Greetings, Friends and Family!

This year has been ordinary and not so ordinary (with a bow to Winston Churchill for cobbling up his best of lines, AND for making a pun of it, all in one sentence).

We started January with a pilgrimage to Disneyland, escorted by our youngest grandsons Alastair and Henry and their mother Jill. Jill and Bob had visited many times; the boys and I were equally agape. I loved the wonderment and the bigger-than-life Disney characters everywhere. Best of all was having an adventure with grandsons we don't often see.

We ended January by driving from Berkeley to Chicago after Bob's Miller Fellowship ended. The weather gods gave us a beautiful and uneventful journey through an America quite unlike Disneyland. Both Bob and I had known of Wyoming's legendary Little America since the Sixties, and we timed our drive so we could stay there, to our great delight. (It was immaculate and surprisingly luxurious, in a Sixties way.)

Since then, Bob has gone hither and yon for his science. I didn't go along as often as in past years, because I have more work now. In theory, I could work remotely, but in reality, it's hard to do from a hotel room hundreds of miles from clients and courtrooms. When we did travel together, we had fun, as always: To Charleston, South Carolina, Sally's home-away-from-home, for an always-welcome winter respite, a great dose of Southern hospitality and history and a wacky St. Paddy's Day parade. To Philadelphia for another look at the Barnes Museum and a rendezvous with friends. To Hawaii, twice, to see Jill and her children, and to make a moving visit to the USS Arizona Memorial. To Point Reyes National Seashore (north of San Francisco) for a Miller Symposium and more time with friends, including one I hadn't seen since the early 1980s.

We had more adventures with assorted subsets of grandchildren. Three of Jill's four children, Holly, James and Henry, visited during the summer. We drove to Springfield to learn more about Abraham Lincoln and happened upon filming of a commercial at the Lincoln home, complete with a live version of Abe, which certainly made the whole trip more real. (The kids reported that the highlight for them was being allowed to share a hotel room without adults, although I note for the record that they either called us or tapped on our door about every five minutes while they were awake.)

We also took a trip to Beloit, Wisconsin with James to check out the college there and get a feel for college visits. [Pause here to contemplate how quickly grandchildren grow up. We did this with granddaughter Chris, too, and she's now a sophomore at Columbia College of Chicago. I think we've seen her Hawaiian cousins more than we've seen her this year. As it should be, of course, but we miss her anyway.]

We had two other special family visits. Our niece Anne Boyles, my brother' s daughter, gave us ten days to get to know her as an adult. We enjoyed every minute. Shorter, but just as sweet, was Jill's and Sally's visit to Chicago in November. We had the rare moment to celebrate Jill's birthday with three of four of Bob's kids at the same table at the same time – a world record since they've grown up and scattered into the winds of adulthood.

Of course, Bob and I are still going to symphony and I'm still going to theater and ballet with friends. In a nutshell, we've had less travel this year, but more time together and with loved ones. We've cherished every minute of this year's meander through life and we know how lucky we are. We hope your year has been full of the same.

## Guess Where? With who(m)*?


**(m) is for brother Ed and other Horace Manners.*

## Henry, James, and Holly Trowbridge

(at Adler Planetarium)

## Let's not leave out Alastair

(**Big Al** to Grandpa Bob)

And two more

## Guess Who(m)?

## Boys can be a Handful

(Is that right Mom?)

From Bob: how about no lecture this year? Just a statement of contentment with the continuing saga of understanding what we never thought we would have understood before. And a super short scientific biography on the next page.

My writing this year has been mostly about something so well known that no one knew it: the ions in water that make life possible are nothing like ideal gases. Ions have size and permanent charge and experience strong electrical forces 'from here to infinity, and eternity'. Ideal gases have no charge and no size. Ions in biological situations are highly concentrated (often half as concentrated as in SOLID salt crystals) and so their size and their charge matters. These ideas were well known, and in fact proven, in the 1920's. They provided such a mathematical challenge however that they were denied. Denial is a most important mechanism to allow people to survive and thrive. Without it, people who knew nothing of physics or biology would only be depressed, strive for nothing, and do much less. But denial is disaster in science, as (I believe: physical chemist friends forgive me) it has been in chemistry and biochemistry. Nothing can be understood about ions in water or in or near the molecules of life if the reality of their charge and size is denied.

This idea seems to have resonated with some colleagues and I was invited to tell the story something like five times last year, in one essay or review after another. You can find them at

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

if you really want to read more (just search for 'interact' without the quotes).

Professional travel brings me again and again to Penn State where Chun Liu lives and works and does more and more. State College is not thought to be a romantic location but it has the best Austrian restaurant I have found in the USA, fine Korean food, and superb science. And we get plenty of romantic travel with our family in Oahu. Trips to Xiamen and Taipei are a particular fun as I see the pure enthusiasm of our Chinese speaking colleagues and students as they learn what they can now do. And over all, the continuing growth of a community of scientists interest in ion channels, but who know how to do physics and mathematics is a source of great joy to me. As is the wonderful faculty in Molecular Biophysics and Physiology at Rush. As is my family. And—most of all—as is my wife whose professional growth this year has made her as fine a lawyer, as she is cook, step-mother, wife, and friend.

I am blessed.

# Life Glimpsed through Ion Channels

***A Super Short Scientific Biography***

I have been interested in how physical things work as long as I can remember, and in how living things work nearly as long, from the day my father (a physician and then psychiatrist) showed me that was the best way to mold my interests to his approval.

At Harvard John Edsall was my tutor, and he did in fact tutor me, biweekly at first and then (nearly) weekly, nominally in biology, but really in the wisdom of science. (John Edsall was born the son of a Dean of Harvard Medical School, and was a fulcrum for the pivotal change from macroscopic to molecular biology at Harvard and elsewhere, training Bruce Alberts, David Eisenberg, and Jared Diamond among many other distinguished scientists.) My coursework was in physics, chemistry, applied mathematics, and electrical engineering, but, if my memory serves me correctly, not in biology at all. (I actually love evolutionary and descriptive biology as I love collecting classical CD's but those loves are hobbies more than anything else.) My undergraduate thesis solved the cable equation of physiology (the transmission line equations of engineering) with a Green's function, reproducing in an elegant but useless way what I had learned from Morse & Feshbach about heat equations.

My graduate work was experimental at University College London, where my department chairman Bernard Katz was to win the Nobel Prize a few years later. Fortunately, Andrew Huxley (Chair of Physiology at UCL, winner of the Nobel Prize with Alan Hodgkin in 1964 a year or two before Bernard Katz, if I remember correctly) had solved the cable equations the way I had, but much earlier and much more originally and insightfully, and so was happy to spend many hours teaching me, on the side, as if he didn't have enough else to do. My experimental work measured the spread of current in crab muscle fibers over a range of frequencies, using impedance spectroscopy, as it is now rather pretentiously named.

I will not bore you with the many decades of experimental work I did analyzing the flow of current in muscle fibers and then the lens of the eye. I became a Department Chairman at Rush Medical College in Chicago in 1976: the temptation of an Endowed Chair was enough to make a 34 year old move from the perpetual spring of Brentwood (LA) to the recurrent vagaries of midwestern weather. In the 1980's, I started thinking about the theoretical problem of describing ion movement through the water filled tunnels of charge we call ionic channels.

**The ionic channel is where we still are; but gazing through this narrow hole has proven to be rather like looking through a keyhole in a door. The closer you get to it, the further you can see, even glimpsing the horizon (of knowledge) occasionally, even seeing a star or two, when all else seems dark.**