

Elements of X

by Lars Öhrström, Special issue editor

We are moving into the last part of the 2019 International Year of the Periodic Table and one wonders: Is there anything left to say? Has the equation *Elements of X*, not been thoroughly investigated? Not quite we think, and an amazing set of authors from around the globe* who accepted the challenge adequately proves the point in this special issue of *Chemistry international*.

Not only do we cover some diverse geographical terrain, this collection also emphasizes that the IYPT2019 did not come to be because of IUPAC only; physics, astronomy, biology, philosophy: they all come together in the Periodic Table. So we want to acknowledge our fellow international unions: International Union of Pure and Applied Physics (IUPAP), European Association for Chemical and Molecular Science (EuCheMS), the International Science Council (ISC, previously ICSU), International Astronomical Union (IAU), and the International Union of History and Philosophy of Science and Technology (IUHPS).

We start with a discipline that truly unites us all, teaching. A lot has been written about Dmitry Mendeleev and his 1869 table, but one thing academic researchers all over the world will do well to remember, when we complain of heavy class room duties, is that this major breakthrough in Science came because Mendeleev needed it to improve teaching of his students. And who better to tell us about this in the *Elements of Education*, than **Peter Atkins**, perhaps the best known now living chemistry textbook writer. He discusses inorganic chemistry, physical chemistry, organic chemistry, but also chemistry for the general public and the value of a chemistry education in commerce and trade. Plus a bit of philosophy, otherwise it would not be Peter Atkins.

The general things that Peter pushes for are abundantly present in **María Lugaro & Ewine van Dishoeck's** essay on the *Elements of Stars*. What other subject touches our imagination and give us this sense of wonder other than astronomy? We are all made of star stuff as Marie and Ewine show us, and with that we also get a bit of science history.

And science history, perhaps unexpectedly given the title, we get plenty of in **Kit Chapman's** *Elements of the Future*. Peter just arrives at the latest elements in his essay, and Marie and Ewine lay a great foundations by telling us about nuclear reactions in stars, and how elements not existing on Earth can be found in Space. Kit, however, will make us meet some real scientific

superstars, both living and dead. And the element hunt certainly takes us to some unexpected places, like the San Francisco Bay area subway system, BART, and stained-glass windows of Russian churches.

A fair distance south of San Francisco and Berkeley, where some of the action takes place in Kit's story, lies Pasadena and the California Institute of Technology. This institution's most famous contribution to the Periodic Table is perhaps Richard Feynman's suggestion that the elements end at $Z=137$, something Kit told us in the preceding essay.

A less known contribution to science is that one of its chemical engineering graduates brought serious chemistry, still relevant today, to Hollywood in the 1930s. In *You Can't Take It with You* from 1938 director Frank Capra has the leading actors, James Stewart and Jean Arthur, discuss the molecular origin of the photosynthesis. Stewart confesses that solving the mystery of this reaction is what he really wants to do with his life, not become a money-maker like the rest of his family. Such work is still indeed going on, and in *Elements of Life* we get a very personal treatise on (di)oxygen, some of the metallic elements of enzymes and their relevance to life and death, by the doyen of bioinorganic chemistry, Caltech professor emeritus **Harry Gray**.

With whatever element it takes, solving the problem of artificial photosynthesis surely has both commercial and societal value and in *Elements of Technology* **Michael Droescher** takes us through some of the elements that have been crucial to our technological advances. A Periodic Table of human History may start with the not so elemental elements of "stone" and "bronze" but Michael takes us all the way from them to the latest atom types relevant for our history such as lithium, cobalt and helium.

Obviously, commercial and societal value is related to abundance and ease of extraction and recycling. Michael touches on these subjects but in *Elements of Scarcity* **David Cole-Hamilton** really gets to the core of what it means for us to live on a planet with limited resources.

Some of these resources have always been scarce and therefore highly valued. Some of this value was, and is, because we can use these elements and compounds to enhance our social status, our desirability, or for the plain and simple joy of making ourselves and our appearances pretty, funny, or artistic. So, in *Elements of Flair and Fashion* **Marielle Agbahoungbata** will take us from the ancient Egyptians to the Lagos Fashion Week in Nigeria. In doing so she will pass through the animal, plant, and mineral kingdoms, but also touch upon some

1. An Asian contribution on the theme will appear in the next issue of CI

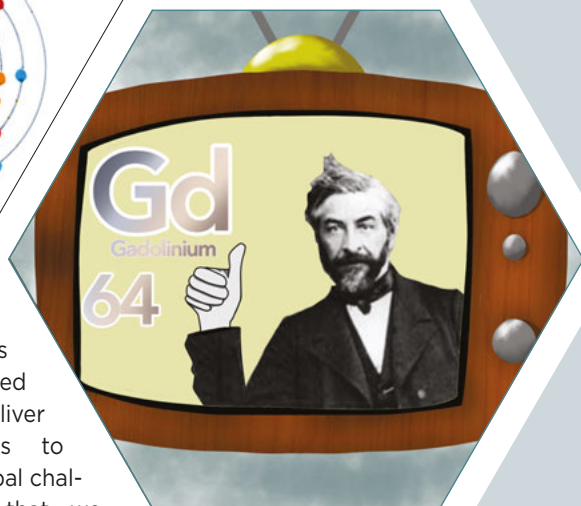
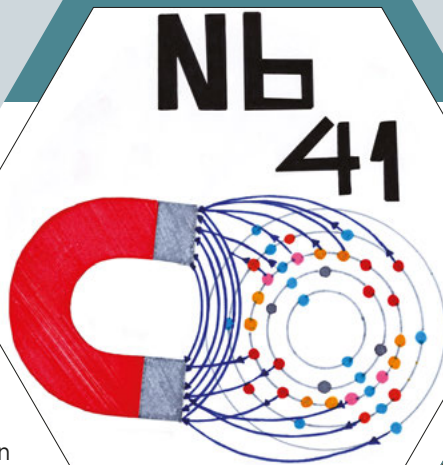
environmental issues that both large and small scale dyeing businesses encounter. Marielle herself has done research on the subject in her native Benin in West Africa.

Now, for anybody even just faintly knowledgeable about the world of super heroes, the geographical connection to the next and final story by **Suze Kundu** is obvious. The fictional element vibranium of course has its origins in the sub-Saharan African country Wakanda (likewise fictional) and form the basis of a number of technological inventions in the Marvel Comics universe. But in Suze's *Elements of Heroism* we will also venture into the worlds of Star Trek and Lord of the Rings.

Fictional as they may be, and perhaps even outrageous to a few because of some of their proposed properties, these elements and their fictitious applications in technology, may nevertheless be inspirational to both old and young minds alike. And now we have come full circle to Peter's first essay on *Elements of Education*: we need to teach and inspire about the elements and their compounds, and if we do that, then we will indeed have equipped new generations with the real

super-powers they need to deliver solutions to the global challenges that we face.

Lars Öhrström <ohrstrom@chalmers.se> is Professor of Inorganic Chemistry and Head of Programme in Chemical Engineering at the Chalmers Tekniska Högskola, Sweden. He is the President of the Inorganic Chemistry Division of IUPAC. Öhrström is co-author of *The Rhubarb Connection and Other Revelations: The Everyday World of Metal Ions* (<https://pubs.rsc.org/en/content/ebook/978-1-78801-094-8>) Published in 2019.



Elements of Credits

The chemical elements tiles illustrating the features of this special IYPT2019 issue of *Chemistry International* are part of the IYPT Timeline of Elements project organized by *Chem 13 News* and the University of Waterloo in Ontario, Canada. The project attracted worldwide participants. Teachers were asked to apply on behalf of their students to design an artwork for one assigned element. 200 applications from over 29 countries were initially received, and ultimately all the elements were assigned to 118 schools from 28 countries, including every province and territory in Canada.

See more details and all artwork and final poster online: <https://uwaterloo.ca/chemistry/community-outreach/2019-international-year-periodic-table-timeline-elements>

The Timeline of Elements will also be turned into a full-wall mural (16 m x 3.3 m) and an interactive exhibit in the Science Teaching Complex (STC) of the University of Waterloo. The grand unveil and opening is scheduled for 26 October 2019.

CI editors would like to acknowledge the Timeline of Elements organizers for their willingness to share their project with CI readers. Special thanks to Jean Hein and Heather Neufeld, and to the following students/schools whose elements are reprinted in this issue (in order of appearance):

Nb, niobium, 41—Escuela Colombiana de Ingeniería Julio Garavito—Bogotá, D.C., Colombia—Teacher: Angela Mercedes Quiñones-Castañeda—Artist: Collaboration of students and teachers

Gd, gadolinium, 64—Ozel Sisli Terakki Tepeoren Anadolu Lisesi—Istanbul, Tuzla, Turkey—Teacher: Gulsen Sokullu—Artist: Alara Aydin

continued on page 38