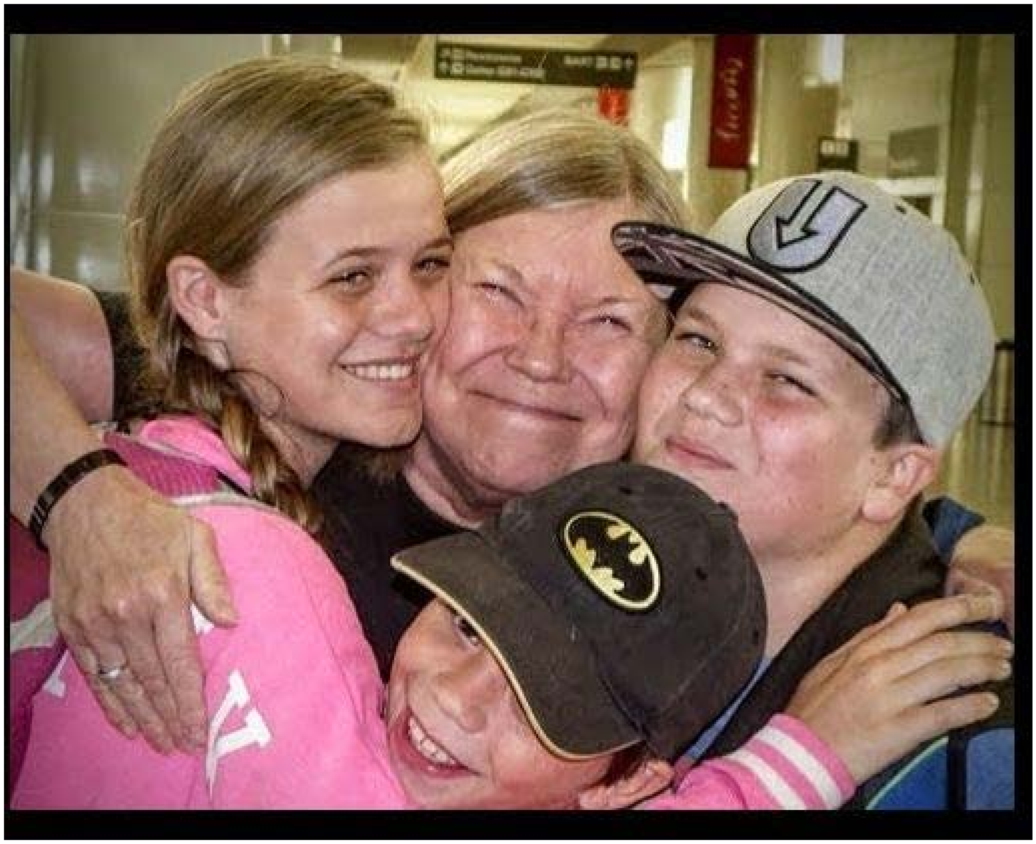
December 2016



Season’s greetings (a term we use because we like it, not because we want to be politically correct)!

Somewhere in the flow of social media this year came “questions to measure your life,” the sort of thing I normally avoid with all my effort. These were so thought-provoking that I’m using them as an outline for our holiday letter. Here goes:

Are you happy? Yes. We give thanks every day for living the life we live and loving our family and friends. (Were we unhappy at certain times of the year, particularly in November? Yes, but overall, we’re not only happy with our lives, we’re deeply satisfied with them.)

Do you like your daily routine? Yes – also satisfying. When we’re home, we’re up early, drinking espresso (the most important appliance in the house, bar none: Allegro Italian Roast), reading papers the old-fashioned way, on paper, and kvetching at the news on TV (or getting so fed up that we put on classical music). We cherish our routine and look forward to waking up every day.

How much time do you spend doing something you enjoy? Bob will probably say, “all of the time,” whether that involves writing papers, preparing lectures, watching sports or grocery shopping. I’ll say, “most of the time,” with the only unenjoyable things being wrestling with software when Bob isn’t around and preparing billings for my legal services. Bob says “I do not enjoy the news….not at all any more.”

Although Bob doesn’t enjoy traveling alone, he’s had a year full of trips – more than he took when he was working at Rush. People everywhere want to hear what he has to say. I went along to the National Portrait Gallery and National Gallery (Mellon, Andrew no less: Washington DC), MFA = Museum of Fine Arts (near Cambridge MA), England, Canada (Banff), and Europe. One could call this cherry-picking, I suppose…

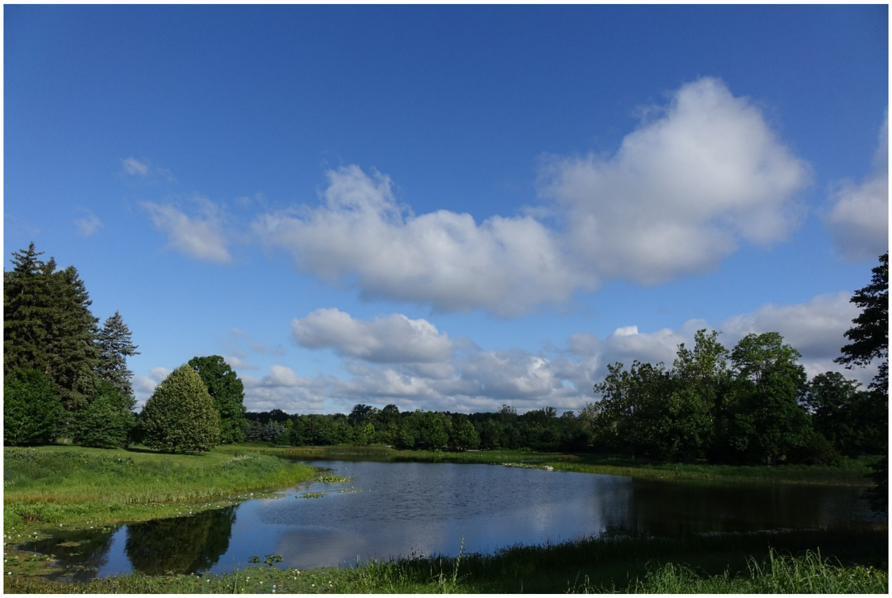
Who are the good people in your life and do you spend enough time with them? Never enough time, but we keep trying! As we did last year, we go downtown for dinner every week to see granddaughter Chris, who lives in a dorm and goes to Columbia College of Chicago, and to confirm that the 11 City Diner is maintaining Lower East Side (or Upper West Side) standards of Manhattan. It's a lovely tradition, especially since Ben does the driving, without complaint despite incredible delays leaving the Loop. We spent a weekend in Charleston, SC, with Sally and her life partner, Reid Burgess. Once a year (coming up soon), we go to Hawaii to see Jill and her children. This year, we had the extra bonus of taking three of them (Alastair, Henry and Holly) on an eight-day road trip on the West Coast – an excellent adventure for all of us. Good fun despite too much driving (we were over ambitious) and continual eating.

I worked more this year, and the schedule limited my ability to travel to see friends and family. I plan to cut back the work in 2017 so I can run around and have more fun.

What do you need to change? Nothing, besides cutting back on my law practice. Otherwise, we're still going to symphony and I go to theater or lunch with girlfriends. Once in a while we go out to dinner, but our days of being foodies have dwindled, given the list of food allergies that we have.

What comes next? A happy and healthy 2017 for everyone we know and love and write holiday letters to!

Some photos from last year's travels (Bob lectured in Milwaukee Univ of Wisconsin, New Mexico NMIT, Lancaster, Cambridge UK, London Birkbeck, London Imperial, Oxford, Banff (AB Canada, June & October), Suzhou, Penn State, MIT, Draper Institute (Cambridge MA), Vienna, Milan(o), Lausanne (Switzerland), (yet to come: Taipei, Taichung, Sanya)




MARTIN LUTHER KING JR. MEMORIAL

From Bob:

A wonderful year for science and for fun. Ardyth described some of the family fun. I describe the science fun. This was the year that PNP (**P**oisson **N**ernst **P**lanck) seems to have been discovered by the world of people interested in ions (like table salt) dissolved in water. That is the world of batteries, nanoscience, and of course biology. All of biology occurs in solutions derived from seawater and seawater is salty! A long time ago (1993: look up my CV on google and search for PNP if you want to see the original paper) Duan Chen and I realized the close analogy (but not identity) between the physics of semiconductors and transistors (that make our computers, cell phones, etc., etc.) and the physics of ions in water and in biological proteins called channels (with a hole down their middle for the ions to move through: ions are balls of electric charge, rather like charged billiard balls moving through a tube for a good first approximation). Up to then, almost all analysis had been done by assuming the electrical forces on the billiard balls because that is a lot easier than calculating the forces. But if one assumes the forces, one cannot understand how the forces vary with conditions, and even worse, one violates the fundamental laws of electricity (called Maxwell's equations although he never wrote them: a working class Englishman named Heaviside despised by the Cambridge inheritors of the Maxwell tradition wrote them). This is unfortunate since the laws of electricity are valid inside the nucleus of an atom and between stars with an accuracy better than 10 significant figures. And it is unfortunate because tiny charges in electrical charge (think 1 %) produce forces large enough to lift the earth (no kidding: write me if you want the reference and explanation). If Bill Shockley (at Bell Labs, difficult person that he was and became even worse) had assumed electric fields instead of calculating them, he would never have invented transistors (specifically FETs) and maybe no one would have invented them. (Young people: imagine no computers, no cell phones, not digital TVs ….) DuanPin Chen and I understood this so we invented the name PNP (1) to draw attention to the analogy with transistors and (2) to emphasize the importance of computing the charge with the **P**oisson equation of **P**NP. It has taken a long time for this idea to catch on, but there are about five new papers every week using or checking or rederiving PNP and there are more than 20 new downloads of my papers every week (more than 1000 per year) from Research Gate (find Research Gate with google).

Of course, ambitious scientists never know what they are doing: they move to a new project (about something they do not understand) as soon as they understand something well enough to publish it.

So I moved on from classical PNP: electric currents in classical PNP are assumed to be stable independent of time. But real currents in biological channels switch from one level to another randomly. I suspect that PNP can be unstable and produce such switching currents either as PNP stands or with some modifications. Collaborators and I are trying to find out if modifications are needed.

Other work this year is closer to being finished.

This year the astonishing result was something I should have understood as an undergraduate, in 1961. I learned how to write the laws of electricity to prove that current is conserved ('complete the circuit' as any of you who have wired anything already know) exactly, ***no matter what the properties are of matter***,everywhere, at all times, from 0.000 000 000 000 000 000 0001 = 10^{-21}= 1E-21 sec to we do not know how many thousands/millions of years).

The 'one line' proof is here for anyone who wants to see it.

$$\overbrace{\mathbf{curl}\left(\mathbf{B}/\mu_0\right) = \underbrace{\mathbf{J} + \varepsilon_0 \frac{\partial \mathbf{E}}{\partial t}}_{\text{'Current'}}}^{\text{Maxwell Equation}} \quad \text{so} \quad \overbrace{\mathbf{div}\left(\underbrace{\mathbf{J} + \varepsilon_0\, \partial \mathbf{E}/\partial t}_{\text{'Current'}}\right) = 0}^{\text{Conservation of 'Current'}}$$

because div curl is always zero.

E the electric force takes on ***ANY*** value needed to conserve current, independent of the properties of matter, no matter what the polarization.

Why is this important? Because usual treatments of chemical reactions **A ==> B ==> C** do not conserve current unless they are amended (!). No, I am not crazy. Just compute the current from **A** to **B** and from **B** to **C** (using the 'law of mass action' found in college chemistry textbooks and high school books too) and you will see they are not equal unless the equations are amended.

What amendments are needed? I do not know in general, but in particular my friends and collaborators and I are working on it.

Is this important? Well, electrical devices (in a computer) work nearly perfectly. All electrical devices and theories satisfy continuity of current. Electrical devices in a computer function some 1,000,000,000 = 10^{9} = 1E9 times a second and there are some 1,000,000,000,000 = 10^{12} = 1E12 of those devices in a computer most of which switch all the time (e.g., when you send photos of each other from one iPhone to another). Computers can tolerate very few errors—none in vital places, say less than 100 per second (error correcting math allows that). ***Does anyone believe that 10^{19} corrected operations a second would be possible if the mathematics and theory did not work exactly?***

Most chemical theories do not satisfy continuity of current. Chemical simulations may or may not (they haven't been checked very much, so it is your guess what will happen when they are checked). Maybe that is why chemical technology lags behind? Maybe that is why lithium batteries are designed without theory or even simulation and so often catch fire and blow up?

What fun!
How lucky to be able to do this when 74 years old!
Thanks to all who make that possible, living and dead.
(The living know who you are, I hope and trust.)


שתו
קוקה-קולה
סימן רשום