Origin of the Names of Chemical Elements

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In 1985 David W. Ball published an article in *this Journal* on "Elemental Etymology: What's in a Name?" (*1*). He presented translations of the names of the elements. In this present article the etymology and the *reason* scientist(s) coined a specific name for a newly discovered element are surveyed. The variation in naming customs throughout the ages is also considered. The *historical* viewpoint leads to a grouping of the elements into 10 categories as compared to Ball's (*1*) six. One of the new categories included here, names from minerals or ores (Table 6), reflects common practice some 200–300 years ago in the naming of the elements. Before presenting the etymology of the present names of the chemical elements, mention is given to the names of the seven ancient metals.

The Names of the Seven Ancient Metals

In ancient times, humankind knew of seven metals and seven celestial bodies and assigned seven days to a week. No wonder that the metals and the days were related to the celestial bodies. Color was often the criterion used for relating a particular planet to a metal. Gold was associated with the yellow corona of the sun, the white silver shone like the moon at night, and the red tint of Mars could be related to iron (rust?). Lead was associated with Saturn because it was a heavy metal; it would "move slowly", as Saturn seemed to do. (Saturn was believed to move slowly because it was the planet farthest from the sun and thus took the longest to complete its orbit.)

During the Middle Ages, the metals and the planets were so closely connected that they bore similar names and were given similar symbols. Literature from the 16th century could be perceived either as astrology or alchemy.

Table 1 demonstrates the connections between the names of metals, celestial bodies, and the days of the week. If one looks at the words for the days of the week, the connection with the names of the celestial bodies is obvious. A selective combination of different languages, can read like this: Sunday, Monday, *mardi*, *mercredi*, *jeudi*, Friday, and Saturday. (Friday originates from the goddess Freya, a Norse counterpart to Venus.)

Table 1. Names and Symbols of the Ancient Metals Compared to Names of Celestial Bodies and Days

Metal	gold	silver	iron	mercury	tin	copper	lead
Symbol	☉	☾	♂	☿	♃	♀	♄
Celestial Body	Sun	Moon	Mars	Mercury	Jupiter	Venus	Saturn
Day							
Lat.	(*dies*) *Solis*	*Lunae*	*Martis*	*Mercurii*	*Jovis* (*pater*)	*Veneris*	*Saturni*
Fr.	*dimanche*	*lundi*	*mardi*	*mercredi*	*jeudi*	*vendredi*	*samdi*
Eng.	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

In chemistry the linguistic connections are fewer. Mercury is the only metal still bearing an ancient name of a planet. We find relics of Mars in *Ma*(r)*sofen*, a German and Scandinavian word for "blast furnace" in which iron oxides are reduced. *Masofen* is a word still in use. Before World War II, saturnism was a synonym for lead poisoning. And lunar caustic (silver nitrate) may still be read of in some textbooks of pharmacology as a caustic used to treat warts.

During the Middle Ages, when the alchemists tried to transform various metals into gold, their procedures were kept secret. Names, such as "sugar of Saturn" for lead acetate and "spirit of Veneris" for sulfuric acid, the latter produced by distillation of copper(II) sulfate, are examples of this secrecy. This type of nomenclature persisted until the end of the 18th century. At that time the names of substances were given by proper chemists. However, they could refer to iron(II) carbonate as "martial chalk" and to tin(II) acetate as "vitriol of Jupiter" (*2*).

As we have seen, seven ancient metals have at one time been named after celestial bodies. This type of naming has also been applied to elements discovered later, for instance, uranium and neptunium (*3*). We shall now see how the roughly 100 elements got their present names.

The Etymology of the Present Names of Chemical Elements

In the following, the origin of the present names of the chemical elements is surveyed. Ten tables (Tables 3–12), each concentrating on one particular naming custom are presented. Table 2 shows the 10 naming customs that have been used and the number of elements in each group.

The ancient elements have names of "obscure origin" according to Ball (*2*). These names have been given a thorough analysis by Jensen (*4*) and are classified below as prechemical names (Table 3). The etymology cited is taken from Jensen.

The etymological explanation of the names of chemical elements (*1–7*) is not always unambiguous. In consequence, two or more explanations may be given for a single element. The word "arsenic", for example, may originate from the Greek word *arsenikos* denoting male or masculine. The mas-

Table 2. A Map of Tables Surveying the Origin of the Names of Chemical Elements

Table No.	Title	Number of Elements
3.	Prechemical names	10
4.	Names from celestial bodies	8
5.	Names from mythology/superstition	10
6.	Names from minerals/ores, other than geographical names	13
7.	Names of colors	9
8.	Names from properties other than color	8
9.	Geographical names from the domicile or workplace of discoverer(s)	13
10.	Geographical names from minerals/ores	10
11.	Constructed names	16
12.	Names from persons	10

Table 3. Prechemical Names

Name	Symbol	No.	
Carbon	C	6	*Carbonis* (Greek) = *carbon* (Latin) = charcoal (English). Lavoisier realized that charcoal, graphite, and diamond were carbon. He called the element *carbone* to distinguish it from *charbon* (French) = charcoal.
Copper	Cu	29	*Kyprion* (Greek) = *cuprum* (Latin). The ore *aes cyprium* was named after Cypern where it was found. Cypern bears its name after the cypress tree called Kyparissos.
Gold	Au	79	*Gold* (Anglo–Saxon) is related to yellow, which in Anglo–Saxon was called *geolo;* from *jval* (Sanskrit) meaning "to shine". *Aurum* (Au) from *hari* (Sanskrit) = yellow. Aurora was the goddess of dawn.
Iron	Fe	26	*Iren* (Anglo–Saxon). Origin uncertain. *Ferrum* (Fe) is probably not derived from *firmus* (Latin) = firm but from a Hebrew or Arabic word.
Lead	Pb	82	Lead is of unknown origin. Related to *lodd* (Norse) and to *Lot* (Germanic). Lead was called *plumbum nigrum* (black lead) by the Romans to distinguish it from tin—*plumbum candidum* (white lead). The origin of the word *plumbum* (Pb) is uncertain, possibly related to *molybdos* (Greek). In Scandinavian languages and in German lead is called *bly* or *Blei;* words originating from *Bhlei* (Indo–European) = shine.
Mercury	Hg	80	From the Roman god of messengers and the planet Mercury. *Hydrargyrum* (Hg) from *hydro-argyros* (Greek) = water-silver, denoting mercury being a shiny liquid metal.
Platinum	Pt	78	*Plata* (Spanish) = silver, *-ina*, a diminutive suffix. Pt looks like silver. Known and used by Indians in South America long before Columbus.
Silver	Ag	47	*Silfr* (Norse) and *soelfor* (Anglo–Saxon) are of unknown origin. The Latin word *argentum* (Ag) originates from *argunas* (Sanskrit) = shining.
Sulfur	S	16	The German and Scandinavian words for sulfur, *Schwefel-/svovel/svävl*, originate from *suelphlos* (Indo–European), which is derived from *swel* = to burn slowly. Sulfur from *sulpur* (Latin) may have the same origin (*swel*). Previously, sulfur was considered to be derived from *sulveri* (Sanskrit) = the enemy of copper. The alchymists regarded metals as compounds of sulfur and mercury. The more sulfur, the less metallic the metal.
Tin	Sn	50	Of unknown origin, perhaps *tina* (Germanic) = shiny little stick. *Stannum* (Sn), connected to *stagnum* and *stag* (Indo–European) = dripping, so called because tin melts easily.

Table 4. Names from Celestial Bodies

Name	Symbol	No.	
Cerium	Ce	58	Named after Ceres, the first asteroid to be discovered. Ce was discovered in 1803, two years after the asteroid. Ceres was the Roman goddess of corn and harvest.
Helium	He	2	*Helios* (Greek) = sun. Deduced from spectroscopic examination of the solar corona during an eclipse in 1868. Helium was believed not to exist on Earth.
Neptunium	Np	93	After the planet Neptune, which is beyond Uranus in our solar system. Neptunium is "beyond" uranium in the periodic table. Neptune was the god of the seas.
Palladium	Pd	46	Named after Pallas (Athene), the second asteroid to be discovered. Pallas was discovered in 1802, palladium in 1803. Pallas was the Greek goddess of wisdom.
Plutonium	Pu	94	After Pluto, the second planet beyond Uranus. Plutonium is two places "beyond" uranium in the periodic table. The planet was discovered in 1930, plutonium in 1940. Pluton was the god ruling over the lower world.
Selenium	Se	34	*Selene* (Greek) = moon. Selenium resembles tellurium in its properties and therefore received a name similar to tellurium.
Tellurium	Te	52	*Tellus* (Latin) = the Earth. In 1798 no single element was yet named after the Earth. It needed to be done! (M. H. Klaproth, 1799)
Uranium	U	92	Named after the planet Uranus, which was discovered in the same decade (Uranus in 1781 and uranium in 1789). Uranos was the god of Heaven in Greek mythology.

culinity may relate to the alchemists attaching metals to sexes (Table 5) or to wall paintings on uncovered human skin, which, in ancient Greece, were painted yellow with arsenic(III) sulfide on men, but white on women. In a more modern opinion the word "arsenic" descends from *zarnik* (Persian), which means golden (*4*). Such distinct meanings may in fact lead to different placements of an element in the following series of tables.

Some names are derived from names of the minerals or ores from which the elements were isolated. One specific type of these names—geographical names—receives special

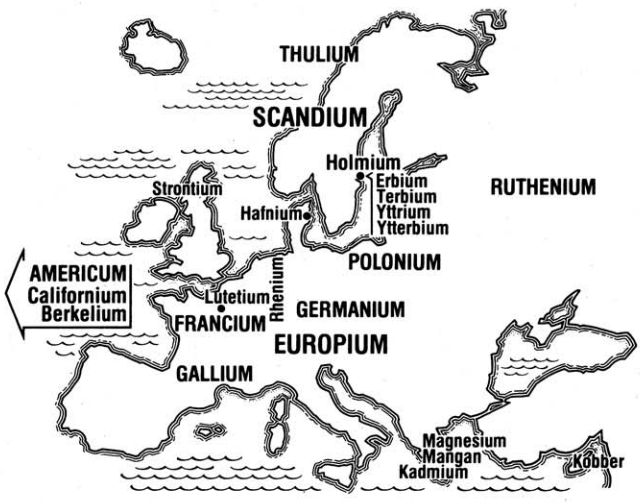

Figure 1. A chemical map. The location of elements according to the etymological explanation of the names.

Table 5. Names from Mythology or Superstition

Name	Symbol	No.	
Arsenic	As	33	*Arsenikos* (Greek) = brave, male. The alchemists attached metals to sexes. Copper goods were made harder and stronger with arsenic. Copper goods with 4% arsenic dating back to 2000 BC are found.
Cobalt	Co	27	*Kobold* (German) = evil sprite. When an ore did not yield any useful metal by ordinary procedures, the *Kobolds* were considered to have been present. Cobalt was discovered in such an ore.
Nickel	Ni	28	*Nickel* (German) = devil. If an ore that looked like an ordinary copper ore did not contain copper, the German miners shouted: "Kupfer-nickel" (copper-devil)! Nickel was discovered in such an ore.
Niobium	Nb	41	Niobe was the daughter of Tantalus in Greek mythology. Niobium was so named because it resembled tantalum and was discovered in the same ore in which tantalum previously was detected.
Promethium	Pm	61	Prometheus, the god who stole fire from heaven. He gave it to human beings and was daily punished by Zeus. Coined to commemorate the courage and possible mental pain that is needed for the synthesis of new elements. Promethium does not exist on Earth, but it is identified in the products from the fission of uranium.
Tantalum	Ta	73	Tantalus, the son of Jupiter, was condemned to hell, standing to his neck in water. However, when he bent to drink, the water sank. Similarly, Ta_2O_5 is not able to take "water"; it does not dissolve in acids.
Thorium	Th	90	Thor, the Norse god of war. The metal was discovered in a Norwegian mineral (later called thorite) by the Swede J. J. Berzelius.
Titanium	Ti	22	The Titans—the giants, the first sons of the Earth. In Greek mythology the sons of Uranos. Klaproth had previously discovered uranium.
Tungsten	W	74	*Tung* (Swedish) = heavy, *sten* (Swedish) = stone. The name coined to indicate the high density of the minerals containing the metal. W, wolfram, from *Wolf* (German) = wolf, *Rahm* (German) = dirt. The minerals wolframite (a later name) and tin-stone (casserite) often occur together. The name wolfram was coined because, before 1700, it was difficult to smelt tin without obtaining wolfram at the same time. Tin had (wolf-) dirt, i.e., it was contaminated by wolfram.
Vanadium	V	23	Vanadis—a nickname for Freya, the Norse goddess of beauty. The name was coined by the Swedes N. G. Sefström and J. J. Berzelius because of the multicolored compounds of vanadium.

attention (Table 10). The rest of the elements with names after minerals or ores are listed in Table 6.

A total of 23 elements have geographical names. Besides those with geographical names after minerals or ores (Table

Table 6. Names from Minerals/Ores, Other than Geographical Names

Name	Symbol	No.	
Aluminum	Al	13	*Alumen* (Latin) = alum. Alum was the name of aluminum potassium sulfate, which in ancient times was used as an astringent.
Barium	Ba	56	*Barys* (Greek) = heavy. Barium was the metal present in baryte, heavy spar ($BaSO_4$), which has a relatively high density (4.5 g cm^{-3}).
Beryllium	Be	4	From *beryllos* (Greek), the precious stone of beryl (beryllium aluminum silicate).
Boron	B	5	*Bauraq* (Arabic) = *burah* (Persian) = borax, in which boron was discovered. The suffix *-on* because of the resemblance of boron to carbon.
Calcium	Ca	20	*Kylix* (Greek) = *calx* (Latin) = chalk. Calcination (Medieval Latin: *calcinare*) meaning to reduce to a calx, as when chalk or limestone were incinerated to lime. The suffix *-ium* denotes a metal.
Fluorine	F	9	From *fluor lapis* = fluorspar (CaF_2). *Fluere* (Latin) = to flow. Fluorspar has been used as a flux in metallurgical operations.
Gadolinium	Gd	64	From the mineral gadolinite, which was named after the Finnish mineralogist and chemist J. Gadolin.
Molybdenum	Mo	42	*Molybdos* (Greek) = lead. Before 1600, soft black minerals (C graphite, Sb_2S_3, PbS, MoS_2) that produced a black mark on a surface were often called "molybdos". These minerals were later distinguished from one another. In 1778 Scheele showed that one of the minerals (MoS_2) contained a new element, which was called *molybdos*.
Potassium	K	19	The "mineral" is ash. When plants were heated, a wood-ash remained. The ash was extracted with water and the solution evaporated in iron pots. The solid produced was called potash (K_2CO_3). The suffix *-ium* in potassium denotes a metal. Potassium is called *kalium* in German and Scandinavian languages. The name originates from Al-quali (Arabic) = the ash ("al" is the definite article).
Samarium	Sm	62	From the mineral samarskite, named after the Russian mining engineer V. E. Samarskii–Bykhovets.
Silicon	Si	14	*Silex* (Latin) = flint, hard stone. Silicon was identified in flint. The suffix *-on*, because of its resemblance to carbon.
Sodium	Na	11	*Suwwad* (Arabic); the name of a plant with a high content of soda (sodium carbonate). *Sodanum* (Medieval Latin), a headache remedy. The suffix *-ium* denotes a metal. *Neter* (Hebrew)/*nitrum* (Latin) are names used in ancient times for alkali substances. From the 15th century they were called *natron* in Europe. The metal in *natron* was later called *natrium* (Na). The suffix *-ium* denotes a metal.
Zirconium	Zr	40	Either: *Zerk* (Arabic) = precious stone. Zirconium produced from the precious stone zircon ($ZrSiO_4$). Or: *Zargum* (Arabic) = golden yellow colored.

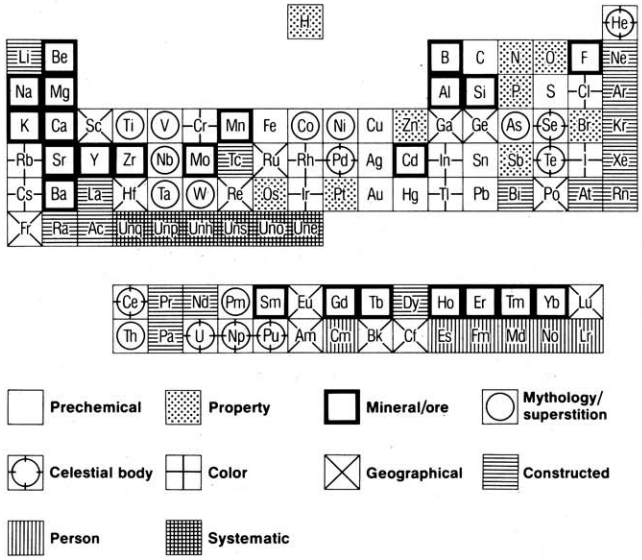

Figure 2. Naming customs of elements.

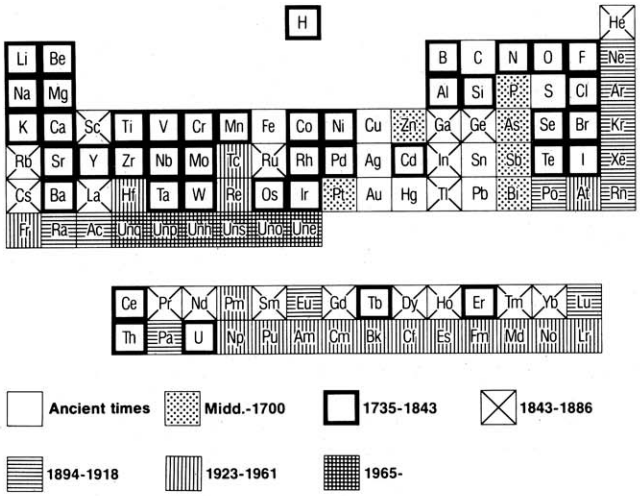

Figure 3. Periods of discovery of elements.

10), there are the ones named after the domiciles or workplaces of the discoverers of the elements (Table 9). All elements may be located on a "chemical map" (Fig. 1).

The Names of the Chemical Elements in Historical Retrospect

In order to look for connections between naming habits and time periods of discovery of the elements, two periodic tables are prepared. In Figure 2 the elements are labeled according to naming custom, while in Figure 3 they are labeled according to time of discovery.

Figures 2 and 3 show that some naming methods are typical for certain periods. The information drawn from the two figures is summarized in Table 13. In the following, a more detailed presentation of the naming customs in each time period as well as some historical comments are given.

Ancient Times

In ancient times man knew of seven metals and two nonmetals. Our trivial names for these elements are prechemical names. The names have developed through the ages just as other words have. One property to which our ancestors must have attached importance is the *shiny appearance* of the metals. The words "gold", "silver", "platinum", and "tin" (and the German word *Blei* for lead) may be traced back to this characteristic (Table 3).

The Middle Ages–1700's

Not only the metallic luster but also other properties must have been borne in mind as the words for the elements developed. Some of the names indicate properties of the elements or of compounds of the elements. Antimony, for example, received its Latin name (*stibium*) in allusion to the black mark left by drawing the mineral stibnite on a piece of paper or along the eyebrows. However, the etymological explanation for some of the names of elements (As, Bi, Zn) discovered in this period is uncertain. The names originate from substances that people used before chemistry was classified as a science.

The first element linked to one particular discoverer is phosphorus. It was discovered by the German Hennig Brand about 1670. He was looking for the "philosopher's stone". He may have believed he was successful when he observed the light from his distillation apparatus containing evaporated urine. Some minerals had previously been shown to give off faint light in the dark, among them the Bolognese stone (ignited barium sulfate). All such specimens were called *phos-phor* = "light-bearer" during the Middle Ages. The name "phosphorus" was eventually used exclusively for element 15.

1735–1843

The second half of the 18th century was a time for reforms in chemical nomenclature. In 1789 Antoine Laurent Lavoisier (*8*) produced a table of elements with several new names and new elements. He asserted that the names of all new elements should give information on the properties of the elements. As he believed that oxygen was a component of all acids, he had in 1777 named that element *oxy-gen* ("acid-producer") (Table 8). He called N_2 *a-zote* ("not-life") because animals died if they respired air depleted of oxygen. In 1790 the Frenchman Jean Antoine Chaptal proposed *nitrogène*, the French name for the gas that we now recognize as the element nitrogen, but ironically the word *azote* was in

Table 7. Names of Colors

Name	Symbol	No.	
Cesium	Cs	55	*Caesius* (Latin) = bluish gray. Cesium has two strong bluish gray lines in its emission spectrum.
Chlorine	Cl	17	*Khloros* (Greek) = yellow green. Named after the color of the gas.
Chromium	Cr	24	*Khroma* (Greek) = color. Different chromium compounds have different colors.
Indium	In	49	*Indicum* (Latin) = indigo. Indium has indigo blue lines in its emission spectrum. The pigment indigo was named after *indicon* (Greek) in allusion to its coming from India.
Iodine	I	53	*Ioeides* (Greek) = violet colored. Named after the color of its vapor. The suffix *-ine* by analogy with chlorine.
Iridium	Ir	77	*Iris* (Greek) = rainbow. Solutions of iridium compounds show a variety of colors.
Rhodium	Rh	45	*Rhodon* (Greek) = rose. Named after the red solutions of rhodium salts.
Rubidium	Rb	37	*Rubidus* (Latin) = dark red. Rubidium has two red lines in its emission spectrum.
Thallium	Tl	81	*Thallus* (Latin) = sprouting green twig. Thallium has a strong green line in its emission spectrum.

Table 8. Names after Properties Other than Color

Name	Symbol	No.	
Antimony	Sb	51	*Anthemoniun* (Greek) probably from *al ithmid* (Arabic), the name of Sb_2S_3 used for mascara. Sb: Stibium (Latin) = mark. Egyptian women used black stibnite, Sb_2S_3, for mascara.
Bromine	Br	35	*Bromos* (Greek) = stink. Named after the smell of the elementary substance. *-ine* a suffix previously used for halogens such as chlorine and iodine.
Hydrogen	H	1	*Hydros* (Greek) = water, *-gen* (Greek) = producing. When hydrogen burns, water is produced.
Nitrogen	N	7	*Niter* (Greek) = saltpeter, *-gen* (Greek) = producing.
Oxygen	O	8	*Oksys* (Greek) = acidic, *-gen* (Greek) = producing. According to Lavoisier's theory of acids from 1774, all acids were considered to contain oxygen.
Osmium	Os	76	*Osme* (Greek) = odor. The volatile OsO_4 has a strong, unpleasant smell.
Phosphorus	P	15	*Phos* (Greek) = light, *-phero* (Greek) = bearing. White phosphorus emits light in the dark.
Zinc	Zn	30	*Seng* (Persian) = stone or *Zinke* (German) = spike. The Greeks produced brass materials from calamine ($ZnCO_3$) having spikes, and from copper and charcoal. The Persians were probably the first people to produce zinc.

use until recently in France. Relics of the word *azote* is found in the present name of compounds with the functional group —N=N—, the azo-compounds.

One specific property was often stressed in the names of elements, namely the color. The color of an element itself or of a compound of the element formed the basis of names of five elements discovered in the period 1774–1811. The elements are chlorine, iodine, chromium, rhodium, and iridium (Table 7).

From 1735 to 1830 it was common practice to give new elements names originating from mythology or superstition. Cobalt and nickel were so named because miners thought sprites or devils had been on the move when it was impossible to extract copper from their "copper" ores. Names from Norse and Greek mythology were also given to newly discovered elements. Eight out of a total of 10 elements bearing names from mythology or superstition (Table 5) were discovered during this time period.

From 1782 to 1817 five elements were named after planets. Astronomy went through tremendous changes reflected in the names of some elements (Table 4). Uranus was discovered in 1781, and uranium (1789) was named thereafter. The asteroids Ceres and Pallas were discovered in 1801–1802, and the metals cerium and palladium were discovered and named a year later. But, until then, not one element was named after the Earth! Element 52 was therefore named tellurium. When another element with properties similar to those of tellurium was discovered 25 years later, the same naming custom was used and the closely related name—*selenium* (the Moon)—was chosen.

The dominating naming custom for about 100 years starting in 1750 was to use the name of the mineral or ore in which the element occurred and add to it a proper suffix (Table 6). In Figures 2 and 3 the same labels are used for names from

Table 9. Geographical Names from the Domicile or Workplace of Discoverer(s)

Name	Symbol	No.	Discoverer(s)
Americium	Am	95	G. T. Seaborg, A. Ghiorso, S. G. Thompson et al. University of California, Berkeley, USA
Berkelium	Bk	97	
Californium	Cf	98	
Europium	Eu	63	E. A. Demarçay, France in Europe
Francium	Fr	87	Marguerite Perey, France
Germanium	Ge	32	C. A. Winkler, Germany
Polonium	Po	84	Marie Curie, born and raised in Poland

Name	Symbol	No.	Latin for	Discoverer(s)
Gallium	Ga	31	France	P. M. Lecoq de Boisbaudran, France
Hafnium	Hf	72	Copenhagen	Discovered at the Bohr Institute in Copenhagen, Denmark, by D. Coster and G. C. de Hevesy.
Lutetium	Lu	71	Paris (*Lutetia Parisorum*)	G. Urbain, France
Rhenium	Re	75	The Rhine	Ida E. Tacke, K. F. Noddack, and O. Berg, Germany
Ruthenium	Ru	44	Russia	K. K. Klaus, Russia
Scandium	Sc	21	Scandinavia	L. F. Nilson, Sweden. Scandium discovered in euxenite and gadolinite. Before that time, found only in Scandinavia.

minerals and ores as for the period 1735–1843. In many cases the minerals or ores were known for a long time and bore, themselves, prechemical names. These names developed in a similar way as the words for the ancient metals. *Alumen*, the base syllable for aluminum, is one example of such an old name.

1843–1886

In the course of the four years from 1859 to 1863, four new elements were discovered as a result of the invention of spectroscopy by Robert Wilhelm Bunsen and Gustav Robert Kirchhoff (*3*). They identified new characteristic lines in some spectra, which could be traced back to new elements. The substance with a grayish blue line was called "cesium" and the one with two dark red lines was called "rubidium" (Table 7). This research method was adopted by other scientists. William Crookes named his new element with a green line "thallium", and Ferdinand Reich and Hieronymus Theodor Richter named theirs with an indigo blue line "indium". Thus the same technique had led to the same naming procedure.

At the end of the 19th century, a new naming custom was introduced. The elements were given names after the domicile or workplace of the discoverer(s). Elements such as europium, gallium, and germanium signal this new naming custom (Table 9). Down to recent times new elements are named accordingly, for example, californium and berkelium.

1894–1918

In 1835 Michael Faraday constructed chemical words from the classical languages Greek and Latin. He introduced words like "ion", "cathode", and "electrolysis". Later, when the noble gases were discovered, this practice used words from Greek and Latin to construct names for the elements. In 1894 William Ramsay and Baron Rayleigh (John William Strutt) independently discovered that atmospheric air in addition to oxygen and nitrogen consisted of still another element. They proposed the name "aeron" derived from *aer* (air) for their new element. The critics argued that the resemblance of aeron to the name Aaron from the Bible was too close. They did, however, accept the word "argon", meaning lazy or unreactive. In the course of the year 1898 krypton, neon, and xenon were discovered, and all three gases were given constructed names. There had definitely

Table 10. Geographical Names from Minerals and Ores

Name	Symbol	No.	Mineral or Ore	Geographical Location
Cadmium	Cd	48	An earth from Kadmeia	In ancient Greece
Erbium	Er	68	Erbia	The minerals are named after Ytterby, a village near Stockholm in Sweden or after Stockholm (holmium) itself.
Holmium	Ho	67	Holmia	
Terbium	Tb	65	Terbia	
Ytterbium	Yb	70	Ytterbia	
Yttrium	Y	39	Yttria	
Magnesium	Mg	12	Magnesia alba (white magnesia, $MgCO_3$)	From Magnesia in ancient Greece.
Manganese	Mn	25	"Magnesia" nigri (black magnesia, MnO_2)	
Strontium	Sr	38	Strontianite	Strontian, Scotland
Thulium	Tm	69	Thulia	Thulium, an early name for Scandinavia

been hiding (krypton) some new (neon), strange (xenon) elements in atmospheric air! (Table 11).

The same naming practice was often used for related elements. This may be exemplified by the names of the radioactive elements: radium, actinium, radon, and protactinium. The names of these four elements are derived from either the Greek or the Latin word for "ray". (The word "radioactive", which was coined by Marie Curie, is itself constructed.)

1923–1965

The American research group at the University of California, Berkeley, under the leadership of the Nobel Prize winner Glenn Theodore Seaborg, has been very active and successful. The group has discovered several elements, among them berkelium, californium, and americium. Through the geographical names given to these elements, the group has assured that their stimulating workplace will be familiar to later generations of chemistry students and researchers (Table 9).

The elements located one and two places beyond uranium in the periodic table were discovered at the University of California, Berkeley, in 1940. The discoverers suggested naming the elements neptunium and plutonium, the planets Neptune and Pluto being one and two "places" beyond Uranus. Thus, an old-fashioned naming custom was applied because the elements were closely related to an element bearing a similar name, that name being coined during a previous time period.

Not one discoverer has suggested his family name as the name of a chemical element. It might, however, have been rather inconvenient to name an element accordingly, when as many as 16 persons were credited with the discovery of elements 99 and 100. Very few elements are actually named after persons. In 1944 the nuclear physicists started the practice of naming elements after former outstanding chemists and physicists. Element 96 was called curium in honor of Marie and Pierre Curie and their pioneering work on radioactive elements. Later other elements were named accordingly (Table 12).

1965–

In 1965 the Russian group at Dubna claimed to have produced an isotope of element 104. The American group at Berkeley was unable to confirm the findings but claimed its own discovery of (some other isotopes of) the element. Correspondingly, the Dubna group in 1967 claimed discovery of element 105, and the Berkeley group did likewise in 1970. Both groups proposed names for each of the two elements. Element 104 was called "kurtchatovium" and "rutherfordium", respectively, and 105 was called "nielsbohrium" and

Table 11. Constructed Names

Name	Symbol	No.	
Actinium	Ac	89	*Aktinos* (Greek) = ray. Radioactive element.
Argon	Ar	18	*A-ergon* (Greek) = no work/no action. Argon is an unreactive element.
Astatine	At	85	*A-statos* (Greek) = not-standing, not-lasting. Astatine is a radioactive element that disintegrates. Estimations show that only milligram amounts of astatine are present in 1 kilometer of the crust of the Earth. The suffix *-ine* denotes an element of the halogen group.
Bismuth	Bi	83	Either: *Wiese* (German) = field, *Muten* (German) = to apply for (the rights to explore ores and mineral resources). Or: *Weisse Masse* (German) = white mass. Bismuth is a Latinized word. Bismuth was called *bisemutum* by Agricola (1530) and was probably produced in Germany in the 14th–15th century.
Dysprosium	Dy	66	*Dysprositos* (Greek) = difficult to attain. It was difficult to isolate this lanthanide.
Krypton	Kr	36	*Kryptos* (Greek) = hidden. After the distillation of N_2, O_2, and Ar from liquefied air, there was still another element (Kr) hiding in the liquid.
Lanthanum	La	57	*Lanthano* (Greek) = to hide, to escape notice. An element, other than cerium, had been hiding in the mineral cerite since the discovery of cerium in cerite in 1803. La was discovered in 1839.
Lithium	Li	3	*Lithos* (Greek) = stone. Lithium was discovered in compounds from the mineral world. It was believed that lithium occurred only in minerals, in contrast to sodium and potassium.
Neodymium	Nd	60	*Neos* (Greek) = new, *-didymos* (Greek) = twin. The syllable *-di-* was left out. This new lanthanide had properties similar to (its twin) lanthanum.
Neon	Ne	10	*Neos* (Greek) = new, the suffix, *-on* by analogy with argon. Still another new noble gas was discovered in liquefied air. Krypton and argon had recently been isolated.
Praseodymium	Pr	59	*Praseios* (Greek) = leek-green, *-didymos* (Greek) = twin. The syllable *-di-* was deleted. The properties of praseodymium are very similar to the "twin element" neodymium, and it has greenish salts.
Protactinium	Pa	91	*Protos* (Greek) = prior, first. Protactinium is prior to the element actinium in a series of radioactive decay.
Radium	Ra	88	*Radius* (Latin) = ray. A radioactive metal.
Radon	Rn	86	*Radius* (Latin) = ray. The suffix *-on* was used to denote a noble gas. Radon was emitted from radium in radioactive decay.
Technetium	Tc	43	*Technetos* (Greek) = artificial. The first artificially produced element. Produced by bombardment of radioactive molybdenum with deuterium.
Xenon	Xe	54	*Xenos* (Greek) = strange. The suffix *-on* was use to denote a noble gas. The last, unknown, noble gas of the series krypton, neon, xenon to be discovered (1898).

"hahnium"—all names in honor of famous scientists.

Rules for Naming New Elements

18th and 19th Centuries

It has always been the right of the discoverer to suggest a name for his new element. Some of the present names deviate, however, from the proposals given by the discoverers of the 18th and 19th centuries. Bromine, for instance, was isolated from brine by the Frenchman Antoine–Jérôme Balard in 1828. He proposed the Latin word *muride*—denoting brine—as the name of the new element. A commission of famous French chemists accepted the discovery but disputed the name because chlorine for a long time had been spoken of as *radical muriatique* (*7*). The commission named the substance *brome*, a word soon accepted and given relevant orthography in different languages.

The majority of the suggestions of names of new elements have been accepted by the society of chemists and become the official names. Element 41 represents a sort of exception. In 1802, the Englishman Charles Hatchett discovered a new element in a mineral that the British Museum had received from America some 50 years earlier. He named the element "columbium" in honor of America and its discoverer. The following year the Swede Anders Gustaf Ekeberg analyzed a specimen of a tantalum mineral and discovered a new element. He called his element "niobium" because of its resemblance to tantalum. (Niobe was the daughter of Tantalos.) The name niobium became commonly accepted in Europe, whereas the Americans adopted columbium as their name of Hatchett's element, which later proved to be identical with niobium.

IUPAC Rules

In 1921 the IUPAC's Commission on the Nomenclature of Inorganic Chemistry (CNIC) was established. In 1938 the commission prepared rules, which were published in 1940.

Table 12. Names after Persons

Name	Symbol	No.	In Honor of
Curium	Cm	96	Marie Curie (1867–1934) and Pierre Curie (1859–1906) from France. They received Nobel Prizes in physics in 1903 and Marie Curie also in chemistry in 1911.
Einsteinium	Es	99	Albert Einstein (1879–1955). A German–American physicist. 1921 Nobel Prize in physics.
Fermium	Fm	100	Enrico Fermi (1901–1954). An Italian–American nuclear physicist. 1938 Nobel Prize in physics.
Hahnium	Ha	105[a]	Otto Hahn (1879–1968). A German chemist. 1944 Nobel Prize in chemistry.
Kurtchatovium	Ku	104[a]	Igor V. Kurtchatov (1903–1960). A Russian atomic physicist.
Lawrencium	Lr	103	Ernest O. Lawrence (1901–1958). An American, the inventor of the cyclotron. 1939 Nobel Prize in physics.
Mendelevium	Md	101	Dmitrii I. Mendeleev (1834–1907). A Russian, the father of the periodic table.
Nielsbohrium	Ns	105[a]	Niels Bohr (1885–1962). A Danish physicist. 1922 Nobel Prize in physics.
Nobelium	No	102	Partly in honor of the Swede Alfred Nobel (1833–1896) and his Nobel Prizes from 1901, and partly in honor of the Nobel Institute in Stockholm where nobelium was claimed to have been produced for the first time.
Rutherfordium	Rf	104[a]	Ernest Rutherford (1871–1937). A New Zealander. 1908 Nobel Prize in chemistry.

[a] Elements with more than one proposed name. Systematic names are preferred.

Table 13. Naming Customs throughout the Ages

Time of Discovery	Type of Names	Comments
Ancient times	Prechemical	7 metals, 2 nonmetals
Middle Ages	Property	Oldest naming custom, 4 elements
1735–1843	Mineral or ore	Typical for this time period, 19 elements
	Mythology or superstition	6 out of 8 elements with mythological names are from this era
	Celestial body	Common type of names
	Property	All other elements from this era
	Color	Half of the elements with color names are from this era
1843–1886	Geographical	A new naming custom, 6 out of 16 elements
	Color	The other half of the elements with such names
	Mineral/ore	3 elements, the last representatives of this type
1894–1918	Constructed	Typical for this time period, total of 8 elements; 4 names from previous periods, 2 in following period
	Geographical	3 elements
1923–1961	Person	Specific for this time period
	Geographical	7 elements
1965–	Systematic	

No instructions regarding how to name new elements were given. In 1957 new CNIC rules came into being (*9*). They comprised a list of elements and included some naming directions; however, no directions regarding the specific (root of the) word to choose as the name of a new element were given. The second edition, 1970 (*10*), states no alterations as compared to the 1957 issue of customs for naming the elements. The CNIC has, for instance, not set a standard that names after persons should be given priority to constructed names. The discoverer proposes a name of the element, and the CNIC has the duty to name it—that is the practice.

If different names of an element are in use, the CNIC will select one name "based upon considerations of prevailing usage and practicability" (*10*). It is emphasized that the selection carries no implication regarding priority of the discovery. In 1949 the CNIC settled the dispute of niobium/columbium to the advantage of niobium. It is not known whether the CNIC took into account the fact that the mythological names (niobium) were usual type of names at the date of the discovery, whereas geographical names (columbium) had not yet come into use.

In Russian and Scandinavian textbooks element 104 is referred to as "kurtchatovium" (Ku), while American and English textbooks write "rutherfordium" (Rf). An IUPAC–IUPAP committee is currently discussing the claims for priority of discovery of elements 104–110. In 1976 the CNIC decided, for the time being, to recommend the usage of systematic names for elements beyond element 103 in the periodic table in order to avoid confusion and to be sure that every chemist is talking about the same element. The systematic name of element 104 is "unnilquadium" (*un* = 1, *nil* = 0, *quad* = 4, and *-ium* denoting a metal) and that of element 105 is "unnilpentium" (*11*).

In this article the etymological explanations of names of chemical elements have been surveyed. Several types of names are disclosed as are different naming customs of the past and naming rules of the present. It is believed that placing chemistry in a linguistic and historical context is a way of increasing students' interest in chemistry.

Literature Cited

1. Ball, D. W. *J. Chem. Educ.* **1985**, *62*, 787–788.
2. Crosland, M. P. *Historical Studies in the Language of Chemistry*; Dover: New York, 1978.

3. Weeks, M. E. *Discovery of the Elements*, 7th ed.; rev. by Leicester, H. M.; Journal of Chemical Education: Easton, PA, 1968.
4. Jensen, K. A. *Dansk kemi* **1985,** *5*, 149–157.
5. Weast, R. C. *CRC Handbook of Chemistry and Physics*, 60th ed.; CRC: Boca Raton, FL, 1983; B3–B27.
6. Bevan, S. C.; Gregg, S. J.; Rosseinsky, A. *Concise Etymological Dictionary of Chemistry;* Applied Science: London, 1976.
7. Rancke–Madsen, E. *Grundstoffernes Opdagelseshistorie* ("History of the Discovery of the Chemical Elements"); Gad: Copenhagen, 1984.
8. Lavoisier, A. L. *Traitê Elementaire de Chimie;* Paris, 1789.
9. International Union of Pure and Applied Chemistry. *Nomenclature of Inorganic Chemistry, Definitive Rules;* Butterworths: London, 1959.
10. International Union of Pure and Applied Chemistry. *Nomenclature of Inorganic Chemistry, Definitive Rules*, 2nd ed.; Butterworths: London, 1971.
11. Scott, W. A. H. *Educ. Chem.* **1983,** *4*, 5.