Science, Language and Poetry

Roald Hoffmann[1]

There was chemistry before the chemical journal. It was described in books, in pamphlets or broadsides, in letters to secretaries of scientific societies. These societies, for instance the Royal Society in London, chartered in 1662, played a critical role in the dissemination of scientific knowledge. Periodicals published by these societies helped to develop the particular combination of careful measurement and mathematization that shaped the successful new science of the time (Garfield 1981 and references cited therein).

In time, the chemical article took on a definitive format, which in many ways has not changed since the middle of the 19th Century. Emotions and history are left out, and the new is reported in a passive voice, third person style that is familiar to all of us. What has changed is the quality of the graphics, essential to chemistry. But the sections of the paper, the mode of presentation and argumentation has not changed. In this ossified stylistic mode, remarkable new discoveries, the making of molecules previously unimaginable, is reported. But there is a lot going on under the surface of the chemical article, some of which I describe below.

Art

The chemical article is an artistic creation. Let me expand on what might be viewed as a radical exaggeration. What is art? – many things to many people. One aspect of art is aesthetic, another that it engenders an emotional response. In still another attempt to frame an elusive definition of that life-enhancing human activity, I will say that art is the seeking of the essence of some aspect of nature or of some emotion, by a human being. Art is constructed, human and patently unnatural.

What is written in a scientific periodical is not a true and faithful representation (if such a thing were possible) of what transpired. It is not a laboratory notebook, and one knows that that notebook in turn is only a partially reliable guide to what took place, it is a more or less (one wishes

1. Roald Hoffmann is the Frank H.T. Rhodes Professor of Humane Letters and Professor of Chemistry at Cornell University, Ithaca, NY 14853–1301. In 1981 he shared the Nobel Prize in Chemistry with Kenichi Fukui for his work in applying quantum mechanics to predict the course of chemical reactions.

more) carefully constructed, man- or woman-made *text,* that serves the rhetorical purpose (no weaker just because it's suppressed) of making us think better of the author. The obstacles that are overcome highlight the success of the story.

The chemical article is a man-made, constructed abstraction of a chemical activity. If one is lucky, it creates an emotional or aesthetic response in its readers.

Is there something to be ashamed of in acknowledging that our communications are not perfect mirrors, but in substantial part literary texts? I don't think so. In fact, I think that there is something exquisitely beautiful about our texts. These "messages that abandon", to paraphrase *Jacques Derrida* (1972), indeed leave us, are flown to careful readers in every country in the world. There they are read, in their original language, and understood; there they give pleasure *and,* at the same time, they can be turned into chemical reactions, real new things. It would be incredible, were it not happening thousands of times each day.

History

One of the oft-cited distinguishing features of science, relative to the arts, is the more overt sense of chronology in science. It is made explicit in the copious use of references. But is it real history, or a prettified version?

A leading chemical style guide of my time admonished: "... one approach which is to be avoided is narration of the whole chronology of work on a problem. The full story of a research may include an initial wrong guess, a false clue, a misinterpretation of directions, a fortuitous circumstance; such details possibly may have entertainment value in a talk on the research, but they are probably out of place in a formal paper. A paper should present, as directly as possible, the objective of the work, the results, and the conclusions; the chance happenings along the way are of little consequence in the permanent record (Fieser and Fieser 1960).

I am in favour of conciseness, an economy of statement. But the advice of this style guide, if followed, leads to real crimes against the humanity of the scientist. In order to present a sanitized, paradigmatic account of a chemical study, one suppresses many of the truly creative acts. Among these are the "fortuitous circumstances" all of the elements of serendipity, of creative intuition at work (Medawar 1964).

Taken in another way, the above prescription for good scientific style demonstrates very clearly that the chemical article is *not* a true representation of what transpired or was learned, but a constructed text.

Language

Scientists think that what they say is not influenced by the language they use, meaning both the national language (German, French, Chinese) and the words within that language. They think that the words employed, providing they're well defined, are just representations of an underlying material reality which they, the scientists, have discovered or mathematicized. Because the words are faithful representations of that reality they should be perfectly translatable into any language.

That position *is* defensible as soon as the synthesis of the new high-temperature superconductor $Yba_2Cu_3O_{7-x}$ was described, it *was* reproduced, in a hundred laboratories around the globe.

But the real situation is more complex. In another sense words are all we have. And the words we have, in any language, are ill defined, ambiguous. A dictionary is a deeply circular device just try and see how quickly a chain of definitions closes upon itself. Reasoning and argument, so essential to communication in science, proceed in words. The more contentious the argument, the simpler and more charged the words (Hoffmann 1987 and 1988).

How does a chemist get out of this? Perhaps by realizing what some of our colleagues in linguistics and literary criticism learned over the last century (for an introduction to modern literary theories see Eagleton 1983). The word is a sign, a piece of code. It signifies something, to be sure, but what it signifies must be decoded or interpreted by the reader. If two readers have different decoding mechanisms, then they will get different readings, different meanings. The reason that chemistry works around the world, so that BASF can build a plant in Germany or Brazil and expect it to work, is that chemists have in their education been taught the same set of signs.

I think this accounts in part for what *Carl Friedrich von Weizsäcker* noted in a perceptive article on "The Language of Physics" (1974). If one examines a physics (read chemistry) research lecture in detail one finds it to be full of imprecise statements, incomplete sentences, halts etc. The seminar is usually given extemporaneously, without notes, whereas humanists most often read a text verbatim. The language of physics or chemistry lectures is often imprecise. Yet chemists understand these presentations (well, at least some do). The reason is that the science lecturer invokes a code, a shared set of

common knowledge. He or she doesn't have to complete a sentence most everyone knows what is meant halfway through that sentence.

Dialectical Struggles

A nice, even-toned, scientific article may hide strong emotional undercurrents, rhetorical manoeuvring, and claims of power. One has already been mentioned the desire to convince, to scream, "I'm right, all of you are wrong", clashing with the established rules of civility supposedly governing scholarly behaviour. Where this balance is struck depends on the individual.

Another dialogue that is unvoiced is between experiment and theory. There is nothing special about the love-hate relationship between experimentalists and theorists in chemistry. You can substitute "writer" and "critic" and talk about literature, or find the analogous characteristics in economics. The lines of the relationship are easily caricatured experimentalists think theorists are unrealistic, build castles in the sky. Yet they need the frameworks of understanding that theorists provide. Theorists may distrust experiments, wish that people would do that missing experiment, but where would the theorists be without any contact with reality?

An amusing manifestation of the feelings about this issue is to be found in the occasionally extended quasi-theoretical discussion sections of experimental papers. These sections in part contain a true search for understanding, but in part what goes on in them is an attempt to use the accepted reductionist ideal (with its exaggerated hailing of the more mathematical) so as to impress one's colleagues. On the other side, I often put more references to experimental work in my theoretical papers than I should, because I'm trying to "buy credibility time" from my experimental audience. If I show experimental chemists that I know of their work, perhaps they'll give me a little time and listen to my wild speculations.

Another struggle, related, is between pure and applied chemistry. It's interesting to reflect that this separation also may have had its roots in Germany in the mid-nineteenth century; it seems to this observer that in the other chemical power of that time, Britain, the distinction was less congealed. Quite typical in a pure chemical paper is a reaching out after some justification in terms of industrial use. But at the same time there is a falling back, an unwillingness to deal with the often unruly, tremendously complicated world of, say, industrial catalysis, And in industrial settings there is a reaching after academic credentials (quite typical, for instance, of the leaders of chemical industry in Germany).

Conclusion

The language of science is a language under stress. Words are being made to describe things that seem indescribable in words equations, chemical structures and so forth. Words don't, cannot mean all that they stand for, yet they are all we have to describe experience. By being a natural language under tension, the language of science is inherently poetic. There is metaphor aplenty in science. Emotions emerge shaped as states of matter and, more interestingly, matter acts out what goes on in the soul.

One thing is certainly not true: that scientists have some greater insight into the workings of nature than poets. Interestingly, I find that many humanists deep down feel that scientists have such inner knowledge that is barred to them. Perhaps we scientists do, but in such carefully circumscribed pieces of the universe! Poetry soars, all around the tangible, in deep dark, through a world we reveal and make.

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