# Nicolas Louis Vauquelin

## EARLY WORK ON IRIDIUM AND OSMIUM

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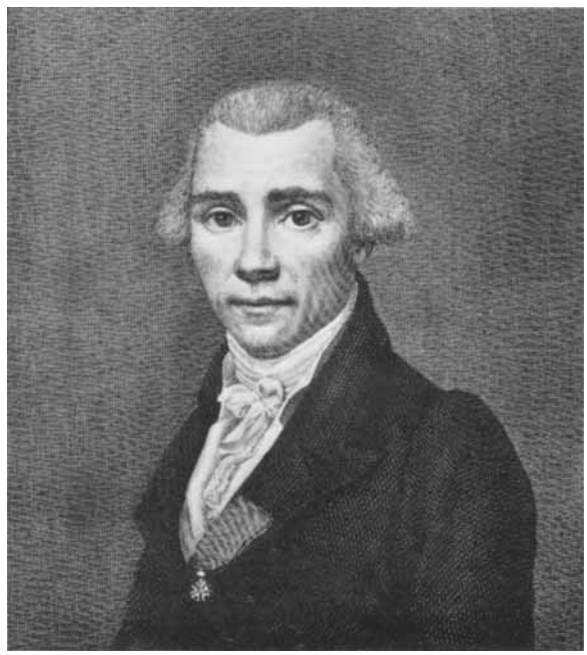
Nicolas Louis Vauquelin was born two hundred years ago, on May 16th, 1763. His father was steward on an estate in Normandy and after leaving the local school Vauquelin worked with him for a time. However, he had other ambitions, and at the age of 14 he went to Rouen and became assistant to a pharmacist who gave a course of lectures in physics and chemistry. Vauquelin listened while attending to his duties, and in his free time he wrote down what he remembered and corrected his notes with the aid of books lent by the students. His master discovered the notebooks and was so angered that Vauquelin left him and moved to Paris. Later, when his former assistant was famous, the obscure pharmacist boasted that he had been his pupil.

After two years in Paris, Vauquelin found a good post with a pharmacist named Auprêtre. He would have stayed with his new employer but he fell ill, and, as Auprêtre lived alone, he had to go into a hospital, the notorious Hôtel-Dieu. To many patients admission to the Hôtel-Dieu was a death sentence, for it was overcrowded and unhygienic, and had an appalling mortality rate. Vauquelin was lucky; after two months he was alive and well and he was taken in by Chéradame, a pharmacist in the Rue Saint-Denis.

This was the turning point of his career, for he met Chéradame's cousin, Antoine François de Fourcroy, who was rapidly establishing a great reputation as a professor of chemistry. Fourcroy soon employed



**Nicolas Louis Vauquelin**
**1763–1829**

*Born 200 years ago, Vauquelin became Professor of Chemistry at the* Muséum d'Histoire Naturelle *in 1804. Here he worked on the constituents of crude platinum and was close behind Smithson Tennant in the work that led to the discovery of iridium and osmium. (From an engraving by Dequevauviller fils after a portrait by Besselièvre, Bibliothèque Nationale, Paris.)*

*The lecture theatre and chemical laboratory of the* Muséum d'Histoire Naturelle *in 1795. Vauquelin was Professor of Applied Chemistry here from 1804 until his death. (From a water-colour by B. Hilair, Bibliothèque Nationale, Paris.)*

Vauquelin as his assistant, at an annual salary of 300 livres (about £12), with board and lodging. When Fourcroy's two sisters opened a small shop for perfumes and children's toys, Vauquelin went to lodge with them, and they looked after him as long as they lived, for he never married. Years later Sir Humphry Davy described their strange but happy ménage as he found it in 1813: "I was ushered into a sort of bed-chamber, which likewise served as a drawing-room. One of these ladies was in bed, but employed in preparations for the kitchen; and was actually paring truffles. Vauquelin wished some immediately to be dressed for my breakfast, and I had some difficulty to prevent it."

While he was Fourcroy's assistant Vauquelin gave the demonstrations during some of his lectures, and at Fourcroy's invitation he himself lectured at the *Lycée*, a fashionable institution where wealthy Parisians attended courses on scientific and literary subjects. However, his voice was weak and he lacked confidence at the beginning of a course, and although he later occupied several important chairs he never achieved fame as a lecturer.

It was at the *Lycée* that Fourcroy and Vauquelin carried out their first joint research, and it soon became clear that Vauquelin was a first-class experimental chemist. The relationship of master and assistant soon changed into an association of equals, and together the two friends achieved great success, particularly in their studies of organic chemistry, a subject then in its infancy.

Most of their joint work was done after the French Revolution. In 1792 Fourcroy entered politics, and made valuable contributions to the reform of higher scientific and technological education, but Vauquelin remained a private citizen. On August 10th, 1792, when Louis XVI was deposed and his Swiss guard massacred, he was manager of a pharmacy near the Royal palace and he and Fourcroy's sisters sheltered one of the Swiss

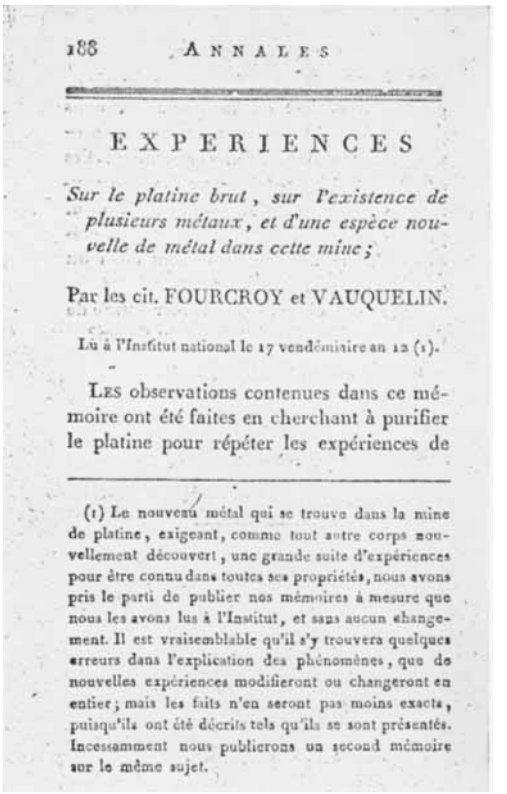
who had escaped from the mob. For a few months in 1793 he was a military pharmacist at Melun, about 25 miles from Paris, and for a year he had the important duty of organising the production of saltpetre, then urgently needed for the manufacture of gunpowder, in the region around Tours.

France was now at war with most of Europe and there was a serious shortage of engineers and other skilled men, without whom the republican armies were powerless. In December 1794 the Government opened the *Ecole Polytechnique*, a college with 400 students in which a basic course in science and mathematics was followed by specialised courses in all branches of engineering. Vauquelin was recalled to Paris and became an assistant professor of chemistry, but soon afterwards he was put in charge of instruction in mineral analysis at the *Ecole des Mines*. He was well suited for this post, for his achievements included the discovery in minerals of two new elements, beryllium and chromium.

In 1801 Vauquelin became professor of chemistry at the *Collège de France*, but in 1804 he moved to the *Muséum d'Histoire Naturelle* as professor of applied chemistry, and there he remained for the rest of his life. Fourcroy was already professor of chemistry, and their collaboration now became very close.

Early in 1803 W. H. Wollaston found a new metal, palladium, in the solution of platinum in aqua regia, and this discovery led several other chemists, including Fourcroy and Vauquelin, to investigate crude platinum.

In their first experiments, reported to the *Institut* in October 1803 (Vendémiaire, an XII according to the Republican Calendar), they found that after three successive extractions with aqua regia, 250 grams of platinum left 5 grams of a black insoluble residue. This was fused with potash, and the product was extracted first with water and then with aqua regia, in which it was partly soluble. The aqueous extract contained chromate, but the extract in aqua regia was found to contain a new metal.



188 ANNALES

EXPERIENCES

*Sur le platine brut, sur l'existence de plusieurs métaux, et d'une espèce nouvelle de métal dans cette mine;*

Par les cit. FOURCROY et VAUQUELIN.

Lu à l'Institut national le 17 vendémiaire an 12 (1).

Les observations contenues dans ce mémoire ont été faites en cherchant à purifier le platine pour répéter les expériences de

(1) Le nouveau métal qui se trouve dans la mine de platine, exigeant, comme tout autre corps nouvellement découvert, une grande suite d'expériences pour être connu dans toutes ses propriétés, nous avons pris le parti de publier nos mémoires à mesure que nous les avons lus à l'Institut, et sans aucun changement. Il est vraisemblable qu'il s'y trouvera quelques erreurs dans l'explication des phénomènes, que de nouvelles expériences modifieront ou changeront en entier; mais les faits n'en seront pas moins exacts, puisqu'ils ont été décrits tels qu'ils se sont présentés. Incessamment nous publierons un second mémoire sur le même sujet.

*The opening page of the first memoir on the analysis of crude platinum by Fourcroy and Vauquelin.* (Annales de Chimie, *1804, vol. 49, p. 188.*)

The solution in aqua regia was brown, and turned green on the addition of either ferrous sulphate or iron. Ammonium chloride, which formed a yellow precipitate when added to a solution of platinum in aqua regia, had no effect on the solution of the new metal. However, when added to a solution containing both metals, ammonium chloride gave a dark red precipitate. Fourcroy and Vauquelin therefore concluded that the new metal formed a red double salt with ammonium chloride, similar to the corresponding yellow platinum salt (and therefore co-precipitated with it), but more soluble. The yellow salt was decomposed on ignition to pure platinum, soluble in aqua regia, but the red salt yielded a mixture of platinum and the new metal, which was insoluble.

Fourcroy and Vauquelin thus observed accurately some of the properties of iridium, but they did not suggest a name for the new metal. They were aware of the work being done independently by H. V. Collet-Descotils, whose shorter memoir, describing similar but less detailed results, was read on the same day. They also described some of the properties of the mother-liquor left after the precipitation of the yellow double salt of platinum. On evaporation to dryness this left a red residue, which, after treatment with alcohol to remove the chlorides of iron, copper and gold, dissolved in water to form a rose-red solution. They investigated a few reactions of this solution, which probably contained rhodium, but did not suggest that it contained another new metal. The discovery of rhodium was announced by Wollaston in 1805.

Further experiments on the insoluble residue from crude platinum were described by Fourcroy and Vauquelin in February 1804. They were now mainly interested in the aqueous extract obtained after the residue had been fused with potash. This solution emitted a colourless vapour with a strong action on the eyes and throat, and when it was distilled the volatile substance was found in the distillate. This substance blackened organic matter such as skin or cork, and yielded a black precipitate on treatment with reducing agents; whenever the precipitate was formed the odour disappeared. Fourcroy and Vauquelin described other properties of this volatile substance, which they considered to be an oxide of the metal described in their first memoir. Here they were in error, for it was really an oxide of osmium, and not iridium.

The constituents of crude platinum were being investigated in England as well as in France, and on June 21st, 1804, Smithson Tennant reported to the Royal Society the results of a masterly piece of research which led him to conclude that there were, in fact, two new metals present. These he named iridium and osmium. When news of this discovery reached Paris, Vauquelin was about to leave for the south of France, where he was to join Fourcroy, then inspecting provincial lycées for the government. Vauquelin left a colleague named Bergman to continue the experiments on platinum, and he wrote from Marseilles urging him to find out as soon as possible whether there were, in fact, two metals or only one as he had himself supposed. "It is absolutely essential" he wrote to Bergman, "to clear up this question, and to admit our error if we have made one."

Fourcroy and Vauquelin soon became convinced that Tennant was correct, and in 1806 they published a review of the properties of the new metals and fully admitted that his work was superior to their own. However, they were perhaps being too modest, for although their first interpretation was incorrect, their experimental observations had been detailed and accurate.

Fourcroy died in 1809 and Vauquelin succeeded to his chair of chemistry at the Faculty of Medicine, while retaining the chair of applied chemistry at the *Muséum d'Histoire Naturelle*. He was also assayer to the Mint, and until his death on November 14th, 1829, he maintained a great output of papers on mineral analysis and the chemistry of vegetable and animal substances.

Liked and admired by his colleagues and students, Vauquelin led a simple and quiet life, finding relaxation in reading and listening to music. His real devotion was to his work, and no chemist can have worked harder or with greater enthusiasm. After his death Cuvier described him as "entirely a chemist, a chemist every day of his life, and throughout every day". Vauquelin would have wished for no other epitaph.

## References

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