The determination of minor elements in zinc, lead, and copper sulphide concentrates is described. The procedure involves the dissolution of the sulphide concentrate by fusion with sodium peroxide, acidification with nitric acid, and measurement of the elements by atomic-absorption spectrophotometry. The method of standard additions is used to eliminate interference. The procedure is applicable to the analysis of ten elements at concentrations varying from 50 to 1000 p.p.m. in the samples, with an accuracy of between 2 and 4 per cent.

Report no. 1747

Magnetohydrostatic separation of gold from gravity concentrates.

Preliminary testwork in which gold was separated from gravity concentrates by magnetohydrostatic separation is described. Belt concentrates from the Welkom Gold Mine were passed through a continuous laboratory-scale magnetohydrostatic separator, either before or after magnetic separation of their iron content. It is concluded that concentrates having a gold content of 13 per cent are readily obtainable from the 8 kg/t feed, with recoveries in excess of 90 per cent. The factors that limit the grade are discussed on the basis of mineralogical analyses, and it is concluded that significant improvements in grade could be expected in practice.

Report no. 1750

A review of the present and future development of sulphur production in South Africa.

Sulphur is a basic raw material essential to the future development of the expanding fertilizer and uranium industry in South Africa. In the next decade, sulphur in the form of sulphuric acid may also become a key commodity in the production of raw materials, like alumina and magnesite, that are at present imported. This report describes the structure of the industry, and an attempt is made to provide a basis for future planning that will enable the needs of consuming industries to be satisfied.

Iron pyrite extracted from the gold ores of the Witwatersrand accounts for the greatest proportion of South Africa's production of sulphuric acid, and this situation is likely to continue, in spite of the large quantities of sulphur compounds that may be produced as a byproduct of future base-metal mining.

Owing to the high railage tariffs per unit of sulphur for the transportation of pyrite and sulphuric acid, as compared with those for the transportation of elemental sulphur, the importation of sulphur is expected to continue, but will probably be confined to coastal consumers, and to inland consumers who are situated long distances from pyrite producers, e.g., at Phalaborwa. The proportion of imported sulphur to total sulphur consumed is expected to decrease. Predictions for the production and consumption of sulphur in 1980 and 1985 indicate that South Africa can be self-sufficient, provided that a means can be found for utilizing the sulphur output of the growing base-metal industry of the north-western Cape. The conversion by the producer of sulphur dioxide into elemental sulphur before transportation may provide the solution to this problem.

As it was not possible to obtain complete statistics for all aspects of the industry for 1973 or 1974, all figures that affect the balance of supply and demand, as well as the input-output parameters of the industry, were calculated for 1972, and, where possible, predictions were made for 1973 and 1974.

Report no. 1754

A new three-dimensional anodic electrode for reduced power consumption during the electrowinning of metals.

This report discloses some aspects of the design, the working conditions, and the uses of an anodic electrode developed at the National Institute for Metallurgy and covered by a provisional South African patent. This new electrode has been specially designed to use anodic-oxidation reactions that require less electrical energy, in such a way that the total power consumption during the electrolytic recovery of metals is reduced.

The eleven reports listed below all deal with the recovery of gold

by cyanidation from mill products after pyrite flotation, and they give the results of work on this topic conducted at the National Institute of Metallurgy from 1967 to 1969.

Report no. 139

A preliminary survey of gold-recovery problems arising in the production of pyrite. (9th Feb., 1967, re-issued Jun. 1975.) 16 pp.

It has been observed that, when pyrite is produced as a by-product on gold mines on the Witwatersrand and the Orange Free State goldfields, certain problems in the recovery of gold by cyanidation occur. For a preliminary investigation, gold-reduction plants and persons who had practical experience of the problems were visited. The information gained is set out and analysed. A programme for proposed testwork is presented.

Report no. 140

A preliminary mineralogical investigation of pyrite from the Kimberley and the Main Reefs, Vogels-truisbult Gold Mine. (13th Feb., 1967, re-issued Jul. 1975.) 11 pp.

Preliminary mineralogical investigations carried out on pyrite samples extracted from the Main and Kimberley Reef at Vogelstruisbult Gold Mine indicate differences in the chemical composition of the pyrite as well as in the cell edge of the pyrites.

The susceptibility to oxidation of the pyrite in the Main Reef is ascribed to a cobalt-to-nickel ratio higher than that shown by pyrite from the Kimberley Reef. The cobalt content of the Main Reef pyrite is also higher.

The differences in the cell edge of the pyrite from the two horizons are attributed to different degrees of replacement of iron by nickel and cobalt in the pyrite lattice. Pyrite from the Main Reef, which shows the largest cell edge, also contains the most cobalt.

Report no. 165

Gold recovery from pyrite flotation mill products by cyanidation. Progress made up to 1st May, 1967. (5th May, 1967, re-issued Jun. 1975.) 8 pp.

Report no. 133

Gold recovery by cyanidation from mill products obtained after pyrite flotation. Progress made up to 1st

July, 1967. (18th Jul., 1967, re-issued Jun. 1975.) 14 pp.

Report no. 219

A review of some of the mineralogical factors influencing the flotation of pyrite. (29th Nov., 1967 re-issued Jun. 1975.) 20 pp.

At present [1967] there is no information about factors that influence the floatability of Witwatersrand pyrites.

Work carried out by various investigators indicates that the following factors may be responsible for variations in the flotation behaviour of pyrite:

- (1) The types of pyrite present.
- (2) Semiconductor characteristics shown by the pyrite
- (3) Structural defects in the pyrite lattice
- (4) Possible attack by bacteria. (It should be stressed that these are all factors inherent in pyrite itself.)

It is proposed that a detailed mineralogical study of pyrite should be undertaken to correlate the mineralogical, chemical, physical, and flotation properties.

The semiconductor properties of pyrite might be a guide to pyrite floatability and should be thoroughly investigated with the 'heated-probe' technique.

Report no. 278

Gold recovery by cyanidation from mill products obtained after pyrite flotation. (24th Jan., 1968, re-issued Sep. 1975.) 51 pp.

The effect of xanthate and other flotation reagents on the cyanidation of gold and of a gold ore has been investigated by means of potentiostatic, rotating disc, and potentiometric methods, by bottle cyanidation and by cyanidation in an instrumented glass column. Although the investigation is incomplete, a number of factors have become apparent.

Potentiostatic and rotating disc experiments have shown the detrimental effects of flotation reagents and have provided some insight into the mechanism of the effects. These effects have been partially confirmed by bottle cyanidation experiments.

The dissolution of gold from a Loraine ore with a 2 in x 15 ft glass column has indicated that pre-aeration is effective in bringing about

good dissolution, even in the absence of xanthate, provided that such pre-aeration is performed in the absence of lime and cyanide. Furthermore, when xanthate is added before the pre-aeration stage, the xanthate is found to be decomposed during pre-aeration and subsequent cyanidation appears to be enhanced. Pulp density is also an important factor in optimizing dissolution.

A difficulty envisaged in the application of pre-aeration to the Loraine plant, is the prevention of the introduction to the ore of both lime and cyanide before reaching the Browns tanks.

Report no. 306

The effect of preaeration on two samples of thickener underflow from the Venterspost Gold Mine. (30th Mar., 1968, re-issued Jul. 1975.) 14 pp.

The results are reported of tests carried out at Gold Fields Laboratories by members of the staff of the National Institute for Metallurgy in collaboration with members of the staff of Gold Fields Laboratory on the preaeration of two samples of thickener underflow from the Venterspost Gold Mine. To one of these, Aeromine 3037 flotation reagent was added. It was found that, after five and a half hours of preaeration, no effect caused by Aeromine 3037 could be detected and aeration for any further period did not lead to any further decrease in the value of the cyanidation residue. Samples preaerated for approximately one hour did indicate an effect caused by Aeromine 3037, and they also indicated that some preaeration might be beneficial; but further tests will be necessary to determine whether these indications are significant.

The measurement of the Eh values of the pulp, or the measurement of the potential of a gold electrode placed in the pulp, does not appear to provide any guide to the progress of preaeration once lime has been added to the pulp.

Report no. 317

Results of tests carried out at the Loraine Gold Mine during the period 5th to 7th February, 1968. (21st Mar., 1968, re-issued Jul. 1975.) 11 pp.

Tests were carried out at the Loraine Gold Mine to assess the

possibility of using preaeration, and of more dilute leaching of pyrite flotation residues to overcome the effect of xanthate. Although the results indicated a slight improvement in gold recovery when these techniques were used, they were inconclusive owing to the small number of tests that could be performed and to the large variations in the gold contents of the samples. Further laboratory testwork is recommended.

Report no. 321

Aeration of ore from the Loraine Gold Mine before the addition of cyanide. (17th Apr., 1968, re-issued Jul. 1975.) 30 pp.

Results are reported of tests carried out on a sample of ore from the Loraine Gold Mine to assess the effect of aerating the pulp before cyanidation. It was found that pre-aeration improved cyanidation, and that the improvement obtained was greater if the pulp initially had a lower Eh value (measured by a platinum electrode with saturated calomel reference electrode). Low Eh values were obtained by passing nitrogen through the pulp, adding Na₂S, or by grinding in a slightly rusty mild-steel laboratory mill instead of a stainless-steel laboratory mill. It was also found that moderate increases in liquid/solid ratios and decreasing the amount of lime added to the pulp led to improved results in cyanidation.

Report no. 380

The effect of aeration, before cyanidation, of pulps of gold ores containing xanthate. (14th Aug., 1968, re-issued Jul. 1975.) 44 pp.

Results are reported of tests carried out on samples of ores from five different mines, to assess the effect of aerating pulps of these ores that contain xanthate before cyanidation. It was found that aeration improved cyanidation and that the improvement was greater if the pulp initially had a low Eh value (measured by a platinum electrode with saturated calomel electrode). Low Eh values were obtained by passing nitrogen through the pulp, adding Na₂S, and grinding in a mild-steel mill. The effect of lime and cyanide on the preaeration has been investigated.

It was also found that moderate increasing of liquid-solid ratios,