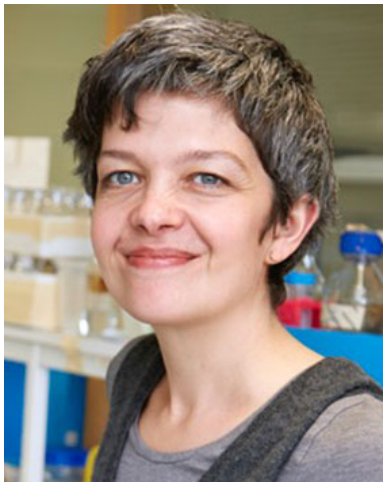

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SCHWERPUNKT

ARBEITSVORHABEN

Developing a New Model System for Research into the Major Evolutionary Transition to Multicellularity

Research on the evolution of multicellularity has focused on organisms that retain the ability to survive and reproduce as single cells, such as slime moulds and algae. In this sense, they have not undergone a major evolutionary transition to obligate multicellularity. Complex multicellular organisms, such as ourselves, have evolved life histories that promote harmony of purpose between our cells. This is why we lack examples of adaptation to genetic conflict within complex multicellular organisms.
Planarian flatworms are obligate, multicellular organisms that cannot survive and reproduce independently as individual cells. Evolutionary processes that promote alignment of interest between cells are nevertheless absent. First, planarians are not necessarily clonal. Each worm is comprised of genetically distinct stem cell lineages. Asexual reproduction is achieved by "ripping apart": each worm is, therefore, a composite of cells derived from the parent. Neither is the germ line irreversibly determined - stem cell lineages can compete to form the germ line. How then is the integrity of the individual organism maintained?
I intend to use my Wissenschaftskolleg Fellowship to design a research programme to address these questions. The challenge is partly technological - how can we experimentally manipulate levels of conflict between cells within organisms or measure the consequences of conflict for cell lineages and the fitness of individual worms? - and partly theoretical - to what extent can we consider stem cell lineages to be distinct selective units; how can we explain species diversity in the levels of conflict? These two sets of challenges are intertwined - understanding the precise evolutionary questions relevant to this system will be key to designing appropriate experiments and maximize the opportunities arising from this extraordinary organism to advance our understanding of multicellular life forms.

Recommended Reading

Andersen, S., R. L. Marvig, S. Molin, H. Krogh Johansen, and A. S. Griffin (2015). "Long-term social dynamics drive loss of function in pathogenic bacteria." PNAS 112, 10756-10761.
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