

Osmium vs. ‘Ptène’: The Naming of the Densest Metal

The early name ‘ptène’ is attributed to French chemists Fourcroy and Vauquelin

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This paper reviews the use and relation of the word ‘ptène’ to osmium. While Smithson Tennant discovered osmium in platinum ore in 1804, the French chemists Antoine-François Fourcroy and Nicolas-Louis Vauquelin simultaneously identified in a platinum residue a metal they called ‘ptène’. This name was most probably attributed to a mixture of platinoids (excluding platinum), mainly osmium and iridium. Nevertheless, Fourcroy later considered that ‘ptène’ was the name they attributed to osmium.

Introduction

In a paper celebrating the bicentenary of the discovery of osmium and iridium, the name ‘ptene’ or ‘ptène’ was reported as an early synonym for osmium. No origin for this name could be found except the references cited by the historians of science James Riddick Partington (1886–1965) and John Albert Newton-Friend (1881–1966) (1–3). Both authors were contradictory on the origin of the word ‘ptène’ and it could not be determined whether the author was Smithson Tennant (1761–1815), the British discoverer of osmium, or one of the French chemists Antoine-François Fourcroy

(1755–1809), Nicolas-Louis Vauquelin (1763–1829) and Hippolyte-Victor Collet-Descotils (1773–1815), as they were all involved in the study of platinum ore in the 1800s. In an earlier paper, the same author had concluded that Tennant was first inclined to call the new element ‘ptène’ instead of osmium (4).

In fact, we can confirm the later statement of Jaime Wisniak that the origin of ‘ptène’ was French (5).

A New Metal in Platinum Ore: ‘Ptène’

The origin of the early research on platinoids was the partnership between Smithson Tennant (1761–1815) and William Hyde Wollaston (1766–1828), two alumni of Cambridge University, UK, to isolate any valuable substance from platinum ore. Wollaston was in charge of the soluble part in *aqua regia* while Tennant took care of the black residue. Wealthier than his friend, Tennant probably provided the money for the first purchase of nearly 6000 ounces of platinum ore and from 1800 they started their research separately (at Tennant’s death in 1815, the amount of platinum they had purchased totaled 47,000 ounces. A major supplier of Wollaston was John Johnson, a commercial assayer in London and the father of Percival Johnson, co-founder of Johnson Matthey Plc) (6–8).

On 21st June, 1804, Tennant read a paper to the Royal Society on the experiments he performed during the summer of 1803 on a platinum ore from New Granada (now known as Colombia) (7). In his paper, he announced the discovery, isolation and naming of two new chemical elements: iridium and osmium, the latter

because of the “pungent and peculiar smell [...] [of its] very volatile metallic oxide” (osmium tetroxide (OsO_4)) (9). Across the Channel, an extract of Tennant’s paper was translated in the *Bibliothèque Britannique* published in Geneva, Switzerland, and partially reprinted in the *Annales de Chimie* on 22nd October, 1804 (10).

Meanwhile, Fourcroy and Vauquelin were repeating experiments by the young Collet-Descotils who claimed to have isolated a new element from the black residue of platinum after its treatment with *aqua regia* (11–14). Tennant himself was aware of these experiments and cited them in his 1804 paper (9).

The main interest of the French chemists was to isolate palladium. In April 1803 a strange notice circulated in the English gazettes that a new metal isolated from platinum ore was sold under the name of palladium by a merchant named Mr Foster in London. Wollaston resorted to this kind of subterfuge to establish his priority on the first isolation of palladium while keeping his process secret until he had completed his research on platinum melting (Wollaston was later involved in the preparation and sale of platinum hardware). Unfortunately the new metal was not recognised because a well-known analytical chemist, Richard Chenevix (1774–1830), considered it as a mixture of mercury and platinum (15, 16). This conclusion intrigued the scientific community and several famous chemists, including Vauquelin and Fourcroy, started analysing platinum (11–14).

The first results of the three French chemists were read at the Institut National (Class of sciences, mathematics and physics) on 26th September and 10th October, 1803 (11–14). Collet-Descotils, a student of Fourcroy and Vauquelin, described a product with iridium-related properties (11).

On 13th February, 1804, Fourcroy and Vauquelin presented their whole research in a second dissertation where they concluded on this newly discovered element:

“we will not decide yet ... on the naming of this metallic body so different from those of the same type”

(“*nous ne nous prononcerons encore ... sur le nom qu’il faudra imposer à ce corps métallique si différent de tous ceux du même genre*”) (17).

In a second set of publications on the same subject, Fourcroy mentioned:

“the platinum ore imported from Peru contains at least nine different substances; namely quartz and iron-bearing sand, iron, sulfur likely

combined in metallic sulfides, copper, titanium, chromium, gold, platinum and a new metal” (“*le platine brut apporté en grains du Pérou, contient au moins neuf substances différentes; savoir, du sable quartzueux et ferrugineux, du fer, du soufre vraisemblablement combiné en sulfures métalliques, du cuivre, du titane, du chrome, de l’or, du platine et un métal nouveau*”) (18).

A second note was added in the next volume where different reactions on this new metal were reported without naming it and the presence of osmium in the insoluble residue was noted by Fourcroy who reported a “pungent, spicy astringent” smell (“*âcre, piquante comme styptique*”) (an indication of OsO_4) (19).

Although Collet-Descotils repeated Wollaston’s experiments, no further paper was published by the French chemists in 1805 (20, 21). However, in the fourth volume of the *Encyclopédie Méthodique*, Fourcroy compiled and defined chemical terms and under the item ‘Docimasie’, we can read:

“We did not speak about either the colombium discovered by Mr Hatchette nor tantalum found recently by Mr Ekheberg nor ptene nor cerium newly announced by Messrs Hisenger & Berzelius because their ores are still too uncommon”

(“*On n’a point parlé ici du colombium découvert par M. Hatchette, ni du tantale trouvé dernièrement par M. Ekheberg, ni enfin du ptène, ni du cérium annoncé tout récemment par MM. Hisenger & Berzelius, parce que leurs mines sont encore trop rares*”) (22).

In the same volume, three ‘ptène’ derivatives were presented as possible compounds: the “ptene malate” (“*malate de ptène*”), “ptene gallate” (“*gallate de ptène*”) and “ptene fluoride” (“*fluat de ptène*”) (22). However, they were still unknown because nobody had isolated ‘ptène’ “in a state of purity and very abundantly” (“*à l’état de pureté & assez abondamment*”) (22). The only definition available in 1805 for ‘ptène’ was settled as “metal combined with platinum” (“*métal qui accompagne le platine*”) (22). A more elaborated definition was expected in the next volume but it never appeared (23).

On 17th March, 1806, Fourcroy finally recognised the presence of four new elements in platinum (in addition to osmium and iridium, there were also palladium and rhodium). He admitted that the metal they named ‘ptène’ was constituted of two distinct elements (although he also considered that the name ‘ptène’ was attributed

to osmium) (24). A note was added to remember the contribution of Collet-Descotils (25). (This note contains a mistake: the paper of Collet-Descotils it refers to was printed in the 7th issue. The 5th and the 6th issues were wrongly written in the title and the content of the note.)

“In a first report of my work on platinum [...] we announced [...] the existence of a new metal firstly named ptene and later osmium and iridium in the black powder that resists the action of nitro-muriatic acid [*aqua regia*] [...] osmium is very volatile, very easily oxidised. We were the first to discover this singular and very different metal in summer 1803 [...] Mr Tennant found and distinguished it only a few months after us because he mentioned in his dissertation the first *Mémoire* we had published in the *Annales de Chimie*. We had proposed ptene as a name for this metal but we willingly accept the denomination of osmium which seems preferable to us”

(“*Dans un premier extrait de mon travail sur le platine [...] nous avons annoncé [...] l’existence d’un métal nouveau nommé d’abord ptène et depuis osmium et iridium dans la poudre noire qui résiste à l’action de l’acide nitro-muriatique [aqua regia] [...] L’osmium [...] est très volatil, très oxydable. Nous avons découvert, les premiers, dans l’été 1803, ce métal singulier et très-différent [...] M. Tennant ne l’a trouvé et distingué que quelques mois après nous, parce qu’il cite dans sa dissertation le premier Mémoire que nous avons publié dans les Annales de Chimie. Nous avons proposé d’appeler ce métal ptène; mais nous adoptons volontiers la dénomination d’osmium qui nous paraît préférable*”) (24).

This naming history was summarised two years later in the *Encyclopédie Méthodique* where Fourcroy wrote an article on osmium:

“From its last characteristic [the pungent smell of OsO₄] Mr Tennant proposed the name of osmium from the Greek *osmè*, smell. We had already discovered these features and we had proposed the name of ptene for which the name osmium, which we prefer, was substituted” (“*c’est de cette dernière propriété que M. Tennant a tiré le nom d’osmium, du mot grec osmè, odeur. Nous avons déjà découvert ces caractères, & nous en avons tiré le nom de ptène, auquel celui d’osmium, que nous préférons, a été substitué*”) (23).

None of the references from the *Encyclopédie Méthodique* (in 1805 and 1808) refer to a possible paper on the naming of ‘ptène’ (22, 23). What should we understand? We believe that between 21st June, 1804, and 17th March, 1806, the French chemists were uncertain of the platinum chemistry and they did not want to publish anything until their results were definitive. A possible source of delay to confirm Tennant’s results was the difficulty in obtaining platinum for their experiments (7).

A first account of splitting ‘ptène’ into two distinct elements (osmium and iridium) had been suggested by Jean-André-Henri Lucas (1780–1825) in his book “*Tableau méthodique des espèces minérales*” (1806) whose acceptance for publication dated back to 13th November, 1805 (26). A similar observation was done in Joseph Capuron’s work (27). The distinction between the platinoids was not clear to everyone: a publication in the *Journal de Physique* (January 1806) presented rhodium and iridium as ‘ptène’ (28). A possible explanation for this mistake may be due to a correction in the third edition of the *Philosophie Chimique* (1806) of Fourcroy where ‘ptène’ was mentioned with platinum (29).

The story of ‘ptène’ was later revived by Jöns Jacob Berzelius (1779–1848) during his research on osmium in 1828. The history of the discovery of platinoids was summarised as follows:

“The ancient chemists associated every metal contained in platiniferous sand, except gold, with platinum until Collet-Descotils discovered two new substances; a blue sublimate ... and a red substance colouring the ammoniac muriate of platinum which he attributed to an unknown metal. While Collet-Descotils was still involved in his research, Fourcroy and Vauquelin, aware of it, started their own experiments and discovered several properties of this new metal they named ptene. Like Collet-Descotils they confounded under this name every metal associated with platinum. Soon afterwards Wollaston discovered palladium and then rhodium ... Tennant taking care of the fraction of platinum insoluble in *aqua regia* found iridium and osmium at about the same period”

(“*Les anciens chimistes prenaient tous les métaux contenus dans le sable platinifère, excepté l’or, pour du platine, jusqu’au moment où Collet-Descotils fit connaître deux substances nouvelles; un sublimé bleu ... et la matière*”

colorant en rouge le muriate ammoniacal de platine, qu'il attribua à la présence d'un métal nouveau auquel il ne donna aucun nom particulier. Pendant que Collet-Descotils était encore occupé à ses expériences, Fourcroy et Vauquelin, instruits de ses expériences, commencèrent des recherches semblables, et découvrirent plusieurs propriétés de ce nouveau métal, qu'ils nommèrent ptène; mais ils confondirent, comme Collet-Descotils, sous ce nom tous les métaux inconnus qui accompagnent le platine. Wollaston découvrit peu de temps après le palladium, et plus tard le rhodium ... Tennant, en s'occupant de la partie de platine insoluble dans l'eau régale, trouva presque en même temps l'iridium et l'osmium") (30).

W. A. Smeaton adopted the same conclusions as Berzelius: in their 1803 and 1804 memoirs, the French chemists reported the characteristics of iridium ammonium salts and OsO_4 (maybe rhodium derivatives too) but failed to isolate a metal from the residue of platinum ore (31). The precise description of the pungent smell of OsO_4 by Fourcroy and Vauquelin led them to consider that the name 'ptène' was mainly attributed to osmium (23–25).

On the etymology of osmium or 'ptène', neither Tennant nor Fourcroy and Vauquelin were clear on a Greek origin in their first publications (9, 24). Tennant only mentioned a connection with smell:

"... as this smell is one of the most distinguishing character, I should on that account incline to call the metal osmium." (9)

In 1808, Fourcroy and Klaproth separately mentioned the Greek origin of osmium (*osmè*: smell) and of 'ptène' (*pténos*: winged) (23, 32).

History of the Element Symbols

The story was not finished. None of the English, French or Swedish scientists discovered the last element of the platinum group, ruthenium (Ru). It was only in 1844 that Carl Claus (1796–1864) isolated this metal and the aging but world-respected Berzelius validated his discovery (33, 34). This discovery had an impact on rhodium: it changed its chemical symbol from R to Rh.

In 1813, Berzelius, inspired by the "System of Chemistry" of Thomas Thomson (1773–1852), had decided to give a chemical sign to each atom:

"I shall take, therefore, for the chemical sign, the initial letter of the Latin name of each elementary substance: but as several have the same initial letter, I shall distinguish them in the following manner: 1. In the class which I call metalloids, I shall employ the initial letter only, even when this letter is common to the metalloid and to some metal. 2. In the class of metals, I shall distinguish those that have the same initials with another metal, or a metalloid, by writing the first two letters of the word. 3. If the first two letters be common to the two metals, I shall, in that case, add to the initial letter the first consonant which they have not in common: for example, S = sulfur, Si = silicium, St = stibium (antimony), Sn = stannum (tin), C = carbonicum, Co = Cobaltum (cobalt), Cu = cuprum (copper), O = oxygen, Os = osmium, &" (35).

A general survey of the Berzelian symbolism can be found in the literature (36) and the influence of Thomson on Berzelius has been reported (37).

In the system of Berzelius, iridium and rhodium had respectively the symbols I and R because there were no other metals starting with the letter I or R (38). Things changed with the discoveries of iodine in 1811 (39) and ruthenium in 1844 (40).

Since iodine was a metalloid according to Berzelius, it had the priority for the initial letter only. The modification could be read in his work '*Essai sur la Théorie des Proportions Chimiques et sur l'Influence Chimique de l'Electricité*' of 1819. While the symbol for iridium is still I in the main text, the table at the end of the book was correct: I stands for iodicum (iodine in Latin) and Ir for iridium (41).

Concerning ruthenium and rhodium, Claus followed the rules of Berzelius when he correctly wrote the new symbols Ru and Rh (40, 42).

Conclusion

To conclude, one may say that osmium and iridium were definitely discovered by Smithson Tennant during the summer of 1803 (6–8). The team of French chemists unfortunately did not achieve the separation of iridium and osmium although they described the properties of salts or oxides from both elements. Fourcroy and Vauquelin honestly attributed the discovery to Tennant and no controversies occurred. The name 'ptène' was attributed to a mixture of osmium and iridium which joined the list of the "lost elements" recorded by Fontani



Fig. 1. Blue-grey crystals of osmium (Courtesy of CristalTech Sàrl, Switzerland)

et al. (43). See also the website of Peter van der Krogt on the periodic table (44).

Osmium still remains particular because of the strong smell of its volatile oxide but one often forgets its distinctive blue colour (Figure 1). In 1814, Vauquelin wrote:

“As to its colour, if we can judge from certain evidence, I believe that it is blue”

(“Quant à la couleur, si l'on peut en juger sur quelques apparences, je crois qu'elle est bleue”) (45).

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