The Platinum of New Granada

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Concluding his article from the last issue of 'Platinum Metals Review', the author continues the story of platinum mining and metallurgy in the Spanish-American colonies during the eighteenth century. At one time platinum was ordered to be thrown into the river as a nuisance, but scientific reports from Europe prompted the Spanish Government to seek useful outlets for the metal.

The publication in 1750 and 1752 of Watson and Scheffer aroused considerable attention in Spain. The affairs of New Granada, which would include platinum, came under the Secretary of State for the Indies, who in 1753 found among his possessions a small bag of native platinum sent to him by the Bishop of Popayan. In view of the interest created already by the publications, he sent this to the Irish naturalist William Bowles, whom his Government had appointed the previous year to examine and advise upon the natural history of the empire and especially on its minerals.

William Bowles and his Warning

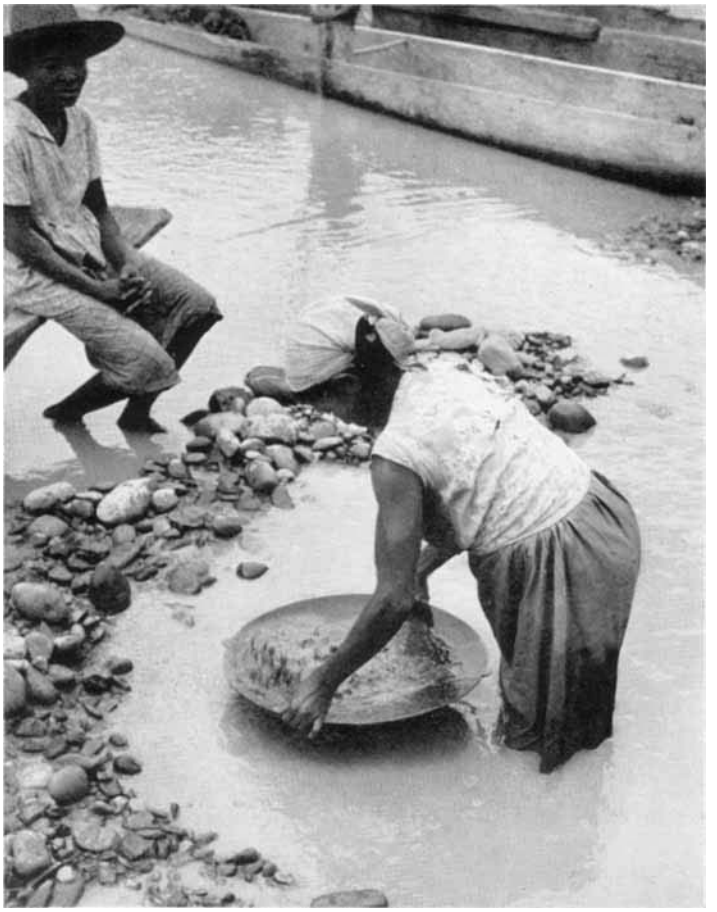
To Bowles the material submitted to him was quite new and he applied to it a series of experiments very similar to those carried out by the other pioneers mentioned above. In particular he noticed its high density, its insolubility in simple acids and its miscibility with gold. The Minister had asked him to give advice on any good or bad uses to which it could be put. His answer was: "Platina is a metallic sand that is *sui generis* which can be very pernicious in the world because it mixes easily with gold and because, although by chemistry it is easy to find the means of recognising the fraud and of separating the two metals, since this means would be available only in the hands of a few people and as cupidity is a general malady, temptation seductive, the means of deceiving easy and in everybody's reach, there can only be great danger in letting platina loose in commerce." (9).

The Government took notice of this report and confirmed the prohibition of the export of platinum from New Granada to Europe.

Persistent statements will be found in the textbooks that the Spanish Government prohibited the mining and recovery of platinum completely and ordered any found to be thrown into the rivers or the sea. Ramon de Manjarres in his *History of Platinum* (10), states definitely that he can find nothing in the archives of the Indies about such an order, and M. L. (2) says equally categorically that "those who believe that the Spanish Minister has caused the platina mines to be shut up have certainly been misinformed, since there are no such mines for platina alone. All he has done is to prevent its introduction into Europe, because of the inconvenience which might have resulted from its being alloyed with gold, which was not easy to recognise at that time; a wise precaution which has assuredly forestalled a large number of frauds in the gold trade".

Prohibition of Exports

It must however be borne in mind by the reader that right from the time of the Spanish conquest in 1526 the trade of the new colonies had always been reserved to Spaniards, and that foreigners were not allowed to partake in it or to enter the countries. An additional bar was the fact that the Spanish Church, acting through the



Native women panning for platinum in the Condoto river area of Colombia. The majority of the hand mining is done by women, employing much the same methods used by the Spanish colonists

Holy Office of the Inquisition, regarded the native inhabitants as its children, needing to be protected from foreigners. So the trade of the Indies was practically a Spanish monopoly, proceeding by way of the Caribbean ports of Vera Cruz, Puerto Bello and Cartagena, through the gauntlet of pirates in the islands, home to the motherland in Spain.

The only new edict was the prohibition of the export of platinum to Europe and, as de Manjarres goes on to point out, the whole question of the collection of platinum carried its own cure, since at that time it was not profitable. The only uses suggested for it round about 1740 were as small shot or as pieces in small bags for adjustable clock weights, since it appears that by then the alloying with copper had ceased on the grounds of increased costs. The metal was thrown away anywhere and everywhere, a practice that led to curious scenes years afterwards when it had become a valuable commodity. In this connection there is a famous story of how the mining village of Quibdo was wrecked completely in an enthusiastic search for discarded metal among its foundations (11).

Separation from Gold

Some platinum however still penetrated to the mints mixed with the gold and M. L. (2) describes how this was dealt with. He states that all the output of gold from the Choco went to the two mints at Santa Fé de Bogotá and Popayan, where a very careful separation of any platinum still remaining in it was carried out. "The King's Officers keep this and when they have a certain quan-

tity of it, they go, accompanied by witnesses, to throw it into the Bogotá River two leagues from Santa Fé or into the Cauca which is one league from Popayan." This is probably the real basis of the story that all platinum had to be thrown into the nearest river.

Enquiries by the Spanish Government

The widespread interest created in scientific circles by the results of the various examinations of its properties soon came to the notice of the Spanish Government and in 1765 the General Commercial Council in Madrid asked the Secretary of State for the Indies to obtain detailed information. In due course he provided them with particulars of how the metal was found and recovered, and of how the mints protected themselves from trouble arising from it; "it was not prohibited but was thrown away in order to prevent miners from deceiving others with it", for instance by offering it for sale as silver. An ironic comment on this is afforded by the existence of gold double-doubloons of Spain dated 1771 containing a considerable amount of platinum alloy. These are said to be the result of a debasement, officially ordered but never announced.

Attempts to Find Uses

The result of the Council's inquiries was an attempt to make the metal useful, and possibly the debasement had its origin in this. Inquiries were also made in the Colonies, since in June 1774 the Viceroy at Santa Fé called for experiments in melting it and reported success, sending to the Council for its inspection, "two portraits of the King, one in pure platinum and the other in platinum alloyed with its own weight of copper". These were said to have been prepared by a process devised by Don Francisco Benito, engraver at the Santa Fé Mint, the details of which he was advised to keep secret. This was so well done that no description has ever been published, though de Manjarres (10) hints in 1913 that one of the medals might still be in existence. But however this may be, there was one important consequence of Don Francisco's exploit, namely that an order was issued that in future "platinum should be worked exclusively for His Majesty as was the case with gold" (10). This resulted in 1778 in a further order that all platinum must be sent to the King's representative or, in other words, to the mints. No payment was offered and little platinum was brought in (12). Consequently in 1788 a price of two Spanish dollars per pound was offered and severe penalties set up for infringement of the law. Before the end of the year this brought in no less than 3,820 pounds. But by that time interest in the metal was widespread in Europe and the demand opened a brisk market for metal smuggled to the coast, or to Jamaica, at up to ten dollars a pound. So, in spite of a long list of heavy penalties, less and less platinum found its way to the mints, while more and more travelled to the smugglers' market at Cartagena (12).

Refining and Fabrication

By this time however the Spaniards at home had mastered the problem of refining platinum and converting it into malleable metal by means of the process devised in 1786 by Don Fausto de Elhuyar and Pierre François Chabaneau. A refinery was set up in Madrid and between then and say about 1804 a considerable quantity of platinum was refined and fabricated into articles for both domestic and scientific use. No figures have so far been published for this so-called "Platinum Age in Spain", but if they ever emerge from the Archives of the Indies, they will be found to be large ones, and from this it is evident that the Spaniards must have been prepared to pay a proper price for the native metal.

But all through the period covered by this story, their Government was always willing to give samples, or sell quantities, to respectable scientific people and bodies, both at home and abroad; de Manjarres quotes an

One of the modern mechanical dredges operated by the Compania Minera Choco Pacifico in the main platinum area now being worked near the San Juan river in Colombia

impressive list of names and amounts (10). Eight or ten pounds were sent to London in 1755 (or was it, as Lewis says, 1754?); in 1779 the Comte de Milly in Paris had a quantity for his important work on the refining process; in 1786 d'Arcet and de Morveau were recipients; in 1797 the French Government were given 700 marks (about 5,500 troy ounces) for the making of the standards of length and weight in the newly devised metric system; and finally in 1798 some was sent to the Russian Trade Envoy. All these seem to have been given quite freely and without payment, and therefore there is little warrant for the accusations that appear in some of the literature of that time that the Spaniards were not willing to allow other people to acquire platinum for scientific purposes. But as interest increased and practical applications appeared, the demand grew.

Scientific Expeditions from Europe

The smuggling trade has been mentioned, and the penetration of the Colonies by scientists continued. The Spaniards themselves encouraged the latter by sending out their own scientists. Of these the first and best known was the botanist, José Celestino Mutis, who became a centre of attraction for visiting scientists and accumulated a vast library of records, which was brought to Spain before the revolts in South America began and remains there safely to this day (13).

A French party arrived in 1781, nominally with ornithological aims, but it is recorded that, before they left Paris, the French statesman Turgot instructed the leader "to spare no pains to procure for men of science such a quantity of platina as might be useful to them in their researches". In 1776 Dombey reported that he had obtained and was sending home no less than 33 livres to be divided between the Academy, Turgot and Buffon.

Later, in 1786, the Spanish Government sent out Don Juan José de Elhuyar to look after the mineral resources, and it is interesting to note that it was one of Mutis' young botanists Francisco Zea who, after the Spaniards had been driven from Colombia,

concerned himself with the first commercial export of platinum from the new Republic in its search for foreign credits (14). But by then other sources of the metal had become available nearer home in Russia, and it was not until the end of the nineteenth century that Colombian platinum again became a noticeable feature of the market.

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Properties of Ruthenium, Osmium and Iridium

MELTING POINT AND HARDNESS DETERMINATIONS

The search for metallic materials capable of some degree of useful service at very high temperatures had led to several investigations being undertaken on the more refractory members of the platinum group metals. Among the several organisations that have pursued these studies is the Research Laboratory of Associated Electrical Industries Ltd. at Aldermaston, and a recent report from there by Dr. J. D. Baird (AEI Report No. A.843) gives the results of an investigation of the melting points, hardness and ductility of ruthenium, osmium and iridium.

The melting points of the three metals were determined by taking optical pyrometer readings on the solid-liquid interface of the metal beads in an argon arc furnace. Between fifteen and twenty readings were taken for each metal, and all but one lay within $\pm 10°$ of the mean values. These are as follows, and represent somewhat different values from those formerly accepted, more particularly for ruthenium and osmium.

Melting Points

Ruthenium	2250° C
Osmium	3000° C
Iridium	2410° C

Room temperature hardness measurements on arc-melted specimens using a Vickers pyramid indenter showed a very wide scatter with the two close-packed hexagonal metals. Ruthenium gave results ranging from 200 to 500 VPN, the variation being found to be due to differences in orientation between grains. A similar variation was found in osmium, readings ranging from 300 to 670 VPN.

As would be expected from its face-centred cubic structure, the hardness of iridium did not vary greatly from grain to grain, but some variation between specimens was observed; most specimens had hardness values from 210 to 240.

High temperature hardness measurements were made on individual grains at 900, 1000, 1100 and 1200°C, and again considerable variation was found. The maximum hardness of ruthenium at 1200°C ranged from 40 to 170 VPN. The mean hardness of osmium at 1200°C was found to be about 300, which is thought to be considerably higher than that of any other metal at this temperature. The mean value for iridium at the same temperature lay around 70 VPN.

The ductility of the three metals was measured by rolling or squeezing arc-melted beads with 2 per cent reduction per pass until cracking occurred. At room temperature ruthenium specimens failed after 8 to 12 per cent reduction, osmium after 2 to 5 per cent, and iridium after 9 to 19 per cent. Increasing the rolling temperature to 500 and 900°C had no significant effect on the ductility of ruthenium and iridium.