IBGC SEMINAR
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EXPERIMENTAL EVOLUTION OF CELLULAR DIFFERENTIATION IN THE VOLVOCINE ALGAE

How new cell types arise is a central question in the study of major transitions in evolution. While we know that genetic changes can result in the evolution of new cell types in multicellular organisms, it remains unclear whether the development of cellular differentiation can be ancestrally plastic prior to coming under developmental-genetic control via genetic assimilation. Using the volvocine green algae as a model system, we utilize experimental evolution to address the question of whether the plastic development of a new cell type could precede its fixation via genetic assimilation. We have previously shown that Eudorina elegans, a volvocine algae species historically characterized as undifferentiated, develops a small proportion of plastic somatic cells following exposure to cold shock. Here, we exposed clonal Eudorina cultures to multiple rounds of repeated cold shock and characterized the differentiation status of our lines more than 30 generations after the cessation of the cold treatment. We found that the repeatedly cold-shocked lines had an increased proportion of colonies with somatic-like cells and that these lines also had more somatic cells per colony than controls, indicating that the plastic response evolved and that development of somatic cells was evolutionarily modified. We also found that cellular differentiation was obligate in one cold-shocked lineage, which always had somatic cells and had a higher proportion of somatic cells per colony than other lineages. Our results demonstrate that genetic assimilation can lead to the rapid evolution of cellular differentiation. We conclude that new cell types can evolve through genetic assimilation and that repeated stressors can potentially both generate genetic variation in differentiation and selectively favor differentiation, resulting in the rapid evolution of cellular differentiation.

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