

SPOTLIGHT

on an excursion to Premier Diamond Mine, Cullinan

by JOHN FREER*

The time 06h30 in midwinter is a little early to set out on an excursion from Johannesburg. Yet this was the hour that members, many accompanied by their wives, started to assemble in the parking lot adjacent to the squash courts at the Wanderers Club, Illovo, for a visit to Premier Diamond Mine at Cullinan.

All fifty were checked in and aboard the coach by 07h00. Coffee and sandwiches, served *en route* by Doris Gardner and Pam Binstead, were most welcome.

Arrival at the Mine

The party arrived at the mine punctually at 08h15 to be met by Mr Clem Sweet, who escorted the group through Security to the Public Relations rooms. Here we were welcomed by Mr Jim McLuskie, General Manager, and enjoyed tea and biscuits during a briefing session covering the history of the mine and the programme that had been

planned for our visit underground and to the Recovery Section.

The party was split into three groups: two of men, and one of ladies. After changing and being kitted out with hard hats, boots, and miners' lamps, the party reassembled on the bank for the underground visit: the ladies in blue overalls led by PRO Lorraine Kinnear in dashing red, and the men looking perfectly at ease in their normal working garb in well-laundered white and well-worn boots.

The ladies supposedly had the shorter and easier tour but, after descending in the skip, they did their whole visit on foot. The men were given a very comprehensive tour underground.

Packed tightly into the skip, we descended to 445 level, where we transferred to Landcruisers and were driven to the deeper levels down a ramp system with an impressive arrangement of traffic lights and ventilation doors.

The kimberlite pipe is elliptical, with axes of 900 m and 460 m, and has an average cross-sectional area of 32 ha at

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The ladies waiting to go underground at Premier Mine, with P.R.O. Lorraine Kinnear extreme right and Secretary Doris Gardner left.



The SAIMM party waiting for the skip to take them underground.

the surface, nearly three times as big as the pipe at Kimberley. The average mining rate is 10 m per year across the 32 ha. The mine is divided broadly into two sections by a gabbro sill some 75 m in thickness, which intrudes right across the pipe at a depth of about 400 m, and at an angle of some 20° to the horizontal and dipping north-west.

Mining Methods

Several methods are used at Premier, and can be classified into those used above the sill and those used below it.

Above the Sill

Primary breaking is done by longhole drilling from sub-level tunnels 55 m apart horizontally, at right-angles to the long axis of the pipe and 40 m apart vertically. Holes of 50 mm are drilled in a ring pattern of 29 holes just inside the face, forming a fan to cover the rectangular area extending to the level above and half-way to the tunnels on either side. The machines used are Seco S36 and Gardner Denver CH123 drifters with reverse rotation and remote-controlled rod holders. They are capable of drilling over 140 m per shift.

Blasting of the rings is done from a central blasting station on 370 level at the end of day shift. The next ring of holes is drilled 2 m back while retreating along the tunnel.

Broken ore from the blasted rings gravitates to continuous cones cut in the kimberlite floor, and thence into drawpoints each equipped with a grizzly 4,6 m by 0,68 m. Oversize material and hang-ups are blasted as they occur.

Rock that has passed through the grizzlies flows via feeder passes to slusher drifts situated 15 m below. These drifts are equipped with 75 kW winches pulling 3,5 t scraper scoops. The rock is scraped to main passes, which are

connected to the main haulage on 500 level, where the rock is transported by electric locomotives to No. 1 shaft and hoisted to surface.

Block caving and open-bench mining using trackless methods are also employed above the sill.

Below the Sill

Mining below the gabbro sill poses special problems for the mine. Because of its volume (55 Mt), there is no way the gabbro sill itself can be mined economically. Some method had to be devised by which the sill would be left intact while the kimberlite beneath it was being mined. The Premier open-stopping system has been evolved to extract the ore by excavating large stopes some 90 to 110 m high, 150 m long, and 75 m wide, supported on each side by pillars of the same length and height and 42 to 50 m wide.

Primary breaking is similar to that used for breaking above the sill. A fan-shaped ring of holes is drilled radially at the distal end of tunnels, and blasting occurs as mentioned before. The broken rock falls to the bottom of the hole, to be drawn off through cones cut on the first extraction level.

Ore is handled with 5 yd diesel load-haul-dump trucks, which tip into grizzlies placed at convenient points in the rim tunnels. Each grizzly is equipped with water sprays, dust-extraction units, and a rockbreaker that reduces oversize rocks to pass through the grizzly.

The ground falls down through raise-bored passes to the haulage, where it is collected by train and taken to a central tip. There, oversize is separated, crushed, and added to the undersize on the conveyor belt that carries it up to 445 level.

The ground is drawn out on 500 level and hoisted to surface through the ore-handling system on 500 level.

As the face of the stope retreats towards the rim, the drawpoint retreats simultaneously. A significant amount of rock is left behind, which will be recovered from the following extraction level.

Men's Tour Underground

We were given a very realistic vision of these mining methods, first below the sill and then above. Having driven down to 508 level, we clambered stiffly from the back of our Landcruiser and followed our leader to the very brink of the excavation, where our tunnel emerged on the cavernous stoped-out area.

Donning safety belts and standing back from the mouth of our cave lest we got struck from above, we surveyed the black chasm above, below, and in front with a powerful spotlight. We lit up the pillar supporting the sill, and then withdrew to examine the ring of 38 m long drill-holes that would be blasted next to send more tons of kimberlite cascading to the bottom of the vast cavern. We withdrew further, and moved 40 m to the entrance of the adjacent tunnel, in which the same preparations were in hand.

Then we walked back to the Landcruiser to descend further down the ramp system, to 553 level. We left our transport again, and walked to the draw-point on tunnel 87, where a Schopf 5 yd³ loader was loading broken ground from 508 level and tipping it over a grizzly, where a hydraulic rockbreaker broke the oversize. The broken ore gravitated to the bottom of the winze on 618 level, to be lifted by an inclined conveyor belt to 500 level and then hoisted to surface.

The cleanliness, tidiness, and order of the underground operations was a most impressive feature to a mere extractive metallurgist.

We then drove deeper down the ramp system to the vehicle workshops on 568 level, where scheduled maintenance of heavy mobile equipment ensures an average availability of 80 per cent. In addition, every machine comes in for a daily one-hour service. If Premier can organize this degree of sophistication, order, and cleanliness underground, why is the automobile industry unable to provide better service to the public up in the sunshine?

Back to our Landcruiser and the long steady haul up the winze (with the ore conveyor alongside) to 445 level, where we waited patiently at the shaft to be hoisted to 285 level. From the station, we walked against a chilling ventilation gale, eventually to emerge at the end of a tunnel with daylight streaming down from the open mouth of the big hole. Far away on the opposite wall we could see the square openings of similar tunnels, which represented the current limit of retreat of the mining face. Below us, intermittent avalanches of ground indicated where ore was being drawn off through the cones into the production levels above the sill, disturbing the rock pigeons from their nesting ledges and setting the swifts circling in the blue dome above all-atwitter.

What an experience, yet the visit was but half done!

Surface Tour

We walked back to the shaft, crammed ourselves into the skip again, and were hoisted to surface, where we shed our



285 level and the opening of the tunnel onto the open face of the mined-out pipe; similar openings are apparent on the opposite wall.

hard hats and lamps and, still in our boots and overalls, clumped across to the mine's museum. Here we were shown replicas of some of the world's most famous diamonds (including a replica of the 3106 carat Cullinan, the biggest diamond ever found, discovered 9 m from surface by Frederick Wells), stages in the cutting process for gemstones, and the classification of the smaller stones into gem and industrial.

For me there was only one disappointment — our visit to the recovery process was confined to the final collection of the medium and smaller stones on grease tables. Every 45 minutes, the tables are scraped and the grease melted by steam heating to release the diamondiferous concentrates for hand-sorting. Of the recovery of larger stones by coarse crushing of the large rocks, sizing, and X-ray-fluorescence sorting, we saw nothing; likewise, nothing of the subse-

quent concentration by successive screening and heavy-medium separation of the diamondiferous material of high relative density from the kimberlite, which has a lower relative density.

Successful Visit

Yet, taken from all points of view, it was a most successful visit rounded off by drinks in the convivial atmosphere of the historic pub and a marvellous buffet luncheon at the Recreation Centre.

Our President, Professor Peter King, expressed our appreciation very aptly when he proposed a most sincere vote of thanks to Mr McLuskie and his staff for an instructive, successful, and well-planned tour, and for making our visit such a happy and enjoyable occasion — the more so for having so many wives in the party.

Thank you again, Premier Mine!

IMM awards

Given below are details of the trust funds, etc., to which applications are invited for grants, etc., payable in 1985. Application forms, which must be returned to the Secretary before 15th March, 1985, are available on request. Applicants should note that, in general, preference will be given to members of the Institution.

Bosworth Smith Trust Fund

Approximately £3500 will be available in 1985 for grants from the Bosworth Smith Trust Fund for the assistance of post-graduate research in metal mining, non-ferrous extraction metallurgy, or mineral dressing. Applications will be considered for grants towards working expenses, the cost of visits to mines and plants in connection with such research, and the purchase of apparatus.

Stanley Elmore Fellowships

Applications are invited for Stanley Elmore Fellowships, which are awarded by the Institution and tenable at United Kingdom universities, for research into all branches of extractive metallurgy and mineral processing. Fellowships to the value of £1500 to £6000 per annum will be available from October 1985.

Atlas Copco Bursaries

Two Atlas Copco travel bursaries for study tours of Swedish mines may be awarded annually to younger mining graduates. One bursary is open to engineers in any country who have at least 3 years of practical mining experience; the second bursary will be awarded to an engineer who is studying at a British university and has a minimum of one year's practical mining experience. The awards, which were established by the Atlas Copco organization in collaboration with the Swedish Mining Association, will comprise

a 3- to 4-week tour of Swedish mining operations in September 1985. Travel expenses from any country will be paid for the first bursar and from London for the second; accommodation expenses will be met for both. The Council of the Institution of Mining and Metallurgy is responsible for the selection of the bursars, who will be required to present a written report to the Institution before 1st December, 1985, on any aspect of Swedish mining practice, methods, or organization that they found of particular interest.

G. Vernon Hobson Bequest

Applications are invited for awards from the income of the G. Vernon Hobson Bequest, established for 'the advancement of teaching and practice of geology as applied to mining'. It is expected that approximately £1500 will be available in 1985. One or more awards may be made for travel, research, or other objects in accordance with the terms of the Bequest.

Edgar Pam Fellowship

The Edgar Pam Fellowship will be awarded in October 1985 for post-graduate study in subjects within the Institution's fields of interest, which range from exploration geology to extractive metallurgy. Those eligible for the award are young graduates, domiciled in Australia, Canada, New Zealand, South Africa, and the United Kingdom, who wish to undertake advanced study or research in the United Kingdom. The value of the Fellowship, which is tenable for one year, will be of the order of £1500 to £3500.

Application forms for Institution awards are obtainable from The Secretary, The Institution of Mining and Metallurgy, 44 Portland Place, London W1N 4BR, England. Telephone: 01 580 3802. Telex: 261410.