The evolution of individuality and conflict mediation

Understanding how multicellular organisms evolved from unicellular forms is fundamental to our comprehension of evolution. But, apart from the enthusiastic reception given by evolutionary biologists to the books by Buss (1987) and Maynard Smith and Szathmáry (1995), the formative role of this transition has received little attention. However, new models, recently developed by Michod and Rose1, which highlight the important role in evolution of the transition from selection at the cellular level to selection at the level of the multicellular individual, will hopefully attract the attention of ‘evo–devo’ scientists to this fundamental area of research.

The models support the hypothesis that increasing cooperation between cells, together with the emergence of conflict mediation between cells, was crucial for the evolutionary transition from cells to multicellular individuals. Furthermore, these models predict an even larger role for conflict mediation during the evolution of organisms with macroscopic body plans and of organisms with maximal indirect development [the development of the adult body plan from undifferentiated set-aside cells (sacs) that are separate from the cells that form the larva]. To control potential conflict between cell lineages (based upon the proliferative ability of sacs) that might lower the fitness of the individual, Michod and Rose’s models predict the evolution of novel or stronger mechanisms of conflict mediation concomitant with the origin of sacs. Michod and Rose, following Blackstone and Ellison2, suggest that germ-line sequestration might be the requisite novel conflict mediator that limits the accumulation of heritable mutations in multicellular organisms as sacs continue to divide in the formation of the adult body plan. Both studies cite research by Ransick and co-workers3 that supports the predicted correlated occurrence of sacs and germ line sequestration in extant animals. Perhaps unsurprisingly, such a scenario, Dedeine et al.’s results illustrate a fifth Wolbachia reproductive manipulation, imposing a no return situation, which could be termed ‘sterilization of aposymbiotic sisters’ (SAS).

The mutualism and SAS hypothesis can be tested experimentally using Wolbachia injections into a novel host species. Under the mutualistic hypothesis, the response to Wolbachia elimination is presumably host specific: Wolbachia in a novel host should not be necessary to oogenesis. Conversely, under the SAS hypothesis, the poison–antidote system could be expressed in a new host, and uninfected daughters from infected mothers would be sterile.


Sylvain Charlat
charlat@ijm.jussieu.fr
Hervé Mercot
mercot@ccr.jussieu.fr


Frieton Galis
Galis@ru.nl
Ronald A. J. enner
jenner@science.uva.nl