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Private prescription:

A thought-provoking tonic on the lighter side

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Please note that these are the personal opinions of the author and do not necessarily represent those of AstraZeneca.

Off with his head – a tragic tale for chemistry

Beheading by an axe or sword, as a means of execution, has its origins in antiquity. In fact, beheading by a sword was regarded by the Romans as a most honourable form of death. It was first introduced in Britain by William the Conqueror in the 11th century for offenders of high rank and continued to be used as such until the 18th century. The last person to be beheaded in this way in England was Simon Fraser, Lord Lovat, a Scottish clan chief, on April 9th 1747. Although generally carried out by a masked executioner, beheading machines using a blade in a chopping motion were in use in Europe in parallel. Machines were in use in Italy from as early as the 13th century, while in Scotland a machine known as 'the maiden' was used throughout the 16th and 17th centuries. However, it was not until the late 18th century that the famous guillotine was developed.

The guillotine is said to have been named after its supposed inventor Joseph Ignace Guillotin, a physician, born in Saintes, near Bordeaux in 1738. Guillotin was elected as a deputy to the Estates General in 1789 where he was instrumental in having a law passed requiring all sentences of death to be carried out by means of a machine so that the privilege of execution by beheading would no longer be confined to the nobility and that the process would be as painless as possible. In his speech to the National Assembly in 1789 he has been quoted as saying [1]:

'My machine will take off heads in a twinkling and the victim will feel nothing but a sense of refreshing coolness. We cannot make too much haste, gentlemen, to allow the nation to enjoy this advantage.'

Needless to say that the law was passed and after the machine had been used in several experiments on dead bodies in the hospital of Bicêtre in Paris, it was erected in the Place de la Grève in Paris and used for the execution of a highwayman on 25 April 1792. Contrary to myth, Guillotin died in his bed and not by his own machine in 1814.

Physics and biology

The machine does not really need much description being well known to most people. It consists of two upright posts grooved inside and connected at the top by a crossbeam. A sharp, angled blade falls under its own weight onto the neck of the victim below. The frame is perfectly vertical to ensure that the blade falls smoothly maximizing its energy as it strikes the neck and the blade is angled to ensure optimum contact. All in all, a very efficient killing machine! It can be calculated that a blade of 40 kg falling through a height of 2.25 m can sever a head in approximately 300 ms [2].

Death, of course, occurs through shock and lack of oxygen. During the French revolution, people tried to ascertain the exact moment of death by picking up the severed heads and shouting in their ears. Apparently, the heads would often blink, no doubt a result of reflex action. There were large numbers of heads to choose from because, in the year from September 1793 to August 1794, some 13,526 French citizens perished at the guillotine at the hands of the infamous Maximilian Robespierre and his Committee of Public Safety.

A tragedy for chemistry

Probably the most famous of all scientists executed using the guillotine was the great French chemist Antoine-Laurent de Lavoisier. Born in Paris on 26 August 1743, Lavoisier was the son of an *avocat du parlement*, or parliamentary counsel. He received an excellent education and, by the age of 20, had studied under experts in astronomy, botany, chemistry, geology and mathematics, and had gained a degree in legal studies. In 1766, he received a gold medal from the French Academy of Sciences (to which he was later admitted in 1768, becoming its director in 1785) for an essay on the best means of lighting a large town. In 1768, to fund his experiments, he became an assistant in one of the revenue collecting departments of the government, subsequently becoming a

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full titular member of the Fermier Général, the main tax-collecting agency.

In 1771, Lavoisier married the 14-year-old Marie-Anne-Pierrette Paulze, daughter of a fellow Fermier Général. Marie was crucial to the communication of Lavoisier's experimental findings and theories, as it was she who wrote up all his experiments, illustrating them with high quality engravings. She also translated foreign works into French for him and his work into other languages.

'A machine which makes a Frenchman shrug his shoulders with good reason.'

Lavoisier is generally regarded as the founder of modern chemistry [3]. Through his studies on combustion he destroyed the phlogistic doctrine that had dominated the development of chemistry for more than a century. He showed that air was a mixture of oxygen and azote (subsequently renamed nitrogen), that oxygen was essential for combustion and respiration, and that oxygen was involved in the formation of oxides. He deduced that water was made up of hydrogen and oxygen and, with others, devised a system of nomenclature of chemicals similar to that used today. He also devoted considerable attention to the study of heat, fermentation and respiration – all of which he regarded as essentially chemical in nature.

In addition to his scientific achievements, Lavoisier had an outstanding career as a public servant. He improved the manufacture of gunpowder for the government, he promulgated the advantages of scientific agriculture, and he developed schemes for the improvement of hygiene, hospitals, prisons, public education and finance. However, even this did not prevent him from being denounced by the extremists of the French revolution, notably Jean-Paul Marat who, early in his career, had pursued scientific ambitions but whose work had been criticised by Lavoisier. In November 1793, Lavoisier and 30 other tax collectors were arrested and in May the following year they were sent for trial by the revolutionary tribunal. After a short trial lasting only a few hours, Lavoisier was condemned to death, the judge rejecting calls for clemency with the statement that the new republic 'has no need of scientists'.

On 8 May 1794 in the Place de la Révolution (now Concorde), Lavoisier and 27 of his companions, including his father-in-law, were guillotined and their bodies thrown in a common grave. Thus, France had lost its greatest scientist using a machine invented by a French physician. A tragedy indeed! It is not without justification that the guillotine has been described [4] as 'a machine which makes a Frenchman shrug his shoulders with good reason'.

References

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