L. B. Guyton de Morveau

EARLY PLATINUM APPARATUS

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French scientists and goldsmiths of the eighteenth century were largely responsible for developing methods of melting platinum and using it for the manufacture of jewellery and scientific apparatus. Most of them lived and worked in Paris, but important contributions were also made by a chemist in the capital of the province of Burgundy.

Louis Bernard Guyton was born in Dijon on January 4th, 1737. After a classical education at the Godran College he entered the Dijon faculty of law, and in 1756 became an advocate, as his father had been. In 1762 he was appointed Avocat-Général du Roi, one of the public prosecutors, in the Dijon parliament, and on taking office he added to his name “de Morveau”, from a family fief in Burgundy. Like many Frenchmen, he prudently dropped the aristocratic “de” during the Revolution, becoming Guyton-Morveau, then Guyton, and finally, under Napoleon, Guyton-Morveau again (1).

In 1764 Guyton was elected to the Académie des Sciences, Arts et Belles-Lettres de Dijon. At first he presented only poems and orations to its meetings, but, like many educated men of the day, he became interested in science. He is said to have taken up chemistry in 1768 after challenging some remarks on a chemical topic by Dr J. P. Chardenon, who told him to rest content with his literary reputation and leave.

Since his death 150 years ago Guyton de Morveau has been remembered by historians of chemistry for his collaboration with Lavoisier in modernising chemical nomenclature in 1787. A reformer in politics as well as science, Guyton helped to organise science for the benefit of the nation during the French Revolution, and he was a pioneer of technological education. He always sought applications of scientific discoveries and he made use of platinum in the laboratory when it was still a rare scientific curiosity.
chemistry to the chemists. Without delay he bought chemicals and apparatus from a disillusioned young man who had expensively housed an itinerant alchemist for six months, he fitted up a laboratory in his house and taught himself chemistry from the books of Macquer. Henceforth Guyton devoted to chemistry all the time that he could spare from his parliamentary duties, and his memoirs and books soon attracted attention in Paris and beyond. He corresponded with chemists in several countries and, with the aid of friends, translated chemical works from English, German, Swedish and other languages. These translations added to the fame of Guyton and the Academy, as did the annual course of lectures that he began to give in 1777.

A reformer by nature, Guyton could not tolerate the antiquated chemical nomenclature then in use. In 1782 he proposed a systematic nomenclature which forms the basis of that now used for salts, and after his acceptance of Lavoisier's anti-phlogistic theory in 1787 he was largely responsible for the extension of the new nomenclature to other substances. This was his most lasting contribution to chemistry, for, while he did much experimental research, his interests were too wide for him to make a profound study of any one topic.

The Nature of Platinum

Buffon, the great naturalist, visited Dijon in 1773 and gave Guyton a specimen of native platinum, pointing out that a magnet separated it into two parts, one containing iron and the other gold. This led Buffon to believe that platinum was merely an alloy of iron and gold. Guyton confirmed Buffon's observations, but he then submitted several samples to cupellation, and found that the resulting buttons of platinum were non-magnetic. He almost reached the conclusion that pure platinum contained no iron, but after pulverising one of the buttons he found small particles of iron and retreated to Buffon's opinion that iron was an essential constituent, suggesting that the magnetism of the platinum had merely been diminished by the action of heat. Buffon was glad to publish this evidence that seemed to support his opinion, which was accepted by few chemists (2).

In 1775 Delisle (or de l'Isle) found that strong heating sufficed to melt platinum that had been freed from iron and sand by dissolving the crude platinum in aqua regia, precipitating with sal-ammoniac and igniting. The discoverer of this important process was a Government official, and not J. B. L. Romé de Lisle, the crystallographer, as has been suggested (3), for on August 12th his discovery was mentioned to the Paris Academy of Science by Lavoisier, who described him as "premier commis du bureau de la guerre" (4). Nothing further is known about him except that he died before 1783, for Romé de Lisle then referred to him as "the late M de l'Isle" (5).

Guyton learnt about Delisle's process in a letter from Lavoisier, and on repeating it he soon found that it yielded malleable platinum with a density of 10.045, which increased to 20.170 after forging. He also heated platinum with a reducing flux of borax, charcoal and glass, and with a flux containing "neutral arsenical salt" (potassium arsenate), and in each case the resulting platinum had a density of about 15 to 17, but it was not malleable and was generally magnetic, unlike that obtained by Delisle's method. Guyton reported these results in a letter to Buffon which was soon published (6). He pointed out that the more malleable the metal, the less it was attracted by the magnet, but he was still unable to come to the conclusion reached by most of his contemporaries that the magnetism of some samples was due to impurities. He no longer stated iron to be an essential constituent, but thought that the magnetism might depend on the arrangement of the particles in platinum. It seems to have been only in 1779, after reading the essay on platinum by Bergman, that Guyton finally accepted it as a metal that was non-magnetic when pure.
The practical applications of chemistry always interested Guyton, and in his letter to Buffon he expressed the hope that uses would be found for platinum, and also for the alloy of platinum and steel that he had prepared. He did not refer again to this alloy, but in the notes that he added to his translation of the second volume of Bergman’s essays he described uses of two other alloys (7).

**Introduction of Platinum Apparatus**

From equal parts of gold and platinum (prepared by Delisle’s method) he made a spoon for holding specimens of minerals that were being examined in the blowpipe flame, and he made the nozzle of the blowpipe from a very hard alloy of silver with two-sevenths of platinum. One of his colleagues in the Dijon Academy succeeded in making a spoon for his blowpipe out of pure platinum, by fusing 1.5 or 2 ounces in a crucible and hollowing out the resulting button with emery on the lathe. These notes were written by Guyton before August 1784, when the text of the book was approved for printing, and it therefore seems that he and his unnamed colleague introduced platinum for laboratory apparatus independently of F. K. Achard in Berlin.

Guyton had been aware since 1775 that an arsenical flux enabled platinum to be fused, but he had not used this process for making blowpipe spoons and nozzles because he knew that the platinum contained some arsenic. However, in 1784 Achard cast a crucible from which the arsenic volatilised, leaving solid platinum in the mould (8). Achard used less than an ounce of platinum, and when Guyton tried to repeat the experiment on a larger scale he found that the flux of potash and white calx of arsenic (arsenious oxide) swelled up excessively. This could be remedied by adding common salt to the flux, and in 1785 Guyton was able to make three crucibles larger than Achard’s. One of these was rather spongy, but the larger of the others was excellent and for alkaline fusions of minerals it was more satisfactory than the iron crucibles recommended by Bergman,
though, like iron, it was attacked by metals and also by nitre (9). Two years later Guyton seems to have realised that the nitre was attacking impurities in the platinum, for when in Paris in 1787 he advised Janety to purify red-hot platinum by quenching it in molten nitre (10). Platinum was then available in large amounts, and apparatus made from it soon became quite common.

Since 1782, when he retired from the Dijon parliament, Guyton had devoted all his time to chemical research, teaching and writing, but all this activity was interrupted by the Revolution. In 1790 he was appointed to an important administrative post in Dijon, and in 1791 he moved to Paris on his election to the National Assembly. He remained in the Convention, which was elected after the dissolution of the Assembly in 1792, and he was a member of the first Committee of Public Safety, before it became dominated by Robespierre. He devoted most of his energy to the application of science to the national economy and to the war effort, and he was also active in the Committee of Public Instruction which in 1794 founded the École Polytechnique, the world’s first great college of technology. Guyton was one of the professors of chemistry in the École Polytechnique, and after retiring from politics in 1797 he continued to lecture there and resumed his research.

In 1798 he published an account of some of the properties of platinum, which he had apparently measured in order to complete a table of properties of the metals for use in his course of lectures (11). He found the density to be 20.847 and compared this with the results obtained by other scientists, and by measuring the weight required to break a wire 2 mm in diameter he found that the “tenacity” of platinum was greater than that of silver and gold, and was exceeded only by iron and copper. He also found that platinum formed an amalgam when boiled with mercury, and thirteen years later he described how this amalgam was used for coating other metals with platinum (12).

Applied science continued to interest Guyton, and he made a long and detailed examination of the methods used for measuring the high temperatures in furnaces and kilns.

**A Platinum Pyrometer**

In 1782 Josiah Wedgwood had introduced a pyrometer with which he estimated high temperatures by measuring the shrinkage of standard cylinders of baked clay when they were heated above red-heat, and this was used and praised by Guyton. However, he thought that the thermal expansion of metals might provide an alternative means of measurement, and in 1803 he described a platinum pyrometer of his own invention (13). This consisted of a platinum rod, 45 mm long, mounted in a groove cut in a piece of baked clay. One end was fixed, but
A platinum pyrometer for measuring high temperatures was described by de Morveau in the Annales de Chimie of 1803.

The platinum pyrometer was similar in principle to a pyrometer utilising the expansion of metals that was invented by J. Ferguson before 1760 (15), but Guyton seems to have invented it independently; it is not known whether it was widely used.

In 1799 Guyton was appointed administrator of the mints, and occupied this post as well as his chair at the École Polytechnique. His duties were not technical, but he took the trouble to investigate personally the possibility of platinum being used in counterfeit coins (16). He found that there was little risk of this being done, for alloys containing platinum were too pale to be mistaken for gold, and gold-plated platinum was too dense.

Guyton retired from the École Polytechnique in 1811, and his services to science and to the State were rewarded with a barony. He retained his post at the mint until the fall of Napoleon in 1815, but he did not live long to enjoy his retirement, for he died on January 2nd, 1816.

References

6. L. B. Guyton de Morveau, Obs. sur la Physique, 1775, 6, 193-203.
7. T. O. Bergman, Opuscules Chymiques et Physiques (Dijon, 1785), II, 91 and 460 (notes by Guyton).