Berzelius and the Platinum Metals

A NOTE ON THE BICENTENARY OF HIS BIRTH

Throughout the first half of the nineteenth century the dominant figure in chemistry was Jöns Jakob Berzelius, not only for his enormous output as an inspired and systematic investigator but also as the prolific author of text-books and, from 1821 to 1849, of an annual review of recent advances. In the course of a lecture to the Swedish Royal Academy of Sciences in 1948, on the hundredth anniversary of his death, Sir Harold Hartley said:

> "Chemistry was indeed fortunate that in the years when it was becoming an independent science and the stream of knowledge was growing so rapidly it had the encyclopaedic mind, the judgement, the craftsmanship, and the watchful eye of Berzelius to guide its career."

His early work stemmed from reading Richter's researches in stoichiometry in 1807, and he immediately set himself the task of improving the infant technique of quantitative analysis and of attaining a level of accuracy that would facilitate the calculation of the composition of oxides and salts. His resources were extremely meagre, and Friedrich Wöhler, one of his pupils and afterwards a life-long friend, described the laboratory as it was on his arrival there in 1823:

> "With a beating heart I stood before Berzelius's door and rang the bell. It was opened by a well-clad, portly, vigorous looking man, Berzelius himself . . . The laboratory consisted of two ordinary looking rooms furnished in the simplest possible way; there were no furnaces or draught places; neither gas nor water service. In one of the rooms were two common deal tables; on one of these worked Berzelius, the other was intended for me. In the other room were the balances and some cupboards containing instruments . . ."

The analytical marathon had not progressed very far, however, when Berzelius learnt from a paper by Wollaston in *Nicholson's Journal* of 1808 of Dalton's atomic theory, and this at once not only widened the scope of his work but prompted him to direct

Jöns Jakob Berzelius
1779-1848

Born in Vafversunda near Linköping in Sweden on August 20th, 1779, Berzelius studied at the University of Uppsala and in 1802 was appointed an assistant professor of botany and chemistry in the University of Stockholm, becoming professor in 1807. His enormous output of experimental work ranged over several fields including electrochemistry, the determination of many atomic weights and the introduction of greatly improved methods of quantitative analysis, while his text books and annual reviews made him an unquestioned authority for many years. He married late in life, in 1835, and on his wedding day was created a baron by King Charles XIV

all his endeavours towards establishing the soundness of Dalton's views. Unfortunately communications with Sweden were so poor that it was not until 1812 that he was able to obtain a copy of Dalton's "A New System of Chemical Philosophy", presented by the author, and he then set out to determine the atomic weights of all the known elements.

In the same year, 1812, Berzelius was in London and there he made the acquaintance of Wollaston, for whom he developed a high regard. On his return to Stockholm he wrote to their mutual friend Alexandre Marcet, the Swiss chemist and physician who had been appointed lecturer in chemistry at Guy's Hospital in London:

> "When you see Dr. Wollaston give him a thousand compliments from me and then ask him if it would be possible to have a little malleable platinum, not separated from its natural alloy with palladium, rhodium, etc., to make a crucible."

Wollaston, however, dismissed the idea of supplying impure platinum, but by 1816 Berzelius could write to Wilhelm Hisinger, his friend and benefactor:

> "I have just got a delicious platinum evaporating basin from England, holding more than 300 cc. It's a jewel."

In the meantime he had found it tedious to refer repeatedly to the elements by their full names, and in 1813 he proposed the use of symbols based upon the initial letter of their Latin names (or the initial letter followed by a second letter taken from the body of the name) to replace the rather cumbersome circular symbols employed by Dalton. Thus we acquired the symbol Pt for platinum, while Berzelius's first suggestion for palladium was Pl, which he later revised to Pa to avoid confusion with platinum, and finally to Pd.

The great work on atomic weights occupied some ten years, and tables of values were published in 1814, 1818 and again in 1826, the later forms being almost identical with modern values except for a few which were double the true value.

Soon after platinum had been discovered in the Ural mountains in Russia the Finance Minister, Count Kankrin, who was also head of the Mining Department, sent Berzelius two samples of native metal with a personal note asking him to carry out analyses and to report the results. Berzelius had earlier, in 1826, reduced platinum chloride to metal with hydrogen and determined for the first time its atomic weight, and he now carried out similar investigations with palladium, iridium, rhodium and osmium and devised a complicated method for their separation on an analytical scale.

In 1828, only a few weeks after he had finally allowed publication of his method of producing malleable platinum, Wollaston died, and on receiving the news Berzelius wrote to his former student Eilhardt Mitscherlich, by now professor of chemistry in Berlin:

> "Wollaston's death grieves me. His specifications for making platina malleable were circulated at the same time as the news of his death."

A few weeks later, in a letter to Wöhler, he showed that he was quickly putting Wollaston's process to use:

> "We are now re-making all our old soldered platina crucibles by Wollaston's method of making platina malleable; it goes like a dance. I think Wollaston must have laughed inside over the many elaborate methods that have been used in vain for this purpose when his is so simple."

Berzelius's final contribution to the chemistry of platinum and its allied metals lay in a rather different quarter. In his annual report to the Swedish Academy of Sciences for 1835 he reviewed some of the results of earlier workers, including Davy and Thenard, on chemical changes occurring in the presence of a substance that remained unaffected and took no part in the reaction. He realised that there must be a common cause for this effect, and he coined the name "catalysis", going on to write:

> "The catalytic power of substances seems to depend upon their ability to awaken the dormant affinities of other substances by their mere presence and not by their own affinity."

Thus we owe to Berzelius a term that has come to signify a phenomenon of vital and far-reaching importance in modern chemical industry and one associated pre-eminently with the platinum metals. L.B.H.