Cologne Evolution Colloquium

SFB 680 Molecular Basis of Evolutionary Innovations

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Phenotypic plasticity and the evolution of developmental pathways

All animals respond to their environment, but some animals have the ability to change their physiology, biochemistry and behaviour, over the long-term, in response to an environmental cue; a phenomenon known as phenotypic plasticity. Using diverse examples of phenotypic plasticity I want to address how plasticity functions in these species, how plasticity has evolved, and whether plasticity has a role in guiding or even driving evolutionary processes. I have begun this work using two independently evolved examples of reproductive phenotypic plasticity in insects, the honeybee (*Apis mellifera*) and the pea aphid (*Acyrthosiphon pisum*).

The honeybee queen is usually the only reproductively active member of the hive and secretes a pheromone, known as queen mandibular pheromone, that represses reproduction in the worker bees. If the queen is lost, or removed, from the hive the worker bees sense this change in their environment and their ovaries undergo complete remodelling to generate large active ovaries capable of producing eggs. Using a variety of techniques, we have shown that Notch signalling has been co-opted into controlling reproduction in the honeybee and that epigenetic mechanisms, such as DNA methylation, have a role in stabilising this change.

The pea aphid also shows remarkable plasticity, switching between sexual and asexual modes of reproduction dependent on the season. We are just beginning to understand the mechanisms that control plasticity in this species. We have shown, however, that there are striking differences in the expression of early patterning genes between morphs produced by asexual reproduction and those produced by sexual reproduction. This implies that plasticity in this species has driven the evolution of two different early developmental trajectories.

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