SPOTLIGHT
on increased underground extraction of coal

by G. C. THOMPSON*

'Increased underground extraction of coal' was the theme selected for the 1981 mining vacation school, which was held at the University of the Witwatersrand in January and February. The response of the industry to the invitation to register was so good that three separate schools of one week each were arranged between 26th January and 13th February. In terms of the total number of delegates, some 225 actually attending, the school can be described as the most successful ever organized by the Institute.

The objective of the school was to provide updated information on the factors to be taken into account in deciding, in the first place, on increased underground extraction and, in the second place, on the methods to be applied in achieving this. It was intended that the emphasis would be essentially conceptual rather than detailed, but the scope of the school was confined to underground extraction because it was considered to be the area of greatest potential application and because the inclusion of surface methods would have entailed extending the school beyond one week. Instead of site visits, case studies occupied the last two days of the week, the delegates being given the opportunity, in an inter-active team situation, of applying their knowledge to the solution of real-life problems.

The traditional vacation-school dinner was arranged for the Wednesday evening of each week, rather than the Thursday, to enable case-study teams to work on Thursday evening if they so wished.

Programme

The first three days of each week were devoted to lectures arranged to provide a sequence from background subjects through specific methods to the illustration of the application of various methods.

Lectures on the first day introduced the topic of the whole school and covered geological, hydrogeological, and ecological factors, legal aspects and implications, and the relevant aspects of rock mechanics.

The second day opened with a lecture on the choice of various methods and the factors influencing that choice. This was followed by a lecture on ashfilling and its influence on pillar design. The rest of the day was devoted to longwall mining, with lectures on the factors affecting longwall layout, criteria for the selection of equipment and longwall operation, the final session being devoted to a lecture on the evaluation of longwalling in South Africa.

The first part of the third day was devoted to three lectures on pillar-extraction methods, including the latest 'rib pillar' techniques. These were followed by a lecture on shortwall mining, and then sessions on the application of various methods in thick-seam and multi-seam situations.

Opening and Introduction

Short opening addresses were made by the Vice Presidents of the Institute, Mr George Nisbet or Professor Alf Brown, in which reference was made to the relevance and importance of the topic and the objective of the school.

The first formal lecture was the Introduction by Mr Ben Leach of Sasol. After referring to the subjects of the lectures to be delivered at the school, he presented a broad cost breakdown of the main methods, and referred briefly to various applications. Next, he dealt with the question of differences in the definition of various terms used in the context of higher extraction, concluding that what is most important is consistency of use on a specific mine or proposition rather than overall agreement, which seems most difficult to achieve. Next, he dealt with the history of the extraction of coal in South Africa, and produced figures to indicate that there appears to have been a reasonable improvement in the percentage extraction in recent years. He then illustrated the dependence of both South Africa and the world on coal, and postulated the source of coal supplies to world markets, further illustrating the beneficial effect that increased extraction would have on new capital requirements.

After drawing attention to the need for better utilization in addition to higher extraction of coal, Mr Leach put forward some thoughts under various headings on what could be done to improve the level of underground extraction. He laid particular emphasis on the education and training of personnel.

Geological, Hydrogeological, and Ecological Factors

This lecture was divided into two parts. The first, on geological factors, was delivered by Mr Rassie Erasmus of General Mining Union Corporation and the second, on hydrogeology and ecology, by Professor Frank Hodgson of the Institute for Groundwater Studies of the University of the Orange Free State.

Mr Erasmus sketched an overall picture of the geology of the South African coal measures, and then dealt briefly with the stratigraphic succession in each field, referring also to such features as dolerite intrusions, faulting, and so on.

Professor Hodgson first defined terms and explained equations used in hydrogeology. He then covered the

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origin and location of groundwater, and illustrated the effect of increased extraction on groundwater resources, dealing with the rate of influx into the mine, the rate of dewatering occurring in overlying and adjacent sediments, and the chemical contamination of groundwater. Professor Hodgson offered some alternative proposals to reduce the impact of increased extraction, and in a final section briefly covered the possible effects of increased extraction on the ecology.

Legal Aspects and Implications

Mr Barry Shipman of the Legal Advisers Department of the Chamber of Mines dealt with this subject under five main headings. First, he referred to the rights and obligations of the mineral-rights holder and the land owner. Then he covered the statutory and common-law obligations of the mine owner. After dealing with other legal considerations, he concluded that various statutory controls may well require innovations to take more specific account of increased extraction, but that possible guidelines by the Coal Mining Research Controlling Council and others being prepared may obviate the need for detailed legislation. Contracts between land owner and mine owner should, in any event, reconcile their interests and those of the country as a whole.

Rock Mechanics of Total Extraction

Dr Horst Wagner of the Mining Operations Laboratory of the Chamber of Mines covered this subject in two lectures on the afternoon of the first day of each school. First, he dealt with the basic principles involved in total extraction, and then proceeded to the regional aspects of layout with particular emphasis on inter-panel pillars. Next, he referred more specifically to the control of immediate roof in high-extraction methods, and concluded with a discussion of the effects on the surface.

Choice of Various Mining Methods

In this lecture, Mr Con Fauconnier of General Mining Union Corporation first established the areas of application of surface and underground mining, and then classified the major underground mining systems and the coal-winning methods possible within the mining methods. After a discussion of geometrical and geological factors influencing the choice of underground methods, he went on to discuss the influence of surface protection, technology, market considerations, size of reserve, financial considerations, labour, and the availability of equipment. This lecture clearly demonstrated the multiplicity and complexity of the factors to be taken into account in deciding on increased extraction methods.

Ashfill and Pillar Design

The lecture by Mr Jim Galvin of the Coal Mining Research Laboratory of the Chamber of Mines illustrated the possibilities for obtaining increased extraction by means of the use of ashfill in bord-and-pillar workings. After describing the mode of failure of pillars, he demonstrated the effect of fill on pillars and then went on to describe the properties of ashfill and ashfilling technology. Mr Galvin then described practical applications at Koornfontein and Springfield Collieries, and postulated that ashfill would find future application in the mining of thick seams.

Factors Affecting Longwall Layout

Dr Bob Sales of Anglo American Corporation introduced the subject of longwall mining, with a discussion of the factors affecting longwall layout. After outlining a modern approach to mine design, he classified the factors into fixed and variable. He specifically discussed retreat mining because of its application in South Africa, and explored possible system layouts.

He then discussed regional and immediate strata behaviour and support load requirements for longwall faces. Finally, he covered the influence of ventilation on longwall layout.

Criteria for the Selection of Longwall Equipment

In an often amusing, but competent, condensed treatment of a subject requiring meticulous attention to detail, Mr Jack Inch of the Sasol organization managed to effectively convey the interdependent and highly-integrated nature of the equipment in a longwall system. He dealt in turn with the selection of the coal-getting machine, the armoured-face conveyor and stage loader, the supports, and the energy and services supply, and effectively linked aspects of his lecture to those of Drs Wagner and Sales, which had been delivered earlier.

Longwall Operation

A soundly practical lecture on longwall operation was presented by Mr Ochse Esterhuysen of General Mining Union Corporation and Coalbrook Collieries, where a new world record for one month's production from a longwall face was established in September 1980. He drew examples from South African practice at Coalbrook, Sigma, and Durban Navigation Collieries, and also dealt with the transfer of equipment from a completed panel to the next, new panel. He also stressed the importance of sound organization and management.

Evaluation of Longwalling in South Africa

Mr Chris Cloete of Sasol delivered a lecture in which he first discussed various factors affecting the effectiveness of the longwall operation. He then made an economic comparison between conventional bord-and-pillar mining, pillar extraction, and longwall mining. The various assumptions used in this comparison would have to be modified for different specific circumstances. As the three methods differ in their sensitivity to increases in the different components of cost, this would have to be borne in mind when projections of future cost were made.

Pillar Extraction

Pillar extraction by conventional equipment and pillar extraction by continuous miners, which appear separately in the pre-printed notes for the school, were dealt with as one subject by Mr Gordon Livingstone-Blevins of Anglo American Corporation. The fundamental requirements for pillar recovery were covered, and then such aspects as panel design, pillar design, strata control, and roof support. He described variations in the two basic methods of pillar extraction, and then presented numerous interesting examples from practice at South

African collieries using conventional equipment, scoops, and continuous miners.

Rib-pillar Extraction

Rib-pillar extraction describes the various methods in which long rib pillars are formed and soon afterwards extracted from a set of entries developed by bord-and-pillar working. Variations of the method in Australia are well known as the Wongawilli or Munmorrah method. Mr Chris Cloete described how Kriel and Sigma collieries in South Africa had recently independently developed their own further successful variations. The method requires slightly more capital than bord-and-pillar methods but offers great promise of higher production tonnages, and can more easily be adapted to thick-seam working.

Shortwall Mining

Shortwall mining is not practised in this country, but has been thoroughly investigated in Australia and the U.S.A. Mr Fred Kirstein of General Mining Union Corporation described the requirements for successful operation, including a good immediate roof and an absence of massive competent sandstone beds or dolerite sills in the superincumbent strata. He presented a tabular comparison of shortwall mining and pillar extraction using overseas figures for shortwall mining that had been reconstituted for South African circumstances, and urged that the method should be considered where conditions are suitable.

Thick-seam Mining

Mr Jim Galvin defined a thick seam in the South African context as one of more than 4 m in thickness. These seams represent more than 50 per cent of the country's mineable reserves and over 85 per cent of these can be mined only by underground methods. Of the total thick-seam reserve, 70 per cent occurs in seams between 4 and 6 m thick, and it is this range that presents the greatest challenge to the South African coal-mining engineer.

After classifying thick seams, Mr Galvin described in some detail the application of various mining methods to these seams.

Multi-seam Operations

Messrs Ray Watson and Mike Rutherford of Anglo American Corporation described the application of various methods ranging from a mini-opencast operation, through pillar-extraction techniques, to longwall methods for achieving high extraction in multiple coking-coal seams at Vryheid Coronation Collieries.

This lecture completed the formal lectures of each school.

Case Studies

For the case studies, the delegates at each school were divided into 9 teams of about 8 members each: 3 teams worked on each of the case studies, which were based on the Vaal Basin, the Natal area, and the Highveld area. A leader was appointed for each team, and each group of three teams was guided by a group leader who led the group discussion on the Friday morning of each week when the leader of each team presented the team answer.

The groups dealing with the Vaal Basin were led by Mr Ochse Esterhuysen or Mr Bobby Jurd of General Mining Union Corporation, and those studying the Natal area by Mr Peter Dickson with Mr Roy Cook of Anglo American Corporation or with Mr Reg Brandt of General Mining Union Corporation. Mr Corrie Engelbrecht of General Mining Union Corporation led the groups dealing with the Highveld area, and was assisted by either Dr Bob Sales of Anglo American Corporation or Mr Japie Stone of General Mining Union Corporation.

The delegates participated enthusiastically in case-study discussions, and a number of innovative solutions were proposed. The group leaders are combining these in the form of notes, which will be made available later to all the delegates.

Conclusion

Short concluding addresses were delivered by Mr David Rankin of Anglo American Corporation or by Mr Graham Thompson of General Mining Union Corporation. They were able to say that the school had been extremely well received, and to observe that the case studies appeared to have been valuable and enjoyable exercises. More difficult mining propositions lie ahead to challenge the South African mining engineer, and it was particularly gratifying to see representatives from both customers of the industry and suppliers to the industry at the school. Thanks are due to all the persons, some 60 in total, who contributed to the lecture notes, to those who printed and compiled the notes and arranged the school, to the lecturers, to the University, and specifically to Mr Clive Workman-Davies, the course manager, for his efficient administration and the cheerful manner in which he conducted proceedings.

The three cocktail parties and dinners were much enjoyed by those who were present. Thanks are due to those senior members of the industry who attended, and to Dr Peter Jochens, President of the Institute, and to Mr George Nisbet and Professor Alf Brown for the addresses at the dinners. Thanks are also due to the delegates, whose enthusiastic participation made it all worth while.

SAIMM is to publish the vacation school notes at the end of 1981 as a volume in the SAIMM Monograph Series. A fouth vacation school session is to be held at the University of the Witwatersrand in November. SAIMM Diary will notify readers once the date has been finalized.

Editor