Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Multicellularity and the Functional Interdependence of Motility and Molecular Transport[1] C. SOLARI, S. GANGULY, J.O. KESSLER, R. MICHOD, R.E. GOLDSTEIN, U. of Arizona — Benefits, costs and requirements accompany the transition from motile totipotent unicellular organisms to multicellular organisms having cells specialized into reproductive (germ) and vegetative (sterile soma) functions such as motility. In flagellated colonial organisms such as the volvocalean green algae, organized beating by the somatic cells' flagella yields propulsion important in phototaxis and chemotaxis. It has not been generally appreciated that for the larger colonies, flagellar stirring of boundary layers and remote transport are fundamental for maintaining a sufficient rate of metabolite turnover, one not attainable by diffusive transport alone. We describe experiments that quantify the role of advective dynamics in enhancing productivity in germ-soma differentiated colonies. First, experiments with suspended deflagellated colonies of *Volvox carteri* show that forced advection improves productivity. Second, Particle Imaging Velocimetry of fluid motion around colonies reveals flow fields with very large characteristic velocities U extending to length scales comparable to the colony radius R. For a typical metabolite diffusion constant D, the Peclet number $Pe = 2UR/D \gg 1$, indicative of the dominance of advection over diffusion, with striking augmentation at the cell division stage.

[1]Supported in part by NSF grants DEB-0075296 and PHY-0551742

Raymond Goldstein
University of Arizona

Date submitted: 06 Jan 2006 Electronic form version 1.4