**Introduction.** I am interested in the device approach to biology that views biological systems as a system of devices, each with inputs and outputs using power supplies to implement a well defined reasonably robust input output relation. This approach was used by the English school of physiology before the word engineering was invented and is a most productive way to initiate investigation of biological systems, no matter how complex. The device approach to biology is very similar to the approach of an engineer to a technological system he is asked to identify and control. The device approach emphasizes the types of models that are appropriate: they must have well defined inputs and outputs which necessarily occur at different places, so spatially uniform models are inherently awkward, to say the least. The device approach emphasizes the need for power to maintain a well defined reasonably robust input output relation. So models at equilibrium where no power is available are limited in their utility. Finally, the device approach emphasizes the goal. The goal is to understand enough detail to establish and control the device equation, but no more. Experiments (from macroscopic measurements of function to atomic scale measurements of structure) are focused on the goal. Preparations are chosen so they make it easy to discover the input output relation and to learn to control it. Much of the progress of biology arises from the judicious and productive choice of preparations, whether microbial genetics, squid nerve fibers, or the retina of the eye.

**Personal History**. 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.

The many decades of experimental work I did analyzing the flow of current in muscle fibers and then the lens of the eye are documented in my Curriculum Vitae and Publication List in detail and in reviews available online at https://ftp.rush.edu/users/molebio/Bob\_Eisenberg/Reprints/Webpages/Full.CV.pdf.

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.**

**Significant Publications documenting recentg work**

**Ten Relevant Papers**

Liu, Jinn-Liang, Bob Eisenberg (2015) Numerical Methods for Poisson-Nernst-Planck-Fermi Model Physical Review E, 92, 012711 Also available on the arXiv as [arXiv:1506.05953](http://arxiv.org/abs/1506.05953).

Liu, Jinn-Liang & Bob Eisenberg. (2015) Poisson-Fermi Model of Single Ion Activities in Aqueous Solutions Chem Physics Letters, Frontiers Article. 637: p. 1-6, also on arXiv as arXiv:[1506.07780](http://arxiv.org/abs/1506.07780)

Lin, Tai-Chia, Bob Eisenberg (2015) Multiple solutions of steady-state Poisson-Nernst-Planck equations with steric effects. Nonlinearity 28 2053-2080

Eisenberg, Bob. (2015) Mass Action and Conservation of Current. Hungarian JIC (in the press) and on arXiv as arXiv: 1502.07251

Kaufman, I., McClintock, P.V.E, and R.S. Eisenberg. (2015) Coulomb blockade model of permeation and selectivity in biological ion channels. New Journal of Physics 17: 083021

Eisenberg, Bob. (2013) Interacting ions in Biophysics: Real is not ideal. Biophysical Journal 104:1849.

Jimenez-Morales, David, Liang, Jie and Bob Eisenberg. (2012) Ionizable Side Chains at Catalytic Active Sites of Enzymes European Biophysics Journal 41 (5):449-460.

Eisenberg, Bob, Hyon, YunKyong, and Chun Liu. (2010) Energy Variational Analysis EnVarA of Ions: Field Theory Primitive Models of Complex Ionic Fluids. J Chemical Physics. 133, 104104 (23p)

Eisenberg, B., Multiple Scales in the Simulation of Ion Channels and Proteins. (2010) The Journal of Physical Chemistry C, 2010. 114 (48): p. 20719-20733

Boda, D, Valisko, M, Henderson, D, Eisenberg, B, Gillespie, D & W Nonner. (2009) Ionic selectivity in L-type calcium channels by electrostatics and hard-core repulsion. J Gen Physiol 133 497-509.