



**Ardyth**: Here are some of the moments this year that enriched our lives:

- Our first winter escape from Chicago, after years of talking about it. We stayed in a house on a mountain overlooking Santa Cruz and the Pacific Ocean. It was gray and rainy some days but we reveled in the view and the walks along the beach and in the redwoods. After, we stayed in San Francisco and indulged ourselves with two visits to a John Singer Sargent exhibit at the Legion of Honor.
- Seeing Sally and Reid in Charleston and visiting their cottage on Edisto Island, a place of peace and beauty. Dense tree branches overhang the road there, making a miles-long archway.
- To Boise twice to celebrate both my siblings' birthdays, a true delight. My sister Barb continues to be living proof that age is just a number. My brother Bob, who wasn't fazed by scaling Half Dome, Mt. Borah, Mt. Rainier, Mt. Whitney and The Grand Teton, was rendered speechless with a surprise party. His wily and loving children kept him entirely in the dark until he walked into the restaurant and realized all the patrons were his friends and family. (Boise readers: The restaurant is The Funky Taco. The restaurateur is Justin. Tell him I said hello.)
- Another birthday weekend, this one for Bob (husband), in NYC with his brother and wife. They know their restaurants and the restaurants know them, but the best meal was the one they made to honor Bob.
- A once-in-a-lifetime visit to celebrate my Uncle Walter's 90<sup>th</sup> birthday. I stayed with him and his partner Norma in Fargo, North Dakota, and spent the weekend with their family, including morning breakfasts at Denny's, telling stories and joking with friends.
- To The Ohio State University to visit our grandson Henry, and his girlfriend Mikaila. (Side note: Bob can explain why it's THE Ohio State University, if you're wondering.) We enjoyed every minute with them and realized – again – how lucky we are to have young family members we like as well as love. Google Maps detected long stretches of construction on the interstates. “She” took us on hundreds

of miles of state highways – a look at the Midwest we wouldn't have had and another one-of-a-kind day in our year.

- And between these moments, so many minutes and hours with loved ones (you know who you are). We've relished every one. The most special of all is the ordinary time Bob and I share: breakfast, mostly spent shouting at the news on television; coffee breaks with Americanos from Barista Bob; and (probably too much) streaming of old detective shows.

Our most significant new experience this year started out rather benignly, got downright scary (at least for me), and has been resolved miraculously. In September, ordinary cardiac tests showed Bob's mitral valve wasn't closing properly. After visits with a team of cardiac specialists at Northwestern Memorial Hospital and more tests, we learned they could replace the mitral valve without open-heart surgery. The PASCAL procedure uses a catheter, threaded through his femoral vein, to carry the new valve to the heart and install it. He was up and around in just days. (To you folks who wonder if increased cardiac output would give him more energy: The answer is yes.)

We hope you've had as much fun and love this year – despite the ghastly national and world events – as we have. Here's to more of the love and memories and far less of shouting at the news.

### **Bob Personal**

A funny thing happened at the doctor's office: a murmur was heard, then an echocardiogram, a referral to Cardiology Chairman Dr. Bonow at Northwestern (thank you again Nishant!), and a perfect PASCAL procedure by cardiologist Dr. Ranya Sweis. Because of her and her team, I have no measurable regurgitation, putting me in [better shape](#) (at least that way) than many my age, and perhaps even most. For those who want more detail, see [murmur](#); [echocardiogram](#), [PASCAL](#)

**The family** is thriving, but I am not supposed to describe that in detail for my children, who have resisted such publicity since they were adolescents thirty-some odd years ago.

Ardyth is not so shy. Her professional growth leaves me in awe, joyous to behold, as she finds ever more law to learn, and disputes to resolve, whether those of the insubstantial (financially), or the more-than-substantial. Leaping from bed to search law files at 5 am, seven days a week, she is as unusual among her peers for her career as for her training with Brian Cuellar which, after several years now, makes her substantially stronger and more fit than I, or most others.

Grandkids have not yet forbidden discussion (yet), so here goes:

Chris (Crystal Moutoussamy) is a happy thriving programmer in Silver Spring, Maryland (Washington DC to most of us).

James Trowbridge schedules the transport of our country's on-line orders. His delightful wife Catherine brings discipline and knowledge to children. They live nearby and share life's joys and woes with us, to our delight.

Holly Trowbridge lives near Seattle where she works with children with special needs and enjoys the world of the Pacific Northwest with her partner Abby Coleman.

Henry Trowbridge is a sophomore at ([‘The’, sic](#)) OSU Ohio State University (for a giggle look up the history of higher education in Ohio, the Western Reserve vs the rest of Ohio, e.g., country folk, Ohio University, Ohio State University and The Ohio State University, but be sure to take notice of the [affiliation](#) of the author of the reference you read). Henry discovered Calculus and proper Physics, and found (to my surprise and delight) that physics and calculus at OSU is taught with lots of problems and work, so understanding emerges from results, not from verbalizations of ignorance as is so often the case. His partner Mikaila Hughmanic is a graceful ice skating mathematician who(m) we have enjoyed immensely.

Alastair Trowbridge is finishing up at Roycemore where his dad teaches him (among others) Chinese. He is accepted at a number of fine Midwestern universities that should be the envy of Europeans and are at least comparable to the best in the UK. His probing insights about Beethoven, his astonishment at Hilary Hahn, and his wonders about what is the motion that we call heat, provide a continual reminder of what a young man can do and we hope will continue doing the rest of his life.

We are blessed.

### **Bob Science**

Learning from my grandkids, I finally did a google search on the Maxwell equations I have been working on for years, and even created a searchable PDF so I could find what he actually said about ‘current’ (that is not in the index).

To my amazement, I found a concise mathematical statement of his equations Maxwell, J. Clerk. 1865. ‘A Dynamical Theory of the Electromagnetic Field’, *Philosophical Transactions of the Royal Society of London*, 155: 459-512 showing that one does not have to reach to Heaviside to find a modern formulation.

More importantly, **I found Maxwell’s definition (Maxwell 1865b) of the ‘true’ current needed to estimate the total movement of electricity:**

*“One of the chief peculiarities of this treatise is the doctrine which it asserts, that the true electric current, that on which the electromagnetic phenomena depend, is not the same thing as the current of conduction, but that the time-variation of the electric displacement, must be considered in estimating the total movement of electricity, so that we must write, [the sum] .... as an equation of true currents.”* Note that ‘peculiarities’ is a Victorian word (in formal 19<sup>th</sup> Century English) equivalent to ‘characteristics’ or ‘features’ in modern scientific American/English. The text is from Vol. 2, Section 610, p. 232. The ‘equation of true currents’ is in, eq H, Vol.2, Sect 610, p. 233 of (Maxwell 1865b). Maxwell uses the name ‘Total current’ throughout his analysis 327-341 of Vol 1.

**This is not the definition of current used in essentially every textbook** of electricity and magnetism, and electrical and electronic engineering. They leave out “time variation of displacement” (which in modern language means they leave out a time derivative) in the

current they use in a Kirchoff's law analysis of circuits. They fix up their treatment by changing the circuit, not by following Maxwell's advice.

Of course, I was particularly delighted with this quotation since in our ignorance we had been advocating a [revision](#) of [Kirchoff's law](#) along these lines for many years now.

This issue is not entirely abstract: the Maxwell definition immediately applies to biological systems like mitochondria and their generation of the chemical energy of life ([ATP](#) also see Wikipedia). Biologists studying mitochondria have identified the crucial role of electron flow with vivid illustrations but seem not to have realized that electron flow is called electrical current, and is subject to the universal laws of electrodynamics that have been exploited by electrical and electronic engineers to create the technology of information transfer (since 1840, the telegraph) and power distribution (~1889).

My collaborators, led by Huaxiong Huang, including Shixin Xu and Zilong Song, have shown how to move from the vague qualitative discussion of electron flow (in the anti physical vitalist tradition) to actual models of cytochrome c oxidase (a crucial component of mitochondria) showing how to compute results directly comparable to experiments. I suspect my Harvard tutor John Edsall and UK mentors (Alan Hodgkin and Andrew Huxley) would have been delighted to see the ideas of biophysics (applied so well to nerve and muscle by Hodgkin and Huxley) applied to the anti-physical verbalizations of biochemists, that are really rationalizations of their ignorance, protections against having to actually learn some physics and use some mathematics.

We are now onto new topics, like models of myelinated nerve in mammals (not what we thought), and an electro-osmotic version of the glymphatic theory of sleep.

**Ardyth and I wish you the best in 2024.**