1108-35-100 **Bob Eisenberg*** (beisenbe@rush.edu), Dept of Molecular Biophysics, Rush University, 1653 West Congress Parkway, Chicago, IL 60305. *Ions in Solutions and Channels: Local Structure and Global Controls.*

Electronic technology is possible because mathematics describes atomic scale electrical structure of semiconductor devices and links them accurately and robustly to power supplies, inputs and outputs. Biology is possible because evolution links ionic structure of proteins robustly to power supplies (ion gradients), inputs (voltages), and outputs (currents). Nanosystems of great technological interest are difficult to design robustly by trial and error. Efficient design and robust function needs mathematics to link atomic scale ionic structure accurately and robustly to power supplies (Dirichlet boundary conditions for electrical and chemical potential), inputs and outputs. Chemical tradition analyzes isolated systems without inputs or outputs. Indeed, its law of mass action does not conserve charge. Crucial mathematical issues are (1) accurate description of Dirichlet boundary conditions far from atomic structures controlling ions. (2) adequate description of NON-ideal properties of ions that link 'everything with everything else'. Several approaches successfully describe properties of calcium channels over a 10^7 range of concentrations. A new approach uses a Fermi like distribution to compute nonideal properties from properties of mixtures of spheres of any diameter. (Received January 04, 2015)