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Historical Article

Dmitry I. Mendeleev and his time

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Abstract. The history of the creation of Periodic table and of the Mendeleev's discovery of Periodic Law is considered. The different approaches used by Mendeleev's colleagues are discussed. The contribution of the Periodic system to the extension of the scientific ideas in geology and best of all in geochemistry and mineralogy is illustrated by the discovery of new chemical elements and by the isomorphic replacements in minerals. The details of uneasy history of Mendeleev's nomination to the St. Petersburg Academy and for the Nobel Prize are given.

Keywords. Periodic table, isomorphism, Nobel Prize, electronic structure of atom.

Periodic table of chemical elements on the front of the main building of the Central Board of Weights and Measures in St. Petersburg; height – 9 m, area – 69 m^2; red colour - elements, known in the Mendeleev lifetime, blue colour – elements discovered after 1907 (Public domain)

INTRODUCTION

The United Nations declared 2019 as the International Year of the Periodic Table. This decision is related to the 150th anniversary since its first version elaborated by the prominent Russian chemist Dmitry Ivanovich Mendeleev (1834-1907, Fig. 1) was published on the 17th of February 1869. On this date he sent his table to the publisher and simultaneously distributed it among his colleagues in Russia and abroad.

In connection with UN resolution it is necessary to address the question whether it is really urgent to discuss the events related to Mendeleev's discovery. Researchers all over the world consider that as before it contributes the further development of many scientific branches. On the basis of the Periodic Table they search the answers to the many mysteries which Nature still hides. Besides that the history of its creation clearly justifies the absolutely non-linear process which usually accompanies the scientific progress [1]. These aspects are the focus of the present paper which is devoted to some applications of the Periodic Table, to its author and to the time when he made his historical discovery.

Figure 1. D.I Mendeleev (photo from public domain).

BIOGRAPHY

Mendeleev was born on the 27th of January (8th of February) 1834 in Tobolsk – the first Siberian town established in 1587, located between Ural and Western Siberia (Fig. 2). He was the last among 17 children in the family of his father Ivan Mendeleev, the director of local gymnasium, and his mother Maria Kornil'eva, a daughter of the "middle class" landowner. In the gymnasium Dmitry was not a brilliant student and had very modest marks in Latin and Scripture, however showing an evident interest in mathematics and physics. He was 10 years old when his father passed away. His mother inherited a small glass factory and she managed it until Dmitry finished gymnasium in 1849. The same year the factory was burned down and the family moved first to Moscow and then to St. Petersburg.

Mendeleev was unable to continue his education immediately. Finally one year later, in 1850, he was admitted to the faculty of mathematics and physics of the Main Teacher's Training Institute in St. Petersburg. Here he also had some problems with his studies. When he was a first year student he failed all the exams except for mathematics. However the turning point occurred at the end in 1855, when he graduated in the Institute with the excellent certificate and with the golden medal. As a result he obtained the position of senior teacher in the Crimean town Simferopol. It was the critical period of the Crimean war and it was the reason why Mendeleev moved to Odessa where he continued to teach in the Richelieu gymnasium.

In 1856 Mendeleev returned to St. Petersburg where he defended his thesis for the Master degree in Chemistry. At that time he began to deliver lectures in organic chemistry. In 1864 he was elected professor of chemistry in the Petersburg Technological University and one year later, in 1865, he defended his thesis for the Doctor's degree. Two years later he became the chair of Inorganic Chemistry in St. Petersburg University.

PRIVATE LIFE

In the spring of 1862 in St. Petersburg Mendeleev married Feozva Leshcheva, who was 6 years older. She was a stepdaughter of the Russian poet Piotr Ershov,

Figure 2. Tobolsk at the end of XIX century: left - the Bogoyavlensky church were Mendeleev was baptized; right - the gymnasium where Mendeleev studied (permission of Museum and archives of Dmitri Mendeleev in St. Petersburg).

who was Mendeleev's teacher of Russian literature in the Tobolsk gymnasium (Fig. 3a). However the relations within the family didn't get on and in 1881 the spouses divorced. Mendeleev's second wife, Anna I. Popova, was 26 years younger than him (Fig. 3b). During 1876-1880 she studied at the Academy of Art in St. Petersburg. Omitting many details of their love story, I can only mention that in December 1880 her father sent Anna to Italy to put distance between her and Mendeleev. She stayed in Rome for 4 months. At that time her main supervisor was Alessandro Rizzoni, a Russian painter of portraits and genre scenes. She also attended the classes in the Academy Gigi (L'Accademia Gigi – L'Accademia Libera del Nudo). On the 14th of March 1881 Mendeleev arrived to Rome to meet Anna and on the 5th of May they came back to St. Petersburg. The same year the Orthodox Church accepted Mendeleev's divorce. However he was condemned to penance for the following six years and during that period he could not be married. However in April 1882 in spite of this verdict the priest of the Admiralty Church in St. Petersburg, whose name was Kuntsevich, received 10 thousand rubles and married Mendeleev with his sweetheart Anna Popova. As a result the breach of inhibit led to the deprivation of Kuntsevich's holy orders.

Mendeleev had seven children with his wives. His and Anna Popova's eldest daughter Lyubov (Lyuba – Fig. 3c) was married to Alexander Blok, the prominent Rus-

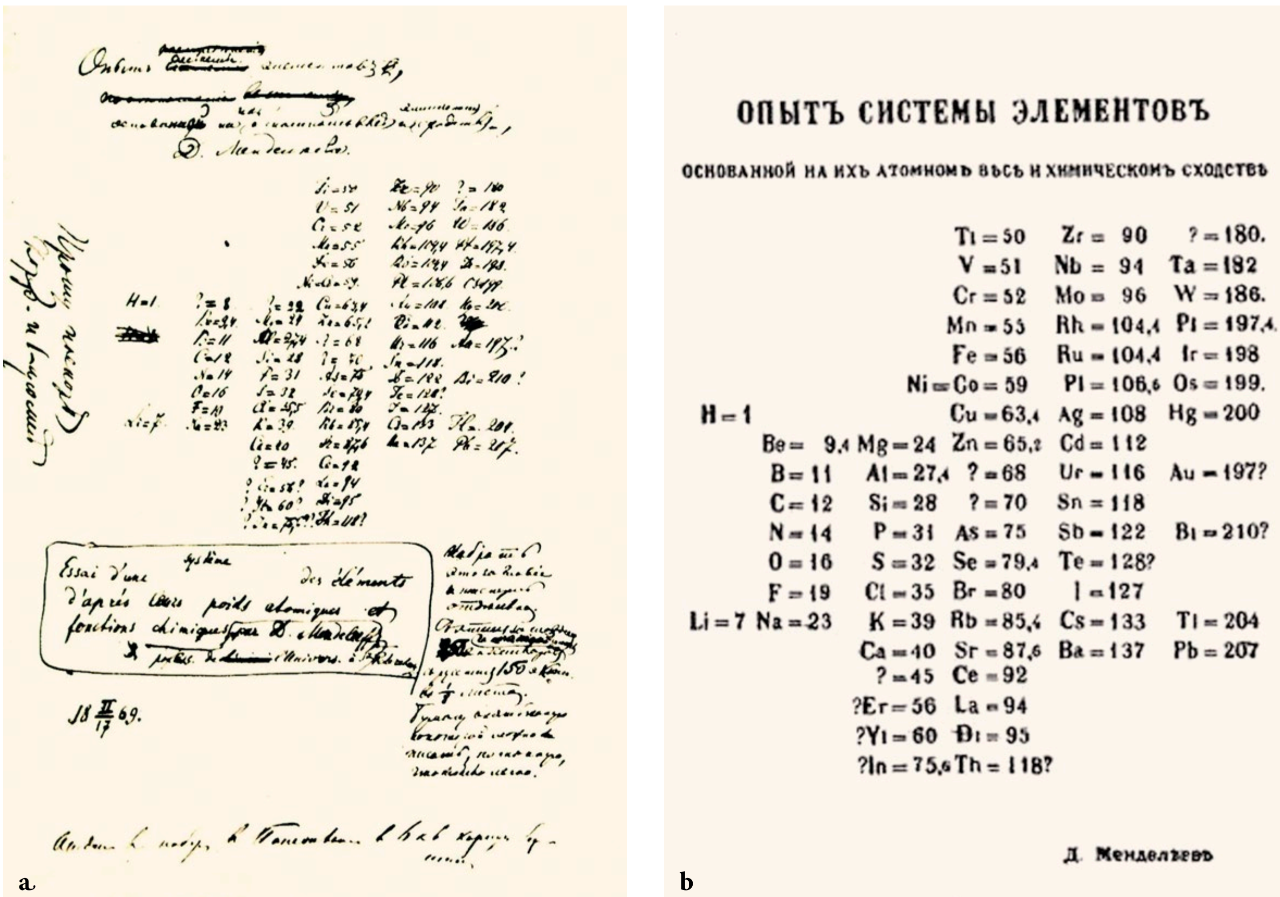
Figure 3. Ladies of Mendeleev's family: Mendeleev with his first wife Feozva Leshcheva (a); Anna Popova – his second wife (b); c – Mendeleev's daughter Lyubov (permission of the Museum and archives of Dmitri Mendeleev in St. Petersburg).

sian poet of Silver Age (period from the last decade of the 19th century up to first two or three decades of the 20th century). He dedicated to Lyuba his first cycle of poetry *Stikhi o prekrasnoi Dame* (*Verses About the Beautiful Lady*, 1905).

WORK ON THE PERIODIC TABLE

Mendeleev worked in St. Petersburg University until 1890, and it is just here he made his most significant discovery – the creation of Periodic Table of chemical elements. He began to give a lecture course "Fundamentals of Chemistry" in October 1867. During 1868-1871 he summarized it in 5 issues with the same name. During the composition of this edition Mendeleev noticed that the properties of chemical elements definitively obey some periodicity. This regularity became specifically clear when he arranged the elements according to their atomic weights, even though some of their values needed a correction. Later on this approach justified the prediction of some chemical elements which were unknown at that time.

The history does not give an unambiguous answer to some questions related to the events when the first version of the Periodic Table was completed. It is known [2] that on Monday 17th of February 1869 Mendeleev prepared the manuscript with the title written by him in French: "Essai d'une systeme des elements d'après leur poids atomiques et fonctions chimiques". It is curious, because Mendeleev's gymnasium mark for foreign languages was far from excellent. In the last decade of February he also finished the work on the corresponding paper with the additional information which was published the same year in the Journal of the Russian Chemical Society – the first chemical journal in Russia [3] (Fig. 4).



ОПЫТЪ СИСТЕМЫ ЭЛЕМЕНТОВЪ

ОСНОВАННОЙ НА ИХЪ АТОМНОМЪ ВѢСѢ И ХИМИЧЕСКОМЪ СХОДСТВѢ

			Ti = 50	Zr = 90	? = 180.
			V = 51	Nb = 94	Ta = 182
			Cr = 52	Mo = 96	W = 186.
			Mn = 55	Rh = 104,4	Pt = 197,4.
			Fe = 56	Ru = 104,4	Ir = 198
			Ni = Co = 59	Pl = 106,6	Os = 199.
H = 1			Cu = 63,4	Ag = 108	Hg = 200
	Be = 9,4	Mg = 24	Zn = 65,2	Cd = 112	
	B = 11	Al = 27,4	? = 68	Ur = 116	Au = 197?
	C = 12	Si = 28	? = 70	Sn = 118	
	N = 14	P = 31	As = 75	Sb = 122	Bi = 210?
	O = 16	S = 32	Se = 79,4	Te = 128?	
	F = 19	Cl = 35	Br = 80	I = 127	
Li = 7	Na = 23	K = 39	Rb = 85,4	Cs = 133	Tl = 204
		Ca = 40	Sr = 87,6	Ba = 137	Pb = 207
		? = 45	Ce = 92		
		?Er = 56	La = 94		
		?Yt = 60	Di = 95		
		?In = 75,6	Th = 118?		

Д. Менделѣевъ

Figure 4. Mendeleev's manuscript "Essay of the system of elements according to their atomic weights and chemical properties", 17th of February 1869 (a). The first version of the Mendeleev's Periodic system distributed before his report among the members of Russian Chemical Society and published in the beginning of the first two issues of "Fundamentals of Chemistry" in March 1869 (b) (permission of Museum and archives of Dmitri Mendeleev in St, Petersburg).

Figure 5. Two of the world's oldest Periodic Table Charts: a - printed in 1876 and exposed in St. Petersburg University (Public domain); b - found at University of St. Andrews in Scotland by Dr. A.Aitken and printed in 1885 in Vienna (Public domain, photo St. Andres University)

From the very beginning Mendeleev understood that his discovery needed international recognition. Therefore immediately, already in February, he sent his table to his colleagues in Western Europe. Apart from that, on the 6th of March his famous report with the same title of his paper was presented by professor N.A.Menshutkin – the first editor of the Journal RCS – during the meeting of the Russian Chemical Society. In 1906 Mendeleev remembered these events [4]: "In 1869 I sent to many chemists the separate page "Essai d'une systeme des elements d'après leur poids atomiques et fonctions chimiques" – "Essay of the system of elements according to their atomic weights and chemical properties" and provided this information to the Russian Chemical Society during its meeting in March 1869 "On the correlation between properties and atomic weights of the elements". From that it is unclear whether the author gave the presentation or not. According to some data just on the 17th of February he had to leave St. Petersburg for an inspection of the cooperative cheese dairy in Tver province. But because this day became the day of discovery of Periodic Table the departure was postponed until the beginning of March. During this trip Mendeleev also planned to visit his homestead Boblovo, where his house had been restored at that time. However, other records of that time show that Mendeleev personally gave a presentation during the meeting of Chemical Society on the 6th of March. Anyway all these details deviate back in comparison with the very essence of Mendeleev's discovery.

Step by step improving the first version of the Periodic system Mendeleev continued his work until 1871, when the table gained the perfect well-known form [5] (Fig. 5). That year he visited several well-known chemical centers where he gave lectures devoted to his Periodic Table of chemical elements and the same year he presented his famous article "Periodic validity for chemical elements". According to [6], perhaps this discovery inspired US physicist Eugene Wigner, the Nobel laureate in 1963, who in his lecture on this occasion at the Stockholm City Hall, formulated the philosophy of scientific research work: "… science begins when a body of phenomena is available which shows some coherence and regularities, that science consists in assimilating these regularities and in creating concepts which permit expressing these regularities in a natural way" [7].

MENDELEEV'S COLLEAGUES

As it often happens with important discoveries, which correspond to the challenges related to the scientific ideas about Nature, several researchers in different countries at the same time were thinking about the periodicity in the system of the chemical elements. Julius Lothar Meyer (1830-1895), who worked in Germany, and British chemist John Alexander Newlands (1837-1898), contributed in a significant way to the development of the ideas concerning the periodicity of elements [6]. Their main results will be reviewed below, however initially in connection with Mendeleev's discovery it is worth mentioning the Italian chemist Stanislao Cannizzaro (1826 –1910, Fig. 6a), whose fate had been complicated. He studied medicine and chemistry at the universities of Palermo, Naples and Pisa. In 1849 he took an active role in the popular revolt in Sicily. It was suppressed and Cannizzaro was condemned to death. He fled to Paris and since 1855 he began to work in different Italian Universities. In 1871 he was elected as a member of the Italian Senate and later on he became its vice-chairman. As a member of Senate, Cannizzaro supervised the scientific education in Italy.

Cannizzaro brought the attention to the concepts already present in literature between atom and molecule. In this respect it is worthy to mention the fundamental paper by A.Avogadro [8], published approximately half a century earlier. Moreover, Cannizzaro elaborated and revised the system of the crucial chemical notions: definition of chemical formula, differences between atom and molecule, atomic and molecular

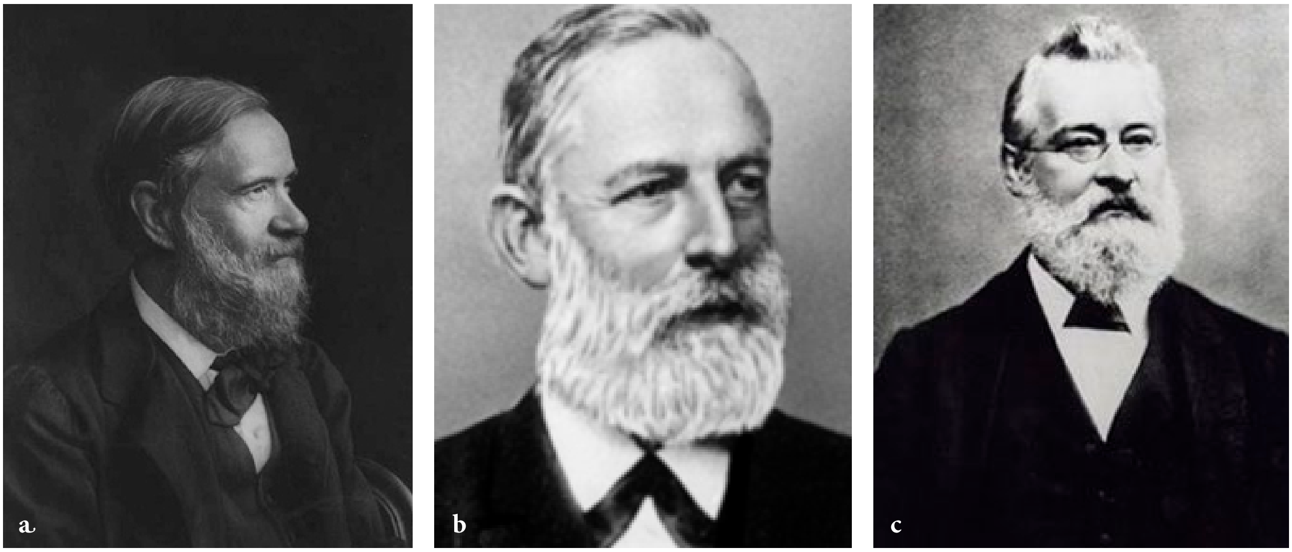


Figure 6. Mendeleev's colleagues: Stanislao Cannizzaro (a); Julius Lothar Meyer (b); John Alexander Newlands (c) (photos from public domain).

weights. J. Berzelius published the first data of atomic weights (consequent to the definition of isomorphism by Mitscherlich) as early as 1828 [9]. However Cannizzaro provided their most accurate values. His historical significance is connected primarily to these results. He expressed his theory and the distinction between atomic and molecular weights in the pamphlet [10,11] which he distributed among the participants of the International Chemistry Congress in Karlsruhe in September 1860. Mendeleev and Julius Lothar Meyer were among the attendees and together with the leading European chemists they highly appreciated Cannizzaro's contribution to general chemistry. Many years later Mendeleev said: "I consider him (Cannizzaro) as my real predecessor", because he determined by himself the values of atomic weights and created a necessary fulcrum".

Lothar Meyer (Fig. 6b), who never used his first given name, was a German chemist and a foreign member of St. Petersburg Academy (1890). In the beginning of their careers both Mendeleev and Meyer worked in Heidelberg with R.Bunsen, who elaborated the spectral analysis. Meyer is one of the pioneers in developing the first periodic table of chemical elements. In Meyer's birthplace Varel (Lower Saxony, Germany) there is a memorial with three sculptural portraits of Meyer, Mendeleev, and Cannizzaro.

In 1864 Meyer composed a table with 28 elements allocated in six columns according to their valences. Obviously such arrangement of limited number of chemical elements revealed the similarity of their chemical properties within the same vertical column. In connection to this approach Mendeleev argued that this system is just a simple comparison of some elements on the basis of their valences.

Such values are even not constant for the same element and therefore should not be considered as its crucial characteristic. Consequently, Meyer's table could not pretend for the full description of elements and did not reflect their inherent Periodic Law.

Only half a year after the first version of Mendeleev's Periodic Table was printed in 1869, Meyer published a revised and expanded version of his 1864 table, which was similar to that published by Mendeleev. This paper "Die Natur der chemischen Elemente als Function ihrer Atomgewichte" ("The Nature of the Chemical Elements as a Function of their Atomic Weight" - *Annalen der Chemie* (1870)) [12], contained the table and the plot with the correlation between atomic volumes and atomic weights for the known chemical elements at that time. It is worthy to recall that Meyer unjustly reproached Mendeleev for the correction of some atomic weights in the Periodic Table. However several years later he wrote: "I confess frankly that I lacked the courage for far-sighted assumptions which Mendeleev expressed with certitude" [2, 13].

Approximately at the same time the British chemist Newlands (Fig. 6c) suggested his own version of the Periodic system of the chemical elements. In the beginning of 1864 Newlands was impressed by the paper, which claimed that for most of the chemical elements the values of atomic weights are multiple of 8. Obviously the author's opinion was erroneous, however Newlands decided to continue his research in this direction. He composed the table where the elements were ordered according their atomic weights. In his paper dated 20th of August 1864 he emphasized the periodicity in the arrangement of chemical elements [14]. After he numbered the elements and compared their properties he noticed the repeating pattern of elements where every 8 each element had similar chemical properties as the first one in common with the eighth note in musical octave. This mysterious musical harmony finally compromised the whole concept which exhibited similarity with Mendeleev's Periodic Table only externally.

One year later, on the 18th of August 1865, Newlands published the new table which he called "Law of Octaves" [15]. On the 1st of March 1866 in the Chemical Society he gave a talk "Law *of* Octaves and the Causes of Numerical Relations among the Atomic Weights", which received the hostile reception on behalf of the audience. In particular, G. C. Foster, professor of physics at the University College of London, humorously inquired whether the speaker had ever examined the elements according to the order of their initial letters [16]. According to [6], in 1884 Newlands collected his various papers on the discovery of the Periodic Law in [17].

In 1887 the London Royal Society awarded Newlands with the Davy Medal "For his discovery of the periodic law of the chemical elements". This medal is given annually since 1877 to an outstanding researcher in the field of chemistry. Five years earlier Dmitry Mendeleev and Lothar Meyer received the Davy Medal from Royal Society "For their discovery of the periodic relations of the atomic weights". Newlands rewarding seemed rather ambiguous, however he primarily revealed the periodic variation of the chemical properties of the elements which is reflected in his Law of octaves, and it is obviously his merit. Mendeleev emphasized that "…due to his works it was possible to perceive Periodic law in its first stages" [18, 19].

PERIODIC TABLE AND MINERALOGY

The Periodic system contributed to the progress in many natural sciences. It significantly extended the scientific ideas in geology and best of all in geochemistry and mineralogy [20]. The discovery of new minerals and consequently of the chemical elements in their composition contributed to the creation of the Periodic table. At the same time the Periodic table indicated some shortcomings in the scientific ideas about these elements. One of the first results of its use was the revision of the atomic weights of uranium and rare earth elements as well as the transfer of the latter from the divalent calcium analogues to the group of trivalent elements. The significance of this correction becomes more important nowadays when the use of the rare earth elements is estimated at 2000 tons per year only in Russia [21]. Electronics and photonics use about 70% of this quantity and thus the hunt for rare earth elements is expanding all over the world.

Besides atomic weights Mendeleev composed his Periodic table on the basis of the chemical properties of the elements. Thanks to that he predicted the analogues of aluminum (gallium) and of silicon (germanium). Both elements were discovered in 1876 [22] and in 1886 [23], respectively. They are widely used in semiconductor technology and thus, the industrial demand for them is growing up. Finally it is worthy to note that when Mendeleev was still alive, the noble gas group was discovered. This discovery definitively indicated that the periods include octets of chemical elements where the 9th element is similar to the 1st one, and have no analogy with the musical octaves. These elements are also of geochemical interest, namely He and Ne are important constituents of the Gas Giants - Jupiter and Saturn.

During several decades after the publication of the Periodic table researchers in different countries continued to think over the question whether a more fundamental property of the chemical element than its atomic weight exists. Thus in 1913, six years after D.Mendeleev passed away, the young British physist Henry Moseley introduced a new characteristic - "atomic number" which is equal to the number of positive charges in the atomic nucleus and consequently to the number of electrons in the neutral atom [24].

The electronic model of atoms enlarged the ideas related to their behavior in the geochemical processes. In particular, in 1958 the German mineralogist Hugo Strunz discovered gallite $CuGaS_2$ - the first Ga-mineral with a crystal structure identical to the widespread chalcopyrite $CuFeS_2$. Thus everybody began to think that gallium, which is a rare chemical element, can be hidden in chalcopyrite. However all attempts to find gallium in chalcopyrite failed because it and iron have different electronic structure: there are 18 electrons in the outer shell of Ga whereas Fe contains only 13 electrons and thus there is no isomorphic replacement between these minerals.

Professor Vladimir Vernadsky at Moscow University highly appreciated the important contribution of the Periodic law to mineralogy [20]. In the end of XIX century he composed the table of isomorphic elements with emphasis on so-called Vernadsky's rows. The atomic radii were not known at that time and thus the isomorphic replacements were examined only within the vertical groups of the Periodic table. Therefore Vernadsky's rows did not receive an acknowledgement on behalf of mineralogists and geochemists and as a result for some time the Periodic table was shifted back in their mind.

This situation radically changed when in 1926 Victor Goldsmith, a Norwegian mineralogist, on the basis of the interatomic distances and the experimentally determined values of radii for O^{2-} = 1.32 Å and F^{-} = 1.33 Å, composed the system of ionic radii and formulated the rule for isomorphic replacements [25]. He indicated that the size difference for the ions involved in such substitution cannot exceed 10-15%. Thus three parameters, namely atomic weight, atomic number and ionic radius were used to characterize each element in the Periodic table. After that the diagonal rows of elements which correspond to the directions of possible isomorphic replacements were revealed within the Periodic table. The following examples illustrate Goldsmith's rule: Li^{+} - Mg^{2+} - Sc^{3+}; Na^{+} - Ca^{2+} - Y^{3+} - Th^{4+}; Al^{3+} - Ti^{4+} - Nb^{5+} - W^{6+}. This idea allowed to explain the complete substitution between Na^{+} and Ca^{2+} in feldspars – the main rock forming minerals in the Earth crust, according the scheme $Na^{+} + Si^{4+} = Ca^{2+} + Al^{3+}$ [26]. This diagonal also contains yttrium and in association with it the whole group of rare earth elements. They always replace calcium in the minerals and that's the reason why these elements were considered primarily as bivalent.

The recent theoretical calculations and experimental results indicate a dramatic transformation of electronic structure in some atoms at high pressures. It leads to some changes in their chemical properties and consequently the formation of several new materials with the unexpected stoichiometry. For example, the cubic $NaCl_3$ was synthesized at the pressure 55-60 GPa and at the temperature >2000 K [27]. Similarly such exotic compounds were found in some other systems, namely Mg – O and Al – O. Obviously these phenomena still require an appropriate explication, however the Periodic table is a starting point for such works.

In general the mineralogical observations and conclusions extend the ideas related to the periodic variations of electronic structure at no ambient conditions, of ionic radii, ionization potential and some other notion of energetic crystal chemistry.

MENDELEEV AFTER HIS DISCOVERY

Mendeleev's lifeline shows that he had many interests and hobbies. He was friends of many artists (Fig. 7), knew painting, he liked to play chess and producing suitcases was among his unusual hobbies. These items were of exceptional quality because Mendeleev invented a completely unique glue. Therefore all the merchants in St. Petersburg tried to get just these suitcases directly "from Mendeleev".

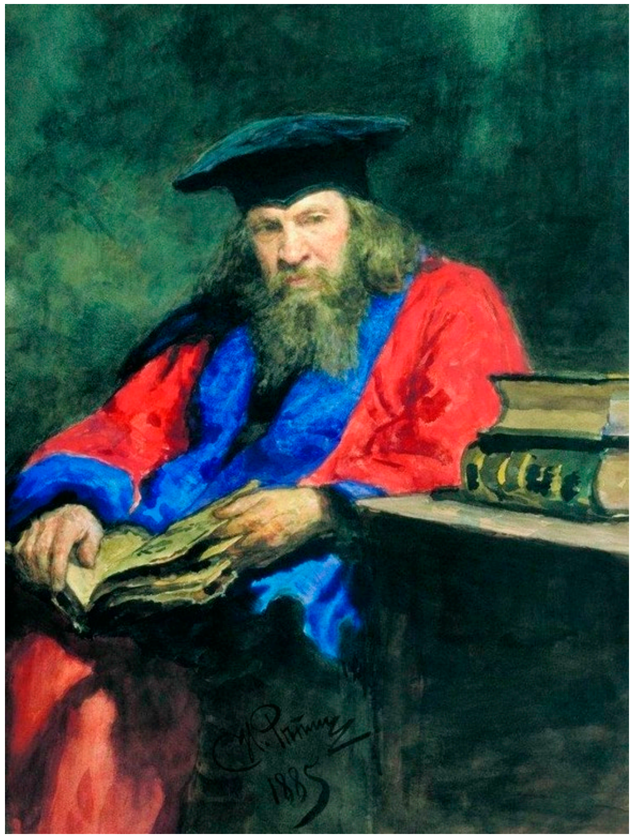


Figure 7. Repin I.E (1885). Mendeleev in the mantle of Edinbourgh University honorable professor (permission of Tretyakov Gallery, Moscow).

During his last years Mendeleev promoted the establishment of the first Siberian University in Tomsk and the Polytechnic Institute in Kiev. In 1866 he initiated the foundation of the first Chemical Society in Russia. In 1890 Mendeleev had to leave St. Petersburg University due to his support to the student's movement related to the displeasure of life and studies conditions. In 1892 the minister of finance S.J. Vitte suggested Mendeleev to be the head of the new Central Board of Weights and Measures in Russia. Being on this position Mendeleev insisted on the implementation in Russia of the metric system which was essentially accepted in 1899 (Fig. 8). In the beginning of January 1907 he fell ill with pneumonia and on the 20th of January he passed away. His tomb is in Volkov's cemetery in St. Petersburg (Fig. 9). At his funeral in St. Petersburg, his students carried a large

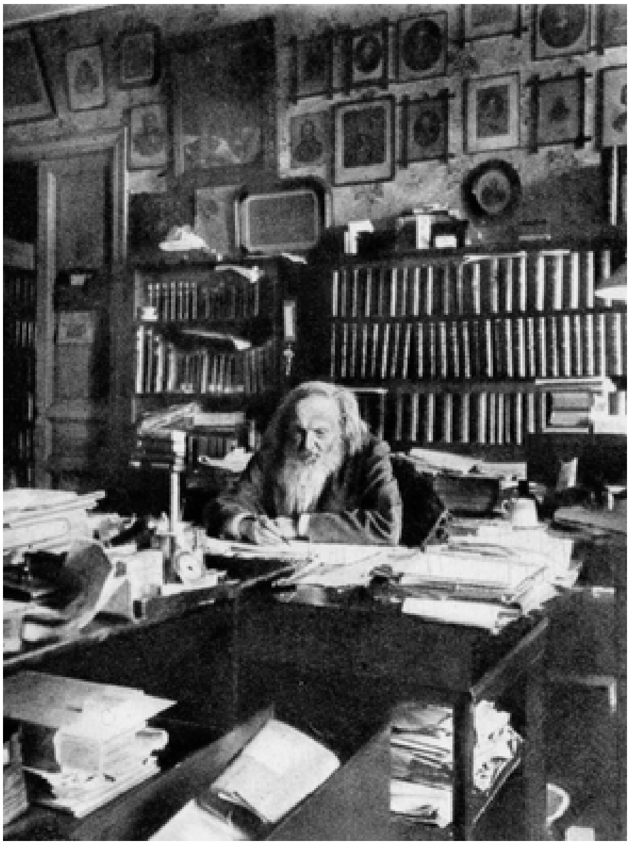


Figure 8. Mendeleev in his office: Russia's new Central Board of Weights and Measures (permission of Museum and archives of Dmitri Mendeleev in St, Petersburg).

Figure 9. The tomb of Mendeleev in Volkov's cemetery in St Petersburg (permission of Museum and archives of Dmitri Mendeleev in St, Petersburg).

copy of the periodic table of the elements as a tribute to his work.

FINAL REMARKS

Mendeleev's priority in the discovery of the Periodic law and in the creation of Periodic Table of the chemical elements was definitively recognized by the International scientific community. In 1905 he was decorated with the Copley medal – the highest award from the Royal Society of London established in 1731 "For his contributions to chemical and physical science". Mendeleev was elected as a member of the London Royal Society, the United States National Academy of Science and the Royal Swedish Academy of Sciences (Fig. 10).

In 1876 he was also elected as a corresponding member of the St. Petersburg Academy of Science. The academician A.M. Butlerov, one of the principal creators of the theory of the chemical structure, nominated Mendeleev as a candidate for the full member vacancy in March 1980. Two other well-known Russian chemists Friedrich Konrad Beilstein and Nikolai N. Beketov were also considered as challengers for the same vacancy. It is really touching that the relations between all of them were full of respect and estimation. However there was no doubt that Mendeleev should have been elected assuming his exceptional contribution to the science. Nevertheless the results of the voting in the Academy meeting on the 11th of November 1880 were really shocking: 10 votes – black, 9 votes – white [2, 28]. There were a lot of protests against this result but Mendeleev accepted it rather quietly and in his autobiographic notes he marked the events of 1880 with the single phrase: '… travelled with Volodia (his son) along Volga". Perhaps it is worthy to add that Anna Popova (later on she became his second wife) accompanied them…

Three times in 1905, in 1906 and in 1907 Mendeleev was nominated to Nobel Prize, however all the times it was done by 1 or 2 his foreign colleagues, whereas his opponents were supported by 20-30 scientists [6]. It is known that the Nobel Prize is conferred for the recently obtained outstanding results and therefore every time there was a controversy whether the creation of Periodic table could be considered as a state-of-the-art work. The discovery of the noble gas group and their very logic placement within the Periodic table were among the most convincing arguments to its urgency.

In 1905 apart from Mendeleev the Nobel Committee considered the works by two other chemists: A. von Bayer (organic chemistry, Germany) and H. Moissan (inorganic chemistry, France). As a result the voting was in favor of von Bayer. Next year the Nobel Committee in chemistry recommended D.Mendeleev to the Gener-

Figure 10. The participants of the 52nd meeting of British Association for the Advancement of Science, Manchester, 1887. 1st rank (from left to the right): Menshutkin N.A., Mendeleev D.I., Roscoe H.E.; 2nd rank: outside left - Joule J.P., president of Association, Shorlemmer C. (second from the right side), Thompson W., outside right (permission of Museum and archives of Dmitri Mendeleev in St, Petersburg).

al Assembly of the Royal Swedish Academy. The voting results for Mendeleev at the Committee meeting was 4:1. The only vote was for H. Moissan, who was again Mendeleev's competitor. The Swedish chemist Peter Klason, who was the member of Nobel Committee, supported him very actively. He positively estimated Mendeleev's contribution but emphasized that the creation of Periodic table could be impossible without the accurate values of atomic weights which were obtained by Cannizzaro. That is him who suggested considering both Mendeleev and Cannizzaro as the candidates for the Nobel Prize. At a first glance this suggestion seemed reasonable. However the inclusion of Cannizzaro into the list of candidates for the prize in 1906 was already impossible because the dead line for nomination was terminated on the 31st of January. Thus the H. Moissan received the prize in 1906. In 1907 both Mendeleev and Cannizzaro were nominated for the Noble prize. However that year Mendeleev passed away and according the statute of Nobel Prize it cannot be conferred posthumously.

Obviously the lack of Mendeleev's name in the list of Nobel Prize Laureates is a great historical mistake. His name is well-known all over the world and the Periodic table is in each classroom and auditorium where people study chemistry. On the 10th of June 1905 Mendeleev wrote in his diary: "Apparently the future does not threaten the Periodic Law by its destruction and on the contrary it promises the superstructure and its further development" [29, 30]. The last 150 years completely justified this prediction.

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