Anal Bioanal Chem (2008) 391:1113–1117
DOI 10.1007/s00216-007-1777-y

FEATURE ARTICLE

Some aspects of the rise of analytical chemistry in Belgium

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Received: 5 October 2007 / Revised: 19 November 2007 / Accepted: 27 November 2007 / Published online: 10 January 2008

Analytical chemistry has been and continues to be an important and fundamental area of both classical and modern chemistry in Belgium, as in the rest of Europe. This position is well demonstrated by the historical and current research and practice papers arising from the EUROANALYSIS series of conferences, ever since the first, held in Heidelberg in 1972.

The early period

The origin of chemical analysis and hence of analytical chemistry in Belgium may be considered to have started with the work of the Flemish physician and iatrochemist, Johannes Baptista Van Helmont (c.1580–1644) [1]. He was from a noble and ancient Flemish family and studied at the University of Louvain (founded in 1425), first in arts and then medicine, graduating in 1599. Realising the need for more than book learning he travelled and studied in Switzerland and Italy and then in France and England (1600–1605). In 1609 he married Marguerite Van Ranst, also from the nobility. After this he embarked on private research for seven years at Vilvoorde, near Brussels. Van Helmont lived in troubled times, because the Spanish occupation was ruthlessly trying to eradicate the rebellion against Catholicism. From 1625, Van Helmont was involved with the ecclesiastic and inquisition authorities because of his interest in the discussions of the "weapon salve" and "the magnetic cure of wounds". After several interrogations he was placed under house arrest for most of the rest of his life.

Shortly before he died he gave all his papers to his son, Franciscus Mercurius Van Helmont (1614–1699), instructing him to publish them. These papers and the parts previously published (mainly in Flemish) were edited and translated into Latin to form *Ortus medicinae*...(1648) [2] (see Fig. 1). Some of the Flemish treatises were published collectively as *Dageraed* (1659) [3], which is not a Flemish version of *Ortus* and appears to have been written much earlier and compiled by J. B. Van Helmont and not by his son. *Dageraed* is more concise than *Ortus* and it is not clear why its publication was delayed until 15 years after J. B. Van Helmont's death.

The contributions to chemistry recorded in *Ortus* and *Dageraed* were reviewed by Partington [4] who paid particular attention to Van Helmont's views on the elements, his observations on gases, water, urinary calculi, fermentation and on inorganic chemicals and reactions. An important feature of Van Helmont's chemical work was its quantitative character; he made extensive use of a balance, for example, when he demonstrated clearly the indestructibility of matter by dissolving metals in acids and recovering these metals by precipitation. He was also the first to recognise the philosophical implications that there was more than one "air-like" substance; he introduced the term gas from the Greek word for chaos. He showed that the gas evolved from Spa water was the same as his "gas sylvestre", discovered from burning wood and also evolved by fermenting wine.

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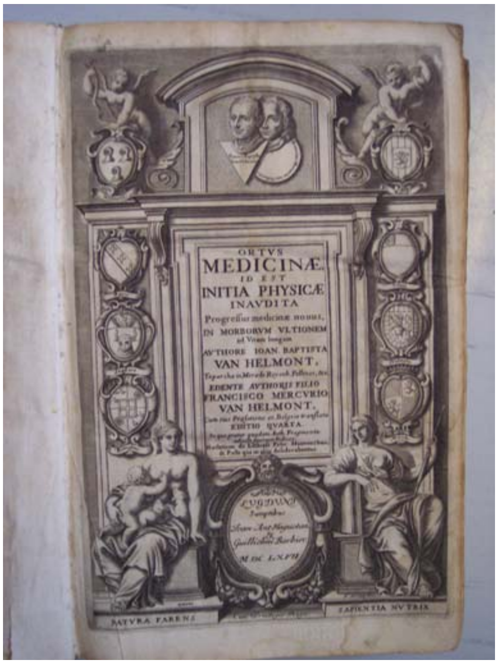

Fig. 1 Title page of Van Helmont's *Ortus Medicinae...* (5th edn), *sumptibus* J. A. Huguetan & G. Barbier, Lyons, 1667

Despite writing in a somewhat obscure manner Van Helmont's work was carefully studied and highly regarded by Robert Boyle (1627–1691) who cited him at least 222 times and included many long quotations and discussions of his work [5]. Van Helmont's work became influential after his death. For example, H. Boerhaave (1668–1738) called him "the greatest and most experienced of all chemists yet appeared..." [6].

At the end of the Spanish occupation of the region now called Belgium a new chair of chemistry was created in 1685 in the Faculty of Medicine at Louvain; however, none of the holders made any significant contribution to analytical chemistry. The old University of Louvain was closed in 1787 following the French occupation. During the Dutch period (1815 till independence in 1830) in 1816, Willem I created three state universities in the "Southern Netherlands", in Ghent, Louvain and Liège. The only chemist, during this rather chaotic period in the region, with a clear international reputation was Jean Baptiste Van Mons (1765–1842) [7]. Besides being a productive chemist he was important for two further reasons: firstly, he was one of the earliest supporters and active disseminators of Lavoisier's new oxygen theory outside of France; secondly, he mentored some excellent students during his time as Professor of Chemistry in the State University of Louvain. Among these were Laurent-Guillaume de Koninck (1809–1887), Louis Melsens (1814–1886) and last, but not least, Jean Servais Stas (1813–1891). In addition to his chemical reputation Van Mons was also a most distinguished contributor to agricultural botany and was responsible for breeding 40 named varieties of *pyrus communis* (pears).

The nineteenth century

Jean Servais Stas

Jean Servais Stas was born in Louvain in 1813 [8] (see Fig. 2). He studied medicine at the State University of Louvain and graduated in 1835. Stas did not practice medicine but chemistry, having been appointed assistant to Van Mons in 1834. His first research, performed in association with L. G. de Koninck, was into the properties of a crystallisable glucoside, they named phloridzine, extracted from the roots of the bark of apple trees from Van Mons' orchards. After the abolition of the State University in Louvain in 1835 the Catholic University moved from Mechelen to Louvain. Due to Stas' liberal ideas he could not stay at Louvain and encouraged by Van Mons he went to Paris and worked in the laboratory of J. B. A. Dumas (1800–1884). Dumas was impressed by the exceptional promise of Stas and made him a research associate in the task of determining the atomic weight of carbon. Dumas and Stas, in a study which is still a model for today, burned carbon (diamond, purified and artificial graphite) in pure oxygen and from the weight of carbon (adjusted for any residual ash) and of carbon dioxide (absorbed in alkali) found the atomic weight of carbon to be 12.000±0.002 (if O=16) [9], which is remarkably close to

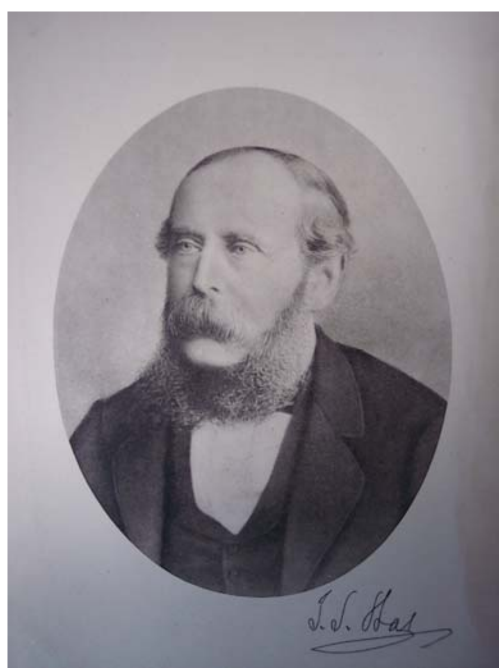

Fig. 2 Portrait of Jean Servais Stas (1813–1891)

the current IUPAC figure, 12.0107(8) [10]. In 1841 Stas returned to Belgium as Professor of Chemistry in the Military Academy in Brussels. As there was no laboratory at the Military Academy Stas made one at his house and at his own expense. Here he carried out his famous series of determinations of atomic weights. The twelve atomic weights established by Stas in 1860 were considered the ultimate in accuracy for the next four decades. He also made contributions to emission spectroscopy and to medico-legal matters. One murder trial in which he took a leading part has had a lasting influence in analytical toxicology. In the 1850 murder by Count Hyppolyte Visart de Bocarmé of his brother-in-law, nicotine poisoning was suspected as the cause of death. At the time no one had managed to detect vegetable poisons in human tissues; indeed four years earlier, M. J. B. Orfila (1787–1853), the leading European toxicologist, had declared it may never be possible so to do. After three months' work as a government expert, Stas devised the still used "Stas method" of extracting alkaloids from body fluids and tissues, prior to their identification in a pure state [11].

The emergence of formal courses in analytical chemistry

The development of the teaching of chemistry and other sciences was severely hampered by the rivalry between the State and the Free Universities, especially on the numbers of students and the esteem of degrees and diplomas [12]. The government solved the problem in 1835 by closing the State University at Louvain and prescribing common programmes and the creation of central juries to examine all students for a given subject. This system had dramatic effects by degrading the level and quality of the students' chemical knowledge. Courses and students focused on the passing of examinations rather than on the broad appreciation of the subject. The government abolished this central control system in 1876, each university was then once more free to examine students for their own degrees and diplomas. The year 1876 was also a crucial year in the history of analytical chemistry in Belgium, because in this year the government required that two new obligatory courses be given during the training of pharmacists, namely a course on analytical chemistry and one on toxicology. The course on analytical chemistry included lectures and practical classes. Earlier, aspects of chemical analysis had been studied by students of pharmacy but not as a specific course. The course on analytical chemistry also became an optional one for students in the last year of study in the Science Faculty; for engineers a short course on analytical chemistry was included within that on industrial chemistry. The first Professors of Analytical Chemistry in Belgium were Ch. Blas (1839–1919) in Louvain, L. L. De Koninck (1844–1921) in Liège, E. Dubois (1842–1892) in Ghent and A. Joly (1841–1911) in Brussels. Their contributions to teaching and to research, those of their successors and of the early Presidents of the Belgian Association of Chemists have recently been reviewed [13]. The most eminent Belgium centres of analytical chemistry in the classical chemistry period (up to 1914) were Louvain and Liège and in the modern/instrumental period (from 1920) changed to Liège, Brussels and Ghent.

The professionalisation of analytical chemistry in Belgium

Whereas in most Belgium industries in the late nineteenth century there were only a few chemists, in the sugar industry their role was crucial and well recognized. In Belgium this sector was expanding rapidly in the 1880s.The importance of the determination of the sugar content of beet secured a prominent place for analytical chemists in the industry. However, the analytical methods then in use were subject to controversy. The chemists working for the factories and the trade associations decided that the best and most definitive way to solve the problem was by an open discussion amongst all the chemists concerned. The first meeting to discuss new procedures for the analysis of sugar beet was held in Brussels on 14 April 1887. The 24 chemists present thought it was of general interest to attract all chemists in Belgium industries to such discussions; they went on to found the *Association Belge des Chimistes* [14]. The number of members rose quickly to 400 by 1891, with problem-oriented sections on sugar, food control, agronomy and fermentation industry. From the start the Association had its own journal, *Bulletin de l'Association Belge des Chimistes*. In 1898 the Association reorganised into local sections and the discussion themes for meetings then included a much wider range of topics than before [15]. A very noteworthy achievement of the young Association was the organisation of the first International Congress on Applied Chemistry in 1894, in Brussels/Antwerp [16]. This gathering of 397 chemists from 27 different countries was the first of a long series of congresses: Paris (1896), Vienna (1898), Paris (1900), Berlin (1903), Rome (1906), London (1909) and Washington (1912). IUPAC lists these as the first congresses of their predecessor bodies [17]. The common theme through all these congresses was the harmonisation of analytical procedures for all kinds of applications.

The rise of academic analytical chemistry in Belgium

The significant contributions of the various Belgian Schools of Analytical Chemistry have not to date been systematically recorded and indeed were overlooked by Brookes and Smythe in their review, "The Progress of Analytical Chemistry, 1910–1970" [18]. In the present article only the most important teachers and productive researchers in the four Belgian universities, prior to 1965, are cited to illustrate the start of analytical chemistry as a distinct academic discipline in the period of classical analytical chemistry and the transition to its current, instrumentally based practice [13].

In Louvain, Godefroid-Charles Blas (1839–1919) created the first course and laboratory for analytical chemistry in 1868. His excellent teaching, numerous well-regarded textbooks, wide-ranging expertise and contributions to the analysis and specifications for potable waters, made him one of the important pioneers of analytical chemistry in Belgium. Louis Michiels (1886–1936) was appointed in 1919 to teach analytical chemistry; a year later he also took over the course in toxicology. He wrote texts in both areas to support his teaching and researched selective reagents for cations. Raymond Breckpot (1902–1983) taught from 1926 in the Faculty of Applied Sciences and in 1936 succeeded Michiels in the Chair. From 1935 till his death, Breckpot was an international authority on spectrographic methods of analysis and very active in research and publication of his work.

In Brussels, none of the early teachers of analytical chemistry left any record of analytical research. The first active researcher before 1965 was Louis Maricq (1901–1984) who from 1936 worked on electrochemical and gas chromatographic methods.

In Liege, Lucien Louis De Koninck (1844–1921) was appointed in 1876 to teach the newly created course in analytical chemistry for students of pharmacy which was also available to students in the last year of the degree of Doctor of Natural Sciences. He produced several textbooks; in his two-volume treatise of 1894, De Koninck noted “this treatise is the result of seventeen years of research”. In addition to his textbooks he published over 200 research papers including a considerable number in *Bull. Soc. Chim. Belge.* After De Koninck’s retirement in 1914 separate Chairs were established in the Faculty of Science and in Medicine. Maurice Huybrechts (1877–1950) was appointed assistant to De Koninck in 1902 and to the Chair in the Faculties of Science and Technology in 1919. He produced a series of textbooks co-authored with De Koninck; his research interest was mainly in metallurgical analysis, but he was less productive than his predecessor. Georges Duyckaerts (1911–1993) followed in the Chair in 1945. His research focused on modern instrumental methods. Duyckaerts and his team achieved an international reputation and attracted research students and post-doctoral workers worldwide. François Schoofs (1875–1959) was appointed to the Analytical Chair in the Faculty of Medicine. He also taught toxicology and food chemistry. His analytical publications were on toxicological topics including a very early hyphenated method, electrochromatography, predating by a decade Kemula’s study of chromatopolarography. Schoofs was followed in 1945 by Robert Chandelle (1893–1959), previously an assistant to Huybrechts. In addition to research into fundamental aspects of analytical chemistry he published several textbooks.

In Ghent, during the classical period of analytical chemistry there were no prominent Professors of Analytical Chemistry. Johannes Baptista Gillis (1893–1978) was the first Professor appointed after the introduction of the Flemish linguistic regime, to the independent Chair of Analytical Chemistry in 1923. He was one of the most outstanding exponents of his generation in the field of modern analytical chemistry, the first in Belgium to introduce a rigorous theoretical approach and made valuable research contributions to electroanalysis, arc emission spectroscopy, organic reagents for metals and to biological applications of radiotracers. He was a founder and first President of the Flemish Chemical Society. Julien Hoste (1921–) followed Gillis in 1958 and built up superb facilities for radiochemical research and produced a large output of research papers and monographs. He gained a worldwide reputation and received the George Hevesy Medal in 1972. Frans Verbeek (1929–) was an Associate Professor under J. Hoste. His research focused on electrochemical methods, especially advanced polarographic techniques and on atomic absorption spectrometry.

Post the 1965 University Expansion Bills

In 1965 the Belgian Government passed the first University Expansion Bill. New universities were created. In 1969 the French-speaking Free University of Brussels formed a new Flemish Free University of Brussels, and Louvain created a French-speaking University which was placed in the newly created city of Louvain-la-Neuve. This major expansion of the universities offered numerous possibilities to young scientists seeking their first academic posts as well as to those seeking promotions. The School of Analytical at Ghent, headed by Hoste and Verbeek, has been particularly influential; of the 100 or so Ph.D.s, the department has produced 23 achieved Chairs in pure or applied analytical chemistry: at Ghent (R. Dams, R. Cornelis, J. Op de Beeck, H. Thun, E. Temmerman, W. Ooghe, W. Maenhaut, L. Moens and K. Strijckmans), the Flemish University of Brussels (D. L. Massart, F. D. Corte and P. Van de Winkel), Hasselt (J. -P. François), Leuven (J. Hertogen, C. Vandecasteele, C. Block and M. J. Janssens) and Antwerp (F. Adams, R. Gijbels, R. Van Grieken, R. Dewolfs, A. Lagrou and H. Deelstra).

Concluding remarks

The outstanding success of Euroanalysis XIV in Antwerp is a fitting tribute to heritage and past achievements in analytical chemistry and to the current good state of analytical chemistry in the universities in Belgium.

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