P L A T I N U M 1 9 9 9

Interim Review

Edited by Michael Steel

SUMMARY & OUTLOOK

PLATINUM

- ***Supplies of platinum will fall by 340,000 oz to 5.06 million oz in 1999, mainly due to a 38 per cent drop in Russian shipments.***
- ***Demand for platinum will rise by 200,000 oz to a new high of 5.59 million oz, leading to a drawdown of market stocks by 530,000 oz.***
- ***Platinum use in autocatalysts will fall by 70,000 oz to 1.75 million oz as substitution by palladium advances in North America.***
- ***Jewellery demand will expand by 320,000 oz to 2.73 million oz with growth in all regions, particularly in China.***
- ***Increased use in process catalysts and computer hard disks will lift industrial demand by 90,000 oz to 1.34 million oz.***
- ***Lower sales of platinum Eagle coins in the USA and large bars in Japan will reduce investment demand by 115,000 oz to 200,000 oz.***
- ***Reacting to market tightness and a sudden rise in the price of gold, the platinum price rose sharply to over $430 in early October.***

Platinum Supply and Demand		JM
'000 oz		
	1998	**1999**
Supply	*5,400*	*5,060*
Demand	*5,390*	*5,590*
Movements in stocks	**10**	**(530)**

Demand for platinum will reach a new record of 5.59 million oz in 1999. Consumption in jewellery fabrication is forecast to grow in all regions, with demand from China soaring by 230,000 oz despite showing some sensitivity to the rising price of platinum in September. Industrial demand has grown again, with increased use of platinum in process catalysts and computer hard disks. In the auto sector there has been further substitution of platinum by palladium in catalysts fitted to gasoline vehicles, but strong sales of diesel cars will help maintain demand in Europe. Sales of platinum investment products are forecast to decline by over one third.

South African supplies will rise by 140,000 oz this year to 3.82 million oz, as output from a number of expansion projects begins to come through. Russian exports have been severely hampered by legislation passed in late December 1998 which contained a provision ('Clause 19') restricting the export of pgm to specially authorised 'State Organs' in Russia. As neither Almaz nor any other Russian organisation precisely fits this description, exports of platinum ceased after the first few months of 1999. Our forecast assumes that exports will be resumed before the end of 1999 and will reach 800,000 oz. Higher supplies from Zimbabwe will be counterbalanced by a decrease from North America. Expected future growth in Zimbabwe has, however, been set back by the closure of the Hartley Platinum mine.

With demand strong, and supplies from Russia limited, we expect a deficit of 530,000 oz in 1999. Part of this will be met from sales by the US Defense Logistics Agency (DLA) of metal that has been accumulated in the US Strategic Stockpile over many years. At the end of 1998 this stock contained 439,887 oz of platinum. The DLA sold 100,065 oz of metal between June and September 1999, and is authorised to sell a further 125,000 oz of platinum in

the period from October 1999 to September 2000.

Despite the lack of exports from Russia, market liquidity was satisfactory for much of the first nine months of the year. However, the price began to move upwards in mid September and was driven up sharply by short covering in all precious metals following the announcement by 15 European central banks on 27 September that they planned to limit their future sales of gold.

For the next six months we expect the price of platinum to trade between $370 and $440. We have assumed that the Russian 'Clause 19' issue will be resolved in time for exports of platinum to recommence before the end of 1999. If this does not happen the Russian supply figure will be less than 800,000 oz and the price could exceed the upper limit of our range.

Supply

The rand income of South African pgm producers has risen significantly in 1999. Although the dollar price of platinum in the first nine months fell by $21 to $359 compared with the same period in 1998, the prices of palladium and rhodium both increased. Overall, the rand value of a representative basket of pgm prices has increased by about 18 per cent this year. With current income rising, and a greater confidence by the mines that platinum demand will continue to grow, the number of expansion projects in South Africa has increased. During 1999, three projects have led to an increase in production, and others are planned to come on-stream over the next few years.

Amplats is leading the way, with output from the new Bafokeng Rasimone Platinum Mine adding to announced expansions at PPRust, Amandelbult and Lebowa, and the company has indicated that further expansion projects will be unveiled before the end of 1999. In September, Amplats also announced an agreement to exchange mineral rights for shares in Northam Platinum, a deal that will extend the life of Northam to more than twenty years.

Platinum Supply JM

'000 oz

	1998	1999
South Africa	*3,680*	*3,820*
Russia	*1,300*	*800*
North America	*285*	*275*
Others	*135*	*165*
Total Supply	**5,400**	**5,060**

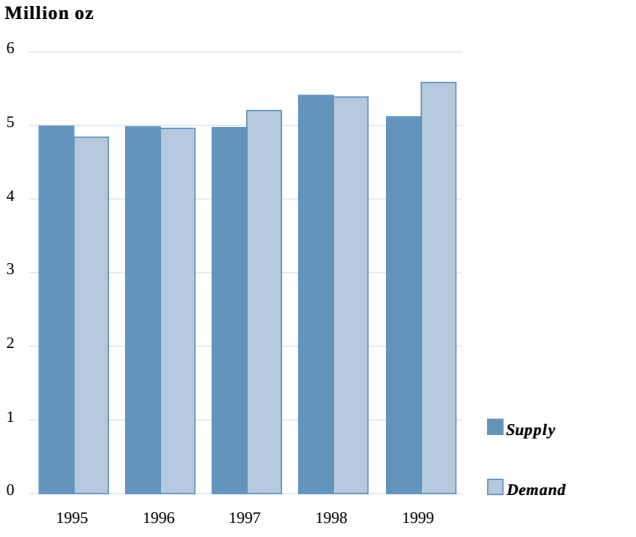
The second largest producer in South Africa, Impala Platinum, is developing a series of decline shafts from its existing underground workings that will enable the company to lift its annual platinum production to 1.1 million oz. Impala is also carrying out feasibility studies on its Crocodile River and Everest South properties and is planning to use spare smelting and refining capacity to take material from a number of independent mining operations on the Bushveld Complex. The first of these is Kroondal Platinum, which delivered the first concentrate from its open pit mine in August 1999.

The Russian supply situation has again been unclear this year, with approval of export quotas and licences severely delayed. Rumours that President Yeltsin had authorised quotas for 20 tonnes of platinum in February proved unfounded. On the contrary, it emerged that a clause contained in a bill concerning the Russian budget, signed by the President on 29 December 1998, had restricted the export of platinum group metals to specially authorised 'State Organs' only, and that none of the bodies presently involved in pgm trade in Russia legally met this specification.

Although a subsequent presidential decree allowed for palladium exports, platinum and other pgm remain trapped by Clause 19 of the Federal Law 'On the top priority measures in the budget and taxation policy'. Efforts are underway to secure an amendment to this law to enable exports to resume but it is not clear if these will be successful before the end of 1999. It is possible therefore that our supply estimate of 800,000 oz will prove to be too high.

Platinum sales from other western mines will rise by 20,000 oz to 440,000 oz in 1999, but this is a smaller increase than had been expected. Output in North America has been affected by

Supply and Demand for Platinum 1995-1999 JM



mining problems at Stillwater Mining in the USA. In June, the closure was announced of the Hartley Platinum mine in Zimbabwe, although metal in process will continue to be recovered for much of 1999.

Demand

Purchases of platinum by the auto industry are forecast to decline for the third successive year, with demand in 1999 expected to be 1.75 million oz, 70,000 oz less than last year. This is despite very high auto sales in the USA and Europe. In both of these regions, manufacturers are increasing catalyst loadings of palladium, at the expense of platinum, to meet tighter controls on hydrocarbon (HC) emissions. Financial incentives for buyers, coupled with marketing strategies by some auto makers, have combined to bring forward the date at which many vehicles meet these lower emission standards.

In Europe, diesel cars have gained market share and now account for 26 per cent of new car sales. Platinum catalysts are fitted to these vehicles to cope with the lean environment of the diesel engine, and this has helped maintain platinum demand in the auto sector. Several auto makers worldwide have increased their research on platinum-based catalysts for gasoline engines, eager perhaps to reduce their dependency on palladium, but it seems unlikely that this will cause a major shift back to platinum in the near future.

Demand for platinum in jewellery has advanced substantially once again and is expected to reach 2.73 million oz this year, up 320,000 oz on 1998. The largest increase has been in China where demand raced ahead during the first eight months of the year. However, as the price of platinum rose during September, purchases by jewellery manufacturers were cut back sharply. It is not yet clear how long it will take for the Chinese jewellery sector to adjust to higher prices. Our forecast allows for much slower demand in the final quarter of the year.

In Japan, total sales of precious metal jewellery have again fallen, being 2 per cent down by number of pieces and 7 per cent down by value in the first seven months of 1999. Despite this, sales of platinum items have risen by 3 per cent and this has led to some rebuilding of stocks in the distribution pipeline. As a result, demand in Japan is expected to rise by 30,000 oz to 1.32 million oz, the first increase for four years.

The Japanese economy has shown clear signs of recovery in 1999, but many members of the public are still concerned about their employment prospects and are unlikely to increase the proportion of their personal disposable income spent on luxuries such as jewellery. Hence, although platinum continues to increase its market share, the jewellery industry in Japan still faces a difficult time for the next year or two.

Platinum demand for jewellery in North America will rise by 20 per cent this year to reach 300,000 oz. Producers of platinum jewellery have been capitalising on the fashion trend for white jewellery and, although platinum consumption is still mainly in the bridal sector, domestic production of platinum neckchains has increased. With some of the larger US jewellery manufacturers having difficulty in keeping pace with growing demand from consumers, an increasing amount of platinum jewellery is being drawn from other countries such as Italy, India and China.

Demand for platinum jewellery is well established in Germany, Italy and Switzerland and has benefited from the general trend for white metal jewellery. There have also been

Platinum Demand by Application

'000 oz

		1998	**1999**
Autocatalyst:	*gross*	*1,820*	*1,750*
	recovery	*(405)*	*(430)*
Jewellery		*2,410*	*2,730*
Industrial		*1,250*	*1,340*
Investment		*315*	*200*
Total Demand		**5,390**	**5,590**

advances in other countries in Europe. For example, in the United Kingdom, hallmarking of platinum jewellery increased by 48 per cent in the first nine months of 1999 compared with the same period last year.

Industrial uses of platinum continue to take more metal, with demand in 1999 forecast to be up by 90,000 oz to 1.34 million oz. The most rapidly growing application is the use of platinum to enhance the memory storage capability of disks in computer hard drives. The market for these disks is expected to grow by 10 per cent this year, and the proportion in which the platinum-based technology is employed will also rise.

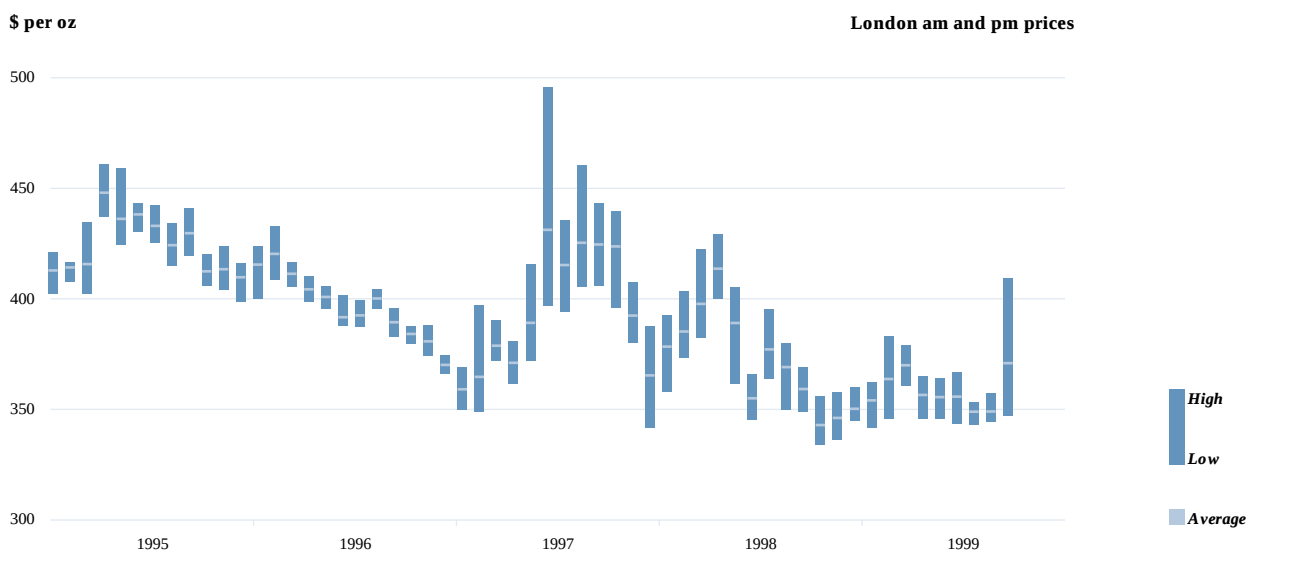
There has been increased demand this year from the chemical industry, particularly for platinum catalysts used in the production of silicones, and for the production of high purity benzene for conversion to nylon. Demand has also grown in the auto sector for non-catalyst applications such as spark plugs and sensors.

Investment demand for platinum is forecast to be down sharply by 115,000 oz in 1999 to 200,000 oz. Sales of US platinum Eagle coins in the first nine months have declined by 41 per cent compared with the same period in 1998. With the coming of the new millennium, some analysts have predicted that investors, concerned about the impact on financial institutions of the potential Y2K computer problem, would decide to switch some of their funds from cash deposits to hard assets, including precious metal investment products. Although there is some evidence of this in the USA, where sales of gold and silver Eagles have been buoyant in the first nine months of the year, platinum has not benefited. With sales of platinum bullion coins weak outside the USA, we predict that worldwide investment in coins

and small bars will fall by 90,000 oz to 120,000 oz in 1999.

Large bar investment in Japan is also expected to be down in 1999, with demand estimated at 80,000 oz. Platinum appears to have lost market share to gold, which fell below the psychologically important level of ¥1,000 per gram in June and was seen as undervalued compared to platinum. Although the platinum price also fell to levels that generated substantial buying of large investment bars in October 1998, no significant purchasing has occurred this year.

Monthly High, Low and Average Prices of Platinum 1995-1999



PALLADIUM

- ***Demand for palladium will rise by 205,000 oz in 1999 to a new high of 8.3 million oz.***
- ***With Russia expected to supply 5 million oz this year, supplies are predicted to fall by 730,000 oz to 7.67 million oz.***
- ***Autocatalyst demand has risen to 4.89 million oz, with sharp increases in the USA and Europe.***
- ***Electronics demand will fall by 11 per cent to 1.84 million oz as substitution of palladium in capacitors accelerates.***
- ***After falling to $295 in late April, the price of palladium settled into a range of $330 to $370 before advancing to over $390 in early October.***

Demand for palladium is expected to increase by just under 3 per cent to 8.3 million oz in 1999. On the other hand, supplies are forecast to fall by 9 per cent to 7.67 million oz. Although there has been no severe shortage of palladium in the market, the change from a surplus in 1998 to a deficit of 630,000 oz this year has driven the price of the metal up: in the first nine months of 1999 it averaged $343 compared to $284 for the same period of last year.

Part of the movement in stocks for 1999 of 630,000 oz has been satisfied by sales from the US Strategic Stockpile. Between June and September, the US Defence Logistics Agency sold 150,089 oz of palladium from the Stockpile, and it is authorised to sell a further 200,000 oz in the fiscal year beginning October 1999. The remaining metal required to satisfy demand has come from market stocks built up in recent years: in the period 1994 to 1998 we estimate that almost 2.3 million oz of palladium went into such stocks. Some of this metal was accumulated by hedge funds that bought palladium at much lower prices than the current level. These funds may have used the opportunity of higher prices to take profits in 1999.

Palladium Supply JM

'000 oz

	1998	1999
South Africa	*1,820*	*1,890*
Russia	*5,800*	*5,000*
North America	*660*	*620*
Others	*120*	*160*
Total Supply	**8,400**	**7,670**

Palladium Supply and Demand JM

'000 oz

	1998	1999
Supply	*8,400*	*7,670*
Demand	*8,095*	*8,300*
Movements in stocks	**305**	**(630)**

With Russia supplying about 60 per cent of the world's demand for palladium, the level of Russian exports is key to determining future prices. In the last two years, there has been a surge of such exports in the last quarter, followed by a cessation of exports early in the succeeding year. The granting of a ten-year quota to Noril'sk Nickel in March 1999 may help avoid this feast and famine situation over the coming year-end and ensure more stable prices. We therefore expect that palladium will trade in the range from $350 to $400 for the next six months.

Supply

Russian sales in 1999 are forecast at 5 million oz, 800,000 oz less than in 1998. In April the Russian government imposed a 5 per cent duty on exports of all precious metals (and many other commodities) and this led to heavy sales of palladium late in the month just before the tax came into effect. As a result, the price fell sharply to the year-to-date low of $295. For the following three months, no further palladium was exported as Almaz ceased sales. When, in July, it became apparent that the government was likely to extend the export tax ruling for at least a further six months, negotiations with prospective buyers began and, in August, exports resumed.

Early in the year, there was speculation about the policy of the Central Bank towards the stock of palladium which it holds. Financial pressures on the Russian authorities remained intense as negotiations for loans from the International Monetary Fund dragged on, and rumours abounded of the use of at least part of the Central Bank's stock of palladium as collateral for loans. Despite this, no firm evidence of such moves appeared and, in July, the Bank and Noril'sk Nickel announced that they had come to an agreement to ensure steady supplies to the market.

In April, the board of Noril'sk Nickel approved a new ten-year plan for the company which will see investment of $3-5 billion in mining, ore concentration, metallurgical processing, and general infrastructure. The main thrust of the plan is to reduce production costs rather than to increase production.

Supplies from western mines are expected to increase by 70,000 oz to 2.67 million oz. South African supplies are forecast to rise by 70,000 oz to 1.89 million oz, principally due to higher sales by Amplats. In North America, supplies from Stillwater Mining have been hit by production problems, although the long-term expansion of this operation is reported still to be on track. The closure of the Hartley Platinum mine in Zimbabwe was announced in June but the refining of ore mined in the first half of the year, supplemented by the processing of a concentrate stockpile, will increase palladium supplies from this source in 1999 and balance the shortfall from Stillwater.

Palladium Demand by Application

'000 oz

	1998	1999
Autocatalyst: gross	*4,390*	*4,890*
recovery	*(175)*	*(200)*
Dental	*1,230*	*1,160*
Electronics	*2,070*	*1,840*
Other	*580*	*610*
Total Demand	**8,095**	**8,300**

Demand

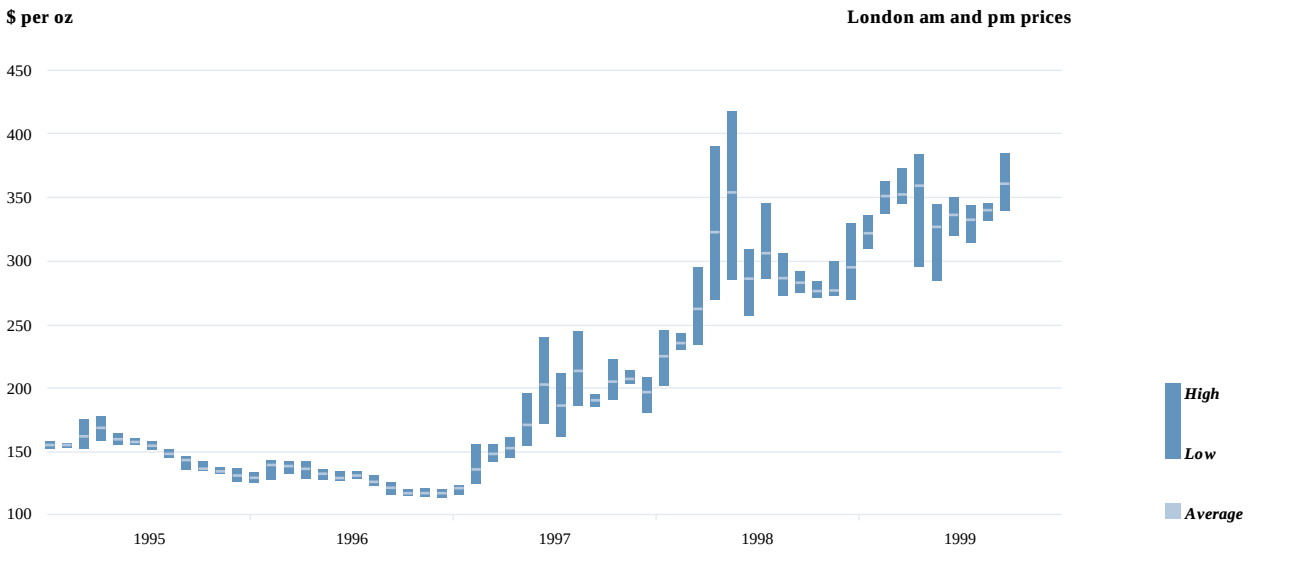
Demand for palladium has risen again, to a new record of 8.3 million oz, although growth has not been as high as in recent years. In the auto industry, where demand has grown by more than 30 per cent in each of the preceding seven years, purchases by auto companies are forecast to rise by 11 per cent this year. There has been further substitution in electronics and dental applications due mainly to the high price of palladium, with demand down by 11 per cent in electronics and 6 per cent in the dental sector.

Autocatalyst demand for palladium has once again grown in response to legislation forcing tighter control on hydrocarbon emissions. The largest increase has been in North America, where the proportion of light-duty vehicles meeting LEV standards is increasing rapidly. Also, in the USA, sales of cars and sports utility vehicles (SUVs) have been particularly strong in 1999. The popular SUVs have large engines and correspondingly large or heavily loaded catalysts and this has added to palladium demand. It also appears that some auto makers have again added to their inventories of metal, both as a response to increasing consumption and as protection against future disruption in Russian supplies.

Electronics companies have made further progress in switching from palladium to base metals in multi-layer ceramic capacitors (MLCC). In 1999, about one third of all MLCC will be manufactured with base metal electrodes, up from a quarter last year. Demand for all electronic applications of palladium is expected to be 1.84 million oz this year, down 230,000 oz on 1998.

Consumption of palladium in dental alloys will fall by 70,000 oz this year to 1.16 million oz, largely as a result of higher metal prices. In contrast, demand for palladium process catalysts and jewellery alloys will both increase marginally.

Monthly High, Low and Average Prices of Palladium 1995-1999



SUPPLIES, MINING AND EXPLORATION

SOUTH AFRICA

Supplies of platinum from South Africa are forecast to rise by 140,000 oz to 3.82 million oz in 1999, principally due to higher output at Amplats. Palladium shipments will increase to 1.89 million oz, but supplies of rhodium will fall to 394,000 oz.

Over the last two years, higher platinum prices in rand terms and confidence in demand growth have encouraged existing producers to plan expansions, and have attracted new entrants to the industry. In 1999, three new projects have added to production, and others are expected to come on-stream soon.

At Amplats' PPRust mine, concentrator capacity has been raised by 70 per cent. The upgraded plant will add to platinum output this year, with full production being achieved in 2000. During 1999, Amplats' new Bafokeng Rasimone Platinum Mine started to mine from an open-pit. The concentrator there will not be commissioned until the end of this year, but some ore is being processed at Rustenburg and will contribute to platinum production during the second half of 1999. Outside the Amplats Group, the Kroondal Platinum mine also entered production this year, delivering its first concentrate to Impala in August.

Output at these three mines will continue to build up next year. In addition, there will be an increase in platinum production at Lonmin, which is currently upgrading its concentrator and smelter capacity, while expansions at Lebowa and Amandelbult will also come on-stream.

Amplats

Milled tonnage at Amplats rose by 6 per cent in the first half of 1999. This was partly offset by a 3 per cent decline in the overall head grade. Refined pgm output was also affected by a temporary technical problem at the precious metals refinery, leading to an increase in pipeline stocks. Platinum and palladium production fell by 3 per cent to 928,000 oz and 464,000 oz respectively, while that of rhodium dropped by 14 per cent to 76,500 oz. Refined output is likely to be higher in the second half of 1999, as the build-up in pipeline stocks is reversed. In addition, some open-cast ore from the new Bafokeng Rasimone Platinum Mine (BRPM) is being milled at Rustenburg, and will make a small contribution to pgm production this year.

Current expansion projects will add significantly to Amplats' production next year. The newly-expanded concentrator at PPRust operated at around 85 per cent of capacity during the first half of 1999; full milling capacity should be reached by the end of 2000. At BRPM, the concentrator is due to be commissioned at the end of this year. The new plant will be used to process open-cast ore, which is being mined during the development of the underground mine. Refined platinum output at BRPM is planned to exceed 100,000 oz next year: at full production, scheduled for 2002, this will rise to 250,000 oz. A further 93,000 oz of platinum output will be added by expansions in UG2 mining at Amandelbult and Lebowa, both of which are expected to reach full production during 2000.

PGM Supplies: South Africa JM

'000 oz

	1998	1999
Platinum	*3,680*	*3,820*
Palladium	*1,820*	*1,890*
Rhodium	*400*	*394*

Impala Platinum

Impala milled 14.64 million tonnes of ore during the financial year to June 1999, an increase of 1 per cent on the previous year. Platinum output rose by 13,000 oz to reach 1.065 million oz. Rhodium production was up 12 per cent to 125,000 oz, with the processing of old residues supplementing production from newly-mined ore. However, refined palladium output fell by 7 per cent to 516,000 oz; production was unusually high in the previous financial year after the commissioning of the new precious metals refinery resulted in a reduction in pipeline stocks of this metal.

The company is developing a series of decline shafts from existing underground infrastructure. These will provide access to replacement ore reserves that should permit annual platinum output from Impala's current mining operations to be maintained at around 1.1 million oz.

Impala is considering a resumption of operations at the

mothballed Crocodile River mine, with the results of a feasibility study due in 2000. The company is also evaluating its Everest South prospect on the eastern limb of the Bushveld Complex.

Lonmin Platinum

Total pgm production at Lonmin was little changed, at 564,000 oz, during the six months to March 1999. For the calendar year, platinum output is expected to be similar to last year's 630,000 oz.

The company is undertaking an expansion programme that is expected to raise annual platinum production to 700,000 oz by 2002. This involves an upgrade of the company's smelting and concentrator plants, giving Lonmin the capacity to process around 9.7 million tonnes of ore per annum. Underground development to access the additional ore reserves required for the expansion has begun, while commissioning of the enhanced smelter complex is due to take place during the second half of 2000.

Northam Platinum

During the financial year to June 1999, Northam operated at full capacity, milling 1.8 million tonnes of ore - up 3 per cent on the previous year. Production of precious metals in concentrate, at 333,000 oz, was up by a similar amount.

The future of the mine appears more secure following an agreement with Amplats, announced in September 1999, under which Northam is to acquire mineral rights adjoining its existing lease area. In return, Amplats will receive 46 million shares in Northam, giving it a holding of around 20 per cent in the company. The new reserves can be accessed from existing infrastructure, and will delay the need to deepen the mine.

Other

At Kroondal Platinum, mining of underground and open-cast ore began in early 1999 and the company delivered its first concentrate to Impala for refining in August. The amount of pgm refined this year will be small, but the project is planned to reach full production of around 100,000 oz of platinum during 2000.

Aquarius Platinum, which holds a 45 per cent stake in Kroondal, has a wholly-owned platinum prospect at Marikana, south of Lonmin's Karee mine. A feasibility study on this project commenced in July 1999.

Also in July, Impala sold its 54.2 per cent interest in the partly-developed Messina platinum project to SouthernEra Resources. As a condition of the sale, SouthernEra is required to undertake a feasibility study on the project, which was partly developed before being mothballed in 1992.

At the Winnaarshoek platinum project, owned by Trojan Platinum (a subsidiary of the Canadian company Platexco), a feasibility study commenced in September 1999 and is due for completion in May next year.

RUSSIA

Russian sales of platinum and rhodium have been severely restricted this year by the impact of legislation passed in late December 1998. Our estimates of sales in 1999 of 800,000 oz platinum and 80,000 oz rhodium assume this legislation will be amended before the year end. A presidential decree in March has enabled sales of palladium by Noril'sk Nickel to proceed steadily and exports in 1999 are forecast to be 5 million oz.

In March it was announced that President Yeltsin had signed a decree giving Noril'sk Nickel a ten-year quota for palladium exports. Although it was initially reported that this decree also covered other pgm, this proved not to be so. Exports of platinum and the minor pgm became stalled by Clause 19 of the bill 'On the top priority measures in the budget and taxation policy', which was passed into law in December 1998. This clause restricts exports of pgm to specially authorised 'State Organs' only, but neither Almaz nor any other Russian organisation precisely fits this definition. As a consequence, exports of pgm, with the exception of palladium, ceased after the first few months of 1999. Although efforts are being made to amend the law, they may not be successful in time for exports to resume before the end of the year; forecasts of Russian sales in 1999 are thus highly uncertain.

Despite its inability to export platinum and rhodium,

PGM Supplies: Russia

'000 oz

	1998	1999
Platinum	*1,300*	*800*
Palladium	*5,800*	*5,000*
Rhodium	*110*	*80*

Noril'sk Nickel's financial situation has improved this year. Most of the company's income is in hard currency, and has been enhanced by the devaluation of the rouble since the August 1998 financial crisis in Russia. In April, the board of Noril'sk Nickel approved a new ten-year plan for the company that will involve major changes in its operations. The plan will involve a total investment estimated at $3-5 billion, which will be spent on mining, ore concentration, metallurgy and infrastructure. For the first five years the main emphasis is to be put on mining and ore concentration. The main thrust of the new scheme is to reduce costs rather than to increase production.

Mining operations at Noril'sk have already undergone some restructuring. At the original Noril'sk-1 deposit, work is underway to increase the amount of ore produced from the open pit and the underground Zapolyarniy mine. At the newer Talnakh operations, the two oldest mines, Mayak and Komsomol'skiy, have been combined with the newest mine, Skalistiy, in a single operational unit.

During 1998 the output of the alluvial platinum deposits at Kondyor and Koryak in the Far East Region of Russia was bought, and subsequently exported, by Gokhran and Noril'sk Nickel respectively. It is not clear what arrangements have been put in place in 1999, with the restrictions on exports of platinum due to 'Clause 19' preventing any purchaser from realising dollar income through overseas sales.

NORTH AMERICA

Supplies of pgm from North America are expected to decline by 5 per cent in 1999, largely due to lower production at Stillwater.

Stillwater Mining is currently undertaking a substantial expansion project, with the aim of tripling its production by 2001; this involves a 50 per cent increase in output at the existing Nye mine and the development of a new operation at the nearby East Boulder prospect. However, productivity and grades at Nye were affected by expansion work during the first six months of 1999, and pgm output fell to 206,000 oz, 6 per cent lower than in the same period of 1998. The mine recently stated that throughput had not increased in the July to September quarter, and we therefore expect refined pgm production for 1999 to be lower than last year.

At Falconbridge, by-product output of pgm is expected to rise this year, as the new Raglan nickel mine contributes to refined pgm production for the first time. Inco is rationalising its nickel mining operations to reduce costs, but pgm output is not expected to change significantly in 1999. Mill throughput at

PGM Supplies: North America JM

'000 oz

	1998	1999
Platinum	*285*	*275*
Palladium	*660*	*620*
Rhodium	*16*	*18*

North American Palladium was unchanged during the first half of 1999, but pgm output was affected by the processing of lower-grade ore. As a result, palladium production fell by 18 per cent to 31,000 oz during this period.

ZIMBABWE

Mining at Hartley Platinum was suspended in June 1999, and the entire operation has been put into care-and-maintenance. The mine had encountered many problems since it began production in 1995, and had reached only around a third of its planned underground mining rate.

At the end of May 1999, BHP entered an agreement to sell its 67 per cent interest in Hartley Platinum and its 61 per cent stake in the Mhondoro project to its joint venture partner Zimbabwe Platinum Mines (Zimplats), formerly part of Delta Gold, for around $3 million. We estimate that refined pgm output from Hartley in 1999 will be almost 150,000 oz. This consists of metal refined from ore mined during the first half, supplemented by the processing of a concentrate stockpile that had accumulated during a smelter shut-down in 1998.

At Zimplats' wholly-owned Ngezi project, a feasibility study on an open-pit mine was completed during the first half of 1999. At the proposed mining rate of 2 million tonnes of ore, annual platinum production would be around 100,000 oz.

The closure of Hartley leaves Mimosa as the only platinum mine currently in production in Zimbabwe. Annual output from this operation, at about 350,000 tonnes of ore, yields 15,000 oz of platinum.

PGM Supplies: Others JM

Includes Zimbabwe

'000 oz

	1998	1999
Platinum	*135*	*165*
Palladium	*120*	*160*
Rhodium	*4*	*8*

PLATINUM

AUTOCATALYST

Demand for platinum in autocatalysts is expected to decline by 70,000 oz to 1.75 million oz in 1999 as auto makers in all regions continue to make greater use of palladium catalysts to meet stricter controls on hydrocarbon emissions from gasoline vehicles. In Europe, a steady increase in sales of diesel cars has helped maintain platinum demand.

Europe

European demand for platinum in autocatalysts is expected to increase marginally to 555,000 oz in 1999. Sales of passenger cars are up in all the major European countries, with the exception of Italy where year-on-year comparisons are still distorted by the effect of an early scrappage tax incentive that ceased in July 1998. Sales of diesel cars have increased and now account for 26 per cent of all new car sales in Europe; this has been a key factor in maintaining platinum demand in the region. Although palladium has gained the position of the leading autocatalyst metal throughout the world over the last 3-4 years, platinum is for technical reasons the preferred catalyst metal for the lean operating conditions of diesel engines.

Japan

Japanese demand for platinum in autocatalysts is also forecast to increase this year, by 20,000 oz to 260,000 oz. After two years of declining domestic sales, Japan has seen a recovery in 1999, with passenger car sales up 3 per cent in the first eight months compared with the same period in 1998. Sales of mini cars have been particularly strong, helped by a change in the Japanese regulations late in 1998 that permits broader and longer vehicles in this category. Much of the growth in mini car sales has been taken by vehicles fitted with platinum catalysts and this has been the main contributor to the increase in platinum demand this year.

North America

Sales of cars in North America increased by 8 per cent in the first eight months of 1999, but those of light trucks have been even more buoyant, being 11 per cent up compared with the same period in 1998. Despite this, North American demand for platinum for autocatalysts is expected to decline by 90,000 oz to 705,000 oz in 1999. More cars are being sold that meet Low Emission Vehicle standards and this has had a negative impact on platinum demand as most auto makers are using palladium-rich catalysts to meet the tight LEV hydrocarbon emission standards.

Platinum Demand: Autocatalyst JM

'000 oz

	1998	1999
Europe	*545*	*555*
Japan	*240*	*260*
North America	*795*	*705*
Rest of the World	*240*	*230*
Total	**1,820**	**1,750**
Autocatalyst recovery	***(405)***	***(430)***

In May, President Clinton presented proposals from the Environmental Protection Agency (EPA) for the next stage of emissions control mandated as part of the 1990 Clean Air Act Amendments. These Tier 2 plans, which are due to take effect from 2004, envisage a substantial tightening of the legislation and will result in light duty trucks, which include the currently highly popular sports utility vehicles, having to meet the same standards as passenger cars. After a period of consultation, the EPA is scheduled to confirm before the end of 1999 the standards that will be imposed under Tier 2.

Rest of the World

Demand for platinum for autocatalysts in the Rest of the World is expected to decrease marginally to 230,000 oz in 1999. Car sales in South America, which have been in decline since November 1997, have fallen further this year. In Brazil, sales in the first five months of 1999 are down 22 per cent on the same period in 1998, while in Argentina domestic sales are down 36 per cent in the first five months of 1999.

In contrast, Korean auto sales and production are recovering quickly from the severe slump seen in 1998. Much of the improvement has come from an increase of around 50 per cent in

domestic car sales. Production rose by 45 per cent in the first half of 1999, but the second half may be less positive, with output expected to be affected by structural changes in the industry following on from the financial crisis experienced during 1998.

China has moved closer to the introduction of autocatalysts. A national vehicle emission policy was promulgated early this year according to which passenger cars will have to meet standards equivalent to European Stage 1 in 2000, and to meet Euro II legislation by 2004. In addition, from January 2000, all petroleum enterprises must produce only lead-free fuel, and car manufacturers must make their models suitable for use with unleaded fuel. The indications are that this will result in catalytic converters being installed on all new cars from July 2000. The Chinese government is also permitting local environmental legislation, provided that such standards are stricter than the corresponding national legislation. As a result, some cities, notably Beijing and Shanghai, have brought forward the commencement of new rules to 1999.

Autocatalyst Recovery

The amount of platinum recovered from scrapped autocatalyst continues to climb gradually and is expected to reach 430,000 oz in 1999, an increase of 25,000 oz over last year.

JEWELLERY

Demand for platinum in the manufacture of jewellery is expected to reach a new record level of 2.73 million oz in 1999, exceeding last year's figure by 320,000 oz. Demand in China has increased sharply again and is expected to reach 850,000 oz this year. The market has expanded in the USA, while in Japan consumption by jewellery manufacturers has resumed its upward path after two years of decline.

The Japanese economy may have bottomed out but there is evidence that consumers do not yet feel confident about spending their personal disposable income because of fears about the long-term outlook for jobs. This in turn has affected the jewellery industry, where the number of precious metal jewellery items sold in the first seven months of 1999 fell by 2 per cent. Despite this, sales of platinum items rose by 3 per cent, helped by the global fashion trend towards white metal jewellery. There are signs that this increase has led to manufacturers regaining confidence and that there has been a modest rebuilding of stocks of platinum jewellery in the distribution pipeline.

There has been a continuation of the trend in which couples are reducing the amount of money spent on marriage rings by buying one stone-set ring and one plain band rather than having an engagement ring plus two wedding bands. This has reduced the quantity of platinum consumed in marriage rings, although the loss has been somewhat offset by a move to heavier wedding bands. Sales of fashion jewellery such as necklaces, pendants and bracelets are up strongly this year, with white metal products gaining market share. Silver and white gold jewellery have advanced at the cheaper end of the market, but lightweight items in platinum have been particularly popular. Overall, we expect demand for platinum in jewellery in Japan to rise by 30,000 oz to 1.32 million oz in 1999.

The fashion trend for jewellery in Europe has also been for white metal. In the watch industry this has been mainly satisfied by stainless steel, so that the number of Swiss platinum watches made in the first half of 1999 was unchanged from 1998. Fabrication of platinum jewellery in Switzerland and Germany has also been broadly similar to last year. Increased output of platinum jewellery in Italy, much of it for export, and from the UK, where consumer demand for platinum has grown significantly, will result in total demand in Europe rising by 6 per cent to 170,000 oz.

Platinum demand in North America is forecast to reach 300,000 oz in 1999, an increase of 20 per cent. The popularity of platinum is spreading in a generally healthy jewellery market. White jewellery is fashionable, and platinum-yellow gold combination jewellery is giving way to platinum-only items. Although bridal rings still account for the majority of platinum jewellery pieces, domestic production of platinum neckchains

has increased. Major jewellery retail stores are now carrying platinum collections and platinum jewellery is regularly featured on television shopping channels. Some of the larger US jewellery companies have had difficulty in keeping up with demand, while production by smaller manufacturers, particularly on the west coast, has grown dramatically in the last two years - hence our revision of 1998 demand from 220,000 oz to 250,000 oz. The strength and spread of consumer demand has drawn in an increasing quantity of imported platinum jewellery, with Italy, India and China being the main sources.

Demand for platinum jewellery has continued to grow within China itself. In major cities a high proportion of counter space in jewellery stores is occupied by platinum, mainly in the form of plain and gem-set rings and lightweight neckchains. Platinum jewellery is also now evident in stores in outlying regions. The popularity of platinum among consumers can be attributed to a high personal disposable income amongst middle class urban Chinese, a desire for the modern look of white metal, and the low price of platinum jewellery in China compared with other markets. Platinum jewellery also appeals to Chinese consumers because of its high purity.

Manufacturing in China is being carried out on an increasingly industrial scale with several new highly mechanised factories starting to make large quantities of platinum jewellery during the year. Some older and smaller manufacturers, on the other hand, have ceased to produce on their own account and have sub-contracted work to the new entrants. Despite the growth in demand for platinum jewellery, profit margins at all levels of distribution are far lower in China than in most other jewellery markets. Consequently, it was no surprise that manufacturers sharply reduced their purchases in September 1999 as the price of platinum rose by over 20 per cent. Although buying could remain subdued if the price continues to rise, demand for jewellery fabrication in China is unlikely to be less than 850,000 oz in 1999.

Production of platinum jewellery in most other Asian countries is dependent on export trade and remains depressed by a lack of demand from Japan, although manufacturers in India have increased output to meet demand for their products in the USA.

Platinum Demand: Jewellery JM

'000 oz

	1998	1999
Europe	*160*	*170*
Japan	*1,290*	*1,320*
North America	*250*	*300*
Rest of the World	*710*	*940*
Total	**2,410**	**2,730**

INDUSTRIAL

Demand for platinum in industrial applications is expected to rise by 90,000 oz to reach 1.34 million oz in 1999. The largest elements of growth are in process catalysts, hard disks, and non-catalyst auto applications.

In the chemical sector, demand for platinum has remained strong for catalysts used in the production of silicones. There has also been some limited, but significant, investment in petrochemical processes that use platinum catalysts to produce high-purity benzene for conversion to nylon.

Platinum Demand: Industrial JM

'000 oz

	1998	1999
Chemical	*280*	*320*
Electrical	*320*	*350*
Glass	*220*	*200*
Petroleum	*125*	*130*
Other	*305*	*340*
Total	**1,250**	**1,340**

The use of platinum in hard disks, which was described in a special feature in *Platinum 1999*, continues to grow apace. Part of the growth arises from higher production of disks, with output worldwide expected to increase by more than 10 per cent to reach 450 million. In addition, the use of a platinum-containing layer to increase the magnetic cooercivity of the disks, and hence their memory storage, is widening. Although demand in other electrical applications of platinum such as thermocouples, varistors and multi-layer ceramic capacitors is expected to be static, its increased use in hard disks should boost platinum demand in the electrical sector by 30,000 oz to 350,000 oz in 1999.

A developing use for platinum is in fuel cells, which we report on in the electrical sector. Although the quantity of metal used at present is small, the prospects of substantial demand in proton exchange membrane (PEM) fuel cells in the medium to long term have improved again in 1999. The holy grail for fuel cell manufacturers is the incorporation of their products in cars, and this year plans were announced by at least six major auto makers to start limited production of cars powered by PEM fuel

cells in either 2004 or 2005. There has also been progress in the development of small PEM fuel cells, with power outputs of 5-10kW, for use in domestic applications, providing power and hot water for individual homes. These may well result in significant demand for platinum before the fuel cell car is fully commercialised.

Sales of liquid crystal displays (LCD) for laptop and notebook computers are growing at more than 10 per cent a year and this has led to strong demand for the high quality thin glass used in these units, which is normally manufactured in platinum equipment. There has been substantial investment in new plants to produce such glass over the last few years but expansion of capacity has now slowed, with the result that demand for platinum has been a little weaker in 1999. With LCD's share of the computer monitor market predicted to double by 2002, further investment in new plants to produce the required glass is likely over the next few years.

Purchases of platinum for petroleum refining catalysts are expected to be 5,000 oz higher in 1999, at 130,000 oz. Growth in ownership of cars, and the popularity of sports utility vehicles in the USA, is leading to increased gasoline consumption and the need for further refining capacity. The principal increases in platinum demand for this application in 1999 are in North America and Europe; demand in other regions of the world will be slightly lower than last year.

The buoyant sales of autos referred to earlier in this chapter has led to increased demand for platinum in the non-catalyst applications associated with the auto industry. Pre-eminent is its use in spark plugs, where the addition of platinum tips to the electrodes substantially increases resistance to erosion, leading to longer life and better performance. This increase has helped boost demand in all other applications by 35,000 oz in 1999 to 340,000 oz.

INVESTMENT

Lower sales of platinum coins in the USA and large bars in Japan will result in a steep drop in investment demand in 1999, with offtake expected to decline by 115,000 oz to 200,000 oz.

Sales of the US Mint's platinum Eagle coins in the first nine months of 1999 were 57,750 oz, a fall of 41 per cent from the corresponding period of 1998. At the beginning of this year it was thought that sales might be stimulated by concerns about the stability of the financial sector at the end of 1999 due to the potential Y2K computer problem. Sales of silver and gold coins by the US Mint have indeed risen sharply, by 162 per cent and 45 per cent respectively in the first nine months of the year, but this speculative interest has not spilled over into platinum. Although sales of the platinum Eagle have fallen, the coin is still

Platinum Demand: Investment

'000 oz

	1998	1999
Coins and small bars		
Europe	*5*	*5*
Japan	*25*	*20*
North America	*175*	*90*
Rest of the World	*5*	*5*
	210	*120*
Large bars in Japan	*105*	*80*
Total	**315**	**200**

increasing its market share at the expense of the Canadian Maple Leaf and the Australian Koala. The US Mint has produced an edition of proof platinum Eagle coins; all 14,595 oz of these are expected to be sold, as were previous proof editions in 1997 and 1998. Total sales of bullion coins and small investment bars in 1999 are expected to be 43 per cent lower than last year, at 120,000 oz.

In Japan, the local price of platinum in yen terms has been less volatile than in 1998, peaking at ¥1,500 per gram in February and then drifting down to approach ¥1,200 per gram in August as the yen strengthened against the dollar. In these conditions, investor interest in platinum investment bars has been muted. Another factor may be that the gold price in yen terms has fallen even further, and in June fell below the psychologically important ¥1,000 per gram level for the first time since 1973. As a result, investment in gold bars has seen much greater speculative interest from the general public and gold has gained share in the physical investment market for precious metals. We expect demand for large platinum bars in Japan to fall by 24 per cent to 80,000 oz in 1999.

PALLADIUM

AUTOCATALYST

Demand for palladium is expected to increase sharply again in 1999, rising by 500,000 oz to reach 4.89 million oz. The largest increases will occur in North America and Europe, where palladium loadings are being increased to meet tougher hydrocarbon emission standards.

Europe

European demand for palladium for autocatalysts is expected to increase by 140,000 oz to 1.51 million oz in 1999. The steady substitution of palladium for platinum in catalysts fitted to gasoline cars has been well documented in our recent reports and is continuing this year. Palladium demand has also been enhanced by fiscal incentives that encourage the early introduction of cars meeting Euro Stage III emissions legislation. These standards are due to be effective for new models from January 2000 and for all new cars from January 2001. From these dates a new set of incentives will come into effect that will apply to cars meeting the Stage IV regulations that are planned for 2005; there are already indications that some auto makers are planning to switch directly to Stage IV technology. These developments are expected to boost pgm demand in autocatalysts, with palladium loadings rising most strongly.

Palladium Demand: Autocatalyst

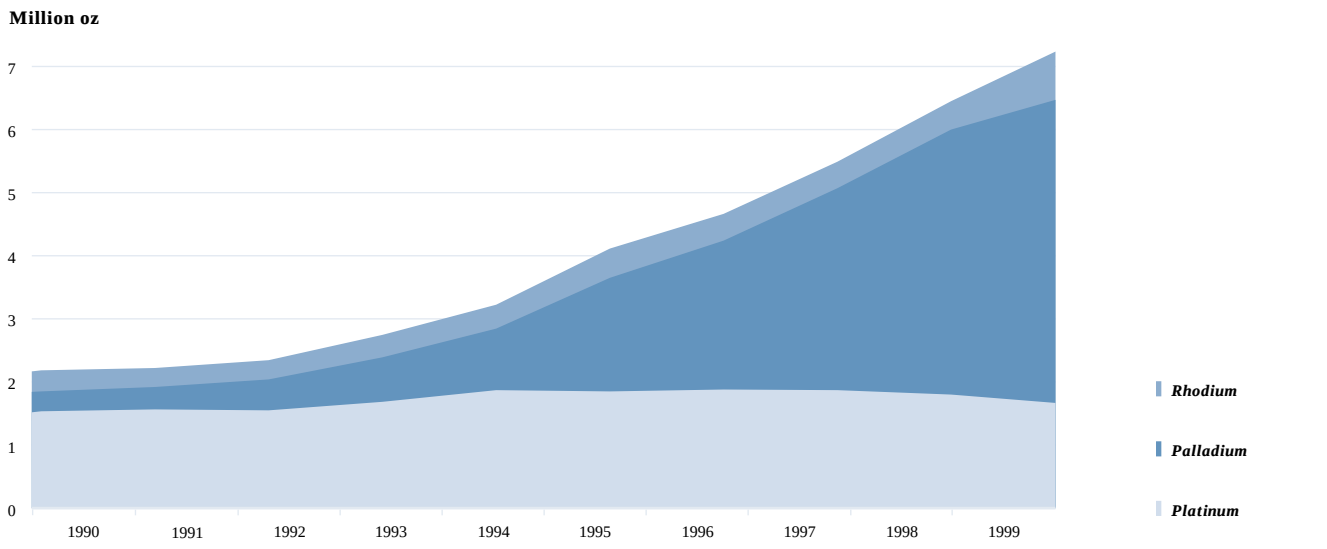
'000 oz

	1998	1999
Europe	*1,370*	*1,510*
Japan	*330*	*350*
North America	*2,470*	*2,810*
Rest of the World	*220*	*220*
Total	**4,390**	**4,890**
Autocatalyst recovery	***(175)***	***(200)***

Japan

In Japan, demand for palladium for autocatalysts is forecast to increase by 20,000 oz in 1999, to reach 350,000 oz. This is partly a result of this year's recovery in passenger car sales, up 3 per cent in the first eight months over the same period in 1998. Another reason for the increase in demand is that exports to North America have risen, and these cars are increasingly being fitted with heavily loaded palladium-rich catalysts to meet LEV standards.

Demand for PGM in Autocatalysts 1990-1999



North America

North American demand for palladium in autocatalysts is expected to grow sharply once again in 1999, rising by 340,000 oz to 2.81 million oz. A major factor in the increase in palladium demand is higher sales of cars and sports utility vehicles, with the large engines of the latter requiring correspondingly larger catalyst volumes to control emissions.

In addition, the proportion of cars that meet LEV standards has increased, with most manufacturers raising the loadings of palladium in catalysts used to meet these standards. Auto makers appear to be accelerating the production of LEV vehicles, both as a marketing tactic and to gain credits against future legislation. From the middle of 2000, virtually all light duty vehicles sold in the USA will meet the LEV standard.

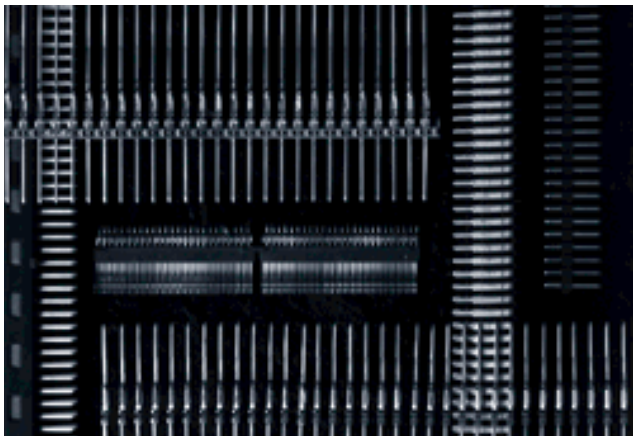
Rest of the World

Demand for platinum for autocatalysts in the Rest of the World is expected to be unchanged at 220,000 oz in 1999. Demand in Korea will increase due to a recovery in domestic car sales. In India, demand for pgm in catalysts is expected to rise this year and next. The Indian Supreme Court has ruled that from 1 April 2000, all new cars sold in Delhi will have to comply with Euro II emission standards; this will affect some 15 per cent of cars sold in India. The catalysts used on most of these cars will contain palladium and rhodium.

Demand for palladium will fall in South America, where car sales have been in decline since November 1997, when the Brazilian Government raised interest rates in an attempt to minimise any knock-on effect from the Asian financial crisis. As a result, car sales in Brazil fell by 23 per cent in 1998, and they have continued to decline in 1999. Argentina, the third largest car producer in Latin America, exports about 45 per cent of its output to Brazil and has therefore also suffered.

Autocatalyst Recovery

The amount of palladium recovered from scrapped autocatalysts continues to climb gradually and is expected to reach 200,000 oz in 1999. The rapid growth in the use of palladium in autocatalysts did not begin until 1995. Therefore, the recovery of this metal from catalytic converters removed from scrapped cars will not accelerate for another 3-4 years. Most of this growth will come from the USA where the recovery infrastructure is much better developed than in Europe, the other region which has seen a dramatic increase in the use of palladium in autocatalysts in recent years.

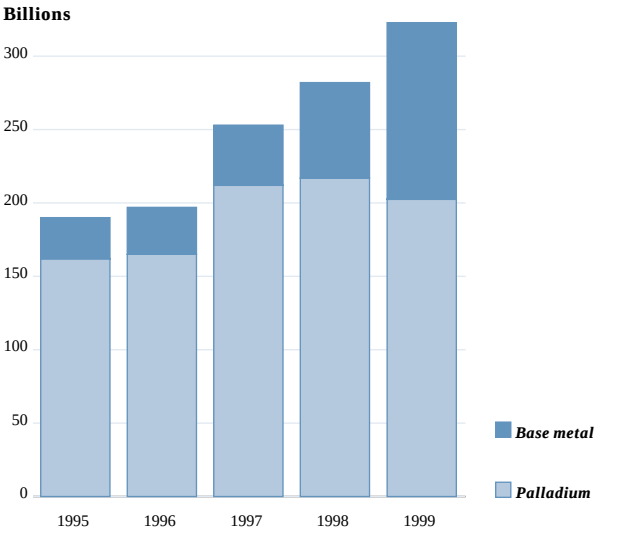


ELECTRONICS

Palladium demand for electronics is expected to decline by 230,000 oz in 1999 to 1.84 million oz due to a combination of substitution by base metals and further miniaturisation of electronics goods.

The principal use for palladium in electronics is in the electrode layers of multi-layer ceramic capacitors (MLCC). Production of these components, which are widely used in mobile phones, auto and consumer electronics, has risen by 18 per cent in 1999, but higher palladium prices have led to an expansion in the use of base metal electrodes - usually nickel - and this is eating into palladium's market share. Base metals are expected to account for almost one third of the MLCC manufactured in 1999, up from around a quarter in 1998. The changeover has occurred most rapidly in Japan, where manufacturers have traditionally used electrodes with a high palladium content, making substitution

MLCC Production by Electrode Type



by base metals very attractive. Even in other regions of the world, where the use of palladium is less intensive, MLCC makers are investing steadily in the new production lines that are necessary to utilise base-metal technology.

In addition to substitution, palladium demand in MLCC is being negatively affected by continued miniaturisation of many electronic devices, as typified by the ever-reducing size of mobile phones. Despite these changes, palladium is expected to be retained in high-reliability and other specialised MLCC, where the technical demands are greatest. Therefore, although base metals will account for much of the forecast growth in the production of MLCC in future years, the use of palladium is likely to remain significant.

Palladium Demand: Electronics

'000 oz

	1998	1999
Europe	*270*	*240*
Japan	*1,080*	*925*
North America	*480*	*450*
Rest of the World	*240*	*225*
Total	**2,070**	**1,840**

The high price of palladium, and its volatility over the past two years, has also impacted other uses in the electronics sector. When the price of palladium was below that of gold it was increasingly being used as an alternative to gold for plating connectors, but the current differential in price between the two metals - a premium of $78 for palladium at the end of September 1999 - makes any further switch from gold unlikely. For the plating of lead frames used to mount semiconductor chips, palladium has an advantage over the traditional tin-lead solders on health and environmental grounds, and some switching to palladium has taken place. However, the high price of palladium is encouraging manufacturers to seek alternative solutions for the replacement of tin-lead.

OTHER

Demand for palladium in other applications will decline marginally this year, from 1.81 million oz in 1998 to 1.77 million oz. Although there has been a reduction in the use of palladium in dental alloys, increased demand in jewellery alloys and process catalysts has largely offset this decline.

In 1998 there was a significant drop in demand for palladium from European dental alloy manufacturers, but this was related more to changes in the method of reimbursing dental patients in the largest dental alloy market - Germany - than to the increase in the price of palladium. The new German government, elected in September 1998, has reversed these changes, but during the current year both the new and old systems of dental remuneration have been operating simultaneously in different parts of the country. As a result, a clear picture of the German dental market is not likely to emerge until well into 2000.

Palladium Demand: Other

'000 oz

	1998	1999
Chemical	*230*	*245*
Dental	*1,230*	*1,160*
Jewellery	*235*	*255*
Other	*115*	*110*
Total	**1,810**	**1,770**

It is plain, however, that some sensitivity to the price of palladium has emerged in the dental sector. This is not surprising because the growth in the use of palladium-based alloys during the 1990s was due to their low price compared with gold alternatives. Although technical factors also play a role in the choice of alloy used by the dentist, the current differential in price between gold and palladium is a disincentive to the use of the latter. This price sensitivity has been seen most sharply in the USA and in some European markets. Demand in Japan has been less affected due to the widespread use of an alloy containing 12 per cent gold and 20 per cent palladium that is covered by the state insurance scheme. Overall, demand for palladium in dental alloys is expected to fall by 6 per cent to 1.16 million oz.

Palladium is used as a component of both platinum and white gold jewellery alloys. The steadily rising price of palladium has led some manufacturers to substitute it with cheaper metals in these alloys. However, any such substitution this year has been outweighed, for platinum jewellery, by the rise in demand in China and, for white gold, by the trend towards white metal jewellery in other parts of the world. We therefore expect palladium demand for jewellery to increase by 20,000 oz in 1999 to reach a total of 255,000 oz.

Demand for palladium in the chemical sector is expected to grow by 15,000 oz this year, to reach 245,000 oz. There has been significant investment in catalysts used in the production of tetrahydrofuran, a chemical used in the production of synthetic fibres, and acetaldehyde, used in the production of acetic acid.

OTHER PLATINUM GROUP METALS

RHODIUM

Demand for rhodium in 1999 is expected to be 525,000 oz, an increase of 16,000 oz over last year. Greater demand from auto makers will outweigh increased recovery from scrapped autocatalyst; industrial demand for rhodium will be similar to that of 1998. By contrast, supplies of rhodium are forecast to decline by 30,000 oz to 500,000 oz in 1999.

The lack of Russian exports during most of the first nine months of the year has been a major feature of the rhodium market in 1999. Trade statistics indicate that the Russians have been active exporters only in March, with US imports of rhodium from Russia amounting to just over 70,000 oz in that month. Apart from this, no other country has reported any significant imports of rhodium from Russia so far this year.

The main reason for the lack of Russian shipments is that Almaz is unable to export rhodium at present due to a clause in the Russian 1999 budget legislation that was passed in December 1998. As a result, supplies from Russia are forecast to fall by 30,000 oz to 80,000 oz. We have assumed that efforts currently underway to amend this legislation will be successful in time for further exports to be made before the end of 1999, but this is far from certain.

Other supplies of rhodium will remain steady at 420,000 oz, with a small reduction in shipments from South Africa being balanced by increased sales from Canada and Zimbabwe.

Rhodium Demand by Application

'000 oz

	1998	1999
Autocatalyst: gross	*483*	*508*
recovery	*(57)*	*(66)*
Chemical	*31*	*34*
Electrical	*8*	*8*
Glass	*34*	*30*
Other	*10*	*11*
Total Demand	**509**	**525**

Rhodium Supply and Demand

'000 oz

	1998	1999
Supply	*530*	*500*
Demand	*509*	*525*
Movements in stocks	**21**	**(25)**

The price of rhodium has strengthened during 1999 as demand has remained firm and supplies have been limited. After starting the year at $780, it quickly rose to $900 and has remained at or above this level for most of the year. For the first nine months of 1999, the rhodium price averaged $898 compared with $596 in the same period in 1998.

Autocatalyst

Purchases of rhodium by auto makers were strong in 1998 compared with the previous year, and have grown again in 1999, to 508,000 oz. Catalyst loadings of rhodium are expected to increase to meet the tougher NOx standards that form part of all the emissions legislation that is scheduled to come into effect over the next few years. Higher loadings of rhodium may also be a means of cutting back on palladium use in autocatalysts.

In addition to purchases for current consumption, some auto makers, perhaps mindful of high prices in the early 1990s, are believed to have increased inventories of rhodium to safeguard against future price volatility or shortages.

Recovery of rhodium from scrapped autocatalysts continues to increase and is now a significant factor in the overall supply-demand balance in this market. Recovery in 1999 is expected to yield 66,000 oz of rhodium, up by 9,000 oz on the level of 1998. This increase reflects the higher loadings of rhodium that began to be employed in autocatalysts from the early part of the 1990s. In North America, in particular, rhodium loadings were increased to meet the NOx standards which were progressively phased in from 1993, as part of the US Clean Air Act Amendments of 1990.

Other Demand

Demand for rhodium in industrial applications, at 83,000 oz, is the same as that of 1998. A small increase in consumption by the chemical industry has been balanced by lower demand in the production of glass.

RUTHENIUM & IRIDIUM

Demand for ruthenium has again grown modestly in 1999 and is expected to reach 388,000 oz, a rise of 13,000 oz compared with last year. Iridium demand is expected to increase by 5,000 oz to 110,000 oz.

The largest application for ruthenium is in the electronics industry, for the manufacture of resistors. The effect of increased production of resistors has been somewhat offset by the miniaturisation of components that is a well-established feature of the electronics industry. However, unlike the use of palladium in MLCC and other components, the combination of a relatively low and stable price for ruthenium, and its excellent resistive properties makes substitution by alternative materials unlikely.

Ruthenium Demand by Application JM

'000 oz

	1998	1999
Process catalyst	*87*	*81*
Electrochemical	*74*	*72*
Electronics	*184*	*195*
Other	*30*	*40*
Total Demand	**375**	**388**

In 1999, demand for ruthenium in electronics is expected to rise by 6 per cent to 195,000 oz.

In the chemical industry, ruthenium is used as a catalyst to produce a number of key chemicals such as ammonia and acetic acid. In both these instances, ruthenium competes with base metals as the catalyst metal of choice but is used preferentially in certain proprietary processes. No major investment in these processes has occurred in 1999 and demand is therefore slightly down on recent years, at 81,000 oz.

Ruthenium and iridium are used to coat electrodes used in the production of chlorine. The use of this chemical as a bleaching agent in paper production remains under threat for environmental reasons. However, demand for chlorine continues to be strong for the production of intermediates in the production of polyvinyl chloride (PVC). Demand for ruthenium and iridium from the electrochemical sector is expected to remain virtually unchanged in 1999 at 72,000 oz and 28,000 oz respectively.

Iridium Demand by Application JM

'000 oz

	1998	1999
Process catalyst	*3*	*7*
Electrochemical	*30*	*28*
Automotive	*36*	*37*
Other	*36*	*38*
Total Demand	**105**	**110**

Ruthenium demand is forecast to rise by 10,000 oz to 40,000 oz for other applications this year, mainly due to increased usage of the metal as an addition to titanium alloys for pipes used in extremely corrosive environments.

Purchases of iridium for use in autocatalysts fitted to gasoline direct injection (GDI) engines have continued, but are expected to decline in future as new tougher emissions legislation comes into force in Europe and Japan. GDI engines may have problems meeting this new legislation and it seems probable that although catalytic solutions will be found, they may not require the use of iridium. Elsewhere in the auto sector, there will be an increase in the use of platinum-iridium alloys in spark plugs in North America.

Demand for iridium in a variety of other applications has remained firm at 38,000 oz in 1999. These include such diverse uses as crucibles for crystal growing, electrode coatings for cathodic protection, iridium-platinum alloy leads for heart pacemakers, and as a minor constituent of some jewellery alloys.

PRICES AND FUTURES MARKETS

PLATINUM

Market Review

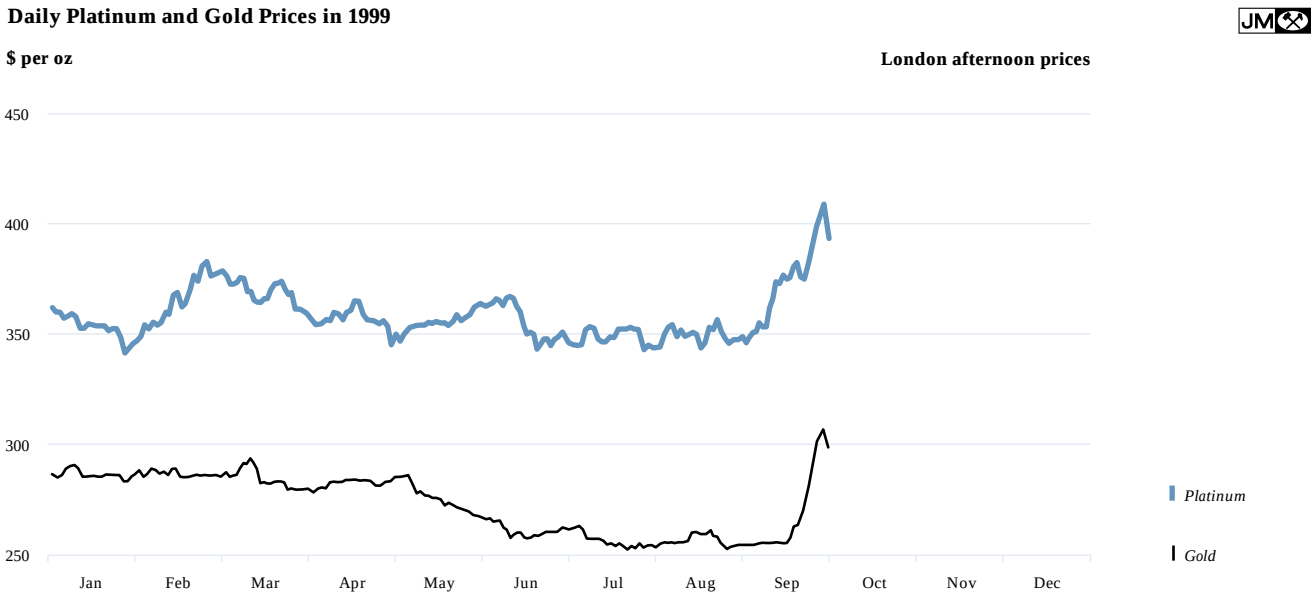
A general fall in world commodity prices depressed the platinum price at the beginning of 1999 but it soon recovered as it became clear that Russian pgm exports would again be delayed. The price jumped by over $40 to a high of $384 at the end of February before falling back to $346 at the end of April when Russian palladium shipments were briefly resumed. The market then quietened down over the summer months and the price stabilised at around $350. Towards the end of September a sharp recovery in gold propelled platinum to a high of $429. Platinum averaged $359.04 during the first nine months of 1999, compared with $380.26 for the same period in 1998.

Platinum held on to the gains made at the end of December 1998 and recorded $362.50 at the first London fix of 1999. On 10th January there were reports that President Yeltsin had signed a decree setting Russian export quotas for 1999 at 20 tonnes of platinum and 100 tonnes of palladium and that deliveries were imminent. This news was, however, quickly overshadowed by widespread turmoil in the world financial markets following a large devaluation in the Brazilian currency and the resignation of the country's Central Bank president. Commodity prices began to fall and platinum, also affected by a drop in the gold price, sank to a low of $342 on the 28th. During the second half of the month there was confusion in the market about whether the Russians had restarted pgm exports. The general feeling was that if any metal had been shipped in early 1999 it would have been from the previous year's quota.

The platinum price recovered sharply during February, its rise tempered only by occasional profit taking. Speculative buying and the continued lack of Russian sales helped platinum reach $384 on the 24th, its highest price since July 1998. At this point the premium to gold was $95. Platinum ended February at $378, $31 higher than at the beginning of the month.

After the gains of the previous month, March was fairly uneventful for platinum. On the 3rd, Vladimir Potanin, the head of the Interros group (the largest shareholder in Noril'sk Nickel) announced that Noril'sk had received a ten-year quota for exports of pgm, instead of the historical one-year quota. It later transpired that this was for palladium sales only. The month's high for platinum of $379.50 was recorded on the 1st and from then on the price slipped downward, falling to a low of $361 at the month's end.

Daily Platinum and Gold Prices in 1999



Platinum's decline continued into the beginning of April with the price falling to $354.25 on the 6th. This trend was attributed to fund selling, later confirmed in a report from the US Commodity Futures Trading Commission that showed a substantial reduction in speculative long positions of 210,000 oz in the previous two weeks' trading. A spate of buying lifted platinum to the month's high of $365.50 on the 19th but the rally proved shortlived. Reports of future IMF gold sales to fund debt relief for poorer countries, and substantial shipments of palladium from Russia at the end of the month, pulled platinum down further to a three-month low of $346 on the 29th.

May was a quiet month for platinum. Firmer gold and palladium prices lifted platinum to $356 on the 7th and the price remained around this level for much of the month, before rising to $365 on the 28th. There was a tightening in the physical market at the beginning of June, with three-month lease rates reaching 6 per cent. News that the Hartley Platinum mine in Zimbabwe was to close reinforced the positive sentiment and the price rose to $367.50 on the 4th. Persistent fund selling later in the month then caused the price to drop sharply from $367.50 on the 10th to $344.50 on the 22nd, the lowest level since the end of January. Bargain hunting at the end of the month lifted platinum to finish June at $349.

July was another quiet month for platinum with little activity in the market. The first in a series of gold sales by the Bank of England triggered a drop in the gold price early in the month and this pulled platinum down to $345 on the 6th. The platinum price then recovered to trade in a $347 to $353 range for the following three weeks before falling back to $343.75 at the month-end London fix. Reports by some analysts that platinum was overvalued compared to gold, causing some investors to buy gold futures and sell platinum, may have contributed to platinum's descent.

A general rally in the metal markets at the beginning of August gave support to platinum and the price recovered to $350.50 on the 3rd. News that over 4,000 miners at Northam Platinum, the smallest of the established South African platinum producers, were on strike then lifted the price to $354.25 on the 5th. It slipped back to $349 at the end of the week following news that the industrial action had ended. A bout of selling on NYMEX caused a brief slump to $344.50 on the 16th but platinum soon recovered, rising steadily to the month's high of $357.50 on the 20th. The price then slipped back to end August at $349.

For much of September the pgm markets took their lead from gold. On the 7th a proposal from the IMF to revalue rather than sell ten million ounces of its gold reserves boosted gold, and platinum reached $355. Heavy fund buying and a tightening in lease rates over the following two weeks caused platinum to rally to a seven-month high of $382.50 on the 22nd. On the 27th a joint statement by 15 European central banks, announcing that they would limit gold sales to 400 tonnes per annum for the next five years, triggered short covering in the precious metals markets. Gold recovered sharply to over $300 and platinum followed, reaching its highest price during the first nine months of 1999 of $429 at the morning fix on the 29th. The price softened to $409 in the afternoon and fell back to $393 at the end of September.

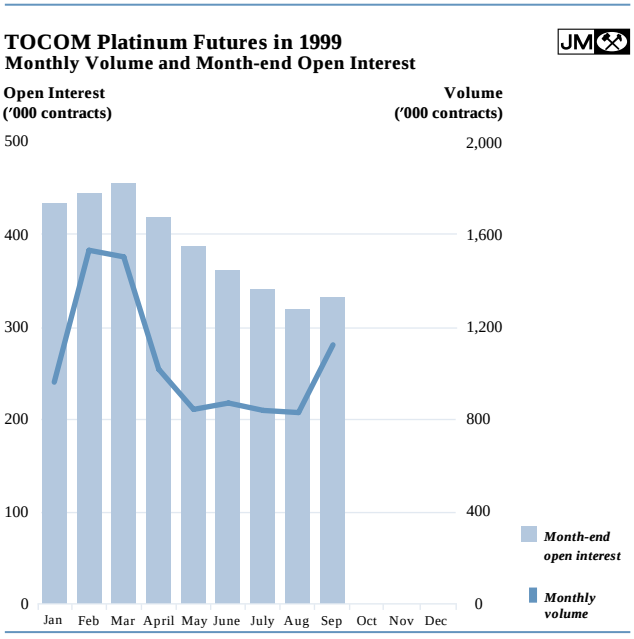
Futures Markets

During the first nine months of 1999 the number of futures contracts traded on TOCOM was 9,650,370, a decline of 14 per cent compared with the same period of 1998.

Open interest rose steadily at the beginning of the year, from 432,291 in January to a year-to-date high of 454,512 contracts in March. Monthly trading volumes also rose strongly during this period with over 1.5 million contracts being traded in February and March. These increases correlated to a rise in the platinum price, which peaked at ¥1,500 per gram during February due to delays in Russian pgm shipments.

The number of contracts traded began to tail off during April, dropping below 900,000 in May and remaining at this level for the following three months. In September the volume climbed back up to 1,135,814 contracts as speculators responded to a sharp rise in the platinum price. Open interest also fell from the peak in March, declining to just over 300,000 contracts in August before edging up to 331,119 contracts at the end of September.

TOCOM warehouse stocks remained between 27,000 oz and



28,000 oz for the first four months, then fell to a low of 22,100 oz in July before recovering to 28,775 oz at the end of September.

Activity on NYMEX was fairly light during the first nine months of 1999 with trading volumes averaging around 40,000 contracts per month before soaring above 100,000 lots in September. Open interest fell to just over 11,000 contracts in May, then recovered to 15,840 in September. Warehouse stocks have remained fairly steady so far this year, at between 50,000 oz and 71,000 oz.

PALLADIUM

Market Review

Concerns over Russian pgm exports once again dominated the first four months of the year. Palladium rallied from $334 at the beginning of January to $384 in April but then plummeted to $284 in early May following large Russian sales at the end of April. The price then quickly recovered and settled down at around $340 until the beginning of September, when rises in platinum and gold lifted palladium to a high of $396. The average palladium price for the first nine months of 1999 was $343.17, compared with $284.36 for the same period of the previous year.

The palladium price had begun to rise at the end of December 1998 in anticipation of Russian supply problems. This rally continued into the beginning of 1999 and palladium recorded $337 at the afternoon fix on 4th January. US fund selling, and reports from Russia that a decree setting export quotas had been signed, then dragged palladium down to a low of $310 on the 14th. Confusion over Russian shipments at the end of the month left traders wary of selling and palladium edged up to $335 on the 29th.

Palladium continued to recover at the beginning of February, supported by steady industrial buying. Continuing uncertainties over Russian supplies were reinforced by news that Russia's Uneximbank, part of the Interros group that controls Noril'sk Nickel, had missed debt repayments. It was also reported that the mine was considering cutbacks in nickel production in 1999. A run of buying on TOCOM pushed palladium up to a nine month high of $362 on the 10th with a $2 premium to platinum. Palladium then settled down into a $346 to $359 range for the rest of the month.

Reports that Noril'sk Nickel had been assigned a ten-year quota for pgm sales and would soon begin shipments were largely ignored by the market at the beginning of March. But fears that Russian supplies would be disrupted due to strained relationships between Russia and NATO over the crisis in Kosovo caused the price to leap to a ten-month high of $372.25 on the 26th. The price then eased back to end the month at $362 with a $1 premium to platinum.

Rumour and speculation regarding Russian sales continued to dominate the palladium market in April and for much of the month palladium traded at a premium to platinum. The untimely death of the head of the Krasnoyarsk Precious Metals Refinery in Russia, and the continuing conflict in Kosovo, helped push the price up to $384 on the 20th. A week later it was finally confirmed that metal had been exported from Russia, a new 5 per cent export tariff that came into effect at the end of the month having prompted significant shipments in the preceding few days. An unusually large sale of palladium, believed to be of Russian origin, during the final London afternoon fix of the

month caused the price to plummet to $295 on 30th April.

After falling to a low of $284 in early May, the palladium price recovered, boosted by renewed demand, to reach a high of $344 on the 14th. The price remained around this level until the second half of June when persistent market selling triggered a steady retreat to $321 at the end of the month.

A rally in platinum and speculation that Russian palladium exports would be minimal in the short term gave support to palladium during July and the price rose to $339 on the 15th. Reports that supply contracts between Russia and Japan were expected to be finalised at the end of July with shipments due in mid August tempered any further increases and palladium ended the month at $337.

After falling back to $331.75 at the beginning of August palladium recovered to $345.50 on the 9th following further political turmoil in Russia. President Yeltsin had sacked his Prime Minister, Sergei Stepashin, and local sources were divided as to whether this would lead to more stockpiled palladium being sold to fund political campaigning or to exports being further delayed. An initial bullish feeling in the palladium market soon died away, and when there was no immediate evidence of either action, the palladium price fell back to $341.

During September palladium followed a similar path to platinum. The price rose steadily through the first two weeks, edging above platinum on the 3rd despite news that the Russians had resumed palladium shipments, which had been suspended since the end of April. The palladium price levelled out in mid month and traded in a tight $359 to $368 range until the 27th when sharp gains in gold and platinum thrust palladium up to a high of $396 on the morning of the 29th. In common with platinum the price fell back and it ended the month at $377.

Futures Markets

There has been a high level of activity in the palladium futures contract on TOCOM during 1999. In the nine months to the end of September, five million contracts were traded compared to 3.8 million during 1998; an increase of 32 per cent.

Trading volumes rose from around 500,000 contracts in January to a high of 877,143 in April. In common with platinum this trend mirrored a rise in the metal price which reached a year-to-date high of ¥1,460 per gram in April. Monthly volumes then began to ease following the resumption of Russian palladium exports and fell to 215,808 contracts in September. Open interest reached a peak of 131,405 in May and then fell back to 83,912 contracts in September.

Activity on NYMEX also rose during the first few months of 1999, with the volume of contracts traded climbing to a high of 8,890 in May. This level fell below 3,500 lots in June and then recovered to 5,836 in September. Open interest rose above 3,000 contracts in March, falling back slightly in the following months before recovering to 3,054 contracts in September. Warehouse stocks peaked at 62,600 oz at the end of February and then drifted down to end September at 32,000 oz.

RHODIUM

Firm demand coupled with limited availability have been behind both of rhodium's rallies so far in 1999. The price rose to $900 at the end of January before easing to $850 in April. A second rally in May then pushed rhodium back up to $930 and the price stabilised at this level, dropping by only $10 at the end of August.

In common with platinum and palladium, the price of rhodium had begun to rise at the end of December 1998 in anticipation of forthcoming Russian supply problems. At the start of January the Johnson Matthey base price for rhodium was $780, compared with $370 at the beginning of the previous year. Firm industrial demand coupled with dwindling supplies in the market lifted rhodium further to a five-year high of $900 at the end of January 1999. A slowing in demand then allowed rhodium to soften to $850 in April.

Rhodium experienced another sharp rally during the second half of May as a rise in demand from Japan, coupled with a continuing lack of Russian supplies, propelled it to $930 at the end of the month. The price stabilised at this level until the end of August when it slipped back slightly to $920.

RUTHENIUM & IRIDIUM

The first nine months of 1999 were quiet for both ruthenium and iridium with little movement in their prices. The two metals stabilised at $39 and $415, respectively, and remained firm until the end of September.

Ruthenium remained subdued during the first nine months of 1999. The only movement in the JM base price was a slight correction from $41 at the beginning of the year to $39 during May.

After the strong gains made by iridium over the previous two years the price stabilised during 1999. At the start of January the Johnson Matthey base price for iridium was $410. It edged up to $415 in mid month and remained at this level through to the end of September.

PLATINUM SUPPLY AND DEMAND

'000 oz		1990	1991	1992	1993	1994	1995	1996	1997	1998	**1999**
SUPPLY											
South Africa		2,760	2,770	2,750	3,360	3,160	3,370	3,390	3,700	3,680	**3,820**
Russia		720	1,100	750	680	1,010	1,280	1,220	900	1,300	**800**
North America		185	220	200	220	220	240	240	240	285	**275**
Others		65	70	120	130	140	100	130	120	135	**165**
Total Supply		**3,730**	**4,160**	**3,820**	**4,390**	**4,530**	**4,990**	**4,980**	**4,960**	**5,400**	**5,060**
DEMAND											
By Application											
Autocatalyst:	gross	1,535	1,565	1,550	1,685	1,870	1,850	1,880	1,830	1,820	**1,750**
	recovery	(210)	(205)	(230)	(255)	(290)	(320)	(350)	(370)	(405)	**(430)**
Chemical		215	240	215	180	190	215	230	235	280	**320**
Electrical		205	175	165	165	185	240	275	305	320	**350**
Glass		135	120	80	80	160	225	255	265	220	**200**
Investment:	small	100	175	145	125	155	75	110	180	210	**120**
	large	100	240	110	180	240	270	130	60	105	**80**
Jewellery		1,365	1,470	1,510	1,615	1,740	1,810	1,990	2,160	2,410	**2,730**
Petroleum		140	150	120	105	90	120	185	170	125	**130**
Other		120	140	150	165	190	225	255	295	305	**340**
		3,705	4,070	3,815	4,045	4,530	4,710	4,960	5,130	5,390	**5,590**
* Western Sales											
to China		0	(20)	0	20	50	130	–	–	–	**–**
Total Demand		**3,705**	**4,050**	**3,815**	**4,065**	**4,580**	**4,840**	**4,960**	**5,130**	**5,390**	**5,590**
Movements in Stocks		25	110	5	325	(50)	150	20	(170)	10	**(530)**
		3,730	4,160	3,820	4,390	4,530	4,990	4,980	4,960	5,400	**5,060**
DEMAND											
By Region											
Europe		705	785	860	895	935	880	840	875	910	**955**
Japan		1,850	2,050	1,870	1,975	2,145	2,215	2,005	1,885	1,805	**1,815**
North America		790	815	705	760	940	1,015	1,180	1,250	1,325	**1,245**
Rest of the World		360	420	380	415	510	600	935	1,120	1,350	**1,575**
		3,705	4,070	3,815	4,045	4,530	4,710	4,960	5,130	5,390	**5,590**
* Western Sales											
to China		0	(20)	0	20	50	130	–	–	–	**–**
Total Demand		**3,705**	**4,050**	**3,815**	**4,065**	**4,580**	**4,840**	**4,960**	**5,130**	**5,390**	**5,590**

For notes see inside back cover.

* *Before 1993, estimates also included Eastern Europe; for 1993 and subsequent years, demand in this region is included in our European figures. From 1996, demand in China is incorporated in our Rest of the World estimates.*

PLATINUM DEMAND BY APPLICATION: REGIONS

'000 oz		1990	1991	1992	1993	1994	1995	1996	1997	1998	**1999**
EUROPE											
Autocatalyst:	gross	375	480	575	610	605	560	515	510	545	**555**
	recovery	0	(5)	(5)	(5)	(10)	(15)	(20)	(25)	(30)	**(35)**
Chemical		60	55	50	40	50	55	60	70	60	**75**
Electrical		40	30	30	20	25	25	25	45	45	**50**
Glass		25	20	15	15	30	35	40	20	25	**25**
Investment:	small	40	40	35	25	45	10	5	5	5	**5**
Jewellery		80	85	85	105	100	120	125	150	160	**170**
Petroleum		40	30	20	25	25	15	15	15	15	**20**
Other		45	50	55	60	65	75	75	85	85	**90**
Totals		**705**	**785**	**860**	**895**	**935**	**880**	**840**	**875**	**910**	**955**
JAPAN											
Autocatalyst:	gross	400	380	350	320	290	270	245	255	240	**260**
	recovery	(35)	(35)	(45)	(50)	(45)	(40)	(50)	(50)	(55)	**(60)**
Chemical		25	20	20	15	15	20	20	20	20	**20**
Electrical		50	50	50	45	45	45	45	65	65	**70**
Glass		50	35	20	30	80	105	80	85	80	**65**
Investment:	small	40	65	40	55	40	35	25	25	25	**20**
	large	100	240	110	180	240	270	130	60	105	**80**
Jewellery		1,190	1,260	1,290	1,350	1,450	1,480	1,480	1,390	1,290	**1,320**
Petroleum		15	15	10	10	5	5	5	5	5	**5**
Other		15	20	25	20	25	25	25	30	30	**35**
Totals		**1,850**	**2,050**	**1,870**	**1,975**	**2,145**	**2,215**	**2,005**	**1,885**	**1,805**	**1,815**
NORTH AMERICA											
Autocatalyst:	gross	690	620	525	600	790	820	850	800	795	**705**
	recovery	(175)	(165)	(180)	(200)	(230)	(260)	(275)	(290)	(310)	**(320)**
Chemical		50	100	90	75	65	70	80	80	80	**100**
Electrical		80	65	55	65	75	115	130	100	105	**110**
Glass		25	20	15	15	20	25	30	45	20	**20**
Investment:	small	5	40	65	40	65	25	75	145	175	**90**
Jewellery		20	20	35	45	55	65	90	160	250	**300**
Petroleum		40	50	35	40	5	40	60	50	40	**45**
Other		55	65	65	80	95	115	140	160	170	**195**
Totals		**790**	**815**	**705**	**760**	**940**	**1,015**	**1,180**	**1,250**	**1,325**	**1,245**
REST OF THE WORLD											
Autocatalyst:	gross	70	85	100	155	185	200	270	265	240	**230**
	recovery	0	0	0	0	(5)	(5)	(5)	(5)	(10)	**(15)**
Chemical		80	65	55	50	60	70	70	65	120	**125**
Electrical		35	30	30	35	40	55	75	95	105	**120**
Glass		35	45	30	20	30	60	105	115	95	**90**
Investment:	small	15	30	5	5	5	5	5	5	5	**5**
Jewellery		75	105	100	115	135	145	295	460	710	**940**
Petroleum		45	55	55	30	55	60	105	100	65	**60**
Other		5	5	5	5	5	10	15	20	20	**20**
Totals		**360**	**420**	**380**	**415**	**510**	**600**	**935**	**1,120**	**1,350**	**1,575**

For notes see inside back cover.

PALLADIUM SUPPLY AND DEMAND

'000 oz		1990	1991	1992	1993	1994	1995	1996	1997	1998	**1999**
SUPPLY											
South Africa		1,230	1,270	1,260	1,395	1,500	1,600	1,690	1,810	1,820	**1,890**
Russia		1,870	2,150	2,100	2,400	3,300	4,200	5,600	4,800	5,800	**5,000**
North America		370	420	450	415	410	470	455	545	660	**620**
Others		70	70	70	70	70	70	95	95	120	**160**
Total Supply		**3,540**	**3,910**	**3,880**	**4,280**	**5,280**	**6,340**	**7,840**	**7,250**	**8,400**	**7,670**
DEMAND											
By Application											
Autocatalyst:	gross	315	355	490	705	975	1,800	2,360	3,200	4,390	**4,890**
	recovery	(85)	(85)	(95)	(100)	(105)	(110)	(145)	(160)	(175)	**(200)**
Chemical		215	225	205	190	185	210	240	240	230	**245**
Dental		1,020	1,165	1,195	1,210	1,265	1,290	1,320	1,350	1,230	**1,160**
Electronics		1,675	1,855	1,830	2,015	2,230	2,620	2,020	2,550	2,070	**1,840**
Jewellery		195	210	205	210	205	200	215	260	235	**255**
Other		80	65	60	35	115	110	140	140	115	**110**
Total Demand		**3,415**	**3,790**	**3,890**	**4,265**	**4,870**	**6,120**	**6,150**	**7,580**	**8,095**	**8,300**
Movements in Stocks		125	120	(10)	15	410	220	1,690	(330)	305	**(630)**
		3,540	3,910	3,880	4,280	5,280	6,340	7,840	7,250	8,400	**7,670**
DEMAND											
By Region											
Europe		590	620	675	680	885	1,340	1,525	1,840	1,985	**2,080**
Japan		1,530	1,800	1,780	1,990	2,200	2,445	1,885	2,350	2,085	**1,910**
North America		1,080	1,095	1,155	1,295	1,430	1,960	2,185	2,675	3,360	**3,640**
Rest of the World		215	275	280	300	355	375	555	715	665	**670**
Total Demand		**3,415**	**3,790**	**3,890**	**4,265**	**4,870**	**6,120**	**6,150**	**7,580**	**8,095**	**8,300**

For notes see inside back cover.

PALLADIUM DEMAND BY APPLICATION: REGIONS

'000 oz		1990	1991	1992	1993	1994	1995	1996	1997	1998	**1999**
EUROPE											
Autocatalyst:	gross	5	5	40	115	260	650	860	1,100	1,370	**1,510**
	recovery	0	0	0	0	0	0	(5)	(5)	(5)	**(10)**
Chemical		75	70	75	65	60	65	65	70	65	**65**
Dental		260	300	300	265	255	250	255	260	210	**200**
Electronics		200	200	210	210	255	325	300	340	270	**240**
Jewellery		35	35	35	35	30	30	30	50	50	**50**
Other		15	10	15	(10)	25	20	20	25	25	**25**
Totals		**590**	**620**	**675**	**680**	**885**	**1,340**	**1,525**	**1,840**	**1,985**	**2,080**
JAPAN											
Autocatalyst:	gross	90	95	85	90	125	145	180	245	330	**350**
	recovery	(25)	(30)	(35)	(30)	(30)	(25)	(30)	(45)	(50)	**(60)**
Chemical		25	25	20	20	20	20	20	20	20	**20**
Dental		320	420	450	500	550	580	600	620	590	**555**
Electronics		990	1,160	1,130	1,280	1,400	1,600	990	1,390	1,080	**925**
Jewellery		115	120	120	120	120	115	115	110	105	**110**
Other		15	10	10	10	15	10	10	10	10	**10**
Totals		**1,530**	**1,800**	**1,780**	**1,990**	**2,200**	**2,445**	**1,885**	**2,350**	**2,085**	**1,910**
NORTH AMERICA											
Autocatalyst:	gross	200	220	320	450	525	950	1,230	1,680	2,470	**2,810**
	recovery	(60)	(55)	(60)	(70)	(75)	(85)	(110)	(105)	(115)	**(125)**
Chemical		75	80	65	65	60	70	70	70	70	**80**
Dental		400	400	400	400	410	410	410	415	390	**360**
Electronics		420	425	405	420	450	545	490	550	480	**450**
Jewellery		5	5	0	5	5	5	5	10	10	**10**
Other		40	20	25	25	55	65	90	55	55	**55**
Totals		**1,080**	**1,095**	**1,155**	**1,295**	**1,430**	**1,960**	**2,185**	**2,675**	**3,360**	**3,640**
REST OF THE WORLD											
Autocatalyst:	gross	20	35	45	50	65	55	90	175	220	**220**
	recovery	0	0	0	0	0	0	0	(5)	(5)	**(5)**
Chemical		40	50	45	40	45	55	85	80	75	**80**
Dental		40	45	45	45	50	50	55	55	40	**45**
Electronics		65	70	85	105	125	150	240	270	240	**225**
Jewellery		40	50	50	50	50	50	65	90	70	**85**
Other		10	25	10	10	20	15	20	50	25	**20**
Totals		**215**	**275**	**280**	**300**	**355**	**375**	**555**	**715**	**665**	**670**

For notes see inside back cover.

RHODIUM SUPPLY AND DEMAND

'000 oz		1990	1991	1992	1993	1994	1995	1996	1997	1998	**1999**
SUPPLY											
South Africa		198	220	278	278	330	342	359	377	400	**394**
Russia		155	110	80	80	80	80	110	240	110	**80**
North America		17	18	19	17	15	13	5	16	16	**18**
Others		0	0	1	1	1	1	2	3	4	**8**
Total Supply		**370**	**348**	**378**	**376**	**426**	**436**	**476**	**636**	**530**	**500**
DEMAND											
By Application											
Autocatalyst:	gross	334	301	305	356	379	464	424	418	483	**508**
	recovery	(13)	(16)	(22)	(25)	(34)	(37)	(45)	(49)	(57)	**(66)**
Chemical		26	25	18	11	10	13	21	36	31	**34**
Electrical		12	10	7	9	8	8	9	9	8	**8**
Glass		17	12	7	3	14	17	53	43	34	**30**
Other		15	14	13	12	11	9	9	10	10	**11**
Total Demand		**391**	**346**	**328**	**366**	**388**	**474**	**471**	**467**	**509**	**525**
Movements in Stocks		(21)	2	50	10	38	(38)	5	169	21	**(25)**
		370	348	378	376	426	436	476	636	530	**500**
DEMAND											
By Region											
Europe		97	101	119	127	129	139	154	165	176	**178**
Japan		115	99	63	68	68	59	64	70	75	**87**
North America		152	111	110	127	139	224	170	137	177	**174**
Rest of the World		27	35	36	44	52	52	83	95	81	**86**
Total Demand		**391**	**346**	**328**	**366**	**388**	**474**	**471**	**467**	**509**	**525**

For notes see inside back cover.

GLOSSARY

g	*grams*
kg	*kilograms*
tonne	*1,000 kg*
oz	*ounces troy*
pgm	*platinum group metals*
prices	*all prices quoted are per oz unless otherwise stated*
$	*US dollars*
R	*South African rands*
¥	*Japanese yen*
Almaz	*Almazjuvelirexport, the pgm marketing agency of the Russian Federation*
CO	*carbon monoxide*
HC	*hydrocarbons*
NOx	*oxides of nitrogen*
LCD	*liquid crystal display*
LEV	*Low Emission Vehicle*
GDI	*gasoline direct injection*
MLCC	*multi-layer ceramic capacitor*
Merensky, UG2, Platreef	*platiniferous orebodies in South Africa*
NYMEX	*New York Mercantile Exchange*
TOCOM	*Tokyo Commodity Exchange*

NOTES TO TABLES

Supply *figures are estimates of sales by the mines of primary pgm.*

With the exception of the autocatalyst sector, ***demand*** *estimates are net figures, demand in each sector being total purchases by consumers less any sales back to the market. Thus, annual totals represent the amount of primary metal that is acquired by consumers in a particular year.*

From 1993, demand numbers for ***Europe*** *include an estimate of net consumption in the former COMECON countries of eastern Europe. From 1996, consumption in China is incorporated into our figures for the* ***Rest of the World*** *region. We continue to exclude the CIS from our demand estimates.*

Movements in stocks *in a given year reflect changes in stocks held by fabricators, dealers, banks and depositories but excluding stocks held by primary refiners and final consumers. A positive figure indicates an increase in stocks; a negative figure indicates a rundown in stocks.*

Gross autocatalyst demand *is purchases of pgm by the auto industry for manufacture of catalytic converters.* ***Autocatalyst recovery*** *is pgm recovered from scrapped catalytic converters and is allocated to the region in which the converter was scrapped.*

Investment: small *refers to the long-term holding of metal in the form of coins, and bars weighing 10 oz or less.* ***Investment: large*** *is in the form of 500 g and 1 kg bars in Japan and includes platinum held on account for subscribers to accumulation plans.*

Johnson Matthey is grateful to the following for their help in providing illustrations in Platinum 1999 Interim Review:

Anglo American Platinum Corporation
Berg Electronics Group
Meister & Co. AG.
Paul Spurgeon Design
Platinum Guild International

ACKNOWLEDGEMENTS

Johnson Matthey gratefully acknowledges the assistance of many individuals within the platinum industry in providing information for the compilation of Platinum 1999 Interim Review. Particular thanks go to the members of the Johnson Matthey precious metals market research team whose help has been, as always, invaluable.

Platinum 1999 Interim Review is based for the most part on information available up to the end of September 1999.

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40-42 Hatton Garden
London EC1N 8EE
England

Designed and produced by Liebling & Cross Design
Printed in the United Kingdom

ISSN 0268-7305