Markov chains are used widely, nearly universally to describe phenomena involving electric charge, including gating of ion channels. Electric charge is almost always involved in atomic and molecular phenomena because a wide variety of chemical bonds are 'polarized' with different partial charge on different atoms; a wide variety of compounds include acid and base groups with permanent positive and negative charge; and all proteins include highly charged peptide chains, and are found in ionic solutions containing ions with permanent charge and highly polarized water molecules. Transitions in Markov chains are by definition independent of each other. Independent processes cannot be always equal. Thus in an unbranched series connected Markov chain current flow in one transition cannot be equal to that in another. Maxwell's equations (specifically, his generalization of Ampere's law) is said by physicists to be accurate to better than one part in 10^17. Maxwell's equations of electrodynamics imply current flow in an unbranched series of reactions is equal to  at all times at all places and under all conditions. Maxwell’s equations imply that flows in an unbranched Markov chain are correlated with correlation coefficient something like  It seems unwise to use Markov chains to describe the movement of charge or atoms or molecules that are charged. Sometime ago (J Chemical Phys (1985) 83:3214; Biophys J. (1987) 51: 48*a*) the need to include friction in descriptions of movements in condensed phases was discussed. Atomic collisions occur on a time scale of sec or so. Markov chains are widely used in biophysics to describe phenomena on the time scale  sec or slower. There is thus ample time for the three thermal atomic collisions needed to convert deterministic motion into the random motion we call heat, by the process we call friction. In my view, models of charge movements in condensed phases must satisfy the equations of electrodynamics and include variables describing friction if they are to be of use in more than one set of conditions.