SPOTLIGHT
on the Phoenix Programme

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The Phoenix Programme takes the Mining and Mineral Processing Industry into the Science Classroom

Introduction

In the early years of mining, methods were crude, simple, labour-intensive, and very slow. Human resourcefulness, however, created innovations (mechanization, and computerization), that resulted in faster development, greater tonnages of ore, more efficient separation, and a superior final product. This expansion occurred at an ever-increasing rate, and resulted in a booming mining industry and a growing economy.

This expansion, along with mechanization, has reduced the number of labour-intensive jobs, but has created a large demand for skilled personnel in the mining, metallurgical, geological, and other scientific and engineering fields. Unfortunately, this demand for skilled manpower has never come close to being met locally, and the situation has gradually deteriorated in certain disciplines over the years. What is most important to note is that this shortage of highly skilled personnel is one of the factors limiting the growth rate of the mining industry in many areas.

The South African Phoenix Programme

Many efforts have been made to reduce this serious shortage of skills. In 1972, the Minerals Manpower Committee of the National Institute for Metallurgy (now Mintek), in conjunction with the Minerals Industry Manpower Careers Unit (MIMCU) of the United Kingdom, initiated the South African Phoenix Programme, which was based on a parallel programme that was operating in Britain. The Chamber of Mines of South Africa took over the Phoenix Programme in 1974, when the full spectrum of the mining industry was represented, and continues to operate it.

The Chamber of Mines funds most of the Phoenix Programme's budget. The balance is made up by outside sponsorship from the members of the Phoenix National Committee. Current members are The South African Institute of Mining and Metallurgy, AECI, Mintek, Envirotech, Iscor, Ferro Alloy Producers' Association, and Palabora Mining Company via Rio-Tinto of South Africa.

The main aim of the Phoenix Programme is to give selected scholars maximum exposure to scientific and technical careers in the mining and mineral processing industry. This is achieved by working through science teachers and student science teachers, and with selected scholars themselves. Teachers of physical science, careers guidance, and geography who have visited the mining industry are in a good position to influence pupils in the choice of a career, and can promote the technological advancement and the 'hi-tech' careers of the mining industry.

Mrs M. Brand and Professor J. Bradley of the Chemistry Department of the University of the Witwatersrand provide the scientific and educational back-up to the Phoenix Programme, which links the mining and mineral-processing industry to teaching activities in the science classrooms in South Africa. They are shown on site at the Palabora Mining Company

In the early days of the Phoenix Programme, science and geography teachers were taken on 4- to 5-day case study exercises. These projects involved feasibility studies on the launching of a new mining prospect, where teachers received technical input from members of the Chamber of Mines, engineering personnel on the mines (that were visited), and mining and metallurgical staff at the different universities.

The feedback after courses of this nature from teachers has always been extremely positive. The participants were exposed to numerous factors influencing the design, feasibility, safety, environmental conditions, economics, and decision-making in the mining industry at managerial level. One weakness in the case-study format is that the teacher leaves the course with little resource material on mining for use in the classroom.

South Africa ranks among the top three mineral-producing countries in the world, and is unique in terms

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of the range and importance of its mineral wealth. Despite this, the mining and mineral-processing industry is mentioned only once in the physical science core syllabus for standards eight, nine, and ten, namely:

'3.8.1b. Reclamation of uranium and copper.'

This is unacceptable when one considers how important mining is to South Africa.

Because of the poor exposure of the mining and mineral-processing industry in the physical science core syllabus, a new strategy was decided upon. This arose from ideas that were propagated by M. Tomlinson in 1977, the South African Association of Physical Science Teachers (SAAPST), and the Human Sciences Research Council Investigation into Education (the 1981 De Lange Commission Report). All recommended the introduction of Optional Science Topics into the physical science curriculum.

Student science teachers of the University of the Witwatersrand are given an overview of the geology of the Loolekop orebody at Foskor

Optional Science Topics

The basic idea is to develop a science syllabus that contains two components. A certain percentage, say 80 per cent of the syllabus content, would be compulsory for all scholars nationwide. The content of this core curriculum would be determined by leading educationalists in consultation with representatives of industry, professional scientific associations, etc. The remaining part, say 20 per cent of the syllabus content, would consist of Optional Science Topics relating school science to its applications in industry.

The concept of Optional Science Topics is designed to give teachers the autonomy to choose material that would be relevant to their own scholars in their particular location, such as:

Copper mining and mineral processing	Phalaborwa/ O'Okiep
Petrochemical industry	Sasolburg
Nuclear energy	Cape Town
Chemistry of wine making	Stellenbosch.

Options of this nature provide an opportunity to involve scholars in 'hands-on' experimentation and exposure to local industries and environments. The Optional Science Topics concept allows for the input of fresh ideas from educationalists, industrialists and, most important of all, teachers.

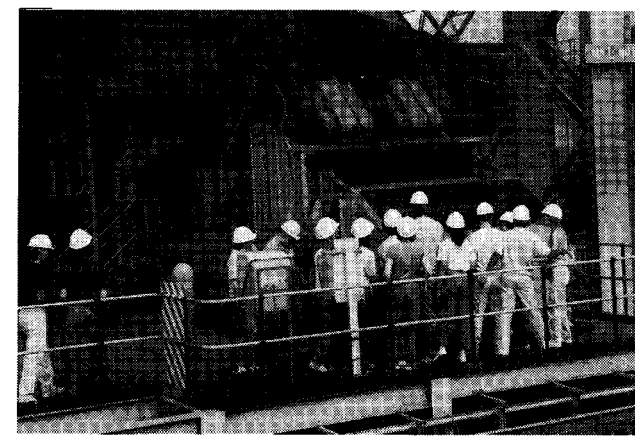
Innovative, high-quality resource material should motivate and help the teacher to improve science presentations in the classroom. This will create fresh interest and motivation from scholars, leading to positive attitudes to science and the mining industry.

We believe that teachers, educationalists, and people in industry should be encouraged to research and develop science resource material for use in the classroom. This is necessary to generate an environment in which scholars can realize that meaningful enquiry is done not only by 'professors' at universities, but also by teachers and, more importantly, by scholars themselves. The prevalent view of scholars that there is always a 'right' or a 'wrong' answer that can normally be found in a text book needs to be dispelled. This approach should, in the long run, help to correct this view and to improve problem-solving and lateral thinking at school level.

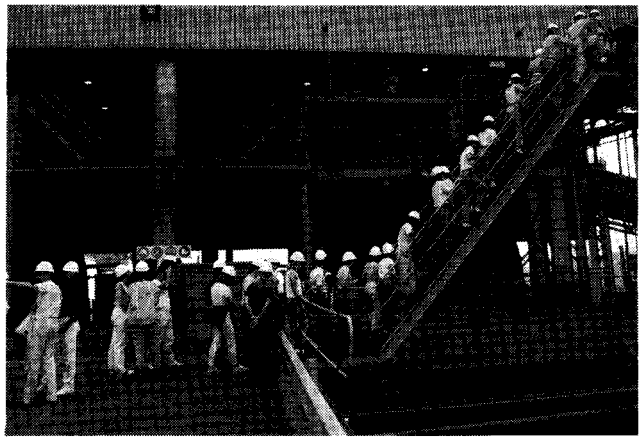
Quality control on Optional Science Topics is necessary to ensure that a suitable standard of resource material is being produced. At present, the Education Departments who have accepted the concept of Optional Science Topics are individually responsible for the evaluation of newly developed material.

Optional Science Topics Developed by the South African Phoenix Programme

The Manpower and Education Department of the Chamber of Mines of South Africa, in conjunction with Professor J. Bradley and Mrs M. Brand of the Chemistry Department of the University of the Witwatersrand, recently produced an Optional Science Topic resource package on the mining, processing, and applications of copper. This package is primarily directed at the standard nine physical science level and consists of eight lessons. Each of the lessons contains background information for the teacher, a suggested teaching strategy, pupil activity guides (worksheets), pupil activity guides with answers for the teacher, and a list of reference books on copper for further reading. Six of the eight lessons involve 'hands-on' experiments that simulate the metallurgical, geological, and analytical processes applying in the mining and extraction of copper. A syllabus cross-



The operation of a vibrating screen at the Palabora Mining Company is watched by student science teachers of the University of the Witwatersrand



The Phoenix Programme exposes student science teachers to the mining and mineral-processing industry, which enables them to link the mining industry to their science-teaching activities

reference for standards five to ten is provided at the back of the file. This allows teachers to use the experiments in the file to demonstrate concepts that occur in the core syllabus and relate them to the mining industry.

Merely creating such a package is futile unless teachers are persuaded of its value. Attention has been given to this crucial point in a number of ways. In one of these, science teachers and student science teachers are invited to attend a 3- to 4-day course on the resource package.

The participants spend the first day in a laboratory and, through lectures, learn how to use the resource package. This, for copper, involves an introductory lecture on careers in the mining industry, technical lectures on the metallurgical processes involved in copper processing, the use of the file, 'hands-on' experimentation, and an evaluation session at the end. The following two days are spent visiting a copper mine and mineral-processing plants. (See Chamber of Mines—*Mining Survey* No. 2/3, 1988.) The visits are continuously related to the resource package to stress the importance of linking classroom science to the mining industry.

At the end of the course, each teacher receives a full resource package on copper which includes a 220-page file, a nine-piece set of rock samples, powdered ore samples, collector and frother for flotation experiments, and strands of copper, aluminium, and iron wire. (Teachers can order fresh samples of ore and rocks from the Manpower and Education Department at the Chamber of Mines.)

Less comprehensive introductions to the package have reached a much greater number of teachers. During 1988, half-day workshops were held for 110 science teachers in the Orange Free State and selected teachers in the Johannesburg, Stellenbosch, and Cape Town areas. Altogether, since the launch of the Optional Science Topics in June 1987, some 320 teachers and student teachers have been exposed to the resource package on copper. Future workshops on the Optional Science Topic on copper are planned for the eastern Cape, Ciskei, Natal, the Transvaal, and other areas during 1989.

During 1988, teachers in the Orange Free State and Cape Province implemented the Optional Science Topic on copper in selected schools for the first time.

Surveys of scholars in schools using the package are being conducted by Professor J. Bradley and Mrs M. Brand. They aim to determine the effects of the material in the source package on pupils' attitudes towards careers in the mining and mineral-processing industry, and science and technology in society. This research is continuing, and a paper on the results will be published when sufficient pupils have been surveyed.

Optional Science Topics for the Future

An Optional Science Topic resource package on manganese is nearing completion by the same development team. The pilot edition will be evaluated with teachers during 1989. As with the copper package, teachers will provide feedback as to the failure and/or success of the pupil activities, and will suggest modifications. The trial editions are thus refined and evaluated by teachers, and also received by educationalists and people in industry. Several trial editions are produced before a final version is printed. The final version of the Optional Science Topic on manganese should be completed by December 1989.

A third Optional Science Topic, on chromium, is being researched at the Chemistry Department of the University of the Witwatersrand, once again under the guidance of Professor J. Bradley and Mrs M. Brand. Workshops for teachers similar to those held for the Optional Science Topic on copper will be conducted for the manganese and chromium resource packages in the next two years.

Conclusion

By introducing Optional Science Topics related to the mining and mineral-processing industry into South African schools, a large number of scholars will be exposed to the industry. This does not mean that the image of mining will necessarily always be positive, but there will be a greater awareness of the activities and careers in the industry. This awareness of our mining heritage should contribute to a greater interest in science and technology and, in the long term in schools, play a major role in encouraging scholars to decide on a future career in engineering or science in the mining industry.