The Periodic Table at 150: A Philatelic Celebration

18

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Abstract

The International Year of the Periodic Table of the Chemical Elements (IYPT), which marks the sesquicentennial of the iconic chart's introduction by Dmitri Mendeleev in 1869, provides a unique opportunity to bring its colorful history to life. Postage stamps, released by many countries to recognize scientific achievements or to honor well-known scientists, are used in this article to celebrate the IYPT. In particular, a detailed description of all the relevant stamps issued during 2019, some of which highlight important milestones in the development of the modern periodic table and the discovery of certain chemical elements, is presented.

18.1 Introduction

The United Nations (UN) and its Educational, Scientific and Cultural Organization (UNESCO) have periodically sponsored the observation of yearlong themes to promote, through awareness and action, their stated goals to increase universal respect for justice, the rule of law, human rights, and international cooperation. For instance, the International Years of Physics (2005), Astronomy (2009), Chemistry (2011), Crystallography (2014), and Light and Light-based Technologies (2015), underscored the importance and contributions of these disciplines to society.

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A resolution adopted by the UN General Assembly on 20 December 2017 proclaimed 2019 as the International Year of the Periodic Table of the Chemical Elements (IYPT), which commemorates the 150th anniversary of the publication of the original elemental chart by the renowned Russian chemist Dmitri Mendeleev (1834–1907). The resolution was endorsed by the International Union of Pure and Applied Chemistry (IUPAC), which was celebrating its centennial in 2019, and several related organizations, including the International Union of Pure and Applied Physics (IUPAP) and the International Union of History and Philosophy of Science and Technology (IUHPST). Not surprisingly, the IYPT was recognized throughout the world in multiple ways, including the organization of thematic conferences and symposia, special activities for children and online games (e.g., IUPAC's Periodic Table Challenge), the publication of a myriad of articles in magazines and technical journals, and the release of postage stamps by several countries.

The use of postage stamps as didactic tools in science communication and teaching is well documented [1–12], and selected publications have explicitly focused on the periodic table and the discovery of chemical elements [13–15]. In honor of the IYPT, this article presents in chronological order all the relevant stamps released during 2019, with brief descriptions that highlight the creativity or idiosyncrasies of the individuals that designed them or the postal authorities that issued them [16–18].

18.2 IYPT Stamps

18.2.1 Algeria and the IYPT Logo

The first postage stamp honoring the IYPT was issued right after New Year's Day (Fig. 18.1). On 2 January 2019, *Algérie Poste* placed into circulation a rather simple stamp featuring the IYPT logo, which includes a depiction of Mendeleev and a globe incorporating the chemical symbols of mendelevium (Md) and the four most common elements found in living organisms (hydrogen, carbon, nitrogen, and oxygen). The stamp, with a face value of 25 Algerian dinars, includes the translation of "International Year of the Periodic Table of the Chemical Elements" into Algeria's two official languages, namely Arabic and Kabyle, the latter being one of the Berber languages spoken mainly by people in the north and northeast parts of the country.

18.2.2 Spanish Chemical Pride

On 9 January 2019, the Spanish postal service (*Correos*) issued a meaningful stamp that prominently displays the chemical symbols of vanadium, tungsten, and platinum (Fig. 18.2). Even though it may not be evident from the stamp's design why these particular elements were selected to represent the periodic table (the Spanish

Fig. 18.1 IYPT stamp from Algeria issued on 2 January 2019

flag in the lower right corner of each periodic table "tile" may provide a clue), it turns out that they are the three chemical elements discovered by Spaniards [19].

The discovery of vanadium is usually ascribed to the Spanish mineralogist Andrés Manuel del Río (1764–1849), who was born in Madrid but spent most of his professional life (and died) in Mexico [20, 21]. In 1801 he analyzed some lead-containing minerals (one of which is now known as vanadinite) sent to him from the Purísima del Cardenal mine in the State of Hidalgo and established the presence of a new metallic element, which he initially named panchromium (based on the vivid colors of the compounds he prepared with it) and later erythronium (since the color of the compounds changed to red upon heating). The identity of the new element was only confirmed in 1830 by the Swedish chemist Nils Gabriel Sefström (1787–1845), who changed its name yet again to vanadium in honor of Vanadis, the Scandinavian goddess of love and beauty. Incidentally, vanadium is the only chemical element to have been discovered in Mexico.

Tungsten, the only element discovered in the Iberian Peninsula, was isolated in 1783 by the Spanish chemist Juan José Delhuyar[1] (1754–1796) and his younger brother Fausto (1755–1833) while working at the Royal Seminary of Vergara in the province of Gipuzkoa (Basque Country) in the north of Spain [22]. The current symbol of the element (W) is derived from wolfram, the original name proposed by the Delhuyar brothers, who isolated it from a sample of the mineral wolframite, a mixed tungstate (or wolframate?) of iron and manganese, with chemical formula $(Fe,Mn)WO_4$. Interestingly, wolfram is still today the preferred name for element 74 in Spain, Scandinavia, Russia, Turkey, Germany, Greece, and other countries, even though tungsten is recommended by IUPAC and widely used in Latin America and most English- and French-speaking countries [23, 24].

Platinum, a fairly rare and expensive element usually found associated with nickel and copper ores, was already known to pre-Columbian natives in the region of present-day Colombia and Ecuador. However, the "European" or "modern" discovery of platinum is usually attributed to the Spanish scientist and explorer

[1]Other known spellings of the last name include Elhuyar, D'Elhuyar, and de Luyart (in the original publication from 1783), but a majority of modern sources seem to prefer Delhuyar. See Caswell [22].

Fig. 18.2 IYPT stamp from Spain issued on 9 January 2019

Antonio de Ulloa (1716–1795) [25]. He was a member of the French Geodesic Mission to South America (1735–1744) organized by the French Academy of Sciences and led by the renowned explorer and geographer Charles Marie de La Condamine (1701–1774). Upon his return to Spain, de Ulloa wrote extensively about the expedition and described for the first time in 1748 some of the physical and chemical properties of the noble metal.

18.2.3 Kyrgyzstan and Mendeleev

On 12 April 2019, a stamp commemorating the IYPT was issued in the Kyrgyz Republic, a landlocked country in Central Asia, bordering Kazakhstan, Tajikistan, Uzbekistan, and China (Fig. 18.3).[2] In addition to the UNESCO and IYPT logos in the upper right corner, the colorful stamp, with a face value of 100 Kyrgyzstani som, shows a portrait of Mendeleev and the chemical symbols of mendelevium, zinc, copper, helium, argon, gold, cadmium, and xenon, among other elements.

18.2.4 Moldova and Rubik's Cube

The Republic of Moldova, a country in Eastern Europe bordered by Romania and Ukraine, recognized the IYPT on 23 May 2019 (Fig. 18.4). The attractive 15.50-Moldovan leu stamp includes the IYPT and UNESCO logos and a picture of a Rubik's Cube with different chemical symbols in each of its six faces. I have not been able to ascertain the connection between the periodic table and the famous puzzle invented in 1974 by the Hungarian architect Ernö Rubik (b. 1944). I can only speculate that the idea behind the design is a subtle tribute to the Russian chemist who solved the puzzle of sorting the chemical elements based on their recurring properties (and, importantly, predicted the existence of unknown elements) 150 years ago.

[2]The suffix -stan means "place of" or "country of" in ancient Persian, hence the country names refer to the land of the Kyrgyz, Kazakhs, Tajiks, Uzbeks, and so forth.

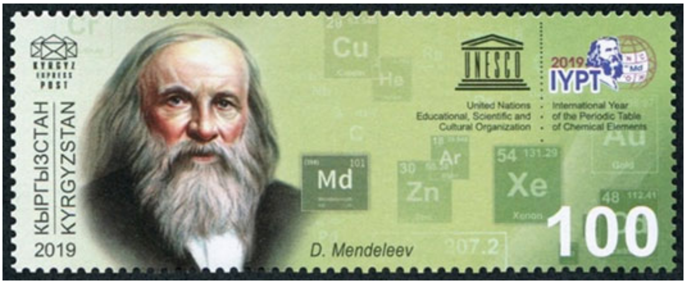

Fig. 18.3 IYPT stamp from Kyrgyzstan issued on 12 April 2019

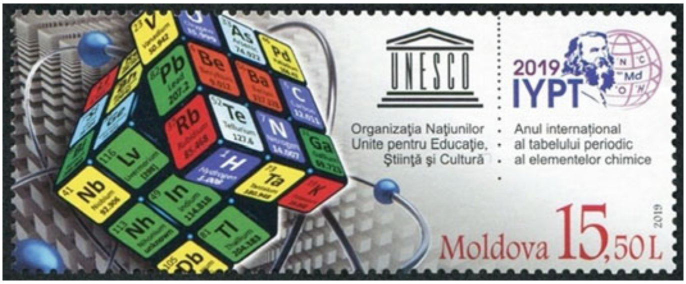

Fig. 18.4 IYPT stamp from Moldova issued on 23 May 2019

18.2.5 Mendeleev's Final Draft of the PT

Magyar Posta, the Hungarian postal service, issued on 3 June 2019 an IYPT stamp that includes a portrait of Mendeleev, a small reproduction of the final draft of his manuscript of the periodic table (i.e., the one dated 17 February 1869), and, to the left, a portion of a modern periodic table (containing the elements of groups 1–7 and the first half of the f-block) (Fig. 18.5). The inscription in Hungarian ("a periódusos rendszer megalkotója") near the upper left corner, below Mendeleev's full name and the dates of his birth and death (1834–1907), translates literally to "the creator of the periodic table."

18.2.6 The 7th Period Is Complete

On 24 June 2019, Bulgaria issued a postage stamp that includes the symbols of all 118 chemical elements in the periodic table and a diffuse portrait of Mendeleev in the background (Fig. 18.6). Although there are many stamps that show chemical symbols or portions of the periodic table, this may well be the first stamp to display a complete table (vide infra). As such, it includes the symbols of the four most

Fig. 18.5 IYPT stamp from Hungary issued on 3 June 2019

recent elemental additions to the beloved chart, whose names were approved by IUPAC in November 2016, namely nihonium (Nh), moscovium (Mc), tennessine (Ts), and oganesson (Og).

18.2.7 Portugal: Four to 118 in 2,500 Years

Portugal went all out to honor the IYPT and, on 24 July 2019, released not one but two stamps plus a so-called souvenir sheet (Figs. 18.7 and 18.8). One of the stamps, with a face value to cover the cost of domestic postage for letters weighing up to 20 g ("N" is for "national") displays the symbol of hydrogen, the most common element in the Universe, and graphical representations of the four classical elements from Ancient Greece (earth, water, air, and fire) originally envisioned by the philosopher Empedocles (ca. 490–430 BCE). The other stamp, to cover the cost of international ("I") postage for letters weighing up to 20 g, displays an elegant black-and-white portrait of Mendeleev and the chemical symbol, name, atomic number ($Z = 101$), and atomic mass ($A = 258$) of the most stable isotope ($t_{1/2} = 51.5$ d) of the element mendelevium.

The souvenir sheet, with a face value of €2.00, features a complete periodic table and uses carbon as an example to explain the information included for each element. In contrast to the stamp from Bulgaria shown above, the fairly large size of the souvenir sheet (13.5 cm × 12.5 cm, with a total area nearly four times that of a typical credit card) allows for the inclusion of the name, symbol, atomic number, and atomic mass for each and every element. Postally used examples of this sheet must be pretty uncommon, but wouldn't we be thrilled to get a large envelope by mail with a periodic table used for postage?

Fig. 18.6 IYPT stamp from Bulgaria issued on 24 June 2019

Fig. 18.7 IYPT stamps from Portugal issued on 24 July 2019

18.2.8 Sri Lanka's Colorful Table

The Philatelic Bureau of Sri Lanka Post released on 6 October 2019 a 45-rupee stamp that includes a full periodic table but unfortunately only the chemical symbol of each element is legible (Fig. 18.9). In addition, the stamp's design incorporates the IYPT logo and a portrait of Mendeleev that looks remarkably similar (but not identical) to the one used in the stamp from Kyrgyzstan (Fig. 18.3). The choice of colors in the periodic table is also somewhat unusual: while distinct hues are used for the alkali metals, the alkaline earths, the halogens, and the noble gases, the metalloids (B, Si, Ge, As, Sb, Te) get their own dark green color and the remaining elements of groups 13–16 are split into metals (lavender) and nonmetals (pale green).

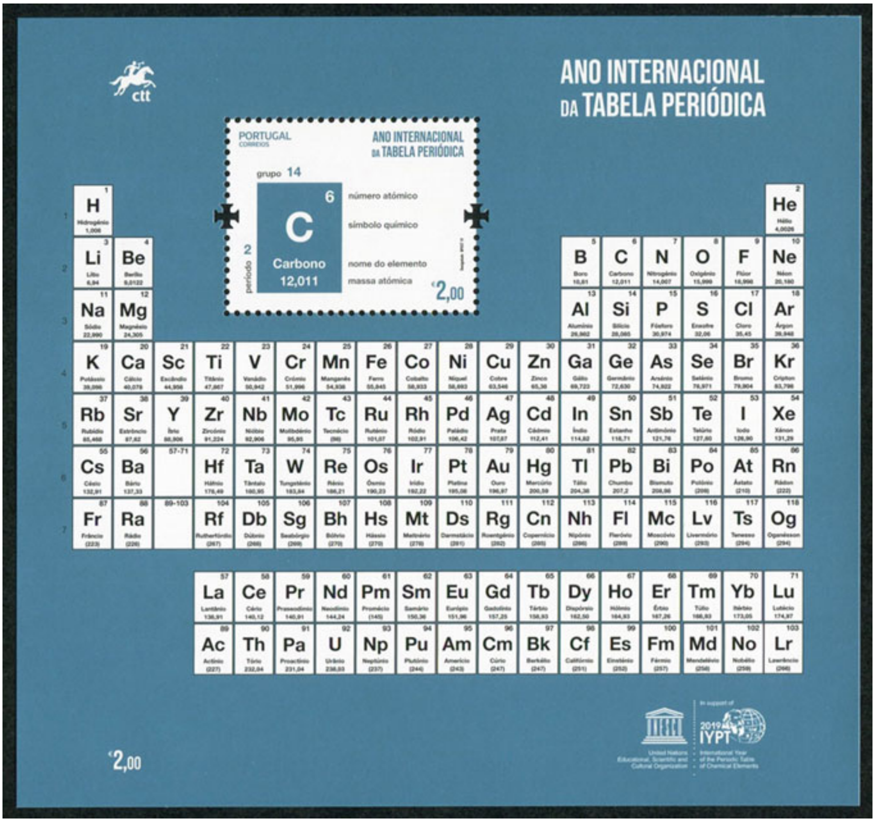

Fig. 18.8 IYPT souvenir sheet from Portugal issued on 24 July 2019

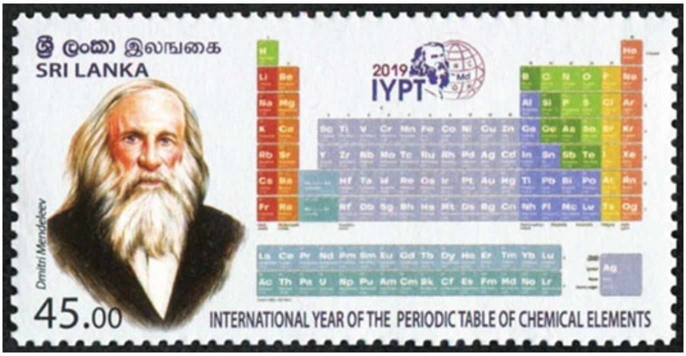

Fig. 18.9 IYPT stamp from Sri Lanka issued on 6 October 2019

Fig. 18.10 IYPT stamp from North Macedonia issued on 9 October 2019

Fig. 18.11 Personalized stamps prepared for hypothetical superheavy elements

18.2.9 North Macedonia's Groovy PT

Last but not least, the Republic of North Macedonia[3] in the Balkan Peninsula issued on 9 October 2019 an eye-catching 50-denar stamp that highlights the relative abundance in the Earth's crust of the 90 naturally occurring chemical elements (Fig. 18.10). Thus, the area occupied by each element is proportional to its abundance using a logarithmic scale since the rarer elements would otherwise be almost invisible. The image is based on a periodic table developed by the European Chemical Society (EuChemS) and is readily available online [26].

Significantly, the captions on the left, in Macedonian and Albanian, can be translated to "150 years – periodic *system* of the elements," which is the original term used by Mendeleev, not "periodic *table*." The stamp also includes in the upper left corner very small logos for both UNESCO and the IYPT.

[3]The country formerly known as the Republic of Macedonia officially (albeit reluctantly) changed its name to the Republic of North Macedonia in February 2019 after a protracted and bitter dispute with Greece, which also has a region named Macedonia.

18.3 Concluding Remarks

What's in the future of the periodic table? There are already concerted efforts by nuclear physicists to generate one or more atoms of elements 119 or 120, mainly at the RIKEN's Nishina Center for Accelerator-Based Science in Japan and the brand-new Superheavy Element Factory at the Flerov Laboratory of Nuclear Reactions in Dubna, Russia [27–29]. Are we ever going to get to the legendary Island of Stability and find superheavy isotopes with more manageable half-lives [30, 31]? What is the limit of the periodic table? Pekka Pyykkö, a computational chemistry professor at the University of Helsinki, has done sophisticated calculations to predict the electron configurations of elements with atomic numbers up to 172 and their positions on a future expanded periodic table [32, 33].[4]

One thing is certain: the synthesis and investigation of new chemical elements is becoming increasingly difficult and requires a massive investment of resources. In this regard, Peter Elias, an engineer and philatelist with a keen sense of humor, has recently prepared a pair of "personalized" stamps[5] that underscore that such elements may just be too expensive to synthesize or simply won't exist at all (Fig. 18.11)!

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[4]See also Pekka Pyykkö's Chapter 17 in this volume, reprinted from *Pure and Applied Chemistry*.
[5]Personalized or customized stamps, often used in birth announcements or wedding invitations, are privately designed but printed by companies authorized by postal authorities (such as the U.S. Postal Service) and are valid for postage.

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