Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

A Geometric Mechanism for Asymmetric Diffusion and Membrane Rectification ROBERT SHAW, NORMAN PACKARD, ProtoLife Srl. — Biological membranes commonly conduct ions freely in one direction while clogging in the other. Existing theories emphasize electrostatic binding of blocking ions in pores as a mechanism for rectification. Here we show that rectification can have a purely geometric origin, based on the interaction of shapes of diffusing particles and pore geometry. The two possibilities can be experimentally distinguished. Blocker binding based on confinement in a potential well will have a strong Arrhenius temperature dependence, whereas "geometric binding" will have a much smaller dependence on temperature. We present both Hamiltonian and Brownian-based computer simulations which demonstrate this effect. A rectifying membrane can maintain different concentrations on either side, resulting in a long-lived metastable state. We derive a dynamic equation of state describing the decay of this metastable system.

Norman Packard
ProtoLife Srl.

Date submitted: 30 Nov 2006 Electronic form version 1.4