ELEMENTAL WORDS REVISITED

TRISTAN MILLER
Darmstadt, Germany
http://www.nothingisreal.com/

The names and abbreviations of the chemical elements have been a perennial topic in *Word Ways*, going back to the very first issue. And Darmstadt, where I live, is perhaps most famous its elemental research: six of the elements currently known to science were discovered here, including of course element 110, darmstadtium. So as both a *Darmstädter* and a recreational linguist it would be remiss of me not to offer up my own humble contribution to this popular logological subfield. One of the nice things about the elements is that new ones get discovered and named all the time, so any findings about the set of names and abbreviations as a whole bear periodic re-examination. In this article I will therefore revisit the subject of words constructed from the abbreviations of elements, with a number of new results made possible by recent advances in chemistry.

There are currently 118 known elements, each represented by a one-, two-, or three-letter symbol (see Figure 1). Dmitri Borgmann was perhaps the first logologist to note that many words, including the names of some elements themselves, can be formed by sequences of such symbols. He dubbed such words *elemental words* or *chemical words*, and in 1974 devoted a short article to finding ones with various interesting properties [2].

Borgmann's first task was to find the longest elemental word, and he came up with the respectable 12-letter specimen CHAmBErLaInS. In 1979 Ed Wolpow and Tom Pulliam claim to have beaten this record with the 22-letter HYPErCoNSCIENTiOUSNeSS [1]. While this was accepted by *Word Ways* at the time, closer examination reveals this word to be spurious, since there is no element with the symbol E (nor Ie, En, Cie, Ien, or Ent). Borgmann's CHAmBErLAInS therefore remained unsurpassed until 1999, when Mike Keith reported the 19-letter SUPErCoNdUCTiVITiEs [5].

Some years ago my own (unpublished) search using a large word list turned up the legitimate 23-letter NONRePReSeNTaTiONAlISmS. This was, to my knowledge, the uncrowned world record up until 2012. In that year, the International Union of Pure and Applied Chemistry (IUPAC) officially named the newly synthesized element 114 *flerovium*, with the symbol Fl. This new symbol now allows the construction of a very impressive 29-letter elemental word: FlOCCINaUCINIHILiPILiFICAtION. I probably need not explain to *Word Ways* readers that this word means "the act of describing something as worthless", though I will point out that it's a rather fitting word to make with flerovium, given that scientists have yet to discover any practical use for the element.

Borgmann's original definition of elemental words stipulated that no one symbol be used more than once; all the elemental words given in the previous paragraph, except for Borgmann's own CHAmBErLaInS, violate this restriction. If we cleave to the stricter definition, then the longest elemental word heretofore known was the 18-letter IrReSPONSiBILiTiEs, identified by Mike Keith in 1999 [5]. I am happy to be able to break this record as well (though no thanks to any recently discovered elements) with the 19-letter specimen IrReCoNCILaBiLiTiEs and the two 20-letter terms HYPErCoNScIOUSnEsSeS and HYPErCOAgULaBILiTiEs.

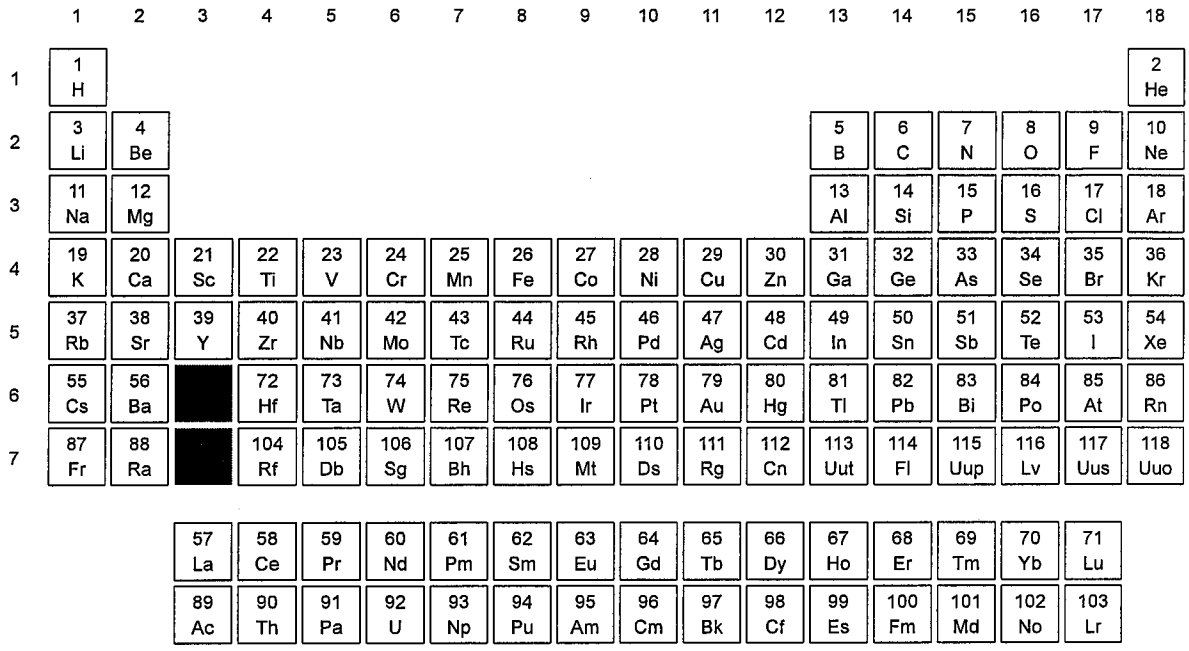

Figure 1: The periodic table of the elements, as of October 2013

Past elemental wordplayers have also tried restricting themselves to symbols of a certain length. For single-letter symbols, I am unable to find anything longer than Ed Wolpow's PSYCHOPANNYCHY [1], though for the case where repeated symbols are forbidden I can offer the 8-letter WICKYUPS, UNBISHOP, CUSHIONY, CHIBOUKS, and BOYCHIKS. For two-letter abbreviations, A. Ross Eckler held the record with the 10-letter HeLiCoPtEr [4]; this can now be supplanted with the 18-letter IrRePrEsSiBiLiTiEs or, where repeated symbols are excluded, the 16-letter ThErMoLaBiLiTiEs, IrRePaRaBiLiTiEs, InSePaRaBiLiTiEs, and InAlTeRaBiLiTiEs. The four three-letter elemental symbols (Uut, Uup, Uus, and Uuo) are utterly unproductive owing to their bothersome double U. However, these are all temporary, "systematic" symbols [3] which IUPAC will eventually supplant with shorter, more logologically useful ones.

Also of interest are those full names of elements which are themselves elemental words. Borgmann's 1974 article identified seven: CaRbON, ArSeNiC, IrON, NeON, PHOSPHORuS, SILiCoN, and XeNoN [2]. Susan Thorpe provided an additional three in 1995 (AsTaTiNe, CoPPEr, and TiN) [6], and in 2007 Antonio Joaquín Franco Mariscal brought the total to twelve with the addition of BiSmUTh and KrYPtON. For this task IUPAC comes to the rescue yet again: in 2012 it officially recognized the name *livermorium* for the recently discovered element 116, and assigned it the abbreviation Lv. To the list of elemental-word elements we can therefore add SiLvEr.

Borgmann's groundbreaking article also charged readers with finding elemental words which can be spelled in two or three alternate ways. As it turned out, this was much too easy a challenge; A. Ross Eckler upped the ante by finding *cosines*, for which he demonstrated thirteen different spellings: COSINeS, CoSINeS, CoSiNeS, COsINeS, COSiNeS, COSInEs, CoSInEs, COSINEs, CoSINEs, CoSiNEs, COsINEs, and COSiNEs [4]. But it's not hard to find even more productive words—here, for example, are 48 different spellings of *innocuousnesses*:

InNoCuOUSNeSSeS InNOCUOUSNEsSeS InNoCUOUSNeSSEs InNoCUOUSNEsSeS
InNOCUOUSNEsSEs INNoCuOUSNEsSeS InNOCUOUSNeSSeS InNOCuOUSNEsSEs
INNoCUOUSnEsSEs INNoCuOUSNEsSEs INNoCuOUSnEsSEs INNOCUOUSnEsSeS
INNOCUOUSNEsSEs InNoCuOUSnEsSeS InNoCuOUSNEsSEs INNoCUOUSNEsSeS
INNoCUOUSNeSSeS INNOCuOUSnEsSEs InNoCUOUSNEsSEs INNOCUOUSNeSSeS
InNoCuOUSnEsSEs InNOCuOUSnEsSEs InNOCUOUSnEsSeS InNOCUOUSNeSSEs
INNOCUOUSNeSSEs InNoCuOUSNEsSeS InNoCUOUSnEsSeS INNoCuOUSnEsSeS
InNOCuOUSNEsSeS InNoCuOUSNeSSEs InNOCuOUSNeSSeS INNOCuOUSNeSSeS
InNoCUOUSnEsSEs INNOCUOUSNEsSeS INNoCUOUSNEsSEs INNOCuOUSNeSSEs
InNoCUOUSNeSSeS INNOCUOUSnEsSEs INNoCUOUSnEsSeS INNOCuOUSNEsSEs
InNOCuOUSnEsSeS InNOCuOUSNeSSEs INNoCuOUSNeSSEs INNoCUOUSNeSSEs
INNOCuOUSNEsSeS InNOCUOUSnEsSEs INNoCuOUSNeSSeS INNOCuOUSnEsSeS

The word *inconspicuousnesses* can also be shown to have 48 different chemical spellings.

Thus far the search for elemental words has largely focussed on adherence to some linguistic or orthographic constraint. It might be more appropriate if we instead look to the *chemical* properties of the elements. The periodic table is useful here, as it structures the elements according to recurring chemical properties. The standard form (refer again to Figure 1) is a grid of 7 rows, known as *periods*, and 18 columns, known as *groups*. There is an additional double row below the main table, the *lanthanides* and *actinides*, which are actually fifteen columns of Periods 6 and 7 which have been cut out of the main table to save horizontal space. (Despite spanning multiple columns, they are sometimes considered to be entirely contained within Group 3.) All the elements in the table are numbered in ascending order, from left to right and top to bottom, according to their atomic number (i.e., the number of protons in their nucleus).

Let's first consider elemental words where the symbols appear in order of atomic number. My searches suggest that PArAsCeNdEr and BONaPArTiSm are the longest, at 11 letters. Going in reverse order, we find the even longer NoNpOsSeSSiON (13 letters). Next we could try forming elemental words from the periods and groups. The longest I found for each period, allowing for repetition of symbols, are as follows: (1) HeH (2) OFFLiNe, OBeLiON (3) SArSArS (4) CuTiNiSe (5) MoTeY (6) WAtErPoWEr (7) PaRaFlEs, PaRaCmEs, EsThEsEs, AmEsAcEs.

Table 1 shows my longest elemental words for the 18 groups, counting the lanthanides and actinides as part of Group 3. Owing to a dearth of vowels, Group 12 produces no elemental words at all, and the symbols of Groups 7 and 11 fail to combine, leaving only those symbols which are themselves words: Re (the second note of the musical scale), Cu (an obsolete spelling of *cow* or *cue*), and Ag (an interjection). But the word for Group 1 is, rather fortuitously, closely related to both Group 1 itself and the motivation for this paper: LiNaCs are the particular type of particle accelerator with which scientists in Darmstadt discovered six new elements, and with which they are currently attempting to synthesize the next element in Group 1, tentatively named ununennium (Uue, or element 119). Group 18's HeXeNe is also chemistry-related, referring to a class of chemical compounds composed of six carbon and twelve hydrogen atoms (though disappointingly, neither carbon nor hydrogen is found in Group 18).

There are, of course, other ways of grouping the elements which are more familiar to the layperson. For example, one can look at their state of matter under standard conditions: two elements are liquids (Hg and Br), eleven are gases (H, He, N, O, F, Ne, Cl, Ar, Kr, Xe, and Rn), and 87 are solids (all the remaining elements numbered 99 or lower). The 19 elements numbered 100 to

group	longest elemental words
1	LiNaCs
2	CaRaCaRa
3	UNdErLaYEr, ThErEuNdEr
4	TiTi
5	TaV
6	MoW
7	Re
8	RuRu, RuFe, FeHs
9	CoIr, CoCo
10	NiDs
11	Cu, Ag
12	—
13	AlBInAl
14	SiC
15	BiBi, BiAs
16	PoSSeSSeS
17	ClIFF
18	HeXeNe, HeArNe

Table 1: Elemental words by periodic table group

118 have been produced in such minute quantities that their state has not yet been determined. Unsurprisingly, there are no elemental words which can be produced from liquids alone. For the elemental gases, the longest elemental word is HeXeNe, though hexenes themselves are liquids and not gases. Neon and xenon *are* gases, however, and, when spelled NeON and XeNON, become the longest elemental words for gases spelled using gaseous elements. The longest word constructible from the solid elements is PHoSPHoMoNoEsTeRaSeS, a term from biochemistry referring to a kind of enzyme. As large biological molecules, the phosphomonoesterases are indeed solid, giving this word the additional distinction of being the longest solid compound which can be spelled using solid element symbols.

Another familiar way of classifying the elements is on the metal–nonmetal range. *Metals* include all the elements from Groups 1 through 12, with the possible exceptions of Mt, Ds, and Rg (whose properties have not yet been established), and with the definite exception of H. Also grouped with the metals are Al, Ga, In, Sn, Tl, Pb, Bi, and (usually) Po. The *nonmetals* include H, He, C, N, O, F, Ne, P, S, Cl, Ar, Se, Br, Kr, I, Xe, At, and Rn. The remaining 17 elements are difficult to classify; either they share properties of both metals and nonmetals, or they have not yet been produced in sufficient quantities to make a determination one way or another. For metals, the longest elemental words we can make have 16 letters, among them ThErMoLaBiLiTiEs. This word, which we previously noted as among the longest elemental words formed with two-letter symbols, is also a chemistry term, meaning "susceptibilities to chemical decomposition upon the application of heat". BiSmUTh is another interesting metal word, since it is the only metallic element which can be spelled exclusively with symbols for metals.

As regards the nonmetals, the longest word we can form from them is the 16-letter PHOSPHAtISAtIONS, meaning "treatments with phosphoric acid". Phosphoric acid is, by happy coincidence, a chemical compound composed entirely of nonmetals: H_3PO_4. The previously mentioned NeON and XeNON are also examples of nonmetal words which can be produced entirely with nonmetal element symbols.

Of course, there are myriad other ways of classifying and ordering the chemical elements: by density, by electrical or thermal conductivity, by radioactivity, by metal subtype, by periodic table block, by year of discovery, and so on. These give rise to all a manner of interesting logological questions. For example, what are the most and least physically dense elemental words of a given length? Among radioactive elemental words, which have the longest and shortest half-lives? Also, can any of the records described in this paper be improved upon, possibly by slightly changing the problem? For example, we have seen that in English there are now thirteen elements whose names are themselves elemental words. Is there another language which has more? And finally, consider the four new elements yet to be formally named—what new one- or two-letter symbols would be most logologically useful? (Perhaps *Word Ways* readers should petition IUPAC with their suggestions!) It's clear that the opportunities for wordplay with elemental words are far from exhausted.

References

[1] Colloquy. *Word Ways*, 12(4):214–219, 1979.
[2] Dmitri Borgmann. Chemical words. *Word Ways*, 7(4):198, November 1974.
[3] Dmitri Borgmann. New elemental vistas. *Word Ways*, 20(1):19–22, February 1987.
[4] A. Ross Eckler. Elemental, my dear Watson. *Word Ways*, 33(1):65–66, February 2000.
[5] Dave Morice. Kickshaws. *Word Ways*, 32(4):283–293, November 1999.
[6] Susan Thorpe. The elemental game. *Word Ways*, 28(2):86–87, 1995.