Language is one of our most powerful metaphors - its ubiquity hides its particularity. Many things are considered to be 'like language'. Music is one, mathematics another, chemistry a very close third. Such statements grab onto a few similarities and invite us to ponder whether the differences are really so significant after all. The similarities are sometimes so overwhelming that we slip from simile to metaphor: chemistry is not 'like language,' it is a language.

One of the reasons people find the metaphor of chemistry as a language so compelling is because of orthography, the systematic way it is written. Speech is fleeting, but writing promises to hold language stable. Spoken languages come and go, and they also display a frustrating capacity to change; the ‘Englishes’ of Beowulf and Chaucer are not the ‘English’ we speak today. Writing preserves languages from extinction (think of Latin and Sanskrit), and also gives them resistance to mutation. A lot of the language we encounter every day comes in the form of writing, and since many (perhaps most or even all) of the languages you or I interact with have written counterparts, it is easy to make the reverse equation: that which has a writing system is a language.

What looks like language

It’s trivial to see how this works for chemistry. Not only are there standardised graphemes for the chemical elements, but the very appearance of chemical equations, like mathematical ones, has a syntax that patterns onto Indo-European languages (like English, French, German and Russian). To pick one of the simplest examples, ‘$2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$’ can be effortlessly translated term for term into a sentence: ‘Two molecules of water transform into two diatomic hydrogen molecules and one diatomic oxygen molecule.’

The analogy goes deeper, since compounds look like words made up of letters - as with H$_2$O and water - and the complexity of possible reactions, and the ability to set down sequences of reactions on paper, resembles writing strongly. (The analogy breaks down with structural formulas of complex organic molecules, which do not resemble written words.)

Like language, we can build an infinity of chemical formulas and reactions from finite components (one of Noam Chomsky’s central observations about human language), but we can’t build them willy-nilly, for there are unbreakable rules that govern the sense of the sentence. The parallel looks rather good.

The catch is that writing isn’t language. It is a system for representing speech, and it does this imperfectly (think of obsolete pronunciations fossilised in spellings like ‘knife’ and ‘night’). More to the point, illiterate individuals (most of humanity for most of history) are still perfectly capable of using language, and a good portion of the Earth’s 7000-odd languages are without orthography. Just as all languages do not have writing systems, so all writing systems do not betoken a language. Chemistry is one of the latter cases: it is not the kind of thing you can teach an infant to speak fluently; it does not have a grammar; it is not, despite its syntax and its formulas, a language.

No lingua franca

Nonetheless, the temptation to think of chemistry in linguistic terms is overwhelming – and productive. Antoine Lavoisier and his collaborators developed the terminology of the elements that we still use today. They broke from an older, evocative system (‘flowers of vitriol’, ‘verdigris’ etc) into an analytic representation whereby the names of compounds would reveal their composition. They did so inspired by the philosophy of language formulated by Otienne Bonnot de Condillac.
Jöns Jacob Berzelius proposed his chemical symbols out of the desire to build an international writing system that harnessed the power of the Roman alphabet. As my student Evan Hepler-Smith is demonstrating in his dissertation in progress at Princeton University, similar linguistic analogies animated the construction of the Geneva nomenclature of organic compounds in 1892. The inspirations of language have enabled some of the most powerful conceptual tools chemists have.

The benefits of entertaining the metaphor do not accrue only to chemists. Two of the great figures of early 20th century linguistics – Ferdinand de Saussure, the Swiss father of structuralism, and Otto Jespersen, the Danish specialist on the English language – both repeatedly pointed to chemical nomenclature as an illustration of some of the constructed properties of the linguistic system. Chemists in every language refer to the same entity responsible for combustion, but some languages (English, Hungarian) adopt Lavoisier’s false Greek neologism of ‘oxygen’, while others (German, Hebrew, Russian) calque it into ‘acid-maker’ in their respective tongues, and others still (Danish, Polish) use their own linguistic roots to capture the concept more accurately as related to fire. None of these is right, a gold standard that undergirds their value; rather, like currency, they are crucial components of separate systems, convertible across linguistic borders.

It is in this sense, the notion of local systems and international translations, and not the symbolic notation, that chemical nomenclatures resemble language most. It’s not a perfect fit, but what metaphor ever is?

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