

Agostinho Vicente Lourenço 1822 – 1893

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Agostinho Vicente Lourenço was born in 1822, at Mormugão, Salsedas, Goa, former Portuguese India. He graduated in Medicine and joined the teaching staff at the Medical School of Nova Goa (today Panji). In 1848, he travels to Lisbon with a bursary from a Goan private association in order to continue his studies, in Paris. Since this scholarship was insufficient to cover his expenses in Paris, the Portuguese Government granted the same amount in order to double the *per annum*. It is worth noting that this decision was based on the recommendation of an official committee in which the member who most supported the concession of the grant was the son of Bernardino António Gomes, also a medical officer of the Navy¹.

At the beginning of his stay in Paris, i. e. from 1849, Lourenço practiced medicine in some Parisian hospitals. Some time later, he visited Bunsen in Heidelberg and Liebig in Giessen, as well as Hofmann in London, where he met his future wife. He also went through the French official education system and graduated as *Ingénieur Civil* (which at that time meant a non-military engineer) of the *Ecole Centrale*. In 1859, he was admitted at the research school of Adolphe Wurtz, in Paris, and obtained his doctorate from the Sorbonne.

Unlike the research schools that meanwhile his colleagues established in Paris, which were more confined to the national context, the school of Wurtz had a distinctive cosmopolitan character which certainly facilitated Lourenço's integration in the French chemical scene. For more than 30 years Wurtz's laboratory was attended by about 200 disciples the majority coming from Alsace, thereby corresponding to an ethnic and religious minority in French society, and from a variety of countries ranging from Germany, Russia, Switzerland, Austria, the British Isles, and the USA. Lourenço, being also a member of a minority, as a Portuguese Catholic of Indian descent, blended easily into its international atmosphere, which surely contributed to his awareness of how important was, for a professional chemist, the command of foreign languages. Not only did Lourenço learn French, English and German, and enjoyed reading writers in their original languages, but he did spend some time abroad, where he improved his linguistic capabilities. On these occasions, he took the opportunity to visit chemistry laboratories. In his three years at Wurtz's laboratory, Lourenço met fellow apprentices of various nationalities; many became chemists of an international reputation, especially in the field of organic chemistry. Wurtz's research programme was based on Auguste Laurent's and Charles Gerhardt's type theories and later advocated atomism, which from the theoretical point of view makes his school unique in the French chemical scene, otherwise marked by the rejection of atoms.

During these three years, Lourenço wrote nine communications presented by Adolphe Wurtz to the Paris Academy of Sciences and published a paper in *Bulletin de la Société Chimique*. The doctoral thesis with the full report of his work at Wurtz's laboratory was published in 1863, in *Annales de Chimie et de Physique*. He reported

¹ See entry 'Bernardino António Gomes'

the synthesis of a number of new compounds, which included the first members of the family of polyethylene glycols $\text{HO}-(\text{CH}_2-\text{CH}_2-\text{O})_n-\text{H}$ up to hexaethylene glycol.

This is the first example known of a condensation polymerization. He determined the boiling points of the compounds which he purified by distillation, and noted their increase with the value of n (about 45°C every time n increases by one). He also observed the increase of viscosity with n . Because today it is so obvious that in Lourenço's formulas n represents the degree of polymerization, one is tempted to conclude that he verified the increase of boiling point and viscosity with degree of polymerization and molecular weight. Lourenço understandably did not propose for these compounds structural formulas (the first papers of Kekulé and Couper had just been published), and instead still uses the symbols of type theory with the extensions to "mixed" and "condensed" types proposed by Odling and Williamson. Consequently, he did not express the increasing value of n as an increase of molecular weight, but as increasing "*complication moléculaire*", meaning the number of radicals involved.

There are, however, several remarkable features in his conclusions:

1. He writes for his reaction a general equation with n and $n+1$.
2. He establishes the correct chain reaction mechanism for each condensation step by stating that, in the propagation step, which transforms the n oligomeric bromohydrine into the $n+1$ glycol oligomer, hydrogen bromide is generated. Hydrogen bromide reacts, in turn, in a second propagation step with the n oligomeric glycol yielding the n oligomeric bromohydrine, necessary in order to repeat the first propagation step. If one is able to decipher the equations written in Gerhardt's type theory and to understand Lourenço's text, then it is clear that this is what he meant. This must be, if not the earliest, one of the earliest organic reaction mechanisms established, based on sound evidence.
3. Although one might argue that Lourenço did not study any polymerization reaction, but only oligomerizations, because he did not go beyond $n=6$, it is, however, obvious that he considered that the residue of the distillation of hexaethylene glycol would contain the member of the series of polyglycols with $n>6$, and that these were even more viscous and less volatile.

P. Flory, in his classical textbook on Polymer Chemistry, reported in loving detail in his historical introduction the work of Lourenço, whom he considered thus a predecessor of Polymer Chemistry. The fact that some polymer chemists of the Staudinger school usually play down the importance of the 19th century predecessors of Polymer Chemistry, is probably nothing more than a collateral damage inflicted to the memory of Lourenço in the notorious long war between the two main schools of polymer chemistry about the relative merits of their leaders.

The work of Lourenço is, however, not only remarkable in the light of the much later developments of Polymer Chemistry, but also because of its role within the school of Wurtz as regards the last developments of the concepts of valency ("atomicity") and atomic structure of radicals immediately before the proposals of Kekulé and Couper were published. His profound reflections on the "atomicity of radicals" and the admission of a still unknown atomic structure of the radicals are such that, for the reader of today, it is amazing to see how near he was to the dawn of structural theory. His reflections on the atomic structure of radicals are based on his findings that it was possible to transform glycerol into propylene glycol, proving thus that radicals could be transformed into other radicals, contrary to the earlier "classical" radical theories.

Lourenço's work was highly praised in a review by the Paris Academy of Sciences signed by Dumas and Balard. In the conclusion this report expressed the hope that "le jeune savant portugais, possédant à la fois l'aptitude à l'observation qui fournit les matériaux, et la connaissance générale qui permet de les interpréter de la manière la plus rationnelle, saurait à son tour susciter à la chimie organique dans le

pays qu'il est destiné à habiter, des travailleurs de plus pour concourir au développement de cette partie de la science si vaste, et où il y a encore tant à faire". Dumas offered to place him as professor in the French Institute in Egypt. He was also offered a position as professor at the Faculty of Medicine in Lyon. He was appointed, however, in 1861, for a post at the *Eschola Polytechnica* in Lisbon, and became holder of the chair of Organic and Analytical Chemistry in 1862. He maintained this position until his death in 1893.

His only contemporary biographer and successor both in his chair at the Polytechnic School and the Academy, Eduardo Burnay (a physician whose research area was zoology) speculated about the reason why Lourenço after his return to Lisbon did not publish any more relevant work in the field of Organic Chemistry. According to Burnay, the position at the Polytechnic School was not what he had expected, he hints about broken promises and frictions with colleagues, as well as Lourenço feeling isolated from the scientific milieu of France, Germany and England. It is very difficult to reconstruct what has really happened. It is also obvious that Burnay knew more about this situation than he wanted to disclose beyond some delicate hints in his obituary speech on the occasion of an academic ceremony in remembrance of Lourenço.

Burnay is however sufficiently outspoken so that one can conclude that Lourenço had great difficulties in expressing himself orally in his lectures. Although his written texts are precise and profound, his students had great difficulties in following him and he was feared as an examiner. One should also be aware that at that time the Portuguese industry did not provide many jobs for chemists. The courses offered at the Polytechnic School were mainly directed to students who expected to be employed by the State. For most, chemistry was probably seen just as a nuisance to be dealt with in order to obtain a degree which opened up a career. A professor without oratory gifts would not be a success, regardless of the gifts which the French Academy had justly recognized in Lourenço.

A less well known fact is that his first attempt to publish a research paper in Portugal was a failure. In a communication where he claimed together with his younger colleague Aguiar to have isolated nonylic, decylic and undecylic alcohol was never cited abroad, neither by Wurtz in his *Dictionnaire de Chimie Pure et Appliquée*, nor by Beilstein in his *Handbuch der Organischen Chemie* or any other author.

The compounds they believed to have isolated by fractional distillation and identified were actually mixtures of a number of compounds with an average composition which simulated the stoichiometry of the alcohols they assumed to have in hands. This must have been quite a blow to Lourenço's pride, and a very proud person he must have been. Socially and in his tastes he is said to have been very elegant and sophisticated, but somehow withdrawn.

In his laboratory, he busied himself mainly with analyses of mineral waters of the numerous Portuguese spas and published in French a book on these spas. These analyses brought him probably also some income. Burnay mentions, however, that Lourenço continued with experiments in the same area of his work at Wurtz's laboratory, but which were never published.

Burnay considered that Lourenço's major contribution while in Portugal was to have awakened Aguiar's interest in organic chemistry and to train him as an achieved experimentalist, in spite of the only paper they co-authored being wrong (something Burnay did however not mention).

Publications

In French:

- A. V. Lourenço, Note sur la formation d'un éther intermédiaire du glycol, *Comptes Rendus de l'Académie des Sciences* 49 (1859), 619.
- A. V. Lourenço, Sur les éthers composés du glycol, *Comptes Rendus de l'Académie des Sciences*, 50 (1860), 91.

- A. V. Lourenço, Action des chlorures organiques monobasiques sur le glycol et les éthers composés, *Comptes Rendus de l'Académie des Sciences*, 50 (1860), 188.
- A. V. Lourenço, Séries intermédiaires de composés polyatomiques, *Comptes Rendus de l'Académie des Sciences*, 50 (1860), 607.
- A. V. Lourenço, Sur les alcools polyéthyléniques, *Comptes Rendus de l'Académie des Sciences*, 51 (1860), 365.
- A. V. Lourenço, Sur l'éther du glycol, *Bulletin de la Société Chimique*, (1860), 207.
- A. V. Lourenço, Alcools et Anhydrides polyglycériques, *Comptes Rendus de l'Académie des Sciences*, 52 (1861), 359.
- A. V. Lourenço, M. Reboul, Sur quelques éthers de Glycerine, *Comptes Rendus de l'Académie des Sciences*, 52 (1861), 401.
- A. V. Lourenço, M. Reboul, Sur quelques éthers éthyliques des alcools polyglycériques, *Comptes Rendus de l'Académie des Sciences*, 52 (1861), 466.
- A. V. Lourenço, Transformation de la glycérine en propylglycol, *Comptes Rendus de l'Académie des Sciences*, 52 (1861), 1043.
- A. V. Lourenço, Recherches sur les composés polyatomiques, *Annales de Chimie et de Physique*, [3] 67 (1863), 186 – 339.
- A. V. Lourenço, Renseignements sur les eaux minérales portugaises, E. Dentu, Paris 1866.

In Portuguese (selection):

- A. V. Lourenço, *Algumas informações sobre as aguas sulfureas salinas do Arsenal da Marinha de Lisboa*, Lisboa, Tipografia da Companhia Nacional Editora, 1889.
- A. V. Lourenço, A. A. de Aguiar, Investigações ácerca da synthese de alcools monoatomicos, *Jornal de Sciencias Mathematicas Physicas e Naturaes*, 1 (1868), 13 – 25.
- A. V. Lourenço, “Estudos preliminares sobre as principaes aguas mineraes do Reino”, in *Trabalhos preparatorios ácerca das aguas minerais do Reino e providencias do Governo sobre proposta da Commissão respectiva*, Lisboa, Imprensa Nacional, 1867.
- A. V. Lourenço, “Relatorio sobre as aguas mineraes de Vidago, de Villarelho da Raia e das Caldas”, in *Trabalhos preparatorios ácerca das aguas minerais do Reino e providencias do Governo sobre proposta da Commissão respectiva*, Lisboa, Imprensa Nacional, 1867.

Bibliography

- Eduardo Burnay, “Elogio historico do Dr. Agostinho Vicente Lourenço”, *Memorias da Academia Real das Sciencias de Lisboa, Classe de Sciencias Moraes, Politicas e Bellas-Letras*, 7 (1895), Parte 1, 1 – 42.
- A. Machado, A. P. Forjaz, Escola Politécnica de Lisboa, Lisboa 1937.
- A. J. Roche, *Nationalizing Science. Adolphe Wurtz and the Battle for French Chemistry*, Cambridge Mass. The MIT Press, 2001.
- P. J. Flory, *Principles of Polymer Chemistry*, Cornell University Press, Ithaca and London, 1953, pp. 12 – 23.
- C. Priesner, “H. Staudinger, H. Mark und K. H. Meyer – Thesen zur Größe und Struktur der Makromoleküle”, Weinheim, Verlag Chemie, 1980, and review by B. Vollmert, *Nachrichten aus Chemie und Technik*, 28 (1980), 891 – 892 and reply by M. Minssen, *ibid.* 29 (1981), 184.
- C. Santos, L. Godinho, J. P. Marques, “Estudo da preparação do valerato de amilo e da sua reacção com sódio de A. A. Aguiar e A. V. Lourenço no Jornal

de Ciências Mathematicas, Physicas e Naturaes”, *unpublished report*, Lisboa, Instituto Superior Técnico, 2000.

- J. B. A. Dumas, A. J. Balard, “Rapport sur plusieurs Mémoires présentées à l’Académie par M. Lourenço”, *Comptes Rendus Hebdomadaires des Séances de l’Académie des Sciences*, 53 (1861), 322 – 326.
- B. J. Herold, “Bernardino Gomes Pai e Agostinho Lourenço Precursores Portugueses da Química dos Alcalóides e dos Polímeros Sintéticos” in “História e Desenvolvimento da Ciência em Portugal, Vol. I, 417 – 433, Lisboa, Academia das Ciências de Lisboa, 1986.
- Ana Carneiro, *The Research School of Chemistry of Adolph Wurtz, Paris, 1853-1884*, Unpublished PhD thesis, University of Kent, Canterbury, 1992.
- Bernardo J. Herold; Ana Carneiro, “Portuguese Organic Chemists in the 19th Century. The Failure to Develop a School in Portugal in spite of International Links”, in Éva Vámos, ed., *Proceedings da 4th International Conference on History of Chemistry, Communication in Chemistry in Europe across Borders and across Generations*, Budapeste, 3-7 Setembro de 2003, Budapeste, Hungarian Chemical Society, 2005, pp. 25-48