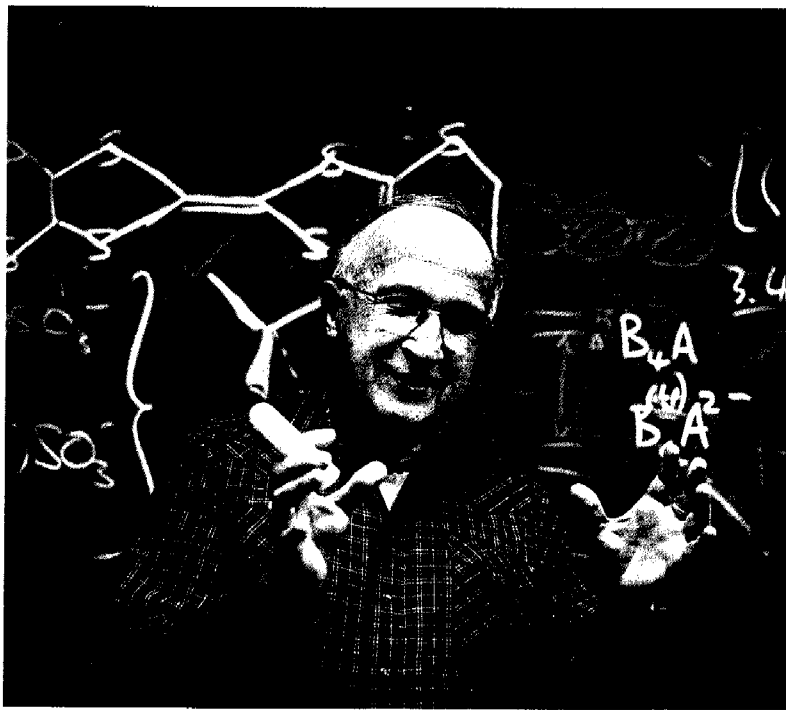
[BY ROALD HOFFMANN]

Passerelles

The title of my Nobel lecture was "Building Bridges between Inorganic and Organic Chemistry." I've brought molecular orbital thinking to bear on problems of not only organic but also organometallic, inorganic, and solid-state chemistry. And now, toward the end of my scientific path, I am having a lot of fun crossing back and forth over the ill-defined borders of chemistry and physics to look at bonding in matter under extreme high pressure.



Roald Hoffmann.

I also have written poetry for 35 years, philosophy and art criticism for 23, and plays for 12. That today 9 of 10 submissions of my poems to literary journals are rejected, and that I cannot get my latest, autobiographical play produced might be taken as evidence of . . . a lack of quality. And, perhaps, as a masochistic inclination. I choose to see the positive—I am struggling in the same way that other poets and playwrights are.

Clearly, building bridges (I prefer the lovely French-origin word *passerelle*—a small bridge, perhaps a footbridge) matters to this chemist and writer: building bridges across different areas of chemistry. Building bridges between science and the arts and humanities in two ways—by joining in, struggling to publish as writers do. And also by bringing chemistry into culture. So some of the poems I write, hardly the majority, use metaphor from science, or its language. In my essays—the form I seem to be best at—I love broaching questions, such as "Is there an analog to abstract art in science?" or "Could there be an element of sadism in chemists trying to make molecules whose bonds are strained, bent, and battered?"

Whence all this bridge building? The psychologist would seek it in childhood and would find much in the story of Roald Safran becoming Roald Hoffmann. It is not only the documents that my parents bought in chaotic Poland in 1945 that transformed Safran to Hoffmann (through a Margulies, my stepfather's real family name). There is a taproot too in that my father, Hilel Safran, killed by the Nazis when I was almost six, was . . . a civil engineer, a builder of roads, culverts, and bridges specifically. He was a hero of resistance in those dark times, a builder to admire.

There followed a series of emigrations and immigrations, crossings of borders and languages, ending in the land of opportunity indeed, in Brooklyn and Queens. Not that all transitions were tough—I recall a sailor giving me a Tarzan comic book on the troop carrier *Ernie Pyle* that brought us to America in 1949. He could point at Tarzan's sidekick and say "ape." I could smile and say, with a good German accent, "Tarzan."

With each border crossed comes a desire to understand, to fit in. It's cold outside. Though standing in the purlieus and trying to decipher from meager clues what makes that wonderful obscured reality within run *is* the work of science. So perhaps this quality, being outside, is what helped first- and second-generation immigrants, European Jews then, Asian immigrants today, become such good *American* scientists.

Together with my physicist colleague Neil Ashcroft, both of us led by a talented French postdoc, Vanessa Labet, I have just written a series of four papers in the *Journal of Chemical Physics*, exactly 50 years after I published my first papers in that border-crossing journal. In the 2012 work we take a fresh look at a fundamental problem that was first broached two years before I was born: the behavior of the first element under extreme pressure.

And do you know what gives me the greatest joy in this work? That as we tease apart what goes on in hydrogen under pressures such as those that one finds at the center of the earth, two explanations subtly contend with each other. The first is a physical one, of confinement of one molecule by the others around it. The second explanation is a chemical one, of the confined and confining H_2 molecules interacting, transferring electrons out of the molecular orbital (a quantum mechanical construct, the place where two electrons move) that holds the atoms together in the molecule; depositing them into another orbital, one that pushes the atoms in the molecule apart. In these H_2 molecules under immense pressure, the same forces are at work as are in the wonderful "organometallic dihydrogen complexes," molecules that no one thought would exist but that the inorganic chemist Greg Kubas made in the 1980s. Hydrogen under extreme pressure is doing just what an inorganic molecule at 1 atmosphere does!

No, the games played by us, this small struggle in compressed hydrogen, are not going to make peace in the Horn of Africa. But this aging little boy keeps at it, intent on building his passerelles.

Roald Hoffmann, the 1981 Nobel laureate in Chemistry, long at Cornell University, is also a writer of essays, poems, and plays.