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Victor Meyer (1848-1897) – The Most Outstanding German Chemist of the Second Half of the XIX Century

Victor Meyer (1848-1897) - El químico alemán más destacado de la segunda mitad del siglo XIX

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ABSTRACT

Victor Meyer (1848-1897) was one of the most outstanding chemist of the second half of the 19th century. He is known for his numerous papers in the field of organic chemistry. The purpose of this paper is to familiarize readers with the important events in the life of Meyer. In addition, his research activities is briefly described, and especially the chemical reaction named after him.

Keywords: V. Meyer, Organic chemistry, Victor Meyer Reaction, Germany – XIX century

RESUMEN

Victor Meyer (1848-1897) fue uno de los químicos más destacados de la segunda mitad del siglo XIX. Es conocido por sus numerosos artículos en el campo de la química orgánica. El propósito de este artículo es familiarizar a los lectores con los eventos importantes en la vida de Meyer. Además, se describen brevemente sus actividades de investigación, y especialmente la reacción química que lleva su nombre.

Palabras claves: V. Meyer, Química orgánica, Reacción de Victor Meyer, Alemania - Siglo XIX.

INTRODUCTION

The important events in the Meyer's life

He was called "the most versatile chemists of his time" (Engel, n.d.b) as well as he "was known as one of the most important researchers of his time" (Biltz, 1898, p. 1). One hundred and twenty-four years have passed since the day of his death, but in that time very little has appeared in the literature about this eminent man.

Victor Meyer (Figure 1) was born in Berlin, on September 8, 1848, and he was the son of Jacques Fischer (1816-1892), a prosperus Jewish merchant in calico printing and dyeing (Horowitz, 1916, p. 364), and his wife Bertha (1822-1895) (Engel, n.d.a).

In 1858, he entered the *Friedrich-Werdersche* Gymnasium (Engel, n.d.ab). In 1864, at the age of sixteen, he became a student at the University of Berlin. He studied there for only one semester, after which he transferred to the University of Heidelberg, where he attended lectures by some of the leading German chemists such as Emil Erlenmeyer (1825-1909) (organic chemistry), Hermann Kopp (1817-1892) in theoretical chemistry, and lectures on analytical chemistry under Robert Bunsen (1811-1899) (Schmidt, 1950, p. 557).

The American biochemist Benjamin Harrow (1888-1970) wrote about Meyer's trip to Heidelberg in one of the chapters in his book (1920):

"… the family persuaded the youth to proceed to Heidelberg, there to attend some lectures in the company of his elder brother [Richard Meyer (1846-1926)]. What the incessant arguments of the parents and friends had failed to do, the chemical lectures of one of the professors easily accomplished. In Bunsen the young man encountered one of those rare minds who can see and demonstrate the beauty and poetry of anything they happen to be engaged in. From the lips of Bunsen chemistry issued forth as a song to nature, and as a song to nature Meyer caught the refrain" (p. 178).

In the spring of 1865 he passed his *Abiturientenexamen* (matriculation examination) (Harrow, 1920, p. 178), and in May, 1867, at the age of nineteen, he received the doctor's degree *summa cum laude* (Biltz, 1898, p. 1; Harrow, 1920, p. 179). He was immediately appointed by Bunsen as his assistant (Anonymous, 1948, p. 364).

During his stay in Heidelberg, he met the British chemist Thomas Edward Thorpe (1845-1925) as well as the American chemist Gideon E. Moore (1842-1895). In one of the letters written by Thorpe to the British chemist Henry Enfield Roscoe (1833-1915), which was published in Roscoe's book (1906), Thorpe wrote:

"I spent in the Heidelberg laboratory, in close association with that great man [Bunsen], as one of the most precious memories of my life. … I had as companions Victor Meyer and an American—Gideon Moore—a man of extraordinary ability, who had the misfortune to be stone-deaf but who taught himself German and spoke it fluently without having heard a sound of the language" (pp. 84, 86).

In 1868, he went to Berlin to work under Adolf von Baeyer (1835-1917) in his chemical laboratory at the *Gewerbeakademie*. In his memoirs, Baeyer (1905) wrote:

"Victor Meyer joined the laboratory two semesters before [Carl] Graebe's [(1841-1927)] departure. [Carl] Liebermann [(1841-1914)] gives the following description of the new intern: "Coming from Bunsen, whose assistant for mineral water analysis he had been for a short time, Victor Meyer entered the organic laboratory in the fall of 1868. Only 20 years old, radiant with freshness and cheerfulness, he was just as gifted and well-educated as he was thirsty for knowledge and striving forwards in the development of the science by the society. Soon he was, like one of the professor's

favorites, that of the whole laboratory. But not only did he spice up the midday meal with a cheerful mood, that the older interns shared in a neighboring bar, and the work in the laboratory through beautiful singing; soon our friend became an indispensable, living reference book for the self-employed for the chemical literature, which, owing to his phenomenal memory, he had completely in his head. As early as 1869 he published 2 smaller papers on "Trimethylglycerammonium" [Meyer, 1869a] and "the Dicarboxylic Acid of Sulfur" [Meyer, 1869b], then groped for a while until he came to a decisive topic in 1870 - the positional questions regarding the bisubstitution products of benzene." Victor Meyer stayed in my laboratory for 3 years, until he was a resident, in the summer of 1871. He was appointed extraordinary Professor of Organic Chemistry to the Stuttgart Polytechnic" (pp. XIX-XX).

In 1872, he was called to the chair of Chemistry at the Zürich Polytechnic. One year later, he married Hedwig Davidso[h]n (1851-1923), daughter of Moritz Davidso[h]n (died in 1852) (Engel, n.d.a).

In 1885, he went to Göttingen, and in 1889, at the age of forty-one, he was appointed Professor of Chemistry at University of Heidelberg. He was Bunsen's successor there (Anonymous, 1897, p. 449). From the same year, he also managed chemical laboratory at the University ("Robert Wilhelm Bunsen", 2011). About the period before he took up his duties at University, Harrow (1920) wrote:

"Before proceeding to assume his duties in Heidelberg he spent several delightful days in Bordighera [Italy]. Here were Baeyer, Emil Fischer [(1852-1919)], [Otto] Wallach [(1847-1931)] and Quincke, "the masters of them that know" in chemistry. To Heidelberg Meyer took as his assistants [Paul] Jannasch [(1841-1921)], [Ludwig] Gattermann [(1860-1920)], [Paul] Jacobson [(1859-1923)], [Karl] Auwers [1863-1939)] and [Robert] Demuth. At this day when one reads these names one cannot but help admiring Meyer's wonderful judgment of men. Every one of these five has since made an enviable name for himself" (p. 191).

Fig.1. *Victor Meyer (1848-1897) ("Meyer, Victor (1848", (1872-1885).*

In 1891, he attended the celebration of Jubilee of the Chemical Society. Roscoe (1906) wrote about it in his book:

"The Chemical Society of London … celebrated its Jubilee in February, 1891. My friend William Russell [(1830-1909)] was President, and amongst other functions naturally came a dinner. The chief guest of the evening was the late Lord Salisbury [(1830-1903)], who delivered a masterly speech on the intellectual pleasure to be derived from the pursuit of science for its own sake. No less eloquent was the recognition by the ever-lamented chemist of Heidelberg, Victor Meyer, of the part played by the society in the development of the science" (pp. 171-172).

He died on August 8, 1897. He was buried in the Bergfriedhof of Heidelberg on August 10 ("Viktor Meyer", 2021; Lieberman, 1897, p. 2168). H. C. Cooper in his article (1897) published in *Science* wrote about his death and funeral as follows:

"That so great a man should depart in such a way, and in the prime of his life, seems to be the regret of all who knew his accomplishments. …Returning from a social gathering rather late Saturday evening, he retired to his room, with the request that he be not disturbed on the following morning. When the door was forced open at noon by the anxious family he had already been dead some time, and the cyanide bottle by the bedside told the story. When it was first reported that the beloved teacher had died by his own hand, not even his most intimate frienads would believe it, and to many the matter is still an enigma. He seemed too great a philosopher to countenance such an act. It is not improbable that temporary insanity shattered his mind. Although the fact was seldom noticeable, the great chemist was a very nervous man and had for an extended period been under medical treatment, but without great avail. … As the quiet assemblage, including many famous scholars, stood around the grave, wreath after wreath was laid at its head. The venerable Bunsen, to whom Victor Meyer went at the age of sixteen to learn chemistry, sent a laurel from his home near by. Adolph von Baeyer came from Munich with a wreath ' to his best friend. ' The German Chemical Society paid a tribute to its lost President, and the grand-ducal family of Baden sent a token. Among the many other wreaths was one bearing the words, ' Dem grossen Lehrer in Dankbarkeit, Seine Amerikanischen Schüler ' [To the Great Teacher in Gratitude, His American Student]" (pp. 449-450).

Meyer's works

The list of Meyer's works includes over three hundred papers that appeared in print for twenty-eight years from 1869 to 1897 ("Victor Meyer.", 1999-2021). His articles presenting the results of his experimental studies were published mainly in *Berichte der deutschen chemischen Gesellschaft* and *Justus Liebigs Annalen der Chemie*. His numerous experimental studies were carried out in chemical laboratories in Berlin (1868-1871), Zürich (1872-1885), Göttingen (1885-1889), and Heidelberg (1889-1897). He was active in research on "compounds of the paraffin series; iodo, iodoso, and iodonium compunds (1895); explained the stereoisomerism of oximes (1883); discovered tiophene [(C_4H_4S)] (1883); developed the vapor density method known by his name (1878); " (Smith, 1949, p. 170).

Meyer is the author of empirical rule which is known as his Law of the Esterification of Aromatic Acids, simply as Meyer Esterification Law (Meyer & Sudborough, 1894, p. 1585). The formulation of this rule gave Ralph William Hufferd (1920) in his thesis for the Degree of Doctor of Philosophy in Chemistry. He presented a German version of this Law as follow:

"*Sobald in einer substituirten Benzoesäure die beiden dem CO_2H benachbarten H-Atomee durch Radicale, wie Br, NO_2, CH_3 etc., ersetzt sind, resultirt eine Säure, welche durch Alkohol und Salzsäure nicht esterficirbar ist*" (p. 2).

The translation of the German text is the following:

"As soon as the two hydrogen atoms adjacent to CO_2H in a substituted benzoic acid are replaced by radicals, such as Br, NO_2, CH_3, etc., an acid results which cannot be esterified by alcohol and hydrochloric acid".

In the history of organic chemistry, his name was written in the name of one reaction called the Victor Meyer Reaction. In 1874, he carried out a reaction to obtain nitroethane ($CH_3CH_2NO_2$) from ethyl iodide (C_2H_5I) and silver nitrite ($AgNO_2$) (Meyer, 1874, p. 19). In the generalized form, the Victor Meyer's Reaction is "the formation of a nitroalkane from the reaction between an alkyl halide and silver nitrite". According to Zerong Wang this "reaction is still the most convenient method for the preparation of the homologues of primary nitroalkanes higher than 1-nitropropane" (Wang, 2010).

In the years 1870-1871, he published the results of experimental studies carried out in the Organic Laboratory at *Gewerbeakademie* in Berlin in nine articles. In the first of them he described the method of the synthesis of aromatic acids (Meyer, 1870a). In subsequent articles published in 1870, the objects of his research interest were the constitution of camphor ($C_{10}H_{16}O$) (Meyer, 1870b), the chemical nature of chloral hydrate ($C_2H_3Cl_3O_2$) (Meyer, 1870c), the dibromobenzene ($C_6H_4Br_2$) (Meyer, 1870d), and the constitution of the doubly substituted benzenes (Meyer, 1870e).

In 1871, he published three articles with E. Adore and one with M. Ascher. He presented in them the results of his research on sulfanilic acid ($C_6H_7NO_3S$) (Adore & Meyer, 1871a), conversion of the bromobenzoic acid ($C_7H_5BrO_2$) into isophthalic acid ($C_8H_6O_4$) (Adore & Meyer, 1871b), constitution of the doubly substituted benzenes (Adore & Meyer, 1871c). The last article published in 1871 was devoted to the history of benzenesulfonic acid ($C_6H_6O_3S$) (Ascher & Meyer, 1871).

Meyer's work was not limited to organic chemistry. He also conducted research in the field of physical chemistry (G.O., 1897, p. 460). He designed an apparatus to carry out studies of the determination of the vapor density (Meyer, 1878, p. 1868). Harry B. Weiser (1916) described it as follows:

„The apparatus commonly used in the Victor Meyer displacement method of determining vapor densities consists of a cylindrical bulb of about 100 cc capacity attached to the end of a long tube. Sear the upper end of the latter a side tube is attached which serves to conduct to a measuring vessel the air expelled during a determination. The bulb and a portion of the long tube are surrounded by a jacket in which a suitable liquid is boiled for regulating the temperature of the enclosed tube. The assembled apparatus is almost four feet tall exclusive of the eudiometer tube in which the expelled air is caught " (p. 532).

G. M. Richardson (1897) quoted from an address made by him, at Heidelberg, in 1889, in which he spoke of a new experimental method of studying the vapor density of inorganic compounds and elements:

"To-day new methods of experiment permit of comparatively easy determination of the vapor-density and consequently of the molecular state of substance at the highest temperatures. Numerous inorganic conipounds, and the elements themselves, have been studied with regard to their vapor density at a white heat. While many of them, as oxygen, nitrogen, sulphur, and mercury, remain unchanged under such conditions, the molecules of chlorine, bromine, and iodine were split into two atoms

in conformity with Avogadro's surmise in regard to the compound nature of the elementary molecules. In the same manner the vapor-density and the molecular condition of the less volatile elements, zinc, thallium, antimony, and bismuth were successfully determined at a white heat. To-day pyrochemical work is limited to a temperature of 1,700° C., because vessels of porcelain and platinum, to the use of which we are limited, fuse above that temperature" (pp. 920-921).

His last papers were published in 1897. They concerned both organic and physical chemistry. The first article describes further observations on the evolution of oxygen gas during reduction (Frenzel, Fritz, & Meyer, 1897). The topics of the following papers concerned on results of investigations of conversion of butyric acid ($C_4H_8O_2$) into isobutyric acid (Hutzler & Meyer, 1897), one rearrangement in the mesitylene (C_9H_{12}) series (Meyer & Molz, 1897a), ν-durolecarboxylic acid (Meyer & Molz, 1897b), preparatory work for an investigation into vapor density determination at extreme heat levels (Meyer & Recklinghausen, 1897), the course of gas oxidation by liquids over time (Meyer & Saam, 1897), hexahydrobenzophenone and its oximes (Meyer & Scharvin, 1897), and triphenyl acrylic acid isomer and its conversion (Meyer & Weil, 1897).

Meyer's other works in chemistry

In 1888, the book written by Meyer under the title *Die Thiophengruppe* (The Thiophene Group) was published in Baraunsweig (Meyer, 1888), and in 1890, his lecture given at the First General Meeting of the 62nd Assembly of German Naturalists and Physicians on September 18, 1889 in Heidelberg entitled *Chemische Probleme der Gegenwart* (Chemical Problems of the Present) was also published (Meyer, 1890).

A book written by him, together with Carl Langer, under the title *Pyrochemische Untersuchungen* (Pyrochemical Investigations) was published in 1885. "The experiments" decribed in this book "were carried out in 1882 and 1883 in the Chemical Laboratory at the Swiss Federal Polytechnic in Zürich (chemischen Laboratorium des eidgenössischen Polytechnikums in Zürich)" (Langer & Meyer, 1885, p. I).

The first volume of his 1,128-page textbook, co-written with the German chemist Paul Jacobson (1859-1923), entitled *Lehrbuch der Organischen Chemie* (Organic Chemistry Textbook), appeared in 1893. The authors dedicated this book to Baeyer. They wrote: " Adolf von Baeyer, the Master of Chemical Research, Approved by the Authors with Admiration and Gratitude" (Meyer & Jacobson, 1893, p. III). The first part of the second volume of this textbook was published in 1902, five years after Meyer's death. Carl Harries was its editor (Meyer & Jacobson, 1902). The second part of the second volume was released a year later (Meyer & Jacobson, 1903).

CONCLUSION

Victor Meyer was one of the most outstanding chemist of the second half of the XIX century (Lunge, 1897, p. 777). He worked in Germany and Switzerland. He achieved incredible success in his short life. In 1883, at the age of 35, he became a corresponding member of the *Bayerische Akademie der Wissenschaften* (Bavarian Academy of Sciences) ("Deceased members. Viktor", 2021). In the same year, he was elected an Honorary Foreign Member of the Chemical Society of London. Among his many honors, Thorpe (1900) mentions the following:

" He was a corresponding member of the Academies of Munich, Berlin, Upsala, and Göttingen, and an honorary member of many learned societies. The University of Königsberg made him an Honorary Doctor of Medicine" (p. 206).

In 1891, the *Royal Society of London* conferred on him the Davy Medal "for his researches on the determination of vapour densities at high temperatures" (Award winner: Davy", n.d.).

His autobiography was published in 1917. The author of this book was his older bother, Richard (Meyer, 1917). It was released in the *Grosse Männer. Studien zur Biologie des Genies* (Big Men. Studies of the Biology of Genius) series, edited by the Russian-German chemist and philosopher Wilhelm Ostwald (1853-1932). Its first edition was also reissued in 1918.

The Meyer's Memorial Lecture delivered by Thorpe to the Fellows of the Chemical Society, 8th February, 1900, was published in the second edition of his 1902 book entitled *Essays in Historical Chemistry* (Thorpe, 1902). It was also published in the *Journal of the Chemical Society* two years earlier (Thorpe, 1900). The Memorial Lecture on Meyer was also given by Liebermann to the members of the German Chemical Society on October 11, 1897 (Liebermann, 1897).

Meyer was very interested in tourism. In 1892-1893, he published two books in this field. The first, entitled *Aus Natur und Wissenschaft. Wanderblätter und Skizzen* (From Nature and Science. Hiking Sheets and Sketches), was released in 1892 (Meyer, 1892), and the second under the title *Märztage im Kanarischen Archipel: ein Ferien-Ausflug nach Teneriffa und La Palma* (March Days in the Canary Archipelago: A Vacation Trip to Tenerife and La Palma) was published one years later in Leipzig (Meyer, 1893).

After Meyer, not only his papers and books survived. His portrait can be found in a book written by the American chemist Henry Monmouth Smith (1868-1950) (Smith, 1949, p. 170). His photos were also posted by some authors of books and articles describing his life and scientific achievements, for instance by Meyer (1917, p. 1), Harrow (1920, p. 177), Meyer (1908, p. 4505), and G. Lunge (1897, p. 777). There is also a photo of his vapour density apparatus ("Victor Meyer", n.d.).

The scientific work of this extremely gifted chemist will never be forgotten. At this point, it is worth quoting the words of his close friend Carl Liebermann. He was also "the ingenious researcher, ... and in the history of chemistry his works will live on" (Lieberman, 1897, p. 2168).

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This article has no conflict of interest