Table 3.1

PGM production by Lonrho South Africa Ltd

Item	1989	1990	1991	1992	1993
Ore milled, kt (WPL)	2 843	4 272	5 217	5 377	5 700
Ore milled, kt (EPL)	–	n.a.	n.a.	1 760	2 171
Total, kt	–	–	–	7 137	7 871
PGM + Au, kg in matte (WPL)	11 218	15 073	17 056	18 781	22 759
PGM + Au, kg in matte (EPL)	–	2 160	n.a.	5 581	7 891
PGM + Au, kg total	–	17 233	–	24 362	30 650

n.a. Not available

western side by the transgression of the main zone ('gap' area) and on the north-eastern side by the Crocodile River fault. The shallowest occurrence of the Merensky reef is at about 1225 m from surface on the farm Zondereinde, and the deepest part at about 4250 m below surface on Kopje Alleen, the dip being about 20° to the south-west. The UG2 occurs some 20 to 35 m below the Merensky reef.

In January 1981, a wholly owned subsidiary of Gold Fields of SA Ltd obtained the right to prospect these farms in return for a Gold Fields holding of 52 per cent active interest in the area. Details of the prospect drilling are confidential, but some 20 boreholes were either drilled or existing boreholes deepened, and the results must have been sufficiently encouraging for Gold Fields to announce the establishment of the Northam mine (now Zondereinde Mine) with a lease area measuring some 10 314 ha. The reserves of the prospective mine to a depth of 2700 m were stated as 163 Mt for the Merensky reef, at an average PGM + Au grade of 10,1 g/t over a stoping width of 90 cm; and 319 Mt for the UG2 at an average PGM + Au grade of 6,6 g/t. Estimated details of the mineralized layers are provided in Tables 2.2, 2.4, and 2.5. However, it should be stressed that these reserves have not been included in the resources calculated from the Bushveld Complex, as they are deeper than the vertical depth limit of 1200 m.

From the initial announcement, the mine took more than five years to develop. Two vertical shafts were sunk, the No. 1 to a depth of 1820 m from surface and the No. 2 to 2080 m, the latter being completed by July 1991 and commissioned in March 1992. Their initial hoisting capacity will be 70 000 t/month, rising to 250 000 t/month by December 1992. Development was undertaken at the 1300 and 1750 m levels, after which it was announced that the stoping width on the Merensky reef was to be increased to 120 cm, thus lowering the grade by about 10 per cent. Since the temperature gradient is much higher than on the Witwatersrand, the rock temperatures underground are about 55 °C, and have had to be cooled to about 28 to 29 °C. A unique and innovative system of cooling has been installed, whereby chilled water is pumped from the surface, and that hydropower is used to operate hydraulic drills underground, thus eliminating the need for the conventional compressed air. However, groundwater of meteoric origin at a temperature of 65 °C has been a problem, and has delayed development. The metallurgical plant, the smelter, the base-metal refinery, housing for employees, and other surface infrastructure was completed so that the first trial milling and smelting was undertaken in August 1992. Early in 1993, the mine finally opened and the first metal was produced. Production is estimated at about 7340 kg (236 000 oz) of platinum, 4012 kg (129 000 oz) of palladium, and 560 kg (18 000 oz) of rhodium at a milling rate of 1,8 Mt per year, although similar yields have been estimated, like 7775 kg (250 000 oz) platinum, from the same throughput. The initial toll refining will be done by the W. C. Heraeus GmbH in Germany, but it is not clear whether this is to be a permanent arrangement.

3.1.5. *Other Producers or Potential Producers*

The PGM production, consisting mainly of iridium and osmium, from the gold mines on the Witwatersrand, was mentioned in Section 2.8.2. The latest reliable production figures that are available concern the period 1950 to 1975, when the average production was a steady 192 kg (6171 oz) per year. The production declined over the whole period by only 0,87 per cent per year. A best-fit regression for 1950 to 1954 gives an average production of 203 kg (a decline of 1,05 per cent) per year; 1955 to 1959, 182 kg (–8,25 per cent) per year; 1960 to 1965, 191 kg (–2,32 per cent) per year. According to Professor George Bain (personal communication, 1982) the distribution of osmiridium production among the mining groups was Gencor 82,6 per cent Anglo American Corporation 14,2 per cent, and Rand Mines 3,2 per cent. Gencor's Evander mines are five times richer than, say, the Free State mines, but production also comes from Grootvlei, ERPM, and Vaal Reefs. The gold-bearing conglomerates higher in the succession are richer in PGM than the lower reefs — but the grade is nevertheless very low, from 0,02 to 0,002 g/t. Small amounts of PGM are also recovered from the refining of copper at the Palabora mine in the north-eastern Transvaal, but no current production figures are available. However, Cousins (1976) suggested that the average production was about 85 kg or 2765 oz of PGM per year.

Over the past few years, exploration in the Bushveld Complex and its related mafic bodies has been very active. Gold Fields has drilled the Molopo Farms mafic body in Botswana, but no results have been re-

The Medvisi open pit at Noril'sk, Russia (courtesy Professor M.J. Viljoen)

Massive sulphide ore underground at the Oktyabr'sk mine, Talnakh ore junction (courtesy Professor M.J. Viljoen)