# Foreword

## Periodic table is 150 years old

If one were to select a single most important discovery of science, the atomic hypothesis, i.e. that all things are made of atoms, would be a strong contender. Hindu and Greek philosophers have discussed atoms for long as a fundamental unit. However, their ancient science divided everything into five elements (panchabutha): earth (solid), water (liquid), fire, air (gas) and space (vacuum).

As our understanding of nature improved, we realized that water itself could be gas, liquid or solid at different conditions and such classifications do not lead to atoms. As science progressed over the last two millennia, we learned that there are many different atoms, which were called 'elements'.

In 1869, Dmitri Mendeleev grouped 34 of them in a Tabular form and the most striking thing about this table was that it left gaps and predicted elements to be discovered! In December 2016, the International Union of Pure and Applied Chemistry approved the addition of four new elements (atomic number in parenthesis), Nihonium (113), Moscovium (115), Tennessine (117) and Oganesson (118), completing the long form of periodic table that came into existence in 1994. There is a natural question that arises: is the periodic table really complete now? The honest answer would be that we do not know. However, scientists can always speculate and the famous physicist Richard Feynmann has speculated that atomic number 137 might end the periodic table[1].

Celebrating the 150 years of periodic table, the UNESCO has announced the year 2019 as the International Year of Periodic Table. Indian Institute of Science (IISc), Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) and Centre for Nano- and Soft-matter Science (CeNS), all from Bengaluru organized a celebration in which four talks covering various aspects of periodic table were given. C. N. R. Rao gave the opening talk giving the history of periodic table and the importance of learning from it. S. Krishna Prasad spoke about the importance of spectroscopy in discovering new elements. G. Mugesh from IISc discussed the elements in biology, highlighting all the elements in human body. Finally, Indumati Rao gave a presentation on Dmitri Menedeleev's history. The celebration was arranged in J. N. Tata Auditorium (IISc), which could accommodate only about 800. From *Current Science*, it was felt that an article based on all the talks could benefit everyone interested in the periodic table, today and in future. All the speakers enthusiastically agreed and prepared an article based on their lectures.

Rao's article (**page 1963**) gives a comprehensive history of periodic table and presents the various forms of the periodic table starting from 1869 to 2016. It also covers the earlier attempts to group the elements in different ways by Dobereiner (1817), De Chancurtois (1862) and Newlands (1864). It highlights the first observation of helium in 1868 by Jensen in Andhra Pradesh during a solar eclipse and argon in 1894 by Rayleigh and Ramsay. Mendeleev's periodic table did not have the rare gases.

The early discovery of new elements was enabled by spectroscopy and Krishna Prasad gives a nice summary in his article (**page 1967**) and gives more details about the first observation of helium and argon. His article also mentions a fact that Ramsay's student Morris Travers was involved in the discovery of xenon and krypton and was the founding Director of the Indian Institute of Science.

Ghosh and Mugesh (**page 1971**) discuss the 'Elements of Life' and provide a detailed account of all the elements occurring in human body. Mugesh points out that 60 elements (more than half of periodic table) are found in human body and only for about 28 of them, we understand their role in healthy functioning of the body. While discussing hydrogen, the article points out that it could form only one covalent bond and still has a remarkable role in biology. Of course, as a hydrogen bond enthusiast, I should point out that it could form a partial second bond known as 'hydrogen bond'.

Hydrogen bond was popularized by one of the best chemists from the 20th century, Linus Pauling, in his famous book on *The Nature of Chemical Bond*[2]. Somewhat coincidentally, Pauling credits Latimer and Rodebush as the first to mention 'hydrogen bond' in their paper[3] published in 1920, another centenary coming soon! Chemists understanding of the periodic table has enabled them to observe bonds similar to hydrogen bonds and over the last decade or two, there are reports about intermolecular bonds formed by all main group elements[4,5].

Finally, Indumati Rao (**page 1986**) provides a passionate account of Dmitiri Mendeleev. It is hoped that this article is read by everyone, as we all remain students throughout our lives and there is a lot to learn from this article. In closing, let me quote from this article: 'Mendeleev was a man of principles and great courage and an outspoken liberal...Even in the Tsarist Russia, he set his own rules and lived life on his own terms.'


1. Ball, P., Column: The Crucible, https://www.chemistryworld.com/opinion/columnthe-crucible/3005076.article?adredir=1 (accessed on 26 October 2019).
2. Pauling, L, *The Nature of the Chemical Bond*, Cornell University Press, Ithaca, New York, 1960.
3. Latimer, W. M. and Rodebush, W. H., *J. Am. Chem. Soc.*, 1920, **42**, 1419–1433.
4. Legon, A. C., *Phys. Chem. Chem. Phys.*, 2017, **19**, 19332–19338.
5. Brammer, L., *Faraday Discussions*, 2017, **203**, 485–407.



E. Arunan
– *Guest Editor*

Department of Inorganic and Physical Chemistry,
Indian Institute of Science, Bengaluru 560 012, India
e-mail: arunan@iisc.ac.in