Picture thanks to Yang-Zsxiao Chen

December 2018

From Ardyth

Hello, family and friends,

We did our usual things this year – traveled, went to concerts (and, for me, to the theater), doted on grandkids, and worked (yes, worked – quite a bit, actually). By contrast, the highlights were beyond extraordinary.

In January, we visited Chinshu, Taiwan. Bob's colleague Jinn-Liang Liu took four days from work to show us the mountains and the coast. In the mountains, we saw five different ranges (on an island the size of the Netherlands) rising from the meeting of two tectonic plates. On the coast, our fish dinner and banana snacks were harvested just steps away from us. No words describe this breathtaking country and how grateful we are to Jinn.

What are the chances of having two one-of-a-kind experiences in Asia in one lifetime, much less in the same year? In June, we attended our friend Chun Liu's wedding to Yang Chen in Suzhou, China. It was as magical in its own way as the Taiwan visit and even included a short opera (and a photo op with the singers) and a face-changing fan dancer performing an ancient ritual dance.

Along with these adventures in awe, we visited two of our most favorite places in the US. Big Basin Redwoods State Park in Northern California is the ultimate cathedral of nature. We never tire of the grandeur and peacefulness. And we went back to Southern Utah for more gasps at cathedrals of stone formations. My brother Bob joined us for most of the trip. After 27 years of visits, it's still just as stunning.

Our family is all well and healthy and all of the grandchildren are thriving in their own milieus. We regularly burst our buttons with pride and delight in them all.

Despite all this running around, both Bob and I still work more than we putter, and still find it fun and interesting.

Bob has suggested that I tell you a little about my law practice. Here's the cocktail party precis: I'm a sole practitioner, which is legalese for "working alone." About three-fourths of my work is for a group of investors who are involved in a wide variety of enterprises. Most of it involves handling tasks that come up after the investment is made. All of it's interesting and most of it's challenging. Best of all, we've worked together as a group for many years, and we do it well. The rest of my practice is what I'm proud to call Good Deeds. I represent some clients who need legal help but wouldn't get it from a law firm, because the issue is too small or too dense for a firm to take on (but is of big concern to the client). Because I work from home and am supported by my generous husband, I can do this. It is the best legal contribution I can make and it's every bit as satisfying as business law.

Henri Matisse said, "Today, I choose joy." We are lucky to be able to do that in our lives and we hope you do too.

From Bob:

What a year with lots of family life with granddaughter Chris Moutoussamy's graduation from Columbia College (Chicago) with a BS in Computer Science; the Trowbridges living in Oak Park 0.2 miles from our Condo; with Holly a few miles from the Kilauea volcano thirty miles from Hilo; and James in the US Marines protecting Darwin (Australia) from invasion; and my joy helping Jill, Henry and Alastair stay provisioned in steaks from Costco. And at home, the pleasurable amazement of watching Ardyth become the strongest person in the family with arduous twice-a-week physical training sessions, while her law practices grows dramatically. (Only Ardyth would be able to do either of these at age 69!)

I had a ridiculous travel schedule, with a wonderful stay in Taiwan, including an unforgettable visit to the East Coast, thanks to Jinn-Liang Liu; a meeting in the Black Forest most notable for 30 minutes on an outdoor train platform at 10deg F; a visit to the Technion in Haifa Israel with Nir Gavish; a trip with grandsons Alastair and Henry to the museums of Washington DC at spring break; a most productive month at the Fields Institute in Toronto, thanks to Huaxiong Huang, and colleagues; Chun Liu's wedding to Yang-Zsxiao Chen in Suzhou followed by the biennial meeting on Applied Mathematics in biology.

A nasty viral infection intervened (most likely coxsackievirus A16, EV-A71, or EV-D6 according to the [CDC](#)) that produced a whiff of old age immobility a few months later (like a very mild case of [AFM](#)), that has fortunately disappeared completely. I still managed a great deal of writing of papers, nine published, and three under review at this time, on a disparate, even disjoint array of subjects:

(1) the activity of ions in bulk solutions (thanks to Jinn Liang Liu),

(2) that are sometimes discontinuous functions of concentration, as Per Nissen discovered long ago,

(3) the stability of PNP (Poisson Nernst Planck) equations, helping Nir Gavish and Chun Liu

(4) gating currents in nerve (the result of a long crescendo of discussions with Pancho Bezanilla starting in 1975: I tell my family only someone(s) as crazy as us would work on the same project for 43 years before getting results, thanks to the contributions of Chun Liu and Allen Horng, as well as our own vigorous fun 'arguments'),

(5) osmosis in general (with Huaxiong Huang, Zilong Song, and Shixin Xu, involving variational analysis of some one hundred equations),

(6) in the lens of the eye (with Yilong Zhu, Shixin Xu, and Huaxiong Huang)

[Reprints](#) can be found at

https://ftp.rush.edu/users/molebio/Bob_Eisenberg/Reprints/Webpages/Full.CV.pdf

Two less technical papers you might want to read

(8) **Asking Biological Questions of Physical Systems: the Device Approach.**
Available on the physics arXiv as https://arxiv.org/abs/1801.05452 [PDF]

(9) **What current flows through a resistor?**
Available on the physics arXiv as https://arxiv.org/abs/1805.04814 [PDF]

Here is an oldie I am particularly proud of (published by the NY Times)

(∞) **Grappling with Cosmic Questions** [PDF]
https://ftp.rush.edu/users/molebio/Bob_Eisenberg/Reprints/2008/Eisenberg_NYTLetter_2008.pdf

People seem to have rediscovered my work on impedance spectroscopy—how electricity flows through muscle, nerve, lens of the eye, epithelia, the heart and syncytia in general— so [ResearchGate](#) is registering between sixty and one hundred fifty new downloads of my papers each week. That has motivated me to re-read our old stuff, from forty years ago, which of course I only remember in a distorted way with gaps. I can see now what we did not know (and should have), along with what we more or less got right.

Now, I am consumed by finally understanding a bit of special relativity, that perplexed me since I was thirteen years old. Little did I know that special relativity explains why I had to 'complete the circuit' when I worked on my [Lionel train](#) set with my Dad, if I wanted the trains to move. To nonscientists: all things involve electricity, from inside atoms to the light from the sun. Even the steric repulsion of atoms—meaning two things cannot occupy the same space—comes from the repulsion of electrons because they all have negative charge, an exchange interaction usually called the Pauli exclusion principle.

It turns out that only electric charge is independent of velocity, even velocities approaching the speed of light. Mass, length and even time change with velocity but (electric) charge does not. Not at all, not one part in 10^{15} or so. That implies the 'polarization of the vacuum' that I wrote about last year which in turn allows light to move through a vacuum and guarantees that conservation of current is an exact and universal law independent of the properties of matter, altogether.

Scientists have not used this exact law, although it was embedded in equations they all have known from about 1860, because they thought it depended on the complex polarization properties of matter. They thus denied themselves a valuable tool for understanding 'everything' (because Maxwell's equations apply to everything, from inside atoms to between stars, if not galaxies).

I am trying to replace that denial with understanding, showing, for example, how to make Kirchoff's current law exact, without much success, but with much energy dissipation on my part, so far mostly wasted as heat from friction with colleagues! I should be patient. Our work on impedance spectroscopy has taken nearly forty years to get popular, so I probably won't live to see scientists using conservation of current as a powerful tool in their everyday work.

And I guess next year I will have to try to convince people that dramatically over simplifying the polarization properties of matter is not a good idea—no matter how much easier it is to write equations with a constant rather than a function(al)—if the simplification prevents us from taking advantage of the law of conservation of current, as we continue our struggle to understand how things work.