



## **The Language of Science** ***The Language of Poetry***

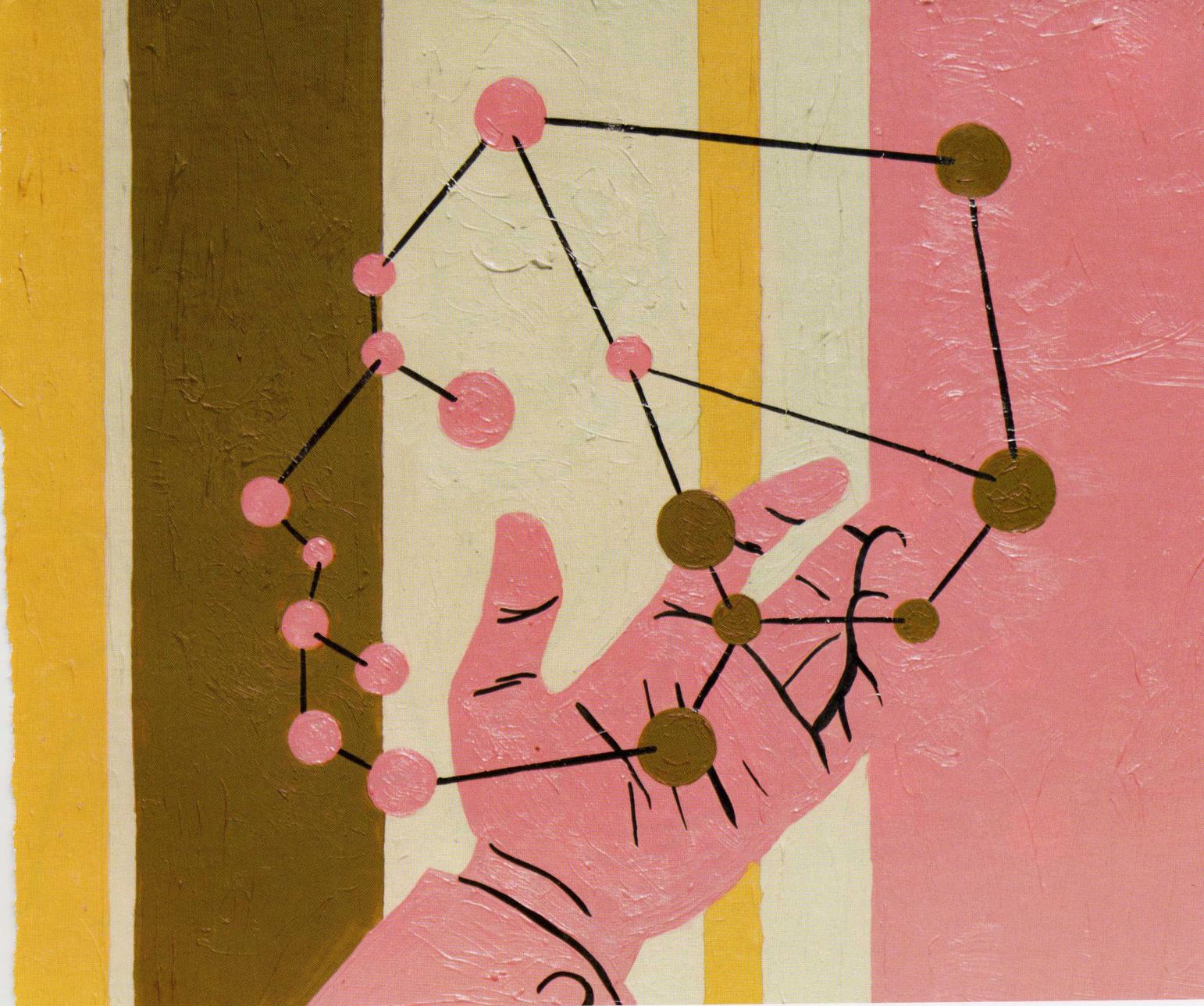
For poet, playwright, professor and Nobel Prize winning chemist Roald Hoffmann the language of science is inherently poetic

*Illustrations Christoph Niemann*

**T**here was a time when they were together, poetry and science – these two luxuriating, contraentropic glories of the human spirit. They walked hand in hand with Lucretius. And in English, with Alexander Pope, who could write poetry of the frontier science of his day. Pope, for that matter, had no trouble in putting the poet and the chemist side by side in their . . . delusions:

*See the blind beggar dance,  
the cripple sing,  
the sot a hero, lunatic a king;  
The starving chemist in his golden views  
Supremely blest, the poet in his muse.*

In a way, both poets and scientists were once natural philosophers. Maybe the same person, maybe two. Both (or one) trying to understand



the beautiful and terrible world around and within us. The natural philosopher never left poetry. But he (and she) lost his way. No wonder – it was getting awfully dark, the smog and stink of the industrial revolution coming down over the Midlands and the Ruhr, and there were all these distracting wild noises, romanticism beating its chest. So part of the natural philosopher went this-a-way – into the scientist’s seductive and productive play with quality and quantity. And part went that-away – in the poet’s principled turn of nature into a willing (or conscripted) mirror for the self.

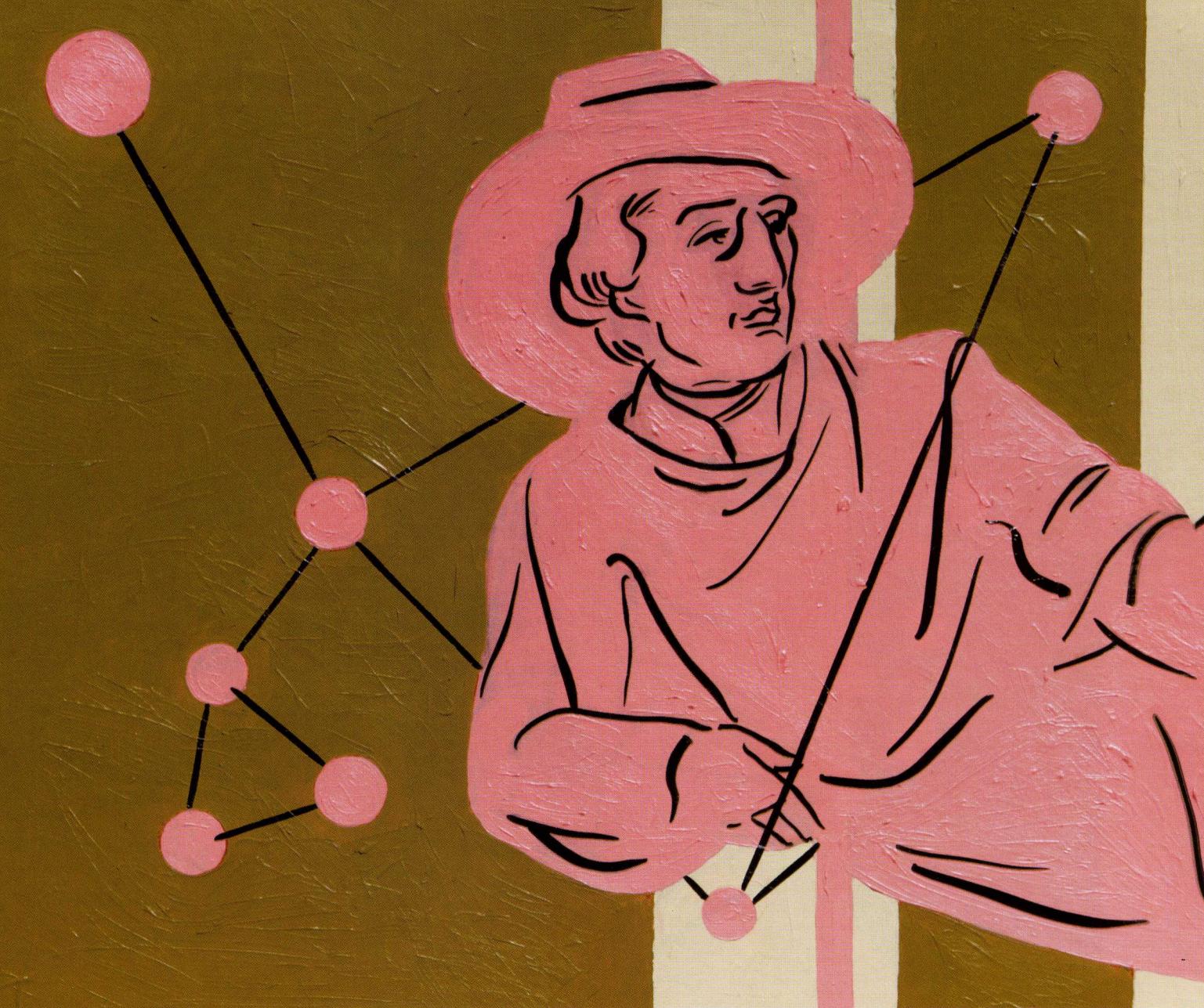
Could one say “too bad,” when what was granted us after separation was 175 years of glorious poetry, Baudelaire to Rilke to Tsve-taeva to Inger Christensen? And the greatest explosion of reliable knowledge of the in-

nards of the beast that humanity has ever seen – this the scientist’s boon? Yes, I would say “too bad,” for they could have moseyed through the beautiful and terrible landscape of the 20th century together.

#### **The Penetration of the Passive Voice**

Let’s look at the problematic in another way. You open an issue of a modern chemical periodical, say *Angewandte Chemie*, or *Journal of the American Chemical Society*, and what do you see? Riches upon riches: reports of new discoveries, marvelous molecules, unmakeable, unthinkable yesterday – made today, reproducibly, with ease.

Let’s, however, take another perspective. To the pages of the same journal turns a humanist who has grappled with Shakespeare, Pushkin, and Paul Celan. My observer notes

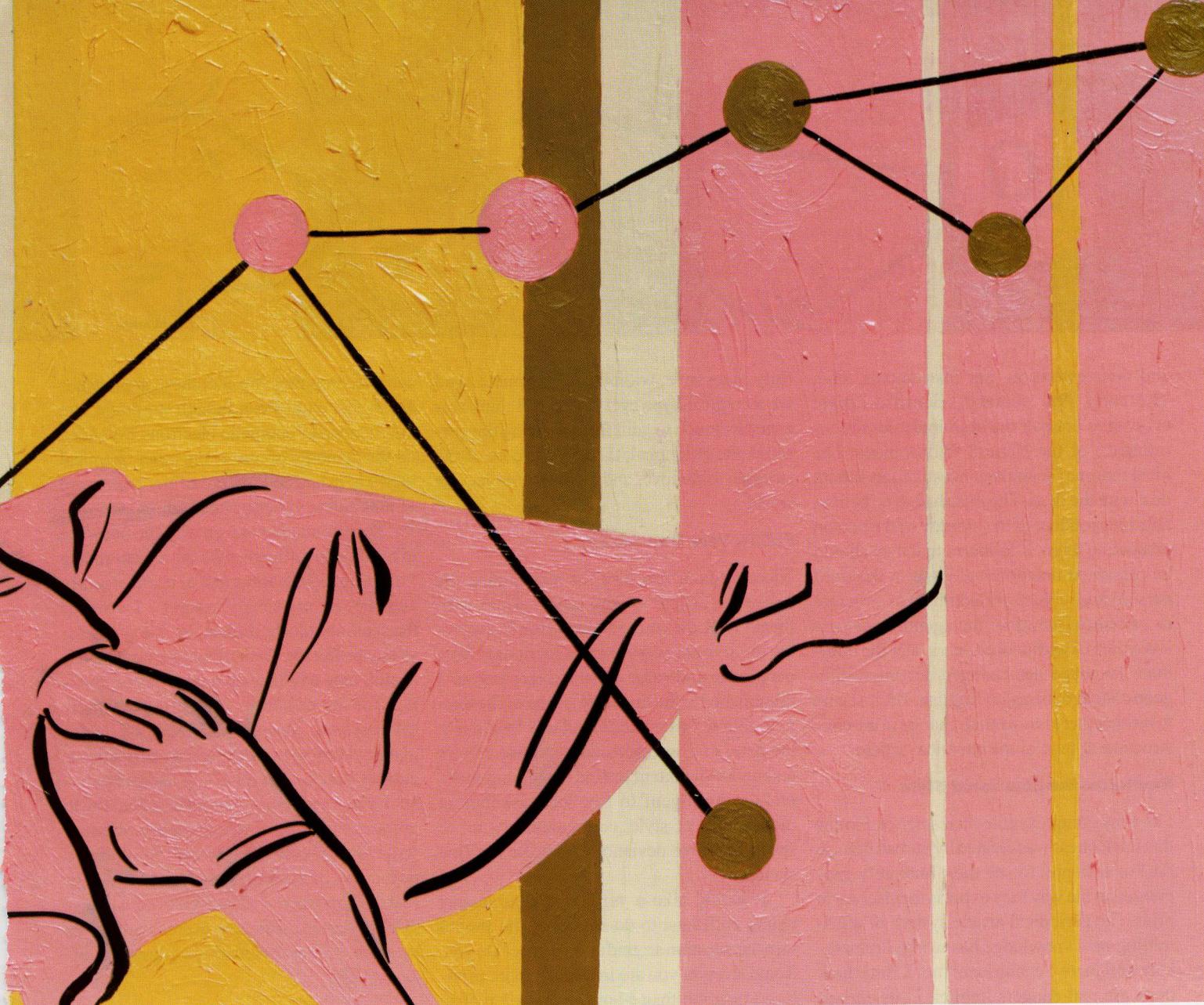


in the journal short articles, a page to ten pages in length. She notes an abundance of references, trappings familiar to literary scholars, but perhaps in greater density (number of references per line text) than in scholarly texts in the humanities. She sees a large proportion of the printed page devoted to drawings. Often these seem to be pictures of molecules, yet they are curiously iconic.

My curious observer reads the text, perhaps defocusing from the jargon, perhaps penetrating it with the help of a chemist friend. She notes a ritual form: The first sentences often begin “The structure, bonding and spectroscopy of molecules of type X have been subjects of intense interest.” There is general use of the third person and a passive voice. She finds few overtly expressed personal motivations, and few accounts of historical de-

velopment. Here and there in the neutered language she glimpses stated claims of achievement or priority – “a novel metabolite,” “the first synthesis,” “a general strategy,” “parameter-free calculations.” On studying many papers she finds a mind-deadening similarity. In the land of the new! Why hide behind an observer? Here is a paragraph from a recent paper of mine:

“The  $\text{TiNiSi}$  (or  $\text{Co}_2\text{Si}$ ) structure type (space group  $\text{Pnma}$ , Pearson symbol  $\text{oP12}$ ) is a lower symmetry relative of the  $\text{CeCu}_2$  structure (space group  $\text{Imma}$ ). In a previous publication, we presented a detailed analysis of the bonding in the  $\text{CeCu}_2$  structure type. While  $\text{CeCu}_2$  is quite a common structure, with 81 known examples as of 1991, the  $\text{TiNiSi}$  structure type is even more versatile; 495 manifestations are reported in the same publication.



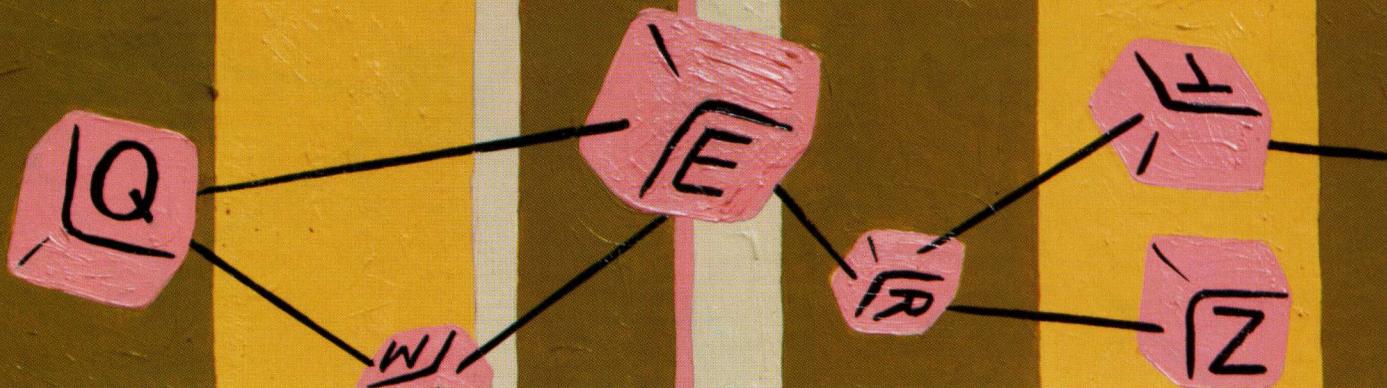
There are strong similarities between the two structure types. Both  $\text{TiNiSi}$  and  $\text{CeCu}_2$  have three-dimensional four-connected (3D4C) anionic networks with cations sitting in large channels. Both networks can be viewed as being composed of two-dimensional sheets of edge-sharing six-membered rings similar to those in black phosphorus running perpendicular to the a axis." Not too bad, but not exciting either...

### English – the Dominant Language

There was chemistry before the chemical journal. The new 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, or the Académie de Sciences, founded in Paris in 1666, played a crit-

ical role in the dissemination of scientific knowledge. Periodicals published by these societies formed the particular combination of careful measurement and mathematization that shaped the extraordinary successful new science of the time.

I think the chemical article form rigidified finally in the 1830s and 1840s and that Germany was the scene of the hardening. The formative struggle was between the founders of modern German chemistry – people such as Liebig, and the *Naturphilosophen*. In that particular period the latter group might be represented by Goethe. The Philosophers of Nature had well formed notions of how Nature should behave, but did not deign to get their hands very dirty. Or they tried to fit Nature to their peculiar philosophical or poetic framework, not caring about what our senses



and their extension, our instruments, said. The early 19th century scientific article evolved to counter the seemingly pernicious influence of the Natural Philosophers. The ideal report of scientific investigation should deal with the facts. The facts had to be believable independent of the identity of the person presenting them. It followed that they should be presented unemotionally (so in the third person) and with no prejudgment of structure or causality (therefore the agentless or passive voice). Two hundred years later the dominant language has changed, for interesting geopolitical reasons, to English. Yet it seems to me that there is not much change in the construction or tone of the chemical article.

### Revitalize the Emotional Style

I love my complex molecular science. I know that its richness was created by human beings. So I'm unhappy to see their humanity suppressed in the way they express themselves in print. The periodical article system of transmitting new knowledge has worked remarkably well for two centuries or more. But I think there are real dangers implicit in its current canonical form.

One danger is that by removing emotion, motivation, the occasionally irrational, we may have in fact done much more than chase away the *Naturphilosophen* of the early 19th century. What we have created is a mechanical, ritualized product that  $5 \times 10^5$  times per year propagates the notion that scientists are dry and insensitive, that they respond only to wiggles in a spectrum.

What is to be done? I would argue for a general humanization of the publication process. The community should relax those strictures, editorial or self-imposed, on portraying in words, in a primary scientific paper, motivation, whether personal and scientific, emotion, historicity, even some of the irrational. So what if it takes a little more space? As it is, we can keep up with the chemical literature, and tell the mass of hack work from what is

truly innovative, without much trouble. And we recognize hype ever so easily. I think science has much to gain from reviving the personal, the emotional, the stylistic core of the struggle to discover and create the molecular world.

### Follow Your Own Advice

Nice words in that plea for humanizing the scientific article – who could argue with them? Well, the young assistant professor trying to carve out a career niche, anxious to have people see and value his or her research as it is published in the literature – is he or she likely to follow this advice? And risk losing it at the gate, so to speak, as conservative editors and reviewers intent to find something moderately intelligent to say, look askance at modernities of style, colloquialisms, not to speak of worse deviances from the ossified standard?

It would take a very, very courageous young colleague to do so. He or she should turn the question around and ask me: “Do you, Roald, even as you are in a much more privileged position than I am (he doesn't realize that my papers are for various reasons criticized more vehemently than his), do you follow your preaching?” Yes, and no; sadly, mostly no. I write papers that generally look like the one you've seen above. Sometimes, my students and I manage to do better. Here is an example:

“The more crystal structures we know, the clearer it becomes that in the solid state there are many contacts in the range between a bond and a van der Waals interaction. N. W. Alcock introduced the useful term ‘secondary bonding’ for these, and formulated a set of rules for their occurrence and directionality. For electron-rich main-group systems there are two popular ways to address in a qualitative way the electronic structure of secondary bonded species – either as a manifestation of hypervalence (electron-rich three center or multicenter bonding) or as directional donor-

acceptor bonding. We feel these approaches are in fact equivalent, though we doubt that the number of energetic electrons expended on the demerits of one or the other chemical views is exhausted.” More of my papers are of the routine variety, I must admit.

There is another reason why I do not write in a radically different style. As a theoretician I try to shape a world view of chemistry. My audience is very clearly in sight – I write for the senior graduate student, for the young assistant professor. Their minds are open; if it is useful, they will take up a new way of thinking. For my audience, writing in an entirely off-beat way, inventing batteries of neologisms, claiming that the patently derivative is entirely new by... rephrasing the problem – all of these are doomed strategies. The way to introduce the new is in a sequence of minor seductions of ever-thirsty mind. So, on stylistic matters, or inventing new words, I go easy. Just here and there I sneak in a word, a phrase that shocks the reader into the realization that he or she is empowered to see things in a different light.

### The Language of Poems

And the language of poetry – what can one say of it? Yes, it can be too personal, or too hermetic. But it need not be. Let me focus here on one figure, arguably the greatest of living American poets, Archie R. Ammons. The figure of the whirlwind rises in many of Archie Ammons' poems. Let me cite one:

#### Planes

*The whirlwind lifts  
sand to  
hide holy  
spun  
emptiness or erect a  
tall announcement  
where formed  
emptiness is to be found*



Archie R. Ammons' poems move from whirlpools and dark holes to whirlwinds, if not tornadoes. The figure is natural, but the questions are deeply metaphysical: How is nothingness to be defined? How are we to reconcile one of the essential tensions, the quietude sculpted by impelled motion? The whirlwind or a tempest in the place ask very important questions. It is the locus from which the Lord asks Job: "Who put wisdom in the hidden parts?"

"Planes" also reveals another characteristic of great poetry that Ammons masters naturally. I will call it clumsily "heightening by backtracking" or "turning back to climb higher" or "reverse resonance." Look at the "holy" in line three of "Planes." It carries the weight of ambiguity of holiness of the sacred type or just the quality of having holes, plus the third enriching acrophonic relation to wholeness; as we puzzle out whether Archie is getting religious, the "emptiness" bounces us back. "Holy" becomes the center; the poem to me caroms back and forth around that word, like a laser beam amplified by mirrors. That reflection is explicit in another beautiful little poem, "Reflective":

**Reflective**

*I found a  
weed  
that had a*

*mirror in it  
and that  
mirror*

*looked in at  
a mirror  
in*

*me that  
had a  
weed in it*

## The Language of Science *The Language of Poetry*

The weeds and mirrors are reflected; the beginning and end, and the incredible focus on a small two-letter word "in." "Reflective," as well as some other of Archie's other poems, do an American turn on Descartes. The natural philosopher is because he thinks, but he thinks because he senses the real world of a dewdrop in a weed, which is. Note how deftly this little poem sashays around Bishop Berkeley's ontological dilemma – you don't have the slightest doubt of the existence, forever and ever, of either weed or observer, do you? And each is enriched by being mirrored in the other. What might have been a stumbling into a dismal corridor of endless mirrors becomes a reconciliation of two seemingly disparate pieces of the world. How soft these mirrors are, how they humanize the harsher mirrors we look into each day!

**Words to Describe the Indescribable**

I begin with a vision of unity of creative work in science and the humanities and arts. The shared ground is clear: acts of creation, accomplished with craftsmanship, an attention to detail. Both science and art value the true economy of statement. They both share a desire to communicate, though that often gets obscured by jargon and the deadening ritual of the scientific article in science, by too personal a style or a disregard for audiences in art.

The creative act is cross-cultural, I believe, and inherently altruistic. Both science and art share the elements of a common aesthetic—for instance there is place in that aesthetic for the simple and the complex: a classic Greek temple is beautiful, so is a molecule, C<sub>20</sub>H<sub>20</sub> shaped as a dodecahedron. But an equal claim to the beautiful is made by the

richness of a Bavarian rococo church and the seemingly tangled functional perfection of ribonuclease. Ultimately, the common ground is a shared, complimentary attempt to understand the world in and around us.

Need I enumerate the dividing forces counteracting that unity? C. P. Snow pointed out many. As for myself, I have no problems doing both science and poetry, or better said trying to do both. Both emerge from an attempt to understand the universe around us. And from a love for words, and the desire to speak to others.

I think that in fact there is a certain richness in the scientific background, which in the hands of someone better than myself might be a real advantage in writing poetry. For instance, the language of science is a language under stress. Words are being made to describe things that seem indescribable in words – equations, chemical structures, etc. Words don't, cannot mean all that they stand for. Yet words are all we have. By being a natural language, yet under tension, the language of science is inherently poetic. Also there is metaphor in abundance in that world of science. Emotions shaped as states of matter, and, more interestingly, matter acting out what goes on in the soul.

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