The Discovery of Iridium and Osmium

BICENTENARY OF SMITHSON TENNANT

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The various men and the one exceptional woman who are credited with the discoveries of the hundred or so chemical elements form a remarkable pattern of dedicated scientists, high-minded divines and happy-go-lucky experimenters, among whom Smithson Tennant stands out as one of the most human and likeable.

He was a good Yorkshireman, only child of the vicar of Selby, where he was born on November 30th, 1761. His father died when he was nine and his mother a few years later. His education was sketchy, but from the beginning he was interested in science. This did not prevent him from acquiring "a competent knowledge of Greek" and becoming "well versed in the Latin language", but directed his attention, when the time came to choose a profession, to that of medicine. With this in view he went to Edinburgh and came under Joseph Black, an event "well calculated to stimulate and direct his curiosity".

In October 1782 he entered Christ's College, Cambridge, where he was most fortunate in both circumstances and companions, and where he devoted his principal attention to chemistry and botany. At the same time he read widely and with a catholic taste, helped by "extraordinary powers of memory and understanding" and by a remarkable power of getting to the heart of a book in little more than a cursory inspection.

In 1784 he travelled in Denmark and Sweden, where he met and talked to Scheele, and a year or two later to Paris to meet the great French chemists. In January 1785, when only 23, he was elected a Fellow of the Royal Society with an imposing body of Cambridge support. In December 1786 he moved from Christ's to Emmanuel, where he took his degree as Bachelor of Physic in 1788. Soon after that he left Cambridge for London.

In 1791 he presented a paper to the Royal Society demonstrating the composition of "fixed air" (carbon dioxide), which attracted considerable notice. In 1792–1793, being very disturbed by the state of affairs in France, he made another extended foreign tour. On returning to London he took up residence in the Temple and resumed attendance at the hospitals. In 1796 he took his doctor's degree at Cambridge, but before long abandoned any idea of entering the medical profession; he was really not fitted temperamentally for such work and already had ample private means. He was now therefore free to follow his scientific tastes in his own time. In 1796 he sent to the Royal Society his paper on the nature of the diamond, in which he confirmed and systematised Lavoisier's opinion that it consisted of carbon. It was in the course of this work, in which a platinum tube was used, that he became interested in that metal, and was assisted by another budding young doctor from Cambridge, William Hyde Wollaston.

He was now able to travel, but the war with France and a proneness to sea-sickness deterred him and he sought a new interest in agriculture. He bought land in Lincolnshire and later in Somerset, and proceeded to study the scientific bases of farming. The first

some kinds of platina may contain that substance, besides the other bodies usually mixed with it. When the alkaline solution is first formed, by adding water to the dry alkaline mass in the crucible, a pungent and peculiar smell is immediately perceived. This smell, as I afterwards discovered, arises from the extrication of a very volatile metallic oxide; and, as this smell is one of its most distinguishing characters, I should on that account incline to call the metal *Osmium*.

The passage from Smithson Tennant's paper, read to the Royal Society on June 21st 1804, describing the discovery and naming of osmium

result of this was a paper sent to the Royal Society in 1799 on the bad effects of dolomitic lime on germination, his conclusions being supported by goniometrical researches by Wollaston.

This continued association of the two men now had a very important result. Both were interested in platinum and, some time in 1799 or 1800, they entered into a partnership for the thorough investigation of the native metal, for which Tennant undertook to provide the finance. Towards the end of 1800 they bought nearly 6,000 ounces of material and extraction commenced shortly after. It was already known that when this mineral was treated with aqua regia there remained insoluble a small quantity of a black powder, which J. L. Proust in 1801 described as "nothing else than graphite or plumbago".

In the summer of 1803 Tennant undertook the examination of this material, while Wollaston devoted his attention to the main aqua regia solution. The results of the latter work are well known, and Tennant's led him to the discovery of iridium and osmium. In the early stages of the work he mentioned it to Sir Joseph Banks, and this establishes his priority over certain work going on at the same time in France. There Descostils had been examining the curious variations from orange to red of the colour of the precipitates obtained by means of ammonium chloride from the solution in aqua regia of native platinum; in 1803 he published his view that these were due to the presence of an unknown metal. About the same time his master Vauquelin, having treated the black powder with alkali, obtained a volatile oxide which he thought to belong to the same unknown metal.

Tennant continued his work during the winter and later studied carefully the papers of Collet-Descostils and of Fourcroy and Vauquelin. He soon realised, however, that whereas they suspected the presence of only one new metal in the black powder, in fact there were two. For breaking up the material he used a method similar to that employed by Vauquelin, namely the alternate action of caustic alkali and of acid. The second metal he found in the alkaline solution which had been suspected by Vauquelin to contain chromium. Tennant was unable to confirm this latter conclusion, but further examination showed that the solution contained a volatile oxide which could be separated by acidification and distillation. This was a colourless body, condensing first to an oily liquid and then solidifying into a semi-transparent mass. In all stages it had a strong and very characteristic smell. It was this that caused him to confer on the metal the name of *osmium*, from a Greek word meaning smell.

> As it is necessary to give some name to bodies which have not been known before, and most convenient to indicate by it some characteristic property, I should incline to call this metal *Iridium*, from the striking variety of colours which it gives, while dissolving in marine acid.
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> *The naming of iridium – a later passage from the same paper*

With regard to the other metal, Tennant's work confirmed and extended the observations of Fourcroy and Vauquelin on the subject, and this one he named *iridium* "from the striking variety of colours which it gives while dissolving in marine acid". Tennant published this work to the Royal Society on June 21st, 1804, in a paper entitled "On two Metals, found in the black Powder remaining after the Solution of Platina". This is a masterpiece of clarity and conciseness, and it is a tribute to it and to him that the French workers accepted the priority of his discovery without question. In 1814 Vauquelin published a paper confirming and extending his work.

For his discoveries Tennant was awarded the Copley Medal for 1804 by the Royal Society, to whom he had also communicated in 1802 a paper on the nature of emery, identifying it with corundum and as principally of alumina.

In 1805 and 1806 Tennant travelled in Scotland and Ireland, where he met Wollaston by chance at the Giant's Causeway. He always had the urge to travel, but was no longer physically strong.

In 1813 his friends induced him to become a candidate for the vacant Professorship of Chemistry at Cambridge, to which he was elected in May. In the spring of 1814 he delivered his first and only series of lectures, which made a great impression. In June of that year he read his last two papers to the Royal Society, one on an easier method of obtaining potassium and the other on "procuring a double distillation by the same heat".

In September 1814 Tennant went to France and travelled widely there to observe the changes that had taken place. He moved leisurely to the south, to Montpellier and Marseilles, and then back to Boulogne, where he arrived on February 20th, 1815. On the 22nd he embarked for home, but rough weather delayed the sailing of the ship. To pass the time Tennant suggested to a German officer, whom he had met on board, a visit on horseback to Napoleon's column. On the way back they came to a drawbridge at the side of a small fort. Unfortunately, the bolt securing this had been stolen a fortnight before and both men were thrown into the ditch beneath. The German escaped with bruises, but Tennant fell under his horse and his skull was badly fractured. He died shortly after in the Civil Hospital at Boulogne and was buried in the public cemetery there.

So passed a man of the highest intellectual character, marked especially by "a prompt and intuitive perception of truth, both upon those questions in which certainty is attainable, and those which must be determined by the nicer results of moral evidence". That is his epitaph as a man; as a scientist his achievements still speak for themselves.

References

Most of the information given above is derived from a rare pamphlet in the library of Johnson, Matthey & Co., Limited, called "Some Account of the late Smithson Tennant, F.R.S." and published in 1815 by some of his friends, the matter having appeared in substantially the same form in Thomson's *Annals of Philosophy* for that year. Reference has also been made to the late L. F. Gilbert's article on the Wollaston MSS at Cambridge (*Notes and Records of the Royal Society*, May 1952). The appropriate section in Mary Elvira Weeks' admirable book on "The Discovery of the Elements" has also been most profitably consulted.