

Essay

**Benjamin Lee Whorf:
once a chemist ...**

ROALD HOFFMANN

Department of Chemistry, Cornell University, NY, USA

PIERRE LASZLO

Pinehurst, NC, USA

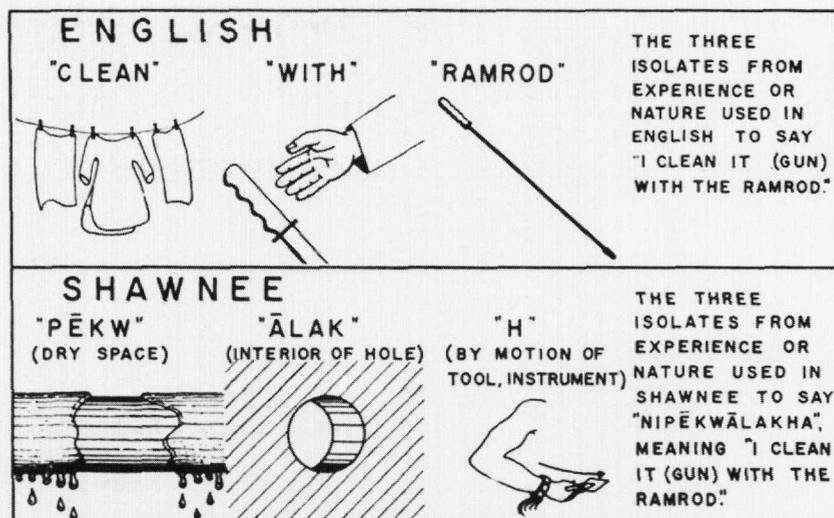
One finds chemists in the strangest places – writers and weavers, business moguls, farmers, and bums. After all, isn't chemistry the central science? And a chemist who can analyse a pheromone mixture should be capable of any complex task under the sun – our business schools demonstrate their valuation of such prowess in their welcome for our undergraduates. What is interesting is not so much that chemists wind up doing things outside chemistry, but a different problematic: when chemists do something else well, does their chemical past influence them?

Consider the all too short life of one of the most interesting linguists of the past century, Benjamin Lee Whorf (1897–1941). Born in Massachusetts in 1897, he graduated with a BS in chemical engineering from MIT in 1918. He was then hired by the Hartford Insurance Company in Hartford, Connecticut, where he spent all his professional life, becoming an expert in industrial fire prevention. Wallace Stevens, the great American poet, worked for the same company, in the same building. They are not known to have met; but there is material for a play in such a hypothetical meeting, whether in a lunchroom or a bathroom.

Whorf married and had three children. In the late 1920s he began to correspond with some of the leading linguists and anthropologists. In 1931 he became a graduate student at Yale (New Haven and Hartford, both cities in Connecticut, are not that far apart), and worked with Edward Sapir, the anthropologist. Whorf then began to publish scholarly papers in the leading journals in linguistics, and more popular essays in a variety of periodicals. As Whorf's reputation grew, he could easily have become an academic. Instead he chose to continue his chemistry related industrial profession, carving out his linguistic career in evenings and vacations. Whorf died young from cancer in 1941.¹

As a linguist, Whorf carried out deep studies of Nahuatl, Maya, and Hopi, as well as other American Indian languages. From these studies he abstracted a programme for linguistics and a hypothesis which has been indelibly associated with his name. And, as we will show below, chemistry affected his way of thinking.

A worldview is determined by the structure of one's language. This idea, known as the Sapir–Whorf (SW) hypothesis, has a lineage going back at least to Pierre Abélard and including Wilhelm von Humboldt in the nineteenth century,² the analytic philosophers writing at the beginning of the twentieth century (Frege, Russell, Wittgenstein, ...), and the influential book by Ogden and Richards 'The meaning of meaning'.^{3,4} The SW notion crystallised again at a time when the disciples of Franz Boas, such as Ruth Benedict ('Patterns of culture', 'The chrysanthemum and the sword') and Margaret Mead ('Coming of age in Samoa'), were presenting compelling evidence for the wide diversity of human cultures – no value



1 Whorf's dissection of the phrase 'I clean with a ramrod' in English and Shawnee¹¹

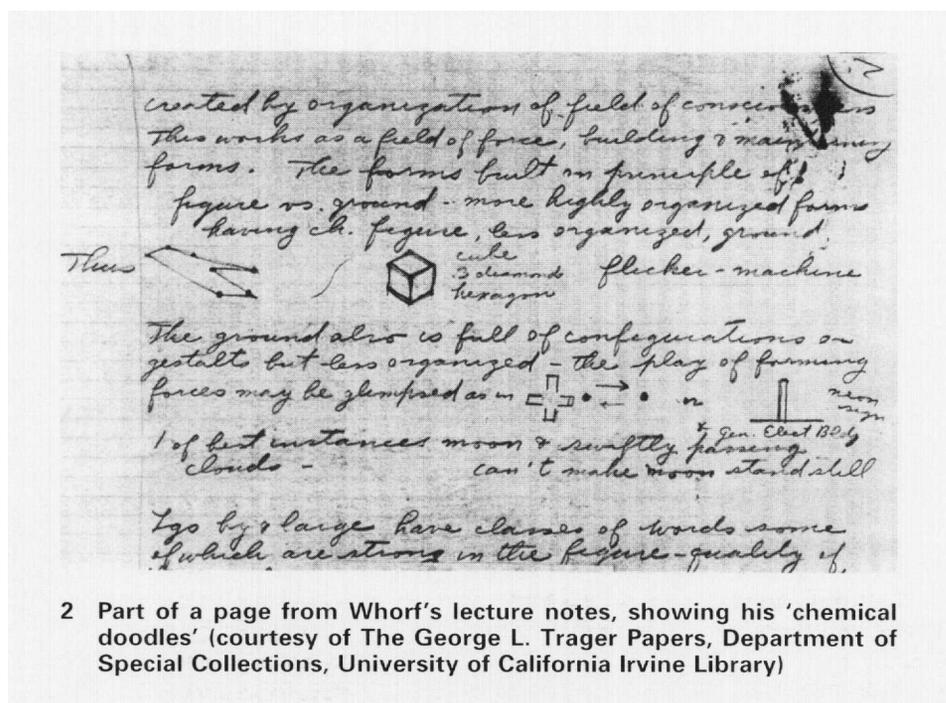
judgement attached. Thus, it partook of the idea, inherited from the mythical Tower of Babel, of a plurality of cultures and languages (even if disparaged in some sectors of the Judaeo-Christian tradition), each specific, each respectable.

In time, the SW hypothesis, immensely attractive, became a casualty of the interest from analytic philosophers, such as Ludwig Wittgenstein, in the terminology of colour, leading to the finding of a universal naming of eleven colours, in a definite sequence.⁵⁻⁷ Another major blow to the SW hypothesis was the intellectual revolution of Chomsky and his followers, positing the innate presence in the brain of a universal grammar antedating the acquisition of language by the child. Unfortunately, Whorf himself became discredited among the linguists, not only because of the influence of MIT linguistics, but on account of his open flirting with theosophy, the occult philosophy associated with Madame Blavatsky; and with the semantics of Count Alfred Korzybsky, dismissed by professional linguists. Here is a typical (and in our opinion unfair) modern condemnation of Whorf, by Steven Pinker: 'No one is really sure how Whorf came up with his outlandish claims, but his limited, badly analyzed sample of Hopi speech and his long-time leanings toward mysticism must have contributed.'⁸

Then there was the rather silly mistake by Whorf about the terms for 'snow' in the languages of the Eskimo: he claimed that those languages did not, like English, have a generic word for 'snow' but that they had, unlike English, many names for the various types of snow (this is played out at some length in Peter Hoeg's popular and ultimately antiscientific novel 'Miss Smilla's feeling for snow'). Whorf was empirically wrong on both counts.

Whorf may have separated his daily lives in applied chemistry and linguistics, but he was not afraid of allowing metaphors, the stuff of the creation of understanding,⁹ to permeate the boundary between his life interests. Here, for instance, is his contrast of English with Nootka and Shawnee:¹⁰

the way the constituents are put together in these sentences ... suggests a chemical compound, whereas their combination in English is more like a mechanical mixture. A mixture, like the mountaineer's potlicker, can be assembled out of almost anything and does not make any sweeping transformation of the overt appearance of the material. A chemical compound, on the other hand, can be put together only out of mutually suited ingredients, and the result may be not merely soup but a crop of crystals or a cloud of smoke.



2 Part of a page from Whorf's lecture notes, showing his 'chemical doodles' (courtesy of The George L. Trager Papers, Department of Special Collections, University of California Irvine Library)

Whorf illustrated some of his linguistics papers with drawings that share representational ground with chemical structures. So in Fig. 1 Whorf dissects, as a chemist is wont to identify atom groups in a molecule, the single phrase 'I clean with a ramrod' in English and in Shawnee.¹² His lecture notes sometimes contain drawings that resemble chemical doodles – as in Fig. 2.

Whorf also wanted to educate his fellow linguists in chemistry! *Main Currents in Modern Thought* was a shortlived newsletter founded and edited by F. Kunz, to which Whorf contributed abundantly in 1940 and 1941. In it he wrote of linguistics to be sure, but he also had a regular item in which he reported to his social scientist and humanist readers the latest advances in chemistry. He also contributed to MIT's *Technology Review*. Here, for instance, is his vivid description of a new material:¹³

Glass is a curious substance. It is not a crystal. In a crystal the atoms are symmetrical about a point. In glass the arrangement is not symmetrical, yet it is geometrical. A diagram of the theoretical structure in this paper¹⁴ shows the atoms in an orderly arrangement of interlocking spirals. These researches into the structure of glass have borne fruit in a new and remarkable variety. It is of great value for chemical work, and is called 'preformed glass'. The dish or bowl, after treatment with heat or acid, shrinks to two-thirds its former size! Its shape is retained exactly.

This is science communication at its best: concise, conveying a sense of wonder, and hinting at what is intriguing to a scientist. Or consider Whorf introducing the topic of tensioactives to the readership of *Main Currents in Modern Thought*:¹⁵

A duck will sink in water to which has been added a small amount of Aerosol Ot (the di-octyl ester of sodium sulfo-succinate). So will powdered sulphur, cotton-wool, or string, which float on ordinary water. This is a spectacular demonstration of the fact that properties popularly thought to be an essential part of the matter involved are due to forces in the interspaces between the molecules of matter. In this case the forces are those that produce surface tension, and a suitable chemical will so alter these forces that the surface tension is reduced.

We cannot resist quoting another snippet of his lovely prose, from a text about the periodic table and about isotopes:¹⁶

These [sensitive electric devices] and the radiant tracer particles carried along with other matter act like extensions of our limited senses and enable us to perceive as though we had more penetrating senses. If we had such senses we should not see things in as isolated a way, stopping short at such marked

boundaries as we now see. There would be zones of flowing atomic matter extending out from objects; metals and chemicals would seem almost alive for we would see motion going on within them and outflowing from them – fine matter would be wandering and streaming about, flowing away from them and right through other pieces of metal. Substances that we call catalysts we should see helping forward these interpenetrations.

In 1924, at the age of 27, Whorf began to write a novel that would remain unpublished, 'The ruler of the universe'.¹⁷ It is a dark contemplation, grounded in the aftermath of the First World War. The memory of chemical warfare during the war permeates the novel, with its deep and pessimistic portrayal of the relationships between science, industry, and war. Here is a passage in which Whorf draws on new chemistry of his day (the Haber-Bosch process) and shows an awareness of biological nitrogen fixation (p. 135):

Consider the gigantic manufacturing plant that was reared in the land of Tennessee in the year 1918. ... its rows of electrical furnaces wherein dazzling blue and violet and orange fires continually transformed lime and carbon into a queer substance unknown in nature, its mazes of moving machinery and criss-cross pipes wherein air was condensed to a simmering liquid or scalding coldness, its ranks of huge stills and retorts and pulverizing mills, and all these miles of paraphernalia and prodigies of heat and cold to accomplish that which a little bacterium cell, microscopic and unorganized, could do quietly and invisibly at ordinary temperature – the bringing of nitrogen from the air into chemical combination – consider this and reflect that the purpose of all this vast-scaled chemistry was to make uncounted ton after ton of explosives with which to blast human beings into bits of decaying slime. Was it not especially remarkable and evidential of original sin that such giant coordination and harmony of chemical, electrical, physical, mechanical, economic sciences should be possible only for a destructive purpose, and that such delving among mysteries and miracles of intensest heat and cold and most marvelous fusion and crystallization should require the stimulus of animosity and await the day of hate and perversion for its full fashioning?

Please do not draw the conclusion that Whorf was a wild radical; on the contrary this endearing and enigmatic man was a personal conservative, and deeply religious.

Extreme relativism has had a run lately in the context of social construction of science – we suspect more as a bogeyman for some overly defensive scientists to berate than as a reflection of realities. Would Whorf, had he lived longer, have translated his relativism of thought shaped by language into some more general doubt about an underlying reality? We strongly doubt it – this speculative dreamer was a conservative Yankee engineer and scientist.

More recently, a discreet Whorf revival has been taking place, as the influence of Chomskyan linguistics is a bit on the wane. A relevant *Scientific American* column is entitled 'New whoof in Whorf'.¹⁸ Also, the awesome difficulties of automatic translation (artificial intelligence), together with the challenges of the translator's art, as pointed out by George Steiner¹⁹ or by William Gass,²⁰ are refocusing serious interest on the SW hypothesis.

In any case, Whorf's was an intellect honed by chemistry into expertise on industrial fires, and his deep interests in linguistics as a weekend linguist did not stifle his curiosity for new developments in chemical science. Chemistry is a language, a language one learns, a language that Whorf learned well at MIT. Language affects thought, Whorf believed. He would hardly have been surprised to hear us say that his life's work in linguistics was influenced by his chemical background.

Whorf brought to linguistics and to anthropology notions of specificity and of relativity that we think are related to the way in which chemists view elements and substances: once a chemist, always a chemist, perhaps?

Notes and literature cited

1. There is no definitive biography of Whorf. See, however, J. B. CARROLL (ed.): 'Language, thought and reality. Selected writings of Benjamin Lee Whorf'; 1956, Cambridge, MA, MIT Press, and T. SEBEOK (ed.): 'Portraits of linguists', Vol. 2: 1967, Bloomington, IN, Indiana University Press.
2. W. VON HUMBOLDT: 'Über die Verschiedenheit des menschlichen Sprachbaues und ihren Einfluss auf die geistige Entwicklung des Menschengeschlechts'; 1836, Berlin, Königl. Akademie der Wissenschaften.
3. C. K. OGDEN and I. A. RICHARDS: 'The meaning of meaning: a study of the influence of language upon thought and of the science of symbolism'; 1923, London, Kegan Paul, Trench, Trubner & Co.
4. J. E. JOSEPH: *Historiographia Linguistica*, 1996, **XXIII**, 365–404.
5. B. BERLIN and P. KAY: 'Basic color terms: their universality and evolution'; 1969, Berkeley, CA, University of California Press.
6. P. KAY and C. K. MCDANIEL: *Language*, 1978, **54**, 610–645.
7. P. KAY, B. BERLIN, and W. MERRIFIELD: *Journal of Linguistic Anthropology*, 1991, **1**, 12–25.
8. S. PINKER: 'The language instinct', 63; 1994, London, Allen Lane.
9. See C. M. TURBAYNE: 'The myth of metaphor'; 1962, New Haven, CO, Yale University Press.
10. J. B. CARROLL (ed.): 'Language, thought and reality. Selected writings of Benjamin Lee Whorf', 233–245; 1956, Cambridge, MA, MIT Press. This article was originally published in *Technology Review*.
11. The illustration comes originally from an essay by Whorf entitled 'Science and linguistics', published in *Technology Review*, 1940, **42**, 229–231, 247–248.
12. See E. A. SCHULZ: 'Dialogue at the margins. Whorf, Bakhtin, and linguistic relativity'; 1990, Madison, WI, University of Wisconsin Press for an analysis of Whorf's non-verbal rhetoric.
13. B. L. WHORF: *Main Currents in Modern Thought*, 1941, **1**, 16.
14. The reference is to an article by B. E. Warren in *Technology Review* (1941).
15. B. L. WHORF: *Main Currents in Modern Thought*, 1940, **1**, 14.
16. B. L. WHORF: *Main Currents in Modern Thought*, 1941, **1**, 12–13.
17. We know the novel only through a secondary source, from which this quotation is taken (P. C. ROLLINS: 'Benjamin Lee Whorf: lost generation theories of mind, language and religion'; 1980, Ann Arbor, MI, University Microfilms. The novel appears as an appendix to Peter Rollins' 1972 Harvard University PhD thesis, 'Benjamin Lee Whorf: transcendental linguist').
18. P. E. ROSS: *Scientific American*, 1992, February, 24–26.
19. G. STEINER: 'After Babel. Aspects of language and translation', 3rd edn; 1998, Oxford, Oxford University Press. Steiner writes admiringly of Whorf and rightly points to the similarity of his linguistic relativism to Claude Lévi-Strauss's cultural relativism in, for instance, 'La pensée sauvage'.
20. W. H. GASS: 'Reading Rilke'; 1999, New York, NY, Alfred A. Knopf.

Roald Hoffmann (email rh34@cornell.edu) is a long time member of ISR's Editorial Board, a professor in the Department of Chemistry at Cornell University (Ithaca, NY, USA), and a published poet. Pierre Laszlo is an emeritus professor of both the Institut de chimie, Université de Liège au Sart-Tilman in Belgium and the chemistry department of the Ecole polytechnique in Palaiseau, France, and now a science writer.