The cessation of supplies of crude platinum from Russia faced Johnson Matthey with a serious problem and a challenge. This was taken up by A. B. Coussmaker, the company’s mining engineer who had been appointed a director in 1925 and who now resolved to search tirelessly for new sources of platinum and to restore the pre-eminent position in the industry that had been built up by George Matthey and John Sellon. Before the first world war he had made a series of prospecting missions in Canada, Australia and New Zealand without success, but an entirely new era was now about to open.

Rumours of platinum being found in South Africa had begun to circulate in 1923 and had alerted a number of prospectors. Then in June 1924 a small bottle of greyish-white concentrates arrived by post in the Johannesburg office of the consulting geologist Dr. Hans Merensky. This had been sent by H.C. Dunne whose brother-in-law Andries Lombaard, a farmer with some experience of panning for gold, had found what he thought was evidence of platinum in one of the streams on his farm at Maandagshoek to the north of Lydenburg in the Transvaal. Analysis quickly confirmed the presence of platinum, as well as of rhodium and iridium, and Merensky immediately went to investigate. Together with Lombaard and two of his wife’s cousins, Schalk and Willem Schoeman, he examined a large stretch of country around the stream and within a few weeks, with great geological insight and deductive reasoning, had located the basic mineral in a reef running parallel to the mountain range in a northerly direction and again in a southerly direction, extending in all some sixty miles. Merensky’s
first thought was to christen it "The Lombaard Reef", but his colleagues overruled him and it was named "The Merensky Reef".

Finance was provided by a small syndicate, soon to become Lydenburg Platinum Limited, but this company was later taken over by a more substantial concern controlled by Consolidated Gold Fields who began mining operations.

Hans Merensky explored still further and traced the reef at Potgietersrust to the north-west, and then much further afield at Rustenburg, some sixty miles west of Pretoria, the indications in the latter area pointing to richer deposits. This caused the emphasis to move away from Lydenburg and Potgietersrust to Rustenburg and so to the most regular and most valuable part of the platinum-bearing reef.

The Merensky Reef forms a layer in the Bushveld Igneous Complex, an irregular oval or saucer-shaped area of some 15,000 square miles in the Central Transvaal. The reef varies in depth, from outcrops at the surface down to about 3,000 feet, but averages only three feet in thickness. A detailed account of its mineralogy was given in 1929 by Dr. Percy A. Wagner, for many years the mining geologist to the South African government, who not only dedicated his book on the platinum deposits and mines of South Africa to Merensky but wrote in his preface:

"The story of the opening up of these deposits – which transcend in magnitude and importance anything that had hitherto been dreamt of in the way of platinum
The scene on the same part of the Merensky Reef thirty years later, the surface plant of Rustenburg Platinum Mines giving some indication of the great activity underground. The shallower parts of the mine, which now stretches for over thirty miles, are worked from inclined haulages, while the deeper areas are opened up from vertical shafts ranging in depth from 500 to 3,000 feet.

occurrences – has often been told, but the writer feels that sufficient credit has never been given to Dr. Hans Merensky for the part that he played in this epic of mineral exploration” (1).

The geological features of the Bushveld Igneous Complex and its resources of platinum were later reviewed by C.A. Cousins (2).

The discovery of the Merensky Reef was quickly followed by a boom in platinum mining and a great many small companies were floated, generally by those whose experience had been confined to the mining of gold with its unlimited market and fixed price and who gave little or no thought to the means of extraction from the complex minerals.

In June 1925 A.B. Coussmaker, keenly interested in this new source of platinum, went out to South Africa and with E.C. Deering from the Research Department as analyst, made contact with the owners of the several properties, sampling the mineral from outcrops throughout the reef and bringing to the survey his outstanding knowledge of platinum from its geology to its marketing. He was fully aware of the serious problem of devising methods for the extraction of the platinum metals and on his return to London in August he assigned the task to the Research Department, headed by A.R. Powell, who was assisted
Hans Merensky 1871–1952

The son of a German medical missionary to the Transvaal, Merensky returned to study geology at the Technical High School in Breslau and then at the University of Berlin. Going back to South Africa in 1904 he set up as a consulting geologist and mining engineer but he was interned for five years during the 1914–1918 war. The following years were difficult ones, but in 1921, hearing of the discovery of alluvial platinum in the Transvaal, he immediately prospected for the basic rock and quickly discovered the extensive reef that was named after him, so initiating the development of a great platinum industry.

A little later by Deering, now back from South Africa with considerable knowledge of the deposits. The minerals were of a type not previously worked in quantity, and the platinum metals were associated with the sulphides of nickel, copper and iron, but intensive work over the next two years yielded a successful and economical process for treating the flotation concentrates by smelting in blast furnaces to a nickel-copper matte and treating this to obtain a residue carrying the platinum metals that could then be refined by the normal methods employed for alluvial platinum. A patent covering this process was filed on May 1, 1928 (3).

In the meantime large samples of concentrates had been sent by the mining companies to Krupp Grusonwerk in Germany, to various American refiners, to the Rand Mines laboratory in Johannesburg and to the Chemical and Metallurgical Corporation in England, a company associated with Consolidated Gold Fields having a hydro-metallurgical plant treating lead and zinc ores at Runcorn in Cheshire.

Nothing was heard of any methods of treatment tried in America. A process devised by Krupps, smelting to a matte and then leaching with sulphuric acid, gave an extraction of 78 per cent of the platinum metals, the Rand Mines
developed a chlorination process that gave good results on a small scale but later proved to be impracticable on larger scale trials (4), while the Chemical and Metallurgical Corporation also relied upon dissolution in hydrochloric acid and chlorine followed by precipitation of the platinum metals with zinc (5), but by early 1930 they had decided to abandon the project (6).

The only workable process remained that devised by Powell and Deering, and Johnson Matthey secured the appointment of refiners of the whole of the output of the only two remaining mining companies, all of the smaller concerns having failed or abandoned their operations. Those still active were more substantial concerns, Waterval Platinum, controlled by Consolidated Gold Fields, and Eerstegeluk Platinum, owned by Potgietersrust Platinum and controlled by Johannesburg Consolidated Investment Trust, both operating adjacent properties on a small scale at Rustenburg with small gravity concentration and flotation plants. In 1928 Coussmaker again set out for South Africa and visited these two companies. From this and his earlier survey he came to the firm conclusion that this section of the reef was the most promising and could well become an important source of platinum. He discussed the position fully with the two companies and stressed the great advantages to be derived from their

Alan Richard Powell
1894–1975

Joining Johnson Matthey in 1918 to establish a research department, Powell remained to manage a growing activity for thirty-six years. In 1926 he initiated work on a process for the extraction of the platinum metals from the newly discovered and complex source of mineral in South Africa and with his colleagues successfully developed a method of treatment that led to Johnson Matthey becoming the sole refiners to Rustenburg Platinum Mines. His many contributions in the refining, purification and analysis of the platinum metals were recognised in 1953 by his election as a Fellow of the Royal Society
Ernest Charles Deering
Educated at King's College, London, and joining Johnson Matthey in 1918, Deering was sent out to South Africa in 1925 to set up a laboratory in Johannesburg for the analyses of samples from the many platinum properties that were being established. Returning to London a year later he joined Powell in the Research Department in developing the process for extracting the platinum metals, and also the nickel and copper, from Rustenburg mineral and then put the process into production in a smelting works he designed and built at Brimsdown on the outskirts of London. He remained in charge of this plant until his appointment as a director in 1949, becoming Chairman in 1964 until his retirement in 1966.

amalgamation. This rather difficult proposition was made a little easier as both Consolidated Gold Fields and Johannesburg Consolidated Investment Trust had been substantial shareholders in Johnson Matthey since 1918 when, on John Sellon's death, his holdings had been offered to them in equal proportions, while for many years, until the building of the Rand Refinery in 1922, the gold from both companies' mines had been refined by Johnson Matthey.

Negotiations went ahead for some time, with the co-operation of Lord Brabourne (1863–1933), a director of both Consolidated Gold Fields and Johnson Matthey, Dr. James Gunson Lawn (1868–1952), a director and the consulting engineer to Johannesburg Consolidated, and John Alexander Agnew (1872–1939), the distinguished mining engineer who was then the chairman of Waterval Platinum and also a director of Consolidated Gold Fields. Initially cooperation was confined to joint investigation of the problems of extraction by the consulting metallurgists, and when the Third Empire Mining and Metallurgical Congress met in Johannesburg in April 1930 a paper on "The Metallurgy of Transvaal Platinum Ores" was presented by F. Wartenweiler of Johannesburg Consolidated and A. King of Consolidated Gold Fields. This recorded their early work on flotation but they emphasised that "the extraction of platinum to
Operations at Rustenburg Platinum Mines include the haulage of the mineral by trains of 15-ton trucks to the main hoisting shafts. To produce one ounce of platinum ten tons of ore have to be brought to the surface, crushed, milled and treated by flotation and smelting processes before refining can begin.

Marketable form presented most difficult metallurgical problems and needed a vast amount of research and experimental work" (7). Finally in 1931 the merger was achieved with the formation of Rustenburg Platinum Mines, the shares being held as to 52.5 per cent by Potgietersrust Platinum and 47.5 per cent by the Waterval Platinum Mining Company, with Johnson Matthey continuing to be responsible for the refining and marketing of all the platinum metals produced. Coussmaker was on the way to seeing his great resolve come to fruition.

Unfortunately the Great Depression was now causing growing problems in finding a market for the increasing output from Rustenburg and operations there were reluctantly discontinued in April 1932 while serious thought was given by the parent companies to their complete withdrawal from the mining of platinum in South Africa. Coussmaker’s faith in the future and in the development of new industrial uses, as well as in the great potential of Rustenburg as a producer, remained unshaken and again he urged the desirability of keeping the mines open on a maintenance basis, prepared to resume operations when a sufficiently attractive market seemed assured (8). This policy was accepted, and by August 1933 a courageous decision was made to re-open the Rustenburg mine.
After the development of a process for the extraction of the platinum metals from the Rustenburg Platinum Mines this smelting plant was built by Johnson Matthey at Brimsdown near London. Here the matte produced from the flotation concentrates was smelted to yield crude nickel and copper which were then refined electrolytically, leaving the platinum metals in the anode residues to be separated and refined in the wet process refinery.

For the first time platinum and its allied metals were being mined as primary products, with nickel and copper as by-products, by contrast with the mines in Canada and Siberia, essentially sources of nickel and copper with the platinum metals as by-products. This difference was to become of great importance in enabling Rustenburg to respond more quickly and effectively to increasing demand and to become the world’s largest producer of platinum.

Meanwhile progress was being made in the extraction and refining of the platinum metals, but as the depth of the mine increased it was found that the ore was gradually changing from a weathered and oxidised form to an unaltered sulphide and that the Powell-Deering process needed to be modified accordingly. In 1929 a smelting plant had been designed and built by Deering at Brimsdown to the north of London, capable of expansion to meet increasing demand, and here further experimental work had to be carried out. Many of the operations were novel and new problems and difficulties were frequently encountered but successfully overcome.

The early years following the re-opening of the mine in 1933 were not without their difficulties. Production gradually increased, but demand was small and in the year 1938 the through-put of platinum in the Johnson Matthey refineries...
In the earlier years the flotation concentrates were smelted to a matte in a series of blast furnaces, but later submerged arc electric furnaces were installed at Rustenburg to cope with increasing demand. Each has six four-feet diameter consumable electrodes.

amounted to only 25,000 ounces. During the war this reached 40,000 ounces a year, but thereafter continual expansion began in order to meet the steadily increasing demand, this stemming largely from the adoption of the melting of optical glass in platinum equipment, from the increasing output of fibre glass and from the extensive use of platinum thermocouples in the steel industry. As the scale of operations increased it was found desirable to carry out certain of the earlier operations in South Africa and a smelting plant was erected at Rustenburg to deal with the flotation concentrates and to yield a matte suitable for treatment at Brimsdown. Later, to cope with the increasing output from the mines, arrangements were made to duplicate the primary stage of the Brimsdown process and a company known as Matte Smelters was formed in South Africa as a joint subsidiary of Rustenburg and Johnson Matthey.

In 1948 the Union Platinum Mining Company, also operating on the Merensky Reef some 60 miles further north, was acquired by Rustenburg and its property now constitutes the Union Section of Rustenburg Platinum Mines. Two years later the quantities of matte being received at the Johnson Matthey refinery at Brimsdown had increased to the extent that a completely new plant was added there. A detailed account of the complex and lengthy cycle of
The final section of the Johnson Matthey platinum refinery, the largest of its kind in the world. This plant, built in 1956, replaced an older and smaller refinery and handled the precipitation, re-dissolving and re-precipitation of platinum and palladium, while the insoluble metals rhodium, ruthenium, iridium, and osmium were treated in another part of the refinery.

operations required to effect the complete recovery of all six metals in a state of high purity was given by two of Deering’s colleagues, A.F.S. Gouldsmith and B. Wilson (9).

Annual production had now reached 70,000 ounces, but then demand from the petroleum industry for the reforming of crude naphthas to both high octane petrol and a range of aromatics, described on page 398, began to take effect and by 1955 the annual production of platinum had risen to 200,000 ounces. A more extensive expansion programme at the mine was then set in train together with a major expansion of the Johnson Matthey refineries, and output was increased to 850,000 ounces, reaching a million ounces a year by 1973. Output of the other five platinum metals increased of course in the same proportion.

To anticipate this history a little, annual output of platinum from Rustenburg has now risen to approximately one-and-a-quarter million ounces, with more than 40,000 workers employed. This achievement has been brought about by a series of capital expenditure programmes aimed at matching supply with demand, by bringing new mining areas into operation, by the mechanisation of
mining methods and by the development of improved methods of extraction. Rustenburg Platinum Mines is now the largest underground mining operation in the world, extending over thirty-three miles in length, and constituting the world's largest source of platinum and its allied metals.

A further development in 1972 was the formation of Matthey Rustenburg Refiners, jointly owned by Rustenburg Platinum Mines and Johnson Matthey, which now undertakes the whole of the extraction and refining operations in three plants. That at Rustenburg treats the matte and separates the base metals from the platinum metals and also refines the nickel and copper, leaving concentrates containing around 50 per cent of total platinum metals. The two plants at Royston in England and at Wadeville near Johannesburg then separate and refine the individual metals to the high degree of purity required for their many applications by means of a number of selective precipitation techniques from solutions of the mixed metals. During the past few years, however, research by Johnson Matthey and development work by Matthey Rustenburg Refiners have shown that improved recoveries may be obtained by a solvent extraction process and a new refinery is being built at Royston to operate this process. The new technique reduces both the number of refining stages and the time required, improves the yield and enables increased automation to be utilised in the refinery (10).

Thus together Rustenburg Platinum Mines and Johnson Matthey ensure to industry throughout the world adequate and continuing supplies of the platinum metals. The known reserves in the Merensky Reef run to over 300 million ounces of platinum alone, while below this is another reef containing as much platinum again.

References for Chapter 23

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