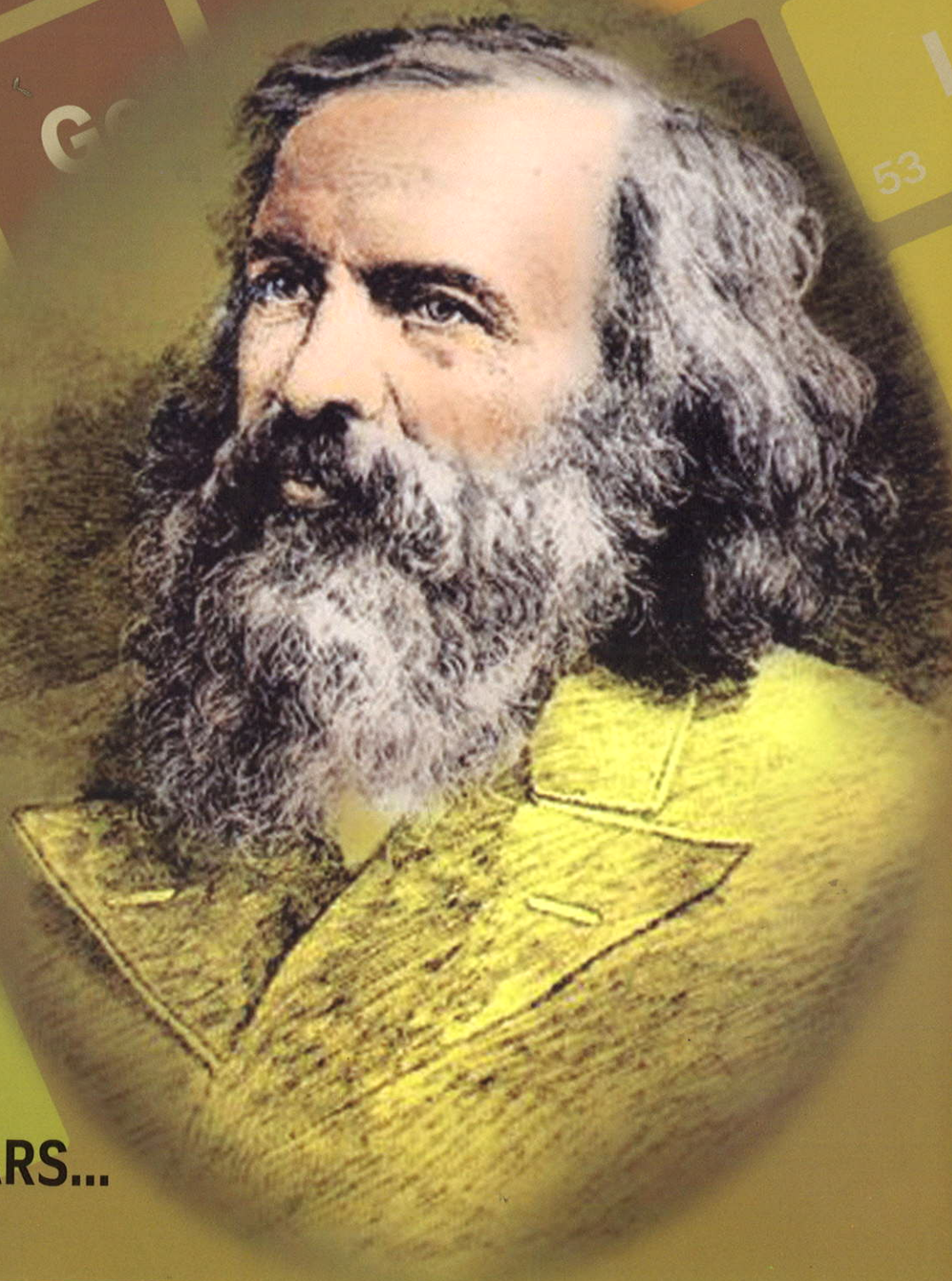


# CHEMICAL NEWS



ICC

**150th**  
ANNIVERSARY  
of PERIODIC TABLE  
& MENDELEEV



**IUPAC 100 YEARS...**



# 150th ANNIVERSARY OF PERIODIC TABLE AND MENDELEEV



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and

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Chemistry (IUPAC), the European Chemical Society (EuChemS), the International Science Council (ISC), the International Astronomical Union (IAU), the International Union of Pure and Applied Physics (IUPAP) and the International Union of History and Philosophy of Science and

Technology (IUHPST). The co-chairs of IYPT2019 are Professor Natalia Tarasova and Professor Jan Reedijk.

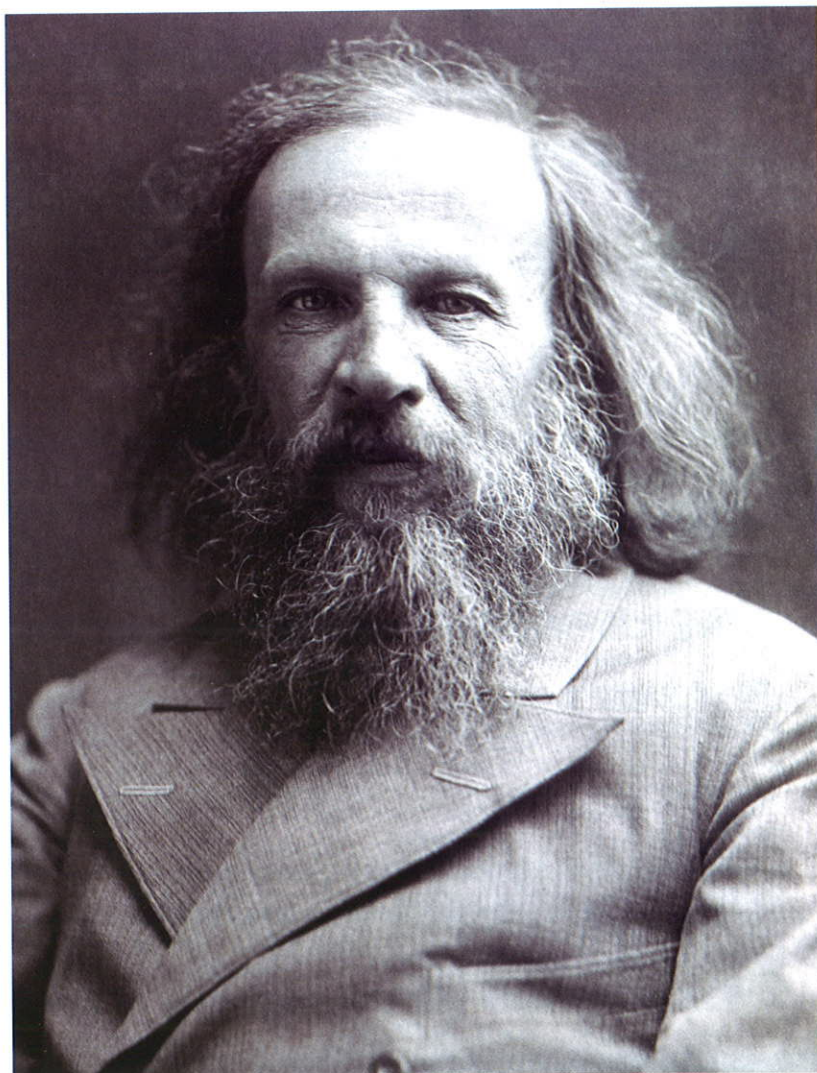
In the global level, a number of activities have been planned to celebrate the "International Year of the Periodic Table of Chemical Elements". This includes:

## INTRODUCTION

In March 1869, Russian Chemist, Dmitri Mendeleev, made a presentation entitled "The Dependence between the Properties of the Atomic Weights of the Elements" to the Russian Chemical Society. In the meeting, he told "elements arranged according to the value of their atomic weights present a clear periodicity of properties" and build a systematic table of all elements known at that time. Thus the "Periodic Table" was born. Rest is history.

2019 marks the 150th Anniversary of the Periodic Table of Chemical Elements. United Nations General Assembly and UNESCO have proclaimed 2019 as the "International Year of the Periodic Table of Chemical Elements (IYPT2019)". Website: [www.iypt2019.org](http://www.iypt2019.org)

The founding partners of IYPT2019 are the International Union of Pure and Applied



DMITRI MENDELEEV



- Opening Ceremony at UNESCO, Paris on January 29, 2019
- Opening Ceremony in Russia, February 8, 2019
- Seminar on "Contribution of Mendeleev – a True Genius, January 2, 2019 in India
- Seminar of "The Periodic Table at 150" during IUPAC World Congress of Chemistry in Paris
- Mendeleev 150, 4th International Conference on the Periodic Table, Saint Petersburg, Russia
- Periodic Table Challenge, organized by IUPAC, throughout 2019
- Closing Ceremony in Tokyo, 5th December, 2019 and many other program

## MENDELEEV: EARLY YEARS

Mendeleev was born on 8th February, 1834 in the village Verkhnie Aremzyani, near Tobolsk in Siberia, Russia. He was the youngest of the 14 surviving children. His father's name was Ivan Pavlovich Mendeleev (1783–1847) and mother Maria Dmitrievna Mendeleeva (née Kornilieva) (1793–1850). Mendeleev's father was Principal of a School and he taught Politics, Philosophy and Fine Arts. His mother Mariya Dmitriyevna Kornileva came from a well known merchant family of Tobolsk. Mendeleev's father became blind in the same year when Mendeleev was born and lost his job. His father expired in 1847, when Mendeleev was only 13 years old. Mendeleev attended the "Gymnasium" in Tobolsk. To support family, Mendeleev's mother restarted her family owned glass factory which was closed at that time. Unfortunately, the glass factory was destroyed by fire in December, 1848.

## MENDELEEV: HIGHER EDUCATION

In 1849, his mother took Mendeleev to Moscow for higher education. The University in Moscow rejected him. They then went to St. Petersburg where the alma mater

of Mendeleev's father "Main Pedagogical Institute" was situated. He got admission in 1850, partly because the Head of the College knew his father. His mother advised him to "patiently search divine and scientific truth". She died in the same year. Mendeleev graduated in 1855 as top student. At this time, he was suffering from tuberculosis and he moved to Simferopol in Crimean peninsula of the Northern coast of Black Sea. Here he took his first teaching assignment as science master of Simferopol Gymnasium. He stayed there for only 2 months and after a brief stint at Odessa, Mendeleev decided to return to St. Petersburg to continue his education. He received his Master's degree and started his research work in Organic Chemistry.

## MENDELEEV IN GERMANY:

Funded by a Government fellowship, Mendeleev went to University of Heidelberg where eminent chemists like Robert Bunsen, August Kekule, Gustav Kirchhoff and Emil Erlenmeyer were faculty. Mendeleev was in Germany from 1859 to 1861 and he set up a laboratory in his residence to carry out research. Mendeleev worked on "Capillarity of fluids" and "Spectroscopy".

In 1860, Mendeleev attended the "International Congress of Chemistry" in Karlsruhe, Germany, which was an important occasion in his life. 140 chemists including Kekule, Cannizzaro and others attended the Congress. Mendeleev met top chemists of Europe and developed contacts with them. The objective of the Congress was to discuss important issues like atomic weights, chemical symbols, chemical formulas etc. The conference played a key role in Mendeleev's eventual development of the periodic table, producing an agreed, standardized method for determining atomic weights. Mendeleev's periodic table was based on these standardized atomic weights.

## MENDELEEV'S BOOK: "ORGANIC CHEMISTRY" IN RUSSIAN

In 1861, Mendeleev returned to St. Petersburg. He was worried that Russia was lagging behind Germany in Chemistry knowledge. He felt that high quality books on Chemistry in Russian language are absolutely necessary to change the situation. He decided to do something about it. He worked very hard like a "possessed" man and within 61 days, he came out with a 500 page book "Organic Chemistry". Mendeleev was awarded "Demidov Prize" by the "Petersburg Academy of Sciences" for this book. He came in the limelight of Russian chemistry education due to this book.

## MENDELEEV'S BOOK:

"The Principles of Chemistry" in Russian and Foreign Languages

In 1864, Mendeleev became Professor of St. Petersburg Technological Institute. In 1865, he defended his doctoral thesis "On the Combinations of Water with Alcohol" and became Professor Chemical Technology at University of St. Petersburg (now known as St. Petersburg State University). In 1867, at the age of just 33, he was appointed as "Chair of General Chemistry" in the same University. Now, he wanted to further improve Chemistry knowledge in Russia and published another book in 1869: "The Principles of Chemistry". This book became very popular and ran into many editions. It was translated into English, French and German. By the year 1871, University of St. Petersburg became an internationally recognized research centre in Chemistry. Mendeleev continued teaching Chemistry in this University till 1890.

## MENDELEEV'S PERIODIC TABLE

During the time of writing second volume of his book "The Principles of Chemistry", Mendeleev noticed

certain recurring patterns between different groups of elements, which led him to prepare the periodic table. He arranged known elements by atomic weight in a grid-like diagram. Mendeleev concluded that atomic weights may be used to arrange elements within each group and also to arrange the groups. He was so confident of his discovery that he predicted existence of new elements, and even their properties, which were not known at that time.

It is said that, while writing second volume of the book "Principles of Chemistry", he took 65 cards (like playing cards) and wrote name of each known element, its properties and atomic weights on a card. He moved the cards for hours to identify a pattern and then fell asleep. In the dream, he found a pattern:

*"In a dream I saw a table where all the elements fell into place as required. Awakening, I immediately wrote it down on a piece of paper".*

In the meeting of Russian Chemical society in March 1969, Mendeleev announced: "elements arranged according to the value of their atomic weights present a clear periodicity of properties." Thus the periodic table saw the light of the day in 1869.

He said that elements with similar chemical properties have their atomic weights increasing regularly, for example:

- (a) Potassium (K, atomic weight 39), Rubidium (Rb, atomic weight 85), cesium (Cs, atomic weight 133).
- (b) Calcium (Ca, atomic weight 40), Strontium (Sr, atomic weight 88), Barium (Ba, atomic weight 137).

He also stated that the arrangement of the elements in groups in order of their atomic weights corresponds to their valences and unique properties (for example, Li, Be, B, C, N, O and F). He was so confident of his periodic

table that he predicted discovery of 3 new elements and even forecasted their properties.

Initially, Mendeleev's periodic table met with skepticism and few chemists accepted it. However, during next 20 years, 3 elements predicted by Mendeleev were discovered: Gallium in 1875, Scandium in 1879 and Germanium in 1886 and their properties were found to be similar to that predicted by Mendeleev. The periodic table was now widely accepted and became part and parcel of modern chemistry. Mendeleev also got international recognition and many awards for his discovery.

### OTHER ACHIEVEMENTS OF MENDELEEV

Although Mendeleev is known for the periodic table, he made notable contribution in many other areas. He has contributed in diverse fields such as (a) studies on expansion of liquid with heat (b) critical temperature of gases (c) origin of petroleum (d) smokeless powder based on nitro cellulose etc.

In 1893, Mendeleev was appointed Director of the "Bureau of Weights and Measures". He conducted extensive research on "Metrology" and published an independent journal of metrology. He occupied the position till his death. He introduced "Metric System" to the Russian empire.

Mendeleev was one of the founders of the "Russian Chemical Society" in 1868. He has published more than 400 articles and books. He has also written on popular science for magazines and encyclopedias. He also wrote projects to develop coal industry and downstream petroleum industry. He realized the role of petroleum as feedstock of petrochemicals. He remarked: "Burning petroleum as a fuel would be akin to firing up a kitchen stove with bank notes".

Mendeleev also contributed to economic theories in areas such as protectionist trade and agriculture. He spent considerable time thinking of development of Russian national economy. Mendeleev was a Government consultant in many issues including National Tariffs. He was also an advisor to the Russian Prime Minister, Sergei Witte. He, in his lifetime, wrote more than 70 papers on social and economical development.

### RECOGNITIONS AND AWARDS

Mendeleev has received many awards and recognitions throughout his career. This includes:

- Davy Medal, Royal Society of London, 1882
- Foreign Member of the Royal Society, 1892
- Member of Royal Swedish Academy of Sciences, 1905
- Honorary awards from Oxford and Cambridge
- Copley medal

The element with atomic number 101 has been named after him (Mendelevium, Md). A large crater in moon is also named Mendeleev. In Moscow, there is D. Mendeleev Institute of Chemical Technology. In St. Petersburg State University, there is Dmitry Mendeleev's Memorial Museum.

### MENDELEEV AND NOBEL PRIZE

In 1906, "Nobel Committee for Chemistry" recommended to "Royal Swedish Academy" to award Nobel Prize in Chemistry for 1906 to Mendeleev for his discovery of periodic table. The proposal was supported by the Chemistry Section of the Swedish Academy. It was expected that the Academy will agree with Committee's choice, which is normally the case. However, in the full meeting of the Academy, an alternate name was proposed by a dissenting member



and supported by an influential chemist. After heated debate, the alternate name was accepted with a margin of 1 vote. In 1907, the attempt to nominate Mendeleev again received opposition from the same influential chemist. It is said that personal politics played a major role in this matter.

## MARRIAGE AND FAMILY

On 4 April 1862 Mendeleev got engaged to Feozva Nikitichna Leshcheva, and they married on 27 April 1862. Subsequently he divorced Feozva and married Anna Ivanova Popova in 1882. From the two marriages, he had six children.

## HEAVENLY JOURNEY:

In 1907, Mendeleev left this world at the age of 72. He was suffering from influenza. At his funeral in St. Petersburg, his students carried a large copy of the periodic table of the elements as a tribute to his work.

As per Russian chemist and science historian Lev Chugaev, Mendeleev was "a chemist of genius, first-class physicist, a fruitful researcher in the fields of hydrodynamics, meteorology, geology, certain branches of chemical technology (explosives, petroleum, and fuels, for example) and other disciplines adjacent to chemistry and physics, a thorough expert of chemical industry and industry in general, and an original thinker in the field of economy."

With folded hands, we bow our head with respect to remember the genius.

## NOTE FROM THE AUTHOR:

To celebrate International Year of the Periodic Table (IYPT), IUPAC has organized on-line contest "Periodic Table Challenge". Details are given in the link: <https://iupac.org/100/pt-challenge/>

Anybody can participate. There are 15 multiple choice questions in the first round. One can take help of Internet in this round. If the answer to 9 out of 15 questions is correct, the participant will go to the next round and will get a certificate from IUPAC. The website of IYPT is [www.lypt2019.org](http://www.lypt2019.org)

I shall be obliged if you publish about this Periodic Table Challenge in the current issue so that there is large participation from India. I will be happy if your office staff also participates in this contest.

I will forward a mail from the Executive Director IUPAC stating that they expect more participation from India.

Regards  
Dr. B. Saha

DR. B. SAHA IN FRONT OF A SCULPTURE OF MENDELEEV AND PERIODIC TABLE IN SLOVAK UNIVERSITY, BRATISLAVA



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