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BIBLIOGRAPHIC REWIEW

VICTOR VON RICHTER (1841-1891) – THE FAMOUS RUSSIAN - GERMAN CHEMIST, AUTHOR OF EXCELLENT ACADEMIC TEXTBOOKS ON CHEMISTRY

Victor von Richter (1841-1891) - el famoso químico ruso-alemán, autor de excelentes libros de texto académicos sobre química

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ABSTRACT

Victor von Richter (1841-1891) was one of the important chemists of the second half of the 19th century. The purpose of this paper is to familiarize readers with the important events in the life of Richter and his writing activities, in particular with his chemistry textbooks for higher education, well-known in different countries. In addition, his research activities is briefly described, and especially the chemical reactions named after him.

Keywords: V. v. Richter, Organic chemistry, von Richter reactions, Richter's textbooks on chemistry, Russia & Germany – XIX century

RESUMEN

Victor von Richter (1841-1891) fue uno de los químicos importantes de la segunda mitad del siglo XIX. El propósito de este trabajo es familiarizar a los lectores con los acontecimientos importantes en la vida de Richter y sus actividades de escritura, en particular con sus libros de texto de química para la educación superior, conocidos en diferentes países. Además, se describen brevemente sus actividades de investigación, y especialmente las reacciones químicas que llevan su nombre.

Palabras clave V. v. Richter, Química orgánica, reacciones de von Richter, libros de texto de Richter sobre química, Rusia y Alemania - siglo XIX

INTRODUCCIÓN

The important events in the Richter's life

One hundred and twenty-nine years have passed since the death of Victor von Richter (Viktor Yul'yevich Rikhter, Виктор Юльевич Рихтер), but in that time little has appeared in the literature about this very interesting man. He went down in the history of chemistry as a researcher of synthesis in organic chemistry as well as he was well-known for his chemistry textbooks published in several languages.

Richter was born in Dobele (Doblensky County, Courland Province, Russian Empire, now Latvia) on April 3 [according to the Julian calendar (Old Style); Apr. 15, by the Gregorian calendar (New Style), adopted in Russia on February 1, 1918] 1841, and he was the son of a preacher (Prausnitz, 1891, p. 1123).

After study at *St. Annenschule*, the German school in St. Petersburg, he continued his education (1858-1862) at the Imperial Univeristy in Dorpat in the Russian Empire (now, Tartu, Estonia) (Hasselblatt, 1899, p. 504; "Russkiy biograficheskiy slovar", 1913, p. 244), where teaching in German was compulsory (Kaji & Brooks, 2015). After completing his studies (1858-1862), the University awarded him the Scholarly Degree of Candidate in Physico-Mathematical Sciences on January 16, 1863 on the basis of a thesis *Ueber die organischen Säuren mit drei Sauerstoffatomen* (Prausnitz, 1891, p. 1123).

In January 1864, he returned to the Russian capital, where he was employed as a chemist in the laboratory at the Imperial Technological Institute of St. Petersburg. In 1866 he was the author of the first chapters under title *Analiz meroyu ili titrovannymi zhidkostyami* (Analysis by Measure or Titrated Liquids) in a book entitled *Analiticheskaya khimiya. Kolichestvennyy analiz* (Analytical Chemistry. Quantitative Analysis) edited by Dmitri Ivanovich Mendeleev (1834-1907) (Rikhter, 1866). On April 1, 1867, he received a master's degree in chemistry for his dissertation *Issledovaniye o nekotorykh proizvodnykh propionovoy kisloty v otnoshenii teorii khimicheskogo stroyeniya* (Research on Some Derivatives of Propionic Acid in Relation to the Theory of Chemical Structure) (Rikhter, 1868).

On May 1, 1872, v. Richter defended his dissertation for the Doctor of Chemistry degree entitled *Issledovaniye o stroyenii benzolovykh proizvodnykh* (Research on the Structure of Benzene Derivatives) (Rikhter, 1872). His official activity at the Imperial Technological Institute of St. Petersburg lasted until May 6, 1872, after which he was appointed Professor of General and Analytical Chemistry at the Institute of Agriculture and Forestry in *Novaya-Aleksandriya* (New-Alexandria, now, Puł awy, Poland) in *Lyublinskaya Guberniya Tsarstva Pol'skogo i Rossiyskoy Imperii* (Lublin Governorate of the Kingdom of Poland and the Russian Empire). The city was so named in 1842 in memory of the Empress Alexandra Feodorovna (1798-1860), the wife of the All-Russian Emperor Nikolai I Pavlovich (1796–1855), who stayed there.

Richter's health was bad because he suffered from tuberculosis (Kaji & Brooks, 2015). Staying in countries with milder climates was necessary to improve it. On June 1, 1874, at his urgent request he was dismissed from his post at the Institute and went abroad. First, he stayed in France, Italy and Turkey. Then he settled for almost two years (1874-1875) in Bonn

(Siemion, 2001, p. 780), where he resumed his experimental work under the direction of August Kekulé's (1829-1896) (Landenburg & Buchner, 1911, p. 455). Anschütz (1929) wrote about it: "*In Kekulés Privatlaboratorium arbeitete damals über ein Jahr der liebenswürdige Deutschrusse V i c t o r*

v o n R i c h t e r (The amiable German-Russian Victor von Richter back then worked in Kekulé's private laboratory for over a year)" (p. 468).

The results of Richter's experimental research carried out there were included in a work under the title *Ueber die Einwirkung von Cyankalium auf halogensubstituirte Nitroverbindungen* (Richter, 1875a).

In the winter of 1875, he came to Breslau in Silesia in the Kingdom of Prussia (now Wrocł aw, Poland). On December 17 of the same year he completed his habilitation as a *Privatdozent* at the University of Breslau. The basis of his habilitation was his *Kurzes Lehrbuch der Anorganischen Chemie* from 1875 (Siemion, 2001, p. 780). His open habilitation lecture was entitled *Ueber das periodische System der Elements und das neuentdeckte Element Gallium* (About the Periodic System of the Elements and the Newly Discovered Element Gallium) (Prausnitz, 1891, p. 1124).

He remained in Breslau after his habilitation and worked here until his death. Carl Jacob Löwig (1803-1890), Director of the Faculty of Chemistry at the University entrusted him with the responsibility of the organic section of the laboratory and prompted him to give lectures on technical chemistry. Accordingly, he read lectures about technology, analytical chemistry, and certain parts of organic chemistry (Landenburg & Buchner, 1911, p. 455).

In May 1879 he became extraordinary professor (Prausnitz, 1891, p. 1124; "Biograficheskiy slovar' professorov", 1898, p. 147). In the years 1882-1890, he was one of the co-authors of the first eight volumes of the *Handwörterbuch Der Chemie* (Concise Dictionary of Chemistry) published in Breslau (Landenburg, 1890).

Beginning in 1886, he went to the sanatorium in *Görbersdorf* (Landenburg & Buchner, 1911, p. 455) (now Sokoł owsko near Wał brzych, Poland) for treatment for his lung disease (Siemion, 2001, p. 780). In 1890, he was appointed the *Director Des Instituts Für Technische Chemie an der Universität Breslau* (Director of the Institute of Technical Chemistry at the University of Breslau) (Richter, 1891, p. 1).

Richter died in Breslau on October 9, 1891, at the comparatively early age of fifty. His friend G. Prausnitz (1891) wrote in the obituary about his sudden death:

ein Blutsturz hatte seinem Leben plötzlich ein Ende bereitet, einem Leben, das er voll und ganz seiner Wissenschaft, der Chemie, geweiht, deren Pflege er sich fast bis zu seinem letzen Athemzuge hingegeben hatte (A hemorrhage had suddenly put an end to his life, a life that he dedicated entirely to his science, chemistry, the care of which he had devoted himself almost to his last breath) (p. 1123).

Richter and Russkoye khimicheskoye obshchestvo

On December 28, 1867, the First Congress of Russian Naturalists and Physicians opened in St. Petersburg. On January 3, 1868, the members of the Chemical Section of the Congress at the initiative of Nikolay Alexandrovich Menshutkin (1842-1907), Nikolay Nikolaevich Zinin (1812-1880) and Mendeleev decided to create the Russian Chemical Society.

Figure 1 is a photography made during this Congress ("Founders of Russian Chemical Society.", 1868). Olga Vorobyova (2014) in the article entitled *Kto sozdaval Russkoye khimicheskoye obshchestvo?* (Who created the Russian Chemical Society?) wrote that it presents:

the faces of those who have already established themselves as a talented scientist, and those who have yet to become one of the outstanding scientists with a worldwide reputation, there are also those who have made their feasible contribution to the development of chemistry in Russia (p. 1). Rikhter is first from the left in the front row; to his left are Stepan Ivanovich Kovalevsky (?- 1907), Nikolay Pavlovich Nechaev (1841-1917), Vladimir Vasilievich Markovnikov (1837-1904), Alexander Abramovich Voskresensky (1809-1880), Pavel Antonovich Ilyenkov (1821-1877), Petr Petrovich Alekseev (1840-1891) and Alexander Nikolaevich Engelhardt (1832-1893). From left to right, in the second row are Felix Romanovich Vreden (1841-1878), Pavel Alexandrovich Lachinov (1837-1892), Gustav Avgustovich Schmidt (1839-?), Alexey Romanovich Shulyachenko (1841-1903), Alexander Porfirevich Borodin (1833-1887), N. A. Menshutkin, Nikolai Alexandrovich Sokovnin (1835-?), Fedor Fedorovich Beilstein (1838-1906), Konon Ivanovich Lisenko (1836-1903), D. I. Mendeleev and Fedor Nikolaevich Savchenkov (1831-1900).

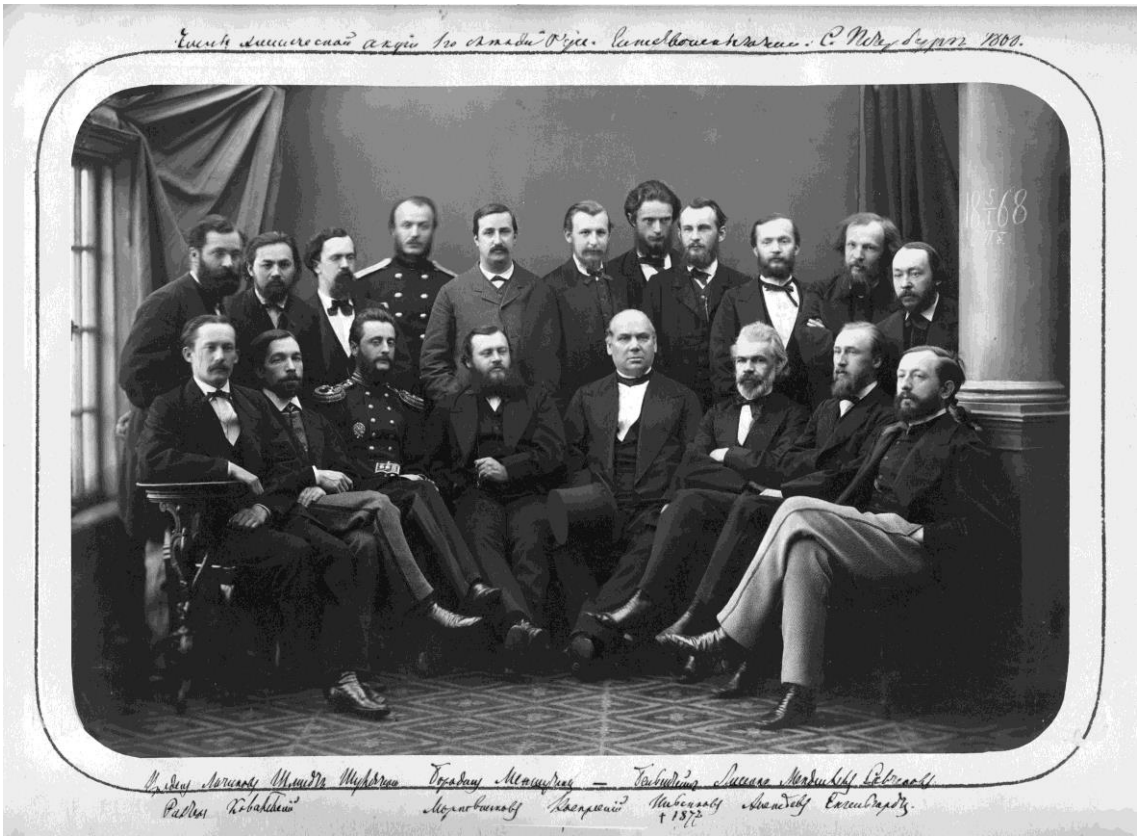

Fig. 1. Nineteen members of the Chemical Section of the First Congress of the Russian Naturalists and Physicians ("Founders of Russian Chemical Society", 1868).

On January 3, 1868, at the last general meeting of Congress, at the request of the Chemical Section, a resolution was adopted to estabilish the Chemical Society. Members of Congress unanimously approved it. Solov'yev (1985) wrote in his *Istoriya khimii v Rossii* (History of Chemistry in Russia):

Химическая секция заявила единодушное желание образовать в Петербурге Химическое общество. … Секция полагает, что это общество будет иметь членов во всех городах России и что его издание будет включать труды всех русских химиков, печатаемые на русском языке. Секция просит Съезд ходатрайствовать об утверждении общества (The Chemical Section has expressed a unanimous desire to form a Chemical Society in St. Petersburg. ... The Section believes that this society will have members in all cities of Russia and that his publication will include the works of all Russian chemists, printed in Russian. The Section asks the Congress to petition for the approval of the society) (p. 172).

The statute of the Russian Chemical Society, as its founding members, was signed, among others, by Richter, Beilstein, Borodin, Zinin, Mendeleev, and Menshutkin (Vorob'yeva, 2014). On November 6, 1868, the first meeting of the Russian Chemical Society was held under the chairmanship of Mendeleev. Zinin was elected as the first president. Four months later, in March 1869, the Society had 47 members (Mendeleev, 1960, p. 447), and in 1893 there were 245 (Vorob'yeva, 2014). The Society began to publish the *Zhurnal Russkogo*

Khimicheskogo Obshchestva (Journal of the Russian Chemical Society). Menshutkin was its first editor (Solov'yev, 1985, pp. 173-174).

Richter and Berichte der deutschen chemischen Gesellschaft

Richter became the first Russian correspondent-chemist of the German Chemical Society (Kaji, 2003, p. 204). In the years 1869-1872 he sent twelve reports to the journal of this Society Berichte der deutschen chemischen Gesellschaft about activities of the Russian Chemical Society.

In one of the first correspondence of October 17, 1869, Richter (1869) reported on Mendeleev's research on the periodic table of the elements. He wrote:

Hr. D. Mendelejeff machte auf einige interessante Verhältnisse aufmerksam, die aus dem von ihm aufgestellten Systeme der chemischen Elemente hervorgehen. ... Von der Ansicht ausgehend, dass die Atomgewichte das wahrhaft Beständige im Wesen der Elemente ausmachen, hält Hr. Mendelejeff dafür, dass die Grösse der Atomgewichte die wahre Basis für die Klassificirung der Elemente abgebe (Mr. D. Mendelejeff pointed out some interesting relationships that emerge from the system of chemical elements he established. ... Starting from the view that the atomic weights make up the truly constant in the essence of the elements, holds Mr. Mendelejeff for it, that the size of the atomic weights provides the true basis for the classification of the elements) (p. 553).

Following Mendeleev, he presented an abbreviated scheme of such a classification there. He also emphasized that the Mendeleev system reflects gradual changes in the valence of chemical elements relative to oxygen (Richter, 1869, p. 553; Siemion, 2001, p. 776).

Richter's correspondence from two meetings of the Russian Chemical Society, held on November 5 (17) and December 3(15), 1870, brought the full version of the Mendeleev table (Richter, 1870, p. 992). Richter reported there that Mendeleev had to change the atomic weights of uranium, thorium, cerium and indium in building his table. He also wrote that, following the logic of his periodic table, Mendeleev predicted the existence of yet unknown elements: ekabor (Eb), ekaalumini (El) and ekasilitsii (Es). He cited Mendeleev's predictions about the physicochemical properties of these elements: their atomic weights, specific densities, atomic volumes, and the characteristics of their chlorides and oxides. At the end of his correspondence, Richter (1870) wrote: Interessante Prognosen, wenn es gelänge eines dieser Element wirklich zu entdecken! Der Weg dazu wäre durch die a priori vermutheten Eigenschaften angezeigt (Interesting prognoses, if one of these elements could really be discovered! The way to do this would be indicated by the properties assumed a priori) (p. 991).

On August 27, 1875, French chemist Paul Emile Lecoq de Boisbaudran (1838-1912) discovered predicated by Mendeleev ekaalumini and named it gallium (Lecoq de Boisbaudran, 1875, pp. 493-495).

Mendeleev's prognosis concerning an existence of ekabor also became the truth (Mendeleev, 1958, pp. 90-91). This element was discovered by Swedish chemist Lars Frederic Nilson (1840-1899) in 1879 and named scandium (Nilson, 1879, pp. 645-648).

Discovery of germanium by German chemist Clemens Alexander Winkler (1838-1904) on the 6th February, 1886, decisively confirmed correctness of the Periodic Table of the Elements defined by Mendeleev (Winkler, 1886, pp. 210-211).

On March 1, 1886, Mendeleev sent a congratulatory telegram to Winkler. Figurovskiy (1983) wrote about their correspondence as follows:

Как явствует из дальнейшей переписки между Винклером и Менделеевым, в часности из письма от 5 марта 1886 г. и от 1 июня 1887 г. …, Винклер очень беспокоился, согласился ли Менделеев с предложенным названием элемента «германий» и не будет ли настаивать на своем названии «экасилиций». Винклер писал в своих письмах, среди прочего: ... Ваша любезная, очень обрадовавшая меня телеграмма, за которую приношу Вам свою нижайшую благодарность... я забыл Вам сказать, что предложение о том, что это (новый элемент ...) есть предсказанный Вами экасилиций, высказано не мною, а В. фон Рихтером в Бреславле, и он об этом сообщает в Berichte der Deutschen chemischen Gesselschaft. В письме ко мне почти одновременно с ним это же предложение высказал и Лотар Мейер в Тюбингене (As is evident from further correspondence between Winkler and Mendeleev, in particular from a letter dated March 5, 1886 and June 1, 1887..., Winkler was very worried if Mendeleev agreed with the proposed name for the element "germanium", and whether he will not insist on its name "ekasilitsii". Winkler wrote in his letters, among other things: ... Your kind telegram, which made me very happy, for which I bring you my lowest gratitude ...I forgot to tell you that the sentence that this (new element ...) is predicted by you ekasilitsii, expressed not by me, but V. von Richter in Breslau, and he reports this in Berichte der Deutschen chemischen Gesselschaft. In a letter to me, almost simultaneously with him, the same sentence was also expressed by Lothar Meyer [1830-1895] in Tübingen) (pp. 127-128).

Richter's works

Seventeen papers presenting the results of the experimental research carried out by Richter were published in German in the *Berichte der deutschen chemischen Gesellschaft* over seventeen years from 1871 to 1888 ("Chemistry Europe", 2020). Among them are his original articles in the field of organic chemistry, in particular the chemistry of aromatic compounds. For example, the experimental studies carried out by Richter focused on the preparation of p-nitrobenzaldehyde (Richter, 1886a) and the constitution of the rosaniline salts (Richter, 1888). One of his articles entitled *Einwirkung von Salpetersäure auf Epichlorohydrin* (Action of Nitric Acid on Epichlorohydrin) was published in the *Journal für Praktische Chemie* (Richter, 1879). His papers can also be found in the journal *Zhurnal Russkogo fiziko-khimicheskogo obshchestva* (Walden, 1990, p. 562).

In the history of organic chemistry, Richter's name was written in the names of two reactions. The first of them, *the von Richter reaction* (Hayes, 2010), also called *von Richter Aromatic Carboxylation* was first discovered by him while still in St. Petersburg (Richter, 1871a, 1871b, 1871c). Hassner & Stumer (1994) wrote that it was "the reaction of m- and p-nitrohalobenzenes with CN^- leading to o- and m-halobenzoic acids with loss of the NO_2 group" (p. 317).

In one of the first experimental studies in this field a mixture of 1-Bromo-4-nitrobenzene ($C_6H_4BrNO_2$) and potassium cyanide (KCN) in ethanol (C_2H_5OH) was heated at 180-200°C. After work up there was obtained of 3-Bromobenzoic acid ($C_6H_4BrCOOH$) (Richter, 1871a).

Martin E. Hayes (2010) described *the von Richter reaction* in a generalized form as follows: The von Richter reaction is the nucleophilic aromatic substitution of a nitroarene [$C_6H_4RNO_2$] with potassium cyanide to give the *cine*-substituted benzoic acid [C_6H_4RCOOH]. The reaction is characterized by the observed regiochemistry of the product where the carboxyl group occupies a position *ortho* to the nitro group that is lost (p. 710).

The second reaction with Richter's name is called *von Richter Cinnoline Synthesis*. In 1883, he carried out the first synthesis of cinnoline from substituted aniline by a diazonium salt (Richter, 1883a; Hassner & & Stumer, 1994, p. 318). According to Li and Cook (2005) the course of this reaction is as follows:

The diazonium chloride ... which was obtained from *o*-aminophenylpropiolic acid [$C_9H_7NO_2$] ... was heated in water at 70°C to provide the 4-hydroxycinnoline-3-carboxylic acid [$C_9H_6N_2O_3$]. ... When this acid ... was heated above its melting point [at 260°C], carbon dioxide was liberated and 4-hydroxycinnoline [$C_8H_6N_2O$] was obtained. Distillation of 4-hydroxycinnoline ... with zinc dust furnished a small amount of oil, which was assumed to be cinnoline [$C_8H_6N_2$] (p. 540).

Richter's textbooks for higher education

Richter became famous for two of his textbooks: one on inorganic chemistry, in which he consistently adhered to Mendeleev's views and the second on organic chemistry, in which he represented Butlerov's views. They were published first in Russian and later in other languages.

The Textbook of Inorganic Chemistry

In 1874, the first edition of his *Uchebnik neorganicheskoy khimii po noveyshim vozzreniyam* (The Textbook of Inorganic Chemistry Based on the Newest Point of View) was published in Tipografii Ivana Yavorskogo in Warsaw (Rikhter, 1874). The preface to it, written in Novaya-Aleksandriya, is dated June 1, 1874. Rikhter (1880) wrote:

Особенно широкое применение и развитие отведено было в этом учебнике понятию о периодичности элементов, которое установлено было Д. М е н д е л е е в ы м и развито им в его капитальном сочинений «Основы Химии». Понятие это, по моему мнению, значительно развивает и обобщает многие фактические и теоретические представления и несомненно сильно повлияет на дальныейшее развитие химии; этим, как мне кажется оправдывается введение его и в элементарный учебник (Particularly wide application and development was given in this textbook to the concept of *the periodicity of elements*, which was established by D. Mendeleev and developed by him in his major works "Osnovy Khimii" [*The Principles of Chemistry* (Mendeléeff, 1891a,1891b)].This concept, in my opinion, significantly develops and generalizes many factual and theoretical concepts and will undoubtedly strongly influence the further development of chemistry; this, as it seems to me, is justified introducing it into an elementary textbook) (p. 4).

The next two Russian editions have been revised and enlarged by the author. The second (1876) edition of his *Uchebnik neorganicheskoy khimii po noveyshim vozzreniyam* was published in Leipzig (Rikhter, 1876), and the third (1878) edition appeared in Varshava in Tipografia K. Kovalevskogo (Rikhter, 1878).

The fourth edition of his *Uchebnik neorganicheskoy khimii po noveyshim vozzreniyam* was published in St. Petersburg in 1880. In this textbook, he first mentioned the discovery of the new elements of gallium and scandium (Rikhter, 1880, p. 248; Kaji & Brooks, 2015). The last 6th Russian edition was published during the life of the author in 1887. He wrote in it about all three discovered chemical elements (Ga, Sc and Ge), predicted by Mendeleev (Rikhter, 1887, p. 281).

After Richter's death, the chemist Ludwig Julievich Jawein (1854-1911), lecturer at the Technological Institute of Emperor Nicholas I in St. Petersburg, continued to expand and refine this textbook until the thirtheenth edition in 1910. In the preface to the seventh edition (the first after Richter's death), which Jawein also included in the 9th edition of the Rikhter's textbook (1897), he wrote:

Приняв на себя труд подготовить новое издание, печатаемое с согласия наследников покойного В. Ю. Рихтера, я ограничился небольшими изменениями, руководствуясь принципами, изложенными самим автором в предисловии к шестому изданию. … я старалась по возможности сохранит первоначальный характер учебника, настолько своеобразный, —благодоря положенной в основу изложения естественной системы элементов—, что книга Рихтера заняла самостоятельное и выдающееся место в среде богатой химической литературы (Having taken the trouble to prepare a new edition, printed with the consent of the heirs of the late V. Yu. Rikhter, I limited myself to minor changes, guided by the principles set forth by the author himself in the preface to the sixth edition. ... I tried to preserve the original character of the textbook as much as possible, so peculiar, —thanks to the basis of the presentation of the natural system of elements—, that Richter's book took an independent and prominent place among the rich chemical literature) (pp. V-VI).

In the ninth (1897) edition of the textbook, Jawein included Richter's portrait (Rikhter, 1897, p. 2). It is also available on the website of the University of Tartu ("Richter, Victor. Rindportree", n. d.). Richter's 1890 photograph was included by the German chemist Richard Anschütz (1852-1937), professor of chemistry at the University of Bonn in his biographical book on A. Kekulé (Anschütz, 1929, p. 469).

The first (1875b) German edition of Richter's textbook *Kurzes Lehrbuch der Anorganischen Chemie*, translated by himself from Russian, was published in Bonn. He placed the following dedication in it: "*AUGUST KEKULÉ In Hoher Verehrung gewidmet vom Verfasser* (Dedicated to August Kekulé with great respect by the author)" (p. 5).

He made some changes to the preface written in Bonn and dated January 1875, compared to the preface in the Russian edition from 1874. In particular, he omitted this place from the Russian edition, in which Mendeleev was mentioned (Mendeleyev, 1960, pp. 527-528). Instead, he wrote:

In dieser Beziehung erweist sich das auf der Atomewichtsgrösse beruhende periodische System der Elemente als ein wichtiges Hülfsmittel zur Erfassung der früher zusammenhangslosen Thatsachen. Obgleich dieses System noch nicht zum Abschluss gelangt ist, so giebt dasselbe schon jetzt ein so anschauliches Bild von dem Gesammtverhalten der Elemente, dass demselben nicht länger wohl die Aufnahme in chemische Lehrbücher verweigert werden darf. Zur Unterstützung dieses, führe ich folgenden Ausspruch von L o t h a r M e y e r (Moderne Theorien der Chemie 1872) an: „Es ist wohl heute unzweifelhaft, dass die auf den Atomgewichtszahlen basirte Systematik der Elemente die

Grundlage einer künftigen vergleichenden Affinitätslehre sein ind bleiben wird." Eine mehrjährige Erfahrung in der Lehrthätigkeit hat mich von der anregenden, didaktischen Bedeutung des periodischen Systems der Elemente überzeugt (In this respect the Periodic System of the Elements, based on the magnitude of the atomic weight, proves to be an important aid for the understanding of the previously disconnected facts. Although this system has not yet come to a conclusion, it already gives such a vivid picture of the overall behavior of the elements that it can no longer be refused entry into chemical textbooks. In support of this, I quote the following statement by Lothar Meyer (Modern Theories of 1872): "There can no longer be any doubt that the systematics of the elements based upon the values of their atomic weights will form the basis of future theory of comparative affinity." Several years of teaching experience convinced me of the stimulating, didactic importance of the Periodic System of Elements) (pp. IX-X).

It should be emphasized here that independently from Mendeleev, in the years 1864-1869, Meyer worked on the classification of chemical elements. He formed a table named *System of Elements* (Seubert, 1895, pp. 6-7). The historian of chemistry Forris Jewett Moore (1867-1927), professor of Organic Chemistry in the Massachusetts (U.S.A.) wrote in his *History of Chemistry* published in 1918:

There was for a time a good deal of feeling between friends of Lothar Meyer and those of Mendelejeff upon the question of priority in the discovery of the periodic law. … The fundamental idea, that the properties of the elements are a periodic function of their atomic weights, had been a slow growth, to which these two men independently gave permanent form of expression. In 1882 the Royal Society conferred the Davy medal upon both in recognition of this fact, and we can well follow the spirit of their compromise. There is documentary evidence that Lothar Meyer had put in writing an arrangement of the elements as early as 1868. His first printed communication on the subject, however, was published in 1870, and contains a reference to the first paper by Mendelejeff (pp. 184-185).

By 1886, four subsequent German editions of Richter's *Kurzes Lehrbuch der Anorganischen Chemie* had appeared. The sixth edition was published in 1889, two years before Richter's death. The next ones, starting from the 7th edition (Richter, 1893) to thirteenth (1914) edition were prepared by the chemist Heinrich Klinger (1853-1945).

The first Dutch edition of the Richter's *Beknopt Leerboek Der Anorganische Scheikunde* was published in 1877, and the second in 1892. The translator was Ludwig Aronstein (1841-1913), a teacher in chemistry at the Military School for Officers in Breda (Richter, 1877).

In 1885, the first Italian edition of the Richter's textbook *Trattato Di Chimica Inorganica* was published (Richter, 1885a). Two subsequent editions of this textbook appeared in 1889 and 1895. The translator was the chemist Augusto Piccini (1854-1905), the Chair of Pharmaceutical Chemistry and Toxicology at the Institute of Practical Higher Studies and Specialization in Florence from 1893 (Fontani, Orna, & Costa, 2016, pp. 37-43).

The Japanese edition of his textbook entitled *Muki Kwagaku* was published in two volumes in Tokyo in 1894. The translator was Tamba Keizō (1854-1927) (Richter, 1894a, Bolton, 1899, p. 353). According to another source, this textbook was also published in two parts in the same year, but its translators were Kozaburo Kosaka and Giichiro Kaneda (Richter, 1894b; Richter, 1894c).

Richter's *Text-book of Inorganic Chemistry* was very popular in the United States of America. The first (1883) American edition of this textbook was published in Philadelphia (Richter, 1883b). The translator was the chemist Edgar Fahs Smith (1854-1928). During Richter's lifetime, the second (Richter, 1885b) and third (1887, 1888, 1889, 1890) American editions appeared (Kaji & Brooks, 2015).

After Richter's death, fourth American (1892, 1893, 1894, 1896, 1898, 1899) and fifth (1900, 1901,1902, 1903, 1904, 1905, 1909) American editions appeared in Philadelphia. It is also important to emphasize the fact that the American edition of his *Text-book of Inorganic Chemistry* in Smith's translation was also published in London in four editions (1884, 1886, 1892, 1896) and in Tokyo in two editions (1893, 1897) (Kaji & Brooks, 2015).

The Textbook of Organic Chemistry

In 1870, the first edition of Richter's *Uchebnik organicheskoy khimii, osnovannyy na teorii khimicheskogo stroyeniya* (Organic Chemistry Textbook Based on the Theory of Chemical Structure) was published in St. Petersburg (Rikhter, 1870). In 1884, a two-volume Russian translation of this textbook under the title *Khimiya uglerodistykh soyedineniy, ili Organicheskaya khimiya* was published in Kharkiv. His translators were A. Blizner and L. Shiperovich (Rikhter, 1884).

The first (1876) German edition entitled *Kurzes Lehrbuch der Organischen Chemie oder der Chemie der Kohlenstoffverbindungen* appeared in Bonn (Richter, 1876). The second edition of this textbook was published in 1880. The next four editions, up to the sixth one (1882, 1885, 1888, 1891), were published while the author was still alive.

After Richter's death, R. Anschütz continued to expand and refine this textbook. The seventh edition appeared in 1894 and the eighth in the years 1897-1898 (Richter, 1897; Richter, 1898). The last 12th German edition was published in 1928. In the years 1931-1959 the publication of this edition was resumed.

In Italy, his textbook under the title *La Chimica Delle Combinazioni Del Carbonio Ovvero Chimica Organica* was published in a translation by the chemist Giovanni Carnelutti (1850-1901) three times, in 1883 and 1895 (Richter 1883c; Richter, 1895). In 1881, Carnelutti won by competition the chair of the Department of Applied Chemistry at the Society of Encouragement of Arts and Crafts in Milan. In January 1901, he was elected president of the Chemical Society of Milan ("La Chimica Italiana", n. d.). In a preface for the 1883 edition he wrote:

After Piria's [Raffaele (1814-1865)] book, no complete Treatise on Organic Chemistry came out in Italy, sufficiently extensive, and which gave an exact concept of the current state of science and could serve as a guide to scholars. It seemed to me to satisfy a generally felt desire and to do something useful, especially for the young chemists among us, by translating a work that was received with extraordinary favor in Germany, where it had in a very short time three editions which were translated into several languages (p. 9).

The Japanese (1894) edition of Richter's textbook under the title *Yuki Kwagaku* was published in two volumes in Tokyo (Richter, 1894d). The translator was T. Keizō (Richter, 1894d; Bolton, 1899, p. 353).

The first volume of the French edition of Richter's *Traité De Chimie Organique* was published in 1910, and the second in 1918. The translator was Henry Gault (1880-1967), lecturer at the Faculty of Science and deputy professor at the School of Medicine and Pharmacy of the University of Caen (Richter, 1910; Richter, 1918).

The American edition of this textbook under title *Chemistry of the Carbon Compounds or Organic Chemistry* was first published in Philadelphia in 1886. The translator was E. F. Smith (Richter, 1886b). A second American edition of this textbook appeared in 1892 and a third in the years 1899-1900 (Richter, 1892; Richter, 1899; Richter, 1900). In the years 1902-1913, the third American edition of this textbook was resumed in Philadelphia and London. In the late 1930s and the second half of the 1940s, Richter's textbook was published several times under the title *The Chemistry of the Carbon Compounds* by Elsevier Publishing House in Amsterdam and New York (Richter, 1946; Richter, 1947) and by Nordemann Publishing Company in New York. In 2010, his *Chemistry of the Carbon Compounds or Organic Chemistry* was published by Nabu Press (Richter, 2010). Two years later, his textbook was published by the same publishing house under the title *Victor von Richter's Organic Chemistry: Carbocyclic and Heterocyclic Serie*s (Richter, 2012).

CONCLUSION

Victor von Richter was one of the important chemist of the second half of the XIX century. He worked in the Russian Empire and spoke Russian and German as his native languages. He lived in Germany for almost 17 years. He achieved incredible success in his short life. In 1870, at the age of 29, he became a foreign member of the German Chemical Society. His scientific activities was conducted both in Russia and Germany. His excellent academic textbooks made him famous among chemists and chemistry students in many countries of the world. Richter's *Uchebnik neorganicheskoy khimii po noveyshim vozzreniyam*, first published in Varshava (Warsaw), was later translated into German, Dutch, Italian, Japanese and English. His *Uchebnik organicheskoy khimii, osnovannyy na teorii khimicheskogo stroyeniya*, first published in Sankt-Peterburg, later achieved many editions in various countries of the world. It has been translated into German, Italian, French, Japanese and English.

According to the Polish chemist and historian of chemistry Ignacy Z. Siemion (1932-2015), full professor at the Faculty of Chemistry at the University of Wrocł aw, Richter was a very good chemist. He also expressed the opinion that from the point of view of the educational needs of the young generation, writing a good, original textbook is important (Siemion, 2001, p. 780). Therefore, the great fame that Richter gained thanks to his textbooks is well deserved.

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