

Statistical Mechanics Conference Rutgers University December 2009

Exploration of Transitions to Multicellular Life in Amoeba Colonies

C. Franck, Cornell University

The social amoebae system *Dictyostelium discoideum* has long been a target of inquiry for its dramatic response to starvation: the aggregation on substrates of tens of thousands of hitherto uncorrelated cells in order to form a genomic lifeboat. We have been particularly interested in the limit of low density where intercell communication would be challenging and one would expect continuum models to fail. Besides varying density of cells, we perturbed this transition to collective life in another essential manner by physically altering its chemical signaling channel through variation of channel thickness from on the order of 1000 microns to less than 1 micron. We succeeded in explaining some key observations with a simplified dynamical theory coupled with an analytical solution to the relevant chemical transport problem. Our results force a reexamination of how this model developmental transition is understood to come about in standard protocols. Switching to another problem in the same living system: we reveal key fluctuation effects in cell proliferation for the unstarved state in shaken bulk suspensions. This is a followup to our earlier work (Phys. Rev. E v. 77, 041905 (2008)) which explored a slow-to-fast population growth transition with increasing density which we interpreted as a collective effect. In contrast to the first problem, we believe that here intercell signaling is conducted by means of short range, possibly mechanical events, rather than through the long range exchange of molecules. These projects, collaborations with Xiao-Qiao S. Zhou, Amrish Deshmukh, Elijah Bogart, Sharon Lau, Kayvon Daie, Albert Bae, Bradley Webster, Ryan Monaghan, Wui Ip, Nathan Franck, and Thanhbinh Thi Le are detailed in papers found at <http://people.ccmr.cornell.edu/~kip/> .