

# Percival Johnson's First Publication

By Donald McDonald

It is perhaps natural that this periodical, published as it is by Johnson, Matthey & Co., Limited, should occasionally look back to the early days of that company for the beginnings of the activity of which it is a modern example. In this respect the present year is a significant one, since precisely one hundred and fifty years ago its founder, Percival Norton Johnson, made his first public contribution to the knowledge of platinum by sending a short article to the *Philosophical Magazine* (1). The main part of this communication dealt with the fact that small quantities of platinum, when mixed with gold and such excess of silver as enabled the alloy to be parted in nitric acid, dissolved with the silver and left the gold completely freed from it. This happening was unexpected, since platinum by itself is quite insoluble in that acid, but it had been known for some time to take place.

The early workers in platinum in the later years of the previous century were very much concerned about the possible use of platinum as an adulterant for gold, with which it could be alloyed without appreciable effects on the latter's specific gravity. Indeed this was one of the main reasons why the King of Spain prohibited the export of native platinum from New Granada. But the danger was soon shown not to exist. A platinum content of only 5 per cent already affects the colour of gold, and further additions soon whiten it completely and seriously affect its physical properties. Also it was noticed that smaller quantities of platinum in gold—less than 5 per cent—completely disappeared from it during the ordinary assaying process of cupelling with silver and parting in nitric acid. Soon it was found that it had simply dissolved with the silver and remained in solution with it, leaving the gold yielding a true assay figure for the original mixture.



**Percival Norton Johnson**

*Founder of the firm of Johnson Matthey, Johnson published his first paper on platinum just a hundred and fifty years ago. The portrait is from the oil painting by G. J. Robertson, dated 1829, now in the boardroom of Johnson, Matthey & Co., Limited*

The first precise recording of this behaviour seems to have been that made by M. Tillet of the Paris Mint in 1779 (2). He experimented with 12 to 24 grains of fine gold, 2 to 4 grains of ductile platinum and fine silver about three times the weight of the gold, and found that all the platinum dissolved with the silver in nitric acid. He further reported that if the platinum was added to fine silver only the solution in nitric acid was incomplete.

A more complete investigation was made in 1798 by Robert Bingley, King's Assay Master at the Royal Mint, London, but he did not publish his findings. Nevertheless they are known, since in 1800 he wrote a letter

describing them in detail to Charles Hatchett, a well-known chemist of the time still remembered as the discoverer of niobium. This letter has been preserved in the archives of the Royal Society (3), and in it Bingley describes how he alloyed platinum with gold in the proportions of 1/48, 1/24, 1/12 and 1/10 and repeatedly assayed the products by variants of the usual assay process. His findings were that with 1/48 "the whole of the platina will be destroyed in the common process of assaying when the operation is properly carried out", but that with 1/24 special care is necessary with the quality of the acid; with the 1/12 and 1/10 alloys further special measures have to be taken. He remarks that the alloy should be cupelled with at least three times its weight of silver and eight times its weight of lead, and that the last stages of the operation should be carried out at a higher temperature to ensure the removal of all the lead, traces of which interfere with the complete solution of the platinum on parting.

In 1812 Percival Johnson (he had not yet begun to use the second name of Norton) was a young apprentice of the Worshipful Company of Goldsmiths working with his father, John Johnson, at his home at 7 Maiden Lane (now part of Gresham Street) in the City of London. The business consisted of the assaying of gold and silver, the analysis of ores and minerals and the buying and selling of materials containing the precious metals, including native platinum. Percival was born on September 29th, 1792, and apprenticed on January 7th, 1807. In July 1812, when his paper was published, he was therefore aged 19 and was still an apprentice. The paper itself fills only a little more than one of the small pages in which the

THE  
PHILOSOPHICAL MAGAZINE.

I. *Experiments which prove Platina, when combined with Gold and Silver, to be soluble in Nitric Acid.* By Mr. PERCIVAL JOHNSON.

To Mr. Tilloch.

SIR, DURING the practice of a profession where much depends on depriving gold of its alloys, having heard it suggested that platina might be used as an advantageous one, under the idea of its being but slightly affected by the nitric acid, I determined on a closer inspection of its action on that metal than had hitherto been described. The insertion of the following remarks on my experiments will oblige me.

I find, although platina when in a pure state is not acted upon by the nitric acid, that when alloyed with gold and silver it is perfectly soluble, and with silver alone partially so.

From 1 to 15 per cent. of platina to the gold was entirely dissolved, leaving the gold a good colour and perfectly pure, having previously mixed the gold with three times its weight of silver for quartation.

Twenty per cent. lost  $\frac{1}{4}$ ths, leaving the cornet flaked and black inside; 30 per cent. lost  $\frac{3}{4}$ ths with the same appearances.

The buttons have an indented crystalline and red appearance after cupellation, more so in proportion to the quantity of platina, and in the two latter proportions are rounded at the edges.

By mixing double the quantity of silver the gold was freed of upwards of 20 per cent. of platina, and more ac-

ording to the quantity of silver employed; and yet the gold seems to be a necessary component for the perfect solution; for by mixing the following proportions of silver and platina, the results were thus;

Platina and silver equal to 1 per cent. of the former left in dilute acid a light powder partly subsiding. 5 per cent. gave the acid a straw colour, half the platina employed being dissolved. 10 per cent. a very bright straw colour, having dissolved the same proportion.

15 per cent. a bright light brown, having dissolved  $\frac{3}{4}$ ths of the platina. 25 per cent. a deep brown, dissolving  $\frac{3}{4}$ ths of the platina.

The two latter proportions required concentrated acid after the action of the dilute.

Maiden Lane, Wood Street,  
July 1, 1812.

PERCIVAL JOHNSON,  
Assayer of Metals.

It may also be worthy the notice of your readers, that we find palladium to be such a general alloy of Brazil gold as often to alter the colour thereof. We have particularly observed it in the Brazil coin, many of which were rejected at first sight, suspecting them to be counterfeit. We found it a short time since in a Brazil bar to the amount of nearly 20 per cent. altering the colour thereof to nearly that of the metal palladium.

J. AND P. J.

*The paper published by Johnson in the Philosophical Magazine in July 1812, his first contribution, at the age of 19, to the metallurgy of platinum*

*Philosophical Magazine* then appeared and is addressed to Mr. Tilloch, the Editor. Its title is: "Experiments which prove Platina, when combined with Gold and Silver, to be soluble in Nitric Acid. By Mr. Percival Johnson." It is subscribed Maiden Lane, Wood Street, July 1st, 1812.

After a short introductory paragraph he states: "I find, although platina when in a pure state is not acted upon by the nitric acid, that when alloyed with gold and silver it is perfectly soluble, and with silver alone partially so. From 1 to 15 per cent. of platina to the gold was entirely dissolved—having previously mixed the gold with three times its weight of silver for quartation. Twenty per cent. lost  $\frac{7}{12}$ ths . . . 30 per cent. lost  $\frac{4}{9}$ ths." He then describes the appearance of the cupelled buttons and continues: "By mixing double the quantity of silver the gold was freed of upwards of 20 per cent. of platina, and more according to the quantity of silver employed; and yet the gold seems to be a necessary component for the perfect solution; for by mixing the following proportions of *silver* and *platina*, the results were thus: Platina and Silver equal to 1 per cent. of the former left in dilute acid a light powder partly subsiding. 5 per cent. gave the acid a straw colour, half the platina employed being dissolved. 10 per cent. a very bright straw colour, having dissolved the same proportion. 15 per cent. a bright light brown, having dissolved  $\frac{4}{7}$ ths of the platina. 25 per cent. a deep brown, dissolving  $\frac{2}{3}$ rds of the platina. The two latter proportions required concentrated acid after the action of the dilute."

So it appears that this young man set about his experiments in a completely logical manner and expressed his results in a plain and simple style, with a nice economy in

commas. His meaning is perfectly clear and he uses no unnecessary words and no far-fetched ones.

In short, it is a model statement of the results of a scientific enquiry.

The question now arises as to how much he knew of the previous work on the subject. Whether he was aware of Tillet's paper is a question no one can answer, but undoubtedly he was acquainted with Bingley. The latter had been King's Assay Master at the Mint since 1798 and must have had intimate business connections with the Johnsons, and there is plenty of evidence later of close personal friendship between him and Percival. It seems safe to assume that Bingley knew of Johnson's proposal to publish and probably encouraged it. That neither the help nor the precedence are acknowledged is not at all unusual for those times, and the fact remains that this was the first publication of the observations in English.

But the statements about the solubility of platinum in nitric acid under these circumstances was not the only communication in this paper. There is also, as will be seen, a short appendix concerning the presence of palladium in Brazilian gold. This addendum is initialled "J. and P.J.", showing that both father and son were responsible for it. Their observation had important results some twenty years later, when Brazilian gold had become a drug in the market owing to the difficulty of removing the palladium, and the tellurium which accompanied it, from the native bullion. At that time Percival Johnson proved to be the only refiner in Europe who could successfully undertake this work, and in the course of the next twenty years he refined more than a quarter of a million ounces of the product of the Imperial Brazilian Mining Association.

#### References

- 1 P. N. Johnson . . . . . *Phil. Mag.*, 1812, 40, 3-4
- 2 M. Tillet . . . . . *Mém. Acad. Sci. Paris*, 1779, pp. 373-377, 385-437, 545-549
- 3 Robert Bingley . . . . . Letter to Charles Hatchett in the Manuscript Collection of the Royal Society