1081-92-27 **Bob Eisenberg*** (beisenbe@rush.edu), Molecular Biophysics 1291 Jelke, Rush University, 1653 West Congress Parkway, Chicago, PA 60612. *Mathematics of Ion Channels: Life's Transistors.*

Ion channels are proteins with a hole down their middle that control flow across otherwise impermeable membranes. Electric current propagates signals in the nervous system and coordinates contraction. Ion channels are a large class of proteins involved in many diseases, and the response to many drugs. Simulations so far have been uncalibrated and unhelpful in dealing with the functional properties of ion channels. Ion channels are suitable for mathematical analysis because the underlying physics is understood and simple. Once open, ion channels have one structure (on the biological time scale > 10 microseconds). Ions move through that structure driven by diffusion and electric forces. The diameter of ions is smaller than the hole in the protein, but it is never negligible. Indeed, the number density of ions in the channel is very high, because the large permanent charge of the channel protein must be balanced by a (nearly) equal amount of mobile charge. Theories of ion channels that neglect the steric repulsion of ions are not useful. They are also not helpful for bulk (NON-biological systems) in almost all cases. The mathematical challenge is to deal with the correlations produced by finite size. Energetic variational methods as developed by Chun Liu are promising. (Received December 23, 2011)