Drug Testing and Analysis

Received: 24 March 2009 Accepted: 22 April 2009 Published online in Wiley Interscience:

(www.drugtestinganalysis.com) DOI 10.1002/dta.32

# Back to the roots of modern analytical toxicology: Jean Servais Stas and the Bocarmé murder case

Robert Wennig*

**In 1850 the Belgian Count Hypolyte Visart de Bocarmé was accused of having killed his brother-in-law Gustave Fougnies by poisoning with nicotine. Bocarmé had isolated nicotine from tobacco leaves (Nicotiana tabacum). J. S. Stas (1813–1891) was committed expert and managed to convince the poisoner. He was the first scientist to deproteinize organ tissues by alcohol and could successfully identify nicotine after diethyl ether extraction from the victim's organs. During court trial this identification was challenged by his mentor M. J. B. Orfila from Paris, who had stated 3 years before, that it would never be possible to isolate and identify organic poisons from organ tissues.** 

Count Hyppolite Visart de Bocarmé (1818–1851) was known to have an extraordinary lifestyle, necessitating a considerable amount of financial support. His father, a tobacco dealer and a hunter, died when Count Hyppolite was 24. Hyppolite succeeded to the title and took over the Château de Bitremont, near Bury, nowadays Peruwelz, in the Belgian province of Hainaut. (This castle was totally destroyed by a fire in 1998.) In 1843, to be able to continue his expensive womanising life, he married a *bourgeoise* called Lydie Fougnies du Bois, daughter of a pharmacist who was in possession of a fortune. At Lydie's fathers death in 1849 her annual income increased but was still not high enough to cover their expensive lifestyle. As her brother, Gustave, had inherited the major part of his father's fortune, they hoped that he would rapidly die, unmarried, so that his assets could be transferred to Lydie.

Indeed Bocarmé's brother-in-law Gustave, was somewhat disabled by an unprofessionally amputated leg and had a precarious health status with a rather short life expectancy, but he resisted death and looked for a wife. When, in spring 1850, Gustave decided to marry Mademoiselle de Dudzech, Bocarmé was not amused and planned diabolical events to get rid of Gustave. On November 21, Gustave arrived at Bitremont to announce his decision to marry officially to his family. On his arrival he was surprised that he was served by the Countess and not the usual château servants. The Count's children were also banished to the kitchen. Soon after the dinner the servants were called for help and were told that Gustave had had a stroke. The servants were terrified by the events; they alerted an examining magistrate in Tournai and told him that Gustave Fougnies had probably died an unnatural death.

The examining magistrate, Juge d'Instruction Heughebaert, arrived at the castle accompanied by three gendarmes and three surgeons: Marouzé, Zoude, and Cosse. The physicians were ordered by Heughebaert to examine the dead body. At this examination they observed that the victim's mouth, tongue, throat and stomach had corrosive burns, so they believed that Gustave had died from drinking a corrosive liquid, like sulphuric acid. Heughebaert supervised the removal of all the organs from the body. These organs were transferred into bottles with alcohol. He immediately decided to go to Brussels with the biological specimens from the remains to consult a famous chemistry professor named Jean Stas and asked him to investigate the case. Meanwhile he placed the Count and Countess under arrest at the prison in Tournai.

Jean Servais Stas was born in Leuven in 1813 and died in 1891. He studied medicine and graduated in 1835 at the State University of Leuven. However, Stas never practised medicine; instead he practised analytical, inorganic, and organic chemistry. In 1834 he was appointed assistant to Professor Jean-Baptiste Van Mons (1765–1842). His first research work, performed in his father's loft, was the isolation of an alkaloid named phloridzin. Later on, in association with Louis Guillaume de Koninck (1809–1887), he studied the purification and properties of crystallisable phloridzin glycoside extracted from the roots of the bark of apple trees from Van Mons' gardens. When the Dutch State University in Leuven was closed, in 1835, the Catholic University moved back from Mechelen to Leuven. For political and philosophical reasons Stas could not stay in Leuven. He moved to Paris and worked in the famous laboratory of Jean-Baptiste Dumas (1800–1884) at the *Ecole polytechnique*. During his stay in Paris Dumas was impressed by the exceptional skill and talent of Stas. He made him his research associate with the task of determining the accurate atomic mass of carbon.[1–3]

During his stay in Paris Stas also assisted the toxicology lessons of Matéo José Bonaventura Orfila (1787–1853), the father of modern toxicology, who originated from Spain. Orfila was a great organiser. In 1823 he followed Professor Nicolas Louis Vauquelin (1763–1829) as a professor of chemistry at the Paris School of Medicine. He was elected dean of the medical faculty in 1831 and exercised this position until 1848. During this period he reorganized the whole educational system for the medical professions. His system was only modified after the student revolution in 1968. In 1841 Stas returned from Paris to Brussels and was appointed

* *Correspondence to: Robert Wennig, Laboratoire National de Santé-Toxicologie, Université du Luxembourg – Campus Limpertsberg, 162a, av. Faïencerie, L 1511 Luxembourg. E-mail: robert.wennig@uni.lu*

*Laboratoire National de Santé – Toxicologie, Université du Luxembourg, Luxembourg*

Professor of Chemistry at the Royal Military Academy (*Ecole Royale Militaire – ERM*). During his lecturing time at the ERM he had a very poorly equipped laboratory, so he had to set up state-of-the-art equipment in his home at his own expense.

Between December 1850 and February 1851 he was able to rule out sulphuric acid as a cause of death in the Bocarmé case and began to suspect the presence of vegetable poisons in Gustave's tissues. Like his contemporary colleagues in the nineteenth century, he used his sense of taste and smell to identify chemicals, as well as colour tests and crystallization tests that could be performed on pure compounds. He identified the smell of vinegar and was told of the repeated washing of Gustave's dead body with this substance. It occurred to him that it might well have been used to mask the presence of another poison. So a plant alkaloid poisoning was suspected by Stas. One afternoon, after a number of experiments, he added caustic potassium hydroxide to the anatomical pieces and made a solvent extraction with diethyl ether. This was followed by the evaporation of the ether extract in a specially designed distillation glass apparatus (with sulphuric acid in the reception vial to bind the suspected alkaloids). When he came back in his laboratory next morning, he observed a smell of tobacco and mouse urine – typical for nicotine. By further purification of the extracted material he obtained brownish residues with the unmistakable smell of cold tobacco. He was then able to submit these residues to the laboratory tests available for pure nicotine, and obtained a positive result.

At that time no one had ever managed to detect vegetable poisons in human tissues. M. J. B. Orfila (1787–1853), the leading European toxicologist, had declared three years earlier that it might never be possible to do so and that they might remain forever undetectable. Bocarmé, who had consulted a certain number of famous chemists and had made a serious literature search on the subject, was aware of this declaration by Orfila.

After three months' work as a forensic expert, Stas had succeeded in extracting alkaloids from body fluids and tissues, prior to their identification in a pure state. Although, by 1847, tests had been designed to identify vegetable poisons in their pure forms in the laboratory, this did not help in cases of suspicious deaths, when the poison would be present in the organs of a victim. Scientists were unable to isolate vegetable poisons from animal tissue. When the tissue was destroyed – the normal procedure for arsenic detection – the organic poison was destroyed as well.

Orfila was proved wrong only three years later. Stas performed nicotine-extraction experiments on animals from the slaughter house and from the veterinary school and examined human anatomical pieces from the St Pierre University Hospital in Brussels from patients dying of lung cancer and controls dying of other diseases or from smokers and non-smokers.

Stas reported his findings to Heughebaert, who at once went to the château and questioned the servants. He also investigated whether the Bocarmés had ever had nicotine in their possession. The Count had made his entourage believe that he was making experiments to prepare a new type of *eau-de-cologne,* or manufacturing an insecticide for his orchards. For this purpose, the Count had bought large quantities of tobacco leaves and made extracts of these in 'laboratory' settings in the castle outbuildings. For his diabolical plan Bocarmé had to visit Professor Loppens, director of the botanical garden and chemistry teacher at the *École industrielle* in Ghent, several times using a pseudonym. Bocarmé also bought different plant materials from Loppens like Aconitum anthora, *Veratrum nigrum, Solanum dulcamare* and Nicotiana tabacum. After several experiments he had chosen tobacco extracts. The next few days following Stas's report to Heughebaert, the examining magistrate was able to identify the chemists to whom Bocarmé had gone to consult about the extraction of nicotine from tobacco leaves. Bocarmé had also designed animal experiments to test the toxicological efficiency of his extracts. In the castle's garden, buried bodies of cats and dogs were found and exhumed. Hidden experimental equipment for nicotine extraction was discovered in outbuildings. The animal remains were sent to Stas, as well as samples of wood from the floorboards and even the trousers of the gardener who helped to prepare the alleged *eau-de-cologne.* Stas found traces of nicotine in all of these items.

An unexpected help for Stas was the addition of alcohol and of vinegar. The organs had been preserved by alcohol, partly deproteinized, and the nicotine had been dissolved in this solvent, which served as a 'keeper', binding nicotine in acidic medium, thus preventing its volatilisation – or Bocarmé had added vinegar as an 'acidic keeper' himself. Stas could demonstrate the toxicity of his extract residues by administering a very small amount to swallows and pigeons, which died within a few minutes, following tetanus-like convulsions.

The tobacco plant, *Nicotiana tabacum*, was introduced from America to Europe in 1561. It arrived in Lisbon, where the French ambassador, Jean Nicot, took an interest in it and introduced it to France. At that time it was used for the treatment of eczema and paralysis. In 1828 it was possible to isolate nicotine as the most active toxic ingredient of tobacco.

Nicotine is a fast-acting poison. It binds to nicotinic cholinergic receptors, resulting initially via actions on autonomic ganglia, in predominantly sympathetic nervous system. At higher doses parasympathetic stimulation may occur, followed by ganglionic and neuromuscular blockade. Central nervous system effects may induce nausea, vomiting, dizziness, miosis, tachycardia, hypertension, sweating, salivation, convulsions, paralysing the respiratory system within a few minutes. Absorption of 40 to 60 mg pure nicotine may be lethal for an adult. Nicotine is rapidly absorbed by all routes of administration with an apparent volume of distribution $V_D = 1$ to 3L/kg. It is rapidly metabolized with an elimination half-life $t_{1/2}$ of 25 to 120 minutes (urine pH dependent). Homicidal use of nicotine is rather rare but accidental poisoning through skin absorption by its use in horticultural and agricultural sprays has occurred frequently in the past. Even nowadays, some Internet sources recommend in detail how to use tobacco extracts to commit suicide.[4]

At the court trial in May 1851, the two defendants accused each other and declared that it was either an accidental poisoning or that Gustave died of apoplexy. Orfila was asked by the defence lawyers to convince the jury that Stas's findings were wrong. Orfila continued to declare that it was impossible to isolate organic poisons from human viscera. Orfila had become famous as an expert in the most exiting court case of the nineteenth century, known as the Lafarge case, where a woman was suspected to have poisoned her husband with arsenic. Bocarmé also had among his defence lawyers Charles Lachaud, who had been involved in the Lafarge case.

As a forensic expert, Stas was bound to keep the details of his new identification method confidential. This fact allowed Orfila to present this method as his own without even quoting the real author. This unethical behaviour did not add a positive contribution to Orfila's professional reputation. After a long judicial process Stas was eventually able to publish his own results.[5] Finally Stas earned the fame that he deserved for his method of identifying alkaloid poisons. Indeed, the methods used today for the extraction of organic substances from biological specimens are fundamentally the same, with modified working-up procedures and more specific identification tools. Like many other important cases of murder by poisoning, the Bocarmé case had a lasting influence on analytical toxicology.

The verdict of the court was that the Count was guilty of murder. The Countess was acquitted. Her husband, despite petitioning the Belgian king, went to the scaffold at a public place in Mons on 19 July 1851.

Today, in the Museum for Forensic Medicine in Brussels, which is not open to the public, at the main Court building, it is possible to see plaster masks of the heads of the last criminals to be guillotined.

After the Bocarmé trial (and even before) Stas was involved in several other trials and was active in many other scientific fields. Stas had to resign as a faculty member in 1865 because of throat trouble, which affected his speech, but he continued with an impressive number of other scientific activities for the rest of his life, including his famous series of atomic mass determinations. The 12 atomic masses established by Stas in 1860 were considered to represent the ultimate in accuracy for the next four decades. He also made contributions to emission spectroscopy and other forensic fields.

## References

[1] T. Daldrup, R. Wennig, *Proceedings of the 24th TIAFT Conference, Banff,* **1987**, pp. 538–542; Edmonton.
[2] R. Wennig, in *Proceed. International J.S. Stas Colloquium* (Eds: R. Hallleux, A. C. Bernès), Derouaux-Ordina: Liège, **1992**, pp. 57.
[3] D. T. Burns, H. Deelstra, *Anal. Bioanal. Chem.* **2008**, *391*, 1113.
[4] S. Schneider, N. Diederich, B. Appenzeller, A. Schartz, Ch. Lorang, R. Wennig, *J. Emergency Med.*, in press.
[5] J. S. Stas, *Bull. Akad. Roy. Med. Belgique* **1852**, *6*, 202.