Happy Holidays from Ardyth and Bob

December, 2009

Here is a quick walk through our year: We strolled through the spring-blooming grounds of the Barnes Museum near Philadelphia, with Sally and her friend Reid, trying to see it in its original incarnation as many times as possible before it is transformed into the world's must-see museum of impressionism. We traipsed all over Paris, through the Musee d'Orsay four times and up the Champs Elysees, with happily sore feet. Across the Chain Bridge in Budapest with our friend Desző Boda. Through Queen Gizella's castle in Veszprem, Hungary. Across the Brooklyn Bridge with Sally on an exultant, sunny fall day. Around the Tate Britain in London, two days in a row, with Bob carefully noting comings and goings at Vauxhall Cross, the home of MI-6/SIS, each time. Through the Brandenburg Gate and along Unter den Linden in Berlin. (Just writing that makes me feel like Marlene Dietrich.) Through the Ishtar Gate of Babylon. (OK, it's in the Pergamon Museum in Berlin, but it's still awesome and the Berlin Philharmonic and Peter Koehler—Bob's college roommate from 1959—and wife Sue were in Berlin too.) And, of course, Bob talked and theorized his way through miles of channels and swarms of ions, relishing every twist and turn, visiting Erwin Neher at Goettingen and Martin Burger at Muenster after I left. We have had a good year, for which we are grateful.

At home, we had good parties with friends and colleagues. I celebrated "back to the 60s" with eleven of my favorite Chicago people. After some initial worries ("Is that a new ache? Did I forget more than usual?"), I've come to enjoy 60. At this age, you can say what you want and people think you're eccentric, not obnoxious. I'm going for it. Bob continues to impress everyone with his energy and focus. I'm not the only person who calls him the Energizer Bunny. His work is going very well, but I'll leave that for him to talk about. [Bob: Ardyth's energy is nothing to slight. She had a department party for 40 guests in her Condo, cooked 3 filet's, with port sauce, baked I don't know how many cakes and cookies, insisting on doing everything herself!]

The rest of the year has been the usual. When we weren't afoot or hosting dinner parties, we went to concerts. Our offspring, nieces, and nephews are doing nicely and producing pride and delight in generous quantities, reaching notable landmarks in their education. Mid-year, Bob bought a giant 147 cm plasma-screen television, which still causes us to say, "Look. At. That. Picture!" We're even watching commercials. And I'm watching football, because I can finally **see** the football. And Bob is watching hockey because HE can finally see the puck (and the [Chicago Black]hawks [hockey team] are playing very very well).

Two of our best stories this year come from New York. In January, I had a reunion dinner with a woman I worked for when I was in college at Barnard (in the 60s). And in October, we had drinks with Susan Holland (Bob's cousin Suzy and the only one left who calls him Robby as his Mom did, but no one remembers how she spelt Robbie) at the Camp Bar in Brooklyn. In this century, the bar is a hangout for Sally and her Kenyon friends. In a much earlier life, it was a pawnshop and upstairs home lived in by Bob's and Susan's Dads (Harold and Dan). The bartender gave us free drinks when he heard the connection. In between the New York visits, I also saw my aunts, uncle and cousins in North Dakota, met my great-nephew Hopper Carman, and saw another nephew get married. The family is growing. And life is good. We wish you and your family as much joy and delight in 2010.

Ardyth

I guess I am supposed to say something about work for the science freaks among you. This year it is as much for the math freaks as the science ones. It turns out that the math guys have finally produced the apparatus to deal with what I have worried about (with no useful result) since 1959, following in the path of my Harvard tutor John Edsall and his scientific ancestors: how do you describe the main properties of salt in water in equations?

Why does this matter? Because the math guys (and gals) can't describe much of the world realistically, but the part they can describe is responsible for our standard of living: electricity, structural engineering, water flow and air flow can be calculated as accurately as they can be measured. Trial and error can be replaced by calculation, increasing efficiency and effectiveness by thousands of times. So far biology is almost all trial and error. If we can replace trial and error with equations the impact on human life will be as great as the computer or antibiotic revolutions.

All life occurs in mixtures of water and salts—like sodium and potassium and calcium chloride—that dissolve into atoms with electrical charge called ions. So ions in water are 'the liquid of life'. The problem is that ions are particles that always come in pairs. Millions of volts of electrical potential keep them together. But in traditional equations particles come alone, uncoupled, and there is no natural way to marry them. If Maxwell had lived, he might have found a way to marry them, since he discovered the equations of electricity (and magnetism and light) and also the (statistical) equations of uncharged particles (not quite the statistical equations of atoms, in my view, because all atoms have charge). [Sadly, I do not know enough history to know if Maxwell, in his personal life, was the marrying type.] In any case, the mathematician Maxwell would surely have charged his atoms with something, sooner or later, seeking the statistical equations of ions, marrying their electrical and statistical properties. Since Maxwell, no one has succeeded in creating a mathematics of charged atoms strongly coupled by electrical potentials.

Until a group of mathematicians led by Chun Liu (Prof at Penn State and Associate Director of the NSF's Institute of Mathematics in Minneapolis) started studying spheres moving in liquids and gases, and said—what the h***—we might as well make them have charge, it doesn't make the math (much) harder, they thought. (I am not so sure, yet, that they were right about that.) Anyway, they developed *EnVarA* an Energetic Variational Approach that combines the classical calculus of variations of mechanics with the dissipation principle of Rayleigh and Onsager using modern mathematics to correct a specific misunderstanding of the previous greats, and modern computers to make the results practical. (All who want to learn more can ask me or Chun, or do a Google/Wikipedia search.) For the mathematicians: the variations of dissipation and conservative forces have to be taken with respect to different variables and then combined.

In brief, math is now available to deal with couplings in an exact way, and this will lead (eventually, in my opinion) to a revolution in science, when the exact equations resulting from this approach are computed in enough realistic conditions. (Guess what we are working on now?)

So I am working hard to apply *EnVarA* to the electrical problems I have worked on since 1959 and to more traditional biology too, like osmosis in the brain (which is probably involved in epilepsy) and viruses fusing to cells (which is a necessary step in how HIV, 'flu, etc attack us). Of course, all this is possible only because of the wonderfully brilliant people I work with, with such delight.

What a vista to wander into breathlessly after 50 years of science: a journey I dreamt of as a student made possible by a wonderful new friend and his colleagues showing me how to make a dream into a reality.

With hyperbolic enthusiasm—some things haven't changes since I was a boy, at least I hope not, ask cousin Suzy and brother Ed—I think *EnVarA* will replace all theories of ions in water (but not all simulations) in physical and biochemistry, biophysics, and I hope molecular biology in the next decades. It will be fun fighting to make it so, even though we are bound to lose many battles along the way. (Only Captain Picard of Star Trek could 'make it so' without fail. It helped that he had script writers and the android Data.) Ions in water are the liquid of life, so the battle is worth the effort. And it's fun too.

Bob