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New UW research reveals how male sex traits evolved

Shawn Doherty — 8/22/2008 10:13 am

Few things seem so silly as a peacock preening its gaudy tail or an elk clanking through the trees with its cumbersome antlers or even a male human displaying his hairy chest, but now we know that these secondary sexual characteristics have evolved because they attract mates, and in the animal kingdom, procreation leads to better odds of survival.

These days, the study of evolution has shifted from the question of why such male traits exist to what makes them work and where they came from. In Thursday's edition of the science journal Cell, a team lead by world-renowned University of Wisconsin-Madison molecular biologist Sean B. Carroll has published the first study to come up with some of the genetic nuts and bolts behind this ornamentation.

"Males tend to have exaggerated traits like a lion's mane or fancy feathers in a bird or a primate's brightly colored face or rear-end that are obvious advertising in the animal world. Just sit down at the Vilas Zoo and look at all the different games going on," Carroll said. "We wanted to take a look at the how and not the why. How are these traits made in one gender and not the other? How can you take the same set of genes and make different things with them? That has been a mystery until now, and that is what's novel about this study."

The UW scientists chose to look at the paths of this genetic machinery not by going to the zoo, however, but by staying in their lab and studying the lowly fruit fly -- thousands and thousands of them. "They're easy to look at and easy to study and dissect," Carroll explained. "With other animals, the gadgetry is not so easy to get at."

What they found is a genetic switch that acts differently in males and females. In males, a protein is suppressed, resulting in the pigmentation of its abdomen. In the drab female, however, this protein acts as a repressor. These gender variations did not require different or distinct genes.

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

Over the past 15 years, Carroll has become famous for studies that demonstrate in intricate detail the choreography of evolution. His work stunned the field of an exploding new science called Evo Devo, or evolutionary developmental biology, by proving that the genes and the choreography of their assembly in the lowly Drosophila melanogaster, or fruit flies, have counterparts in all higher animals, including humans. Previously, scientists had assumed that the genetic recipe for making the fruit fly would be very distinct from other animals, because the anatomy of these creatures seems so different.

But "looks can be deceiving," Carroll explained. All animals from the fly to the elephant are built from the same basic "tool kit" of genetic material over millions of years. A different path in evolution can lead to a spot on butterfly's wing or a limb on a frog.

This DNA serves as a forensic record of the evolution of life and can one day be applied to answer key questions about human health. Over the past twenty years, Carroll said, the amount of DNA sequences in databases in his and other labs has grown 40,000 fold. Carroll likes to say that if printed onto pages, the amount of DNA text available in 1982 would have fit into a novel. Today, if put into novels and stacked, it would reach to more than double the height of the 110-story Sears Tower in Chicago.

The UW team was able not only to discover the genetic switch for color variation in the Drosophila, but to track where it came from by manipulating the fruit fly's DNA.

"That was the second complicated bit of detective work we did," Carroll said. They determined that in ancient times the same switch that triggers the pigmentation of the male's colorful behind was responsible for the segmentation of the fly's abdomen. "The switch got remodeled," Carroll explained. "New traits can evolve from old machinery. They are not created from scratch, but by a tweak to machinery that was already there."

Does that mean that if female peacocks scorn their preening partners or human females select sensitive souls over hairy musclemen one day these masculine traits will disappear? "It depends," Carroll said, chuckling. "Behavioral traits can be hard-wired, but collectively females have to find certain sexual traits not so desirable before we will see those body traits fade away."

It will take a long, long time, he said. While these kinds of secondary sexual traits evolve more rapidly than any other components of the body's architecture, Carroll said, the evolution of the fruit fly's colorful bottom still took millions and millions of years.

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