Journal Comment

Platinum in the 21st Century

'There is a tide in the affairs of men'
Shakespeare

The theme of most of my previous Journal Comments has been job creation. This demands identifying the goods and services for sale, and its corollary, the skills and education required.

On this latter score, the mining professional community has had some spectacular success in the 21st century. Many hundreds of skilled mining engineering graduates and diplomates have been produced using the latest in computer-based education, a good percentage being women.

In the last few months there have been some remarkable announcements regarding the hydrogen fuel cell – the platinum content alone would probably be equal in quantity to the total annual gold production at the peak period of the last 'golden' 20th century.

Since a number of the papers in this issue of the Journal can be related to platinum, I started planning my Comment around this topic. I soon realized that the mining industry might be facing the possibility of replicating the successes of the previous century. I had visions of a suite of mining operations around the full perimeter of the Bushveld Complex. I termed these 'mining clusters' to signify their potential to attract a host of other job-creating options and spark a revolution in education at all levels, thanks to digital information technology.

As regards the first paper:

'*Transformation in the South African mining industry – looking beyond the employment equity scorecard*' by N.V. Moraka and M. Jansen van Rensburg.

Job creation is more productive than job dictation. Could such discussions move away from the legalistic semantics of BEE scorecards into a national commitment to job creation? Could the whole mining industry not invoke the cooperation of Mintek, the CSIR, IDC, the departments of Minerals and Energy, Trade and Industry, Water Affairs, and the agricultural industry to become stakeholders and participants in the innovative development portfolios about to be undertaken by mining and metallurgical, industrial, and agricultural clusters? The target is an affluent first-world nation in this 21st century.

From lofty ideals to nuts and bolts in the remaining papers in this issue …

There are many job creation opportunities indicated in the assignments by A.S. Macfarlane in the paper '*Reconciliation along the mining value chain*', which can be coupled with the paper '*The physical ability of women in mining: can they show muscle*?' by D. Botha and J.F. Cronjé'

I gather Macfarlane aims to establish materials balances at every stage of mining and processing, *i.e.* the added value links in the chain; to be reported in the mine call factors (MCFs). An enormous undertaking, particularly if codes of practice are envisaged.

In the mid 1950s, when I was deeply involved in investigating gold losses, the MCF was legally required to be reported monthly to the police via the Government Mining Engineer in order to combat theft of gold from the plants. (Large thefts have been reported recently.) But, as demonstrated recently in a paper to this Journal, the methods used for sampling a stope face are most unreliable. Since this first link is suspect, the usefulness of the subsequent links in the chain is undermined. Perhaps the contempt shown towards MCFs by gold and platinum mine personnel is well justified.

The eighth paper is: '*Mine Occupational Safety and Health Leading Practice Adoption System (MOSH) examined – the promise and pitfalls of this employer-led initiative to improve health and safety in South African Mines*' by M. Hermanus, N. Coulson, and N. Pillay

It represents a report-back by a group established at the University of the Witwatersrand, representing the employees known as MOSH. They focus on outcomes and activities on the health and safety aspects of mining. The most important outcome is that we are moving forward to match the statistics of leading international companies.

Most interesting, and hopefully welcome as the harbinger of more to come, is a contribution from China:

'*Effects on entrainment of serpentines by hydrophobic flocs of ultra-fine copper-nickel sulphides during flotation*' by M. Tang, S. Wen, and X. Tong.

At first sight this paper, treating ore from the Yumang deposit in China, has little relevance to platinum. However, it will be noted that the orebody

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contains approximately 2 ounces of platinum and palladium per ton. This shows that the platinum metals are more common than I thought! The base metals in the ore are much the same as those in the BC ores. Availability of water, and the recycling and disposal of aqueous effluents are common considerations in hydrometallurgy. If expansion takes place in the platinum sector, the opportunity for research, particularly on the use of the platinum fuel cell, will become attractive and international co-operation could be worthwhile. Since Chinese investors are already involved in South Africa, it is worth suggesting they may become stakeholders in the research portfolios.

Basic nickel carbonate is a material that can be readily available from the proposed hydrometallurgical 'Kell' process for platinum group metals recovery. The paper '*Smelting of calcined basic nickel carbonate concentrate in a 200 kw DC arc furnace*' by M. Abdellatif indicates that this material can be smelted to produce nickel metal which could be the preferred form in sales. Moreover, the DC arc furnace could be powered by the hydrogen fuel cells, manufactured locally to produce low cost power.

There are alternative options for sources of hydrogen. One is in the form of 'syngas' (a mixture of hydrogen and CO) which can be produced by the pyrolysis of carbonaceous plant material such as bagasse, shells of nuts, and sawdust from timber waste. A South African option named the 'Beauti-fuel' process is available among the many other options to form a worthwhile research portfolio.

The pyrolysis of such materials is described in two papers: '*Thermogravimetric investigation of macadamia nut shell – coal and anthracite in different combustion atmospheres*' by S.O. Bada, R.M.S. Falcon, L.M. Falcon, and M.J. Makhula '*The influence of selected biomass additions on the co-pyrolysis with an inertinite-rich medium rank C grade South African coal*' by C.A. Strydom, T.Z. Sehume, J.R. Bunt, and J.C. van Dyk. Since it is possible that the 'Platinum Province' will be associated with agricultural activities, particularly the rural small-lot farmers, it is certainly worthwhile to consider such possibilities. The second of the papers introduces the uses of coal materials. There are billions of tons of waste coal discards which can be considered for processing to recover the coal macerals as well as the other valuable constituents in the ash such as iron, sulphur, alumina, and silica. Once again the call for stakeholders in a portfolio of such projects can be usefully considered.

The ninth paper in this selection, and possibly the most erudite in terms of fundamental work on mineral processing and highly significant in the smelting route for platinum recovery from the UG2 reefs, is '*Application of the attainable region technique to the analysis of a full-scale mill in open circuit*' by F.K. Mulenga and M.M. Bwayla

The attainable region technique is one of the great advances in theoretical mathematical modelling algorithms, developed by David Glasser and Diana Hildebrand (incidentally one of the notable female chemical engineers) from the University of the Witwatersrand, which is the home of metallurgical research.

Predicting the performance of open circuit ball milling is possibly a forerunner of many more advances in the mathematical modelling of mineral (and even mining) technology. The correlations between the model and experimental results are promising. This work may be a step forward in circumventing the comminution problems associated with the handling of the UG2 reefs.

In the paper, '*Comparison of physical properties of oxidative sintered pellets produced with UG2 or metallurgical grade South African chromite: a case study*', by R.I. Glastonbury, J.P. Beukes, P.G. van Zyl, L.N. Sadiki, A. Jordaan, Q.P. Campbell, H.M. Stewart, and N.F. Dawson meticulously demonstrate that the chromites obtained from the final residues from the processing of the UG2 Reef for platinum group metals are every bit as favourable for manufacturing sintered pellets for ferrochrome production as the standard material. This material could be of value to both the platinum and the ferrochrome producers in terms of its superior properties and mutually advantageous prices. There are many other options for using the platinum fuel cell and for job creation in conjunction with South Africa's wealth of other mineral resources

R.E. Robinson