# Manes, trains and antlers explained

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For Charles Darwin, the problem of the peacock's tail, in light of his theory of natural selection, was vexing in the extreme.

Indeed, in 1860, writing to Asa Gray, his most ardent American champion, Darwin confessed: "The sight of a feather in a peacock's tail, whenever I gaze at it, makes me sick!"

In his struggle to explain why such extravagant and seemingly burdensome features existed, the great English naturalist struck upon the idea of sexual selection -- that showy traits such as the Peacock's ornamentation were an advantage in the mating game that outweighed other disadvantages.

A team of Wisconsin scientists has turned from the question of why such male traits exist to precisely how they evolved. They have worked out the molecular details of how a simple genetic switch controls decorative traits in male fruit flies and how that switch evolved. By extension, the work explains the mechanics of how the male lion got his mane, how the bull moose acquired such an impressive set of antlers and, yes, how the peacock got its magnificent tail.

Writing in the latest edition (Aug. 22, 2008) of the journal Cell, a team led by University of Wisconsin-Madison molecular biologist Sean Carroll describes the regulation and evolution of a genetic circuit in fruit flies that permits the male to decorate its abdomen. The work also shows how the regulation of the same genetic circuit in females represses such ornamentation.

"This study is about the how, not the why," says Carroll, a Howard Hughes Medical Institute investigator and one of the world's noted evolutionary biologists. "How can this trait be made in one gender and not the other?"

The question of the origins of secondary sexual characteristics -- traits other than reproductive organs that are peculiar to one gender or another -- is one that dominates modern evolutionary biology, says Thomas Williams, a UW-Madison postdoctoral fellow who helped lead the study. "Males and females basically have the same set of genes, so how do you specifically modify the activity of a male's genes but not a female's genes?"

The answer, according to the new Cell report, resides in the genetic repression of a protein in the male fruit fly that permits it to color the tail end of its abdomen.

"The flies did not need new genes to make a new pattern," Carroll says. "They just changed how males and females use a common set of genes."

The genetic switch that governs expression of the protein, Carroll notes, is ancient and originally evolved for an entirely different purpose, but over time mutations accumulated, perhaps in response to sexual selection, that drove the evolution of male flies with more colorful derrieres.

"The switch existed for tens of millions of years because it had a different job," says Carroll. "But it got remodeled. Evolution is a cumulative process. You have this machinery and it's easy to add a bell or a whistle. With this particular trait, it evolved by exploiting (genetic) information that was already there to make male bodies different from female bodies."

According to Williams and Carroll, the study provided no evidence that the ornamentation process ever occurred in females and was subsequently repressed. "We have enough evidence to believe this evolved in a male-specific way," says Carroll.

The same process, Carroll and Williams argue, is at play in animals from humans and elephant seals to fish and beetles. There is a world of exaggerated traits in animals and evolutionary biologists today, like Darwin 150 years ago, are engaged by the question of what advantages they confer.

"These are the most rapidly evolving traits in evolution," Carroll explains. "If female tastes change, these traits go away. There is no reinforcement.

"It's a tradeoff," Carroll concludes. "As long as the gain outweighs the cost, the feature will survive. The fruit fly's color pattern is a paradigm for understanding how to use the same sets of genes in different sexes to come up with different features."

Source: University of Wisconsin-Madison

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