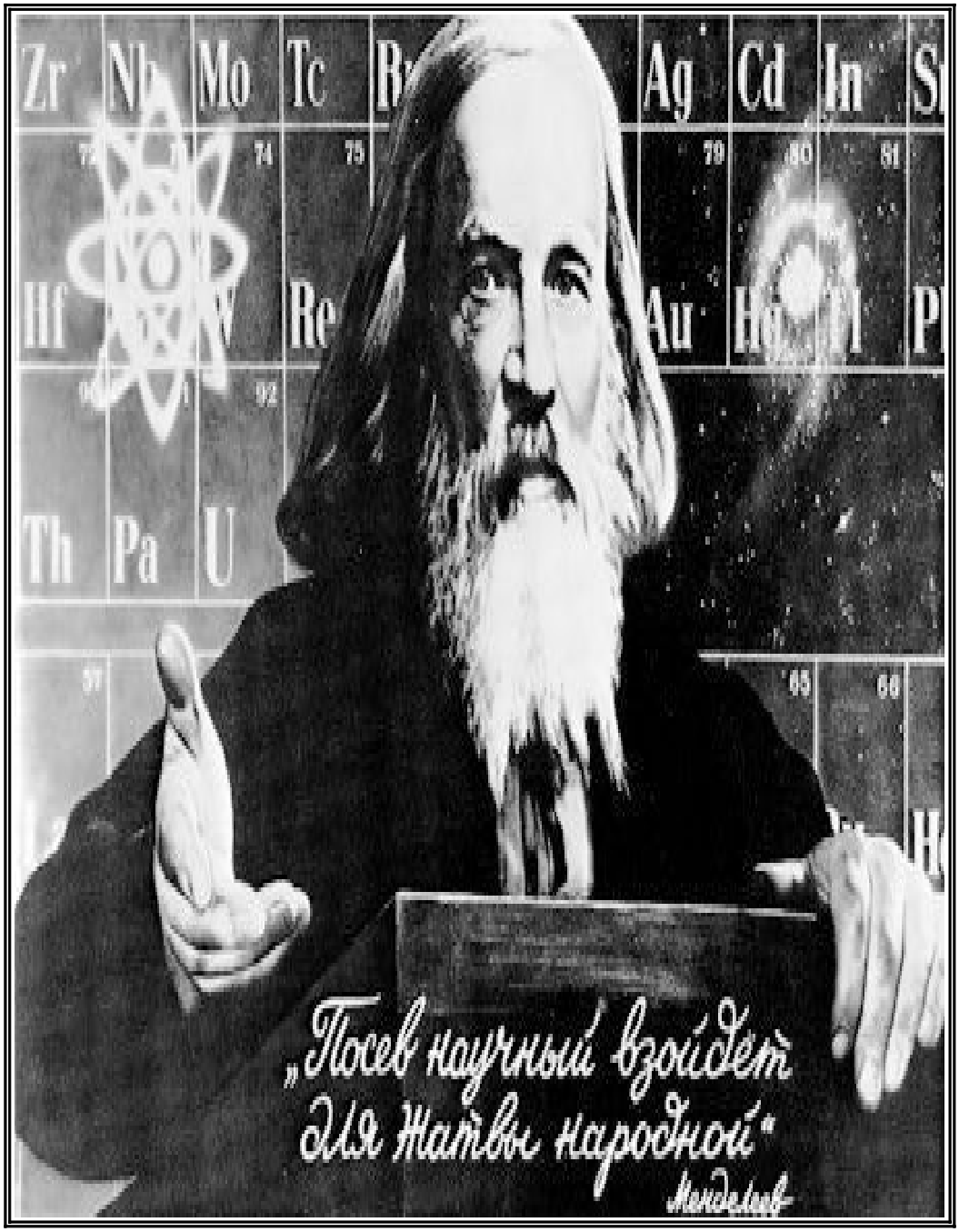
The father of Periodic Table

Dimitrii Mendeleev

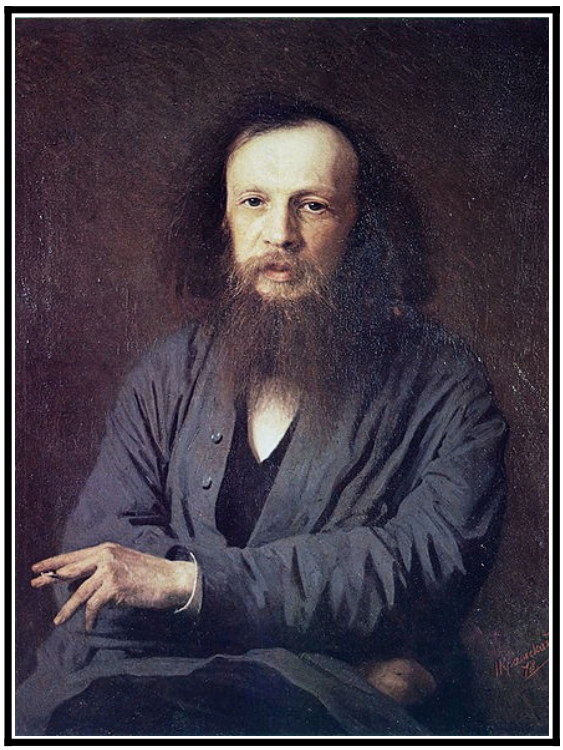


"Physicist in chemistry and chemist in physics"

- physicist Vavilov

Mendeleev was born on 8th February 1834 in Verhnie Aremzyani village, near Tobolsk in Russian Empire. His father, Ivan Pavlovich Mendeleev was a teacher at several schools. In 1820s he returned to Tobolsk (Siberia) to serve as the director of gymnasium. His mother, Maria Dmitrievna Kornilyeva came from the family of the publisher - Dmitri Kornilyev. Her grandfather, a successful merchant and owner of the first Siberian glass factory, has become the first Siberian typographer and publisher in 1780s. Dmitri Mendeleev was the 17th (and the last) child in the Mendeleevs' family. Eight siblings died in their childhood. The Mendeleev had an excellent library and lived in comfort. However, in 1834 his father, Ivan went blind as the result of the eye cataract, and, despite the successful surgery, had to retire with an insufficient pension. His wife Maria tried to support her family by governing her brother's glass factory, although without much of success. Eventually, the factory was burnt down, and shortly thereafter Maria's husband, Ivan Mendeleev, died.

Dmitri graduated the gymnasium one year earlier, at the age of 15. To avoid the administrative problems, his teachers noted him as a 16 years old in his certificate list. Dmitri was successful in the natural sciences and mathematics, and not so good in languages. Maria's wanted her son to study in Moscow, where her wealthy brother Vasiliy resided. In summer 1849, she took Dmitri and his sister Liza for a long journey from Siberia to Moscow. However, the strict regulation for the school graduates allowed the Tobolsk residents to enter only the geographically nearest regional university, which was located in Kazan. For this reason, the Moscow University rejected Dmitri Mendeleev's application in 1849. When the family moved to the Russian capital (that times it was St.-Petersburg) next year, rejection for the similar reason happened to Dmitri's application at the St.-Petersburg University.



Finally, Maria found a school that had accepted Dmitri. It was the Main Pedagogical Institute in St.-Petersburg, which taught students for teaching in Gymnasia and from which the Dmitri's father, Ivan, graduated in the past. The last fact was helpful, and Prof. Chizhov, a coursemate of Ivan Mendeleev, supported the Dmitri's application. In summer 1850, Dmitri was allowed to take the admission tests, which he passed, although not with honors (his average score was 3.22 at the five-point scale) but good enough to receive a full scholarship with residency in the dormitory. A scholarship student had to sign an obligation for teaching at middle schools after graduation.

Shortly after Mendeleev became a student, his mother died (in 1850); soonafter, his uncle

Vasiliy died in Moscow (in 1851) and then his elder sister Liza (died in 1852). Dmitri himself got seriously ill; he was coughing with blood, and doctors suspected tuberculosis. In 1853, he spent a few months in the hospital, and once received a physician verdict: "This one will never recover". However, he did recover leaving the hospital shortly for passing exams and getting applauds from his fellow students. During the first year, he had moderate marks (between 2 and 3.5; only chemistry had a score of 3.75) and his initial education rates were rather poor (in 1851, he was only on the 25th place in the group of 28 students). However, in spite of poor health, Mendeleev worked really hard: in 1854 he raised to the 7th place in overall rating, and in 1855 graduated with the gold medal for excellence.

The themes in the Mendeleev's student research were extremely wide and diverse. As a few examples, those were “The Primary education in China”, “Rodents of the St. Petersburg Region”, “Influence of heat on animals' spreading”, “Ancient plants” . His first published student scientific research was in German- the analysis of a mineral, and one of the supervisors of that work was prof. A. Voskresensky (a follower of Liebig in 1830s). Voskresensky is known in the Russian scientific history as “The Grandfather of Russian chemistry”; further, Voskresensky played an important role in the Mendeleev's life.

After the final exams Mendeleev relocated to the southern region where the climate was better for his health. He picked up a teacher position in Odessa. However, by mistake in the documents, the Ministry sent him to the small city Simferopol. There he was the witness of the Crimean War. Luckily, after two months he moved to the Odessa and finally in May 1856 he returned to St.- Petersburg, in order to achieve the habilitation and get the abroad scholarship.

After several problems he got a magister degree in September 1956 with the thesis on isomorphism and specific volumes. Soon after, he completed his second magister thesis (which was required for a docent position) on the structure of silica compounds and next month defended his degree (October 1956). He engaged in 1956, but a year later his bride (Sofya Kash) unexpectedly broke the engagement.

Design of weight devices for firm and gas substances

At the end of 1858 the University Administration sent him abroad to develop his scientific abilities. After the visiting a dozen of European Universities Mendeleev decided to stay and work at the Heidelberg University (with famous professors Bunsen, Erlenmeyer, and Kirchhoff). The town of Heidelberg also attracted him with its a large Russian diaspora community. Soon Mendeleev was surrounded by the new friends: a chemist and composer Borodin (the author of "Prince Igor" opera), physiologist Sechenov, the famous chemist Zinin and some others. Soon he was dissatisfied with the Bunsen's laboratory, so he built up his own laboratory in his apartment. He bought the whole equipment from the experienced masters in Bonn and Paris. Then he could started his first series of researches on liquids. He found the phenomenon, which he called an absolute boiling point, now known as critical temperature. He also invented his first device – picnometer. In September 1860 Mendeleev took part (along with Zinin, Borodin and three other Russians) in the First Chemistry Congress at Karlsruhe, which was attended by 140 famous European chemists (including Kekule, Bayer, Dumas and others).

In February 1861 he came back to St.-Petersburg. There he found out that had lost his

position at the university and he had a serious money problems. He was obligated to support his daughter Rosa, whom he left in Heidelberg with her mother, the actress Agnes Feuchtman. He wrote that time: "debts to sew coat and boots, always hungry". In order to get money and repay his huge debt Mendeleev accepted any paid lessons or text writings and started lecturing at several high schools. There was a quite simple solution of his money problems - a receiving the prestigious Demidov Prize for excellent scientific writings. So Mendeleev started writing a handbook on Organic Chemistry and completed the manuscript in an extremely short timeliness. He formulated in his book the first documented statement that the C:H ratio for alkanes is minimal among other hydrocarbons, i. e. there is the limit of possible saturation. This 500-pages book was very popular, and actually, was the first Russian organic chemistry handbook. Its first edition was sold quickly, and next year, the publishers printed the second edition . The Mendeleev's application for the Demidov Prize was supported by Zinin and appraised by Voskresensky (both organic chemists); for this book, Mendeleev received the Demidov Prize in 1862. With the big Prize money, he finally paid almost all of his debts.

On 30th Arpil 1862 he married Feozva Leschova - her father-in-law was the well-known Russian poet and fairy tale teller P. Ershov. The person, who convinced Mendeleev to get marry was his sister– Olga. In her opinion the wife would have the positive influence on her brother's life.

In tough period of his life (1861-1862) he accepted a post of the editor from German of the Technology by J.R. Wagner. During his work, he expanded the book and wrote a several chapters of it. Here, probably, were the roots of further Mendeleev's interest in technology (and industry) topics. He got he docent position at the University (at its Technology Chair) through his technological achievements. In 1863 Mendeleev was invited to consult special Technical Committee, in order to invent the new exact methods and devices to measure the concentration of ethanol. His project was accepted by the Finances' Ministry and he received the support (a salary and two barrels of alcohol). Mendeleev obtained extremely purified ethanol and received exact (though quite complex) formula to be used for further calibrations in industry.

After habilitation in 1865 Mendeleev received the position of Professor of Technical Chemistry at the University. Then he withdrew from his professorship at Technological Institute. In autumn his family moved to big communal apartments at the University campus, where 3 years later he wrote the first draft of his Periodic Chart.

In June 1865 Mendeleev bought a summer country house in the village Boblovo for his family. Mendeleev built a new house (with laboratory) and equally enjoyed to work both in lab and garden. In the village Mendeleev's interest to agriculture fully flourished. He ran some experiments, in order to improve the quality of his soils and the yield of crops.

In 1867 Menedleev inherited the vacancy of Pure Chemistry Professor from Voskresensky. At the end of 1860s he took the initiative of creation the Russian Chemical Society and personally wrote its regulation. The novel union (later called Mendeleev Chemical Society) was established in October 1868 and officially recognized by the government.

As the ancestor of Voskresensky, Mendeleev received a new duty to teach students with the course of inorganic chemistry. Surprised by the lack of suitable handbooks, he decided to write his own course. That was such an ideal led to appearance of his most famous book : “Foundation of Chemistry”. This two- volume handbook survived 13 editions and was later translated to German, English and French. With no doubts, work on this book was the main reason of the birth (and future development) of the Periodic system.

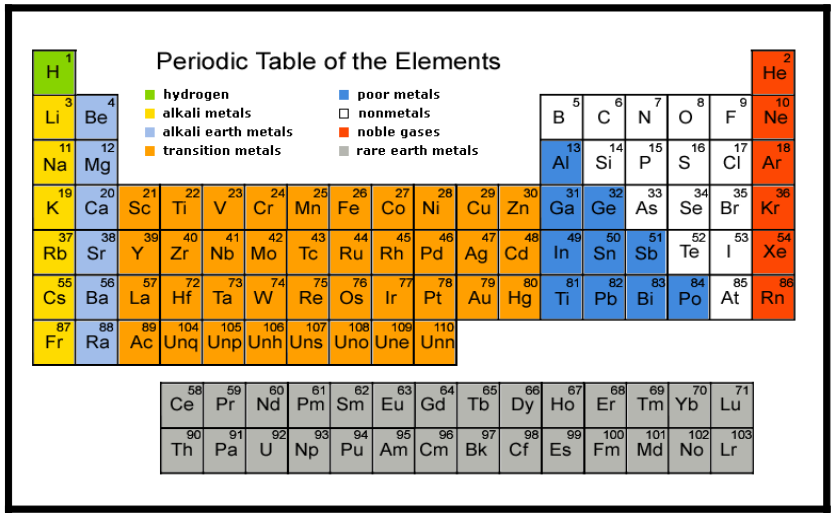
The handbook started from the common elements (H, O, N, C) and the further plan was clear: halogens. However, the plan for next chapters was less clear: where to put and how to order heavier elements? Mendeleev noticed patterns in the properties of several families of light elements, arranged by increase of their atomic weights, and found a sort of periods. He realized that discovered pattern could be applied to arrange heavier elements. Mendeleev printed first draft of the Periodic chart with all 63 known elements on 1st March 1869. Most important was that he left places for unknown elements. On 13th March this small printout (150 copies in Russian and 50 in French) was sent to many his colleagues. Finally, he realized the difference in nature of odd and even

periods, and drew a chart. There are two stories of his discovery: that he saw the Table in a dream and that he used cards with elements for a sort of "solitaire" patience, although both are not well documented.

The history and further development of the Periodic law is well known. The strict law found by Mendeleev required not only changes of some known atomic weights, but more importantly, existence of some yet undiscovered elements with certain atomic weight and properties. Of course, the Periodic Table had several precursors and cocursors, but only Mendeleev realized that Periodic Table is the Natural Law (not just a convenient taxonomy), and only Mendeleev used it for successful prediction of unknown elements.

Although Mendeleev continued to popularize his discovery and update the book, since 1872 the topic of his interest dramatically changed to the physics of gases. In his theoretical studies he re-examined the ideal gas laws and contributed to the equation **pV=nRT** (Mendeleev-Clapeyron formula). In 1887 he made an adventurous solo balloon flight to observe the solar eclipse.

The newspapers of 1870s were full of reports about the mediums and spirits - the persons capable of moving objects distantly, violating the physical laws and common sense. Many scientists considered the phenomena seriously. Mendeleev decided to study these forces experimentally. In 1875 he headed the Scientific Commission to examine the phenomena (he put hidden sensitive manometers under the table with mediums sitting around). He confirmed that most of the demonstrations were tricks and published special report on this topic.



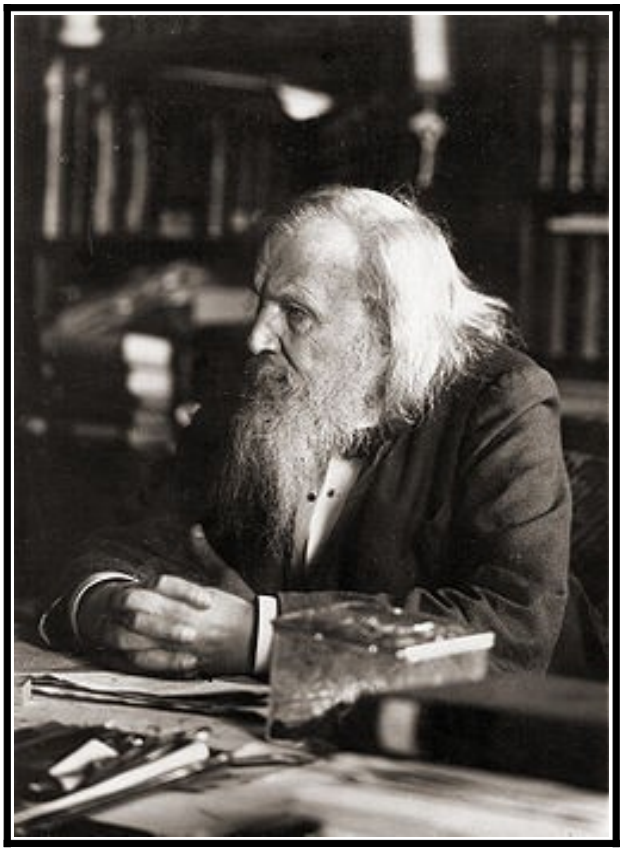
His scientific authority had grown not only in Europe, but also in Russia. In 1876 he was elected to St. Petersburg Academy of Science as corresponding member.

After 1871 Mendeleev's interests also turned to humanitarian topics. The first was the problem of high education. In 1871 he contributed to foundation of the first women courses and started lectures there. In one of his publications he called the need of reform in gymnasiums (to direct them in the system of permanent education). The second area of his interest was fine art.

In 1877 Mendeleev met young lady Anna Popova. This meeting changed his private life dramatically, and in next few years caused his divorce with F. Leschova. Around 1880 Mendeleev survived the biggest crisis of his life. Several negative events quickly changed each other. His spouse remembered a moment when he thought on the suicide. The sunlight in the darkness was the birth of his daughter Lyubov, but the Church prohibited his second wedding. Mendeleev made an attempt to withdraw from the University. Slowly the things ran more positively. On April 1882 he violated the ban and did have married officially (the priest Kutnevich, who assisted this wedding for big money, immediately lost his job). Mendeleev remained at his place at the University too.

In the first half of 1882 he switched to research at another topic. His main chemical interest after 1882 was the solutions theory. His viewpoint found some followers, but Arrhenius and his school, developers of the physical theory of solutions, mostly criticized it. Decades later both theories were considered to be complementary.

In early 1880s Russia faced deep crisis. A special event, the Congress on Industry and Trade, was organized in Moscow in 1882 for business community. One of the most active speakers was Mendeleev, who gave 7 talks on the key topics of national industry. In fact, it was a program of his activity for next decade.



Always absorbed by his passion- chemistry....

In March 1890 Mendeleev tried to bring students' petition to the Minister of Education-Delyanov. After receipt of rejection he immediately resigned from the University. He was unemployed only the shortly period of time - from September 1891 became scientific consultant of the Navy Ministry.

In 1892 Mendeleev accepted the proposal of the Finance Minister Sergey Witte to serve as scientific keeper of the Bureau of Weights and Measures. The small bureau was transformed into the Main Chamber, which soon became third in Europe (after France and Germany) center of excellence in metrology studies.

Witte and Mendeleev had shared viewpoints on key aspects of modernization of the country and The Minister used the authority of The Scientist to convince the tsar in necessity of certain economical reforms. Mendeleev finally turned to the topics of demography, politics and problems of society. He expressed his futuristic and philosophical ideas in the last books.

In 1905 he wrote in the diary: "Only four subjects built my name: the Periodic Law, the study of elasticity of gases, understanding of solutions as associates and the Foundations of Chemistry". A year later, in his letter to Witte, Mendeleev considered his life as three services: first - research, second - teaching and third - less visible service to the national industry.

He never received the Nobel price. Mendeleev was nominated in 1905, but the prize was given to Bayer. Mendeleev was nominated again in 1906, but the prize got Moissan (both times Mendeleev was second in the list). Mendeleev was nominated third time for the year 1907, before the deadline on 31st January. Too late.

On 2nd February 1907 Dmitri Ivanovich Mendeleev died from influenza. Streets were crowded. The funeral procession was headed by students who carried in their hands big Periodic Table.