



## Evolution of "irreducible complexity" explained

*Oregon researchers unravel Darwinian evolution of complex molecular system*

EUGENE, Ore.—(April 4, 2006)—Using new techniques for resurrecting ancient genes, scientists have for the first time reconstructed the Darwinian evolution of an apparently "irreducibly complex" molecular system.

The research was led by Joe Thornton, assistant professor of biology at the University of Oregon's Center for Ecology and Evolutionary Biology, and will be published in the April 7 issue of *SCIENCE*.

How natural selection can drive the evolution of tightly integrated molecular systems—those in which the function of each part depends on its interactions with the other parts—has been an unsolved issue in evolutionary biology. Advocates of Intelligent Design argue that such systems are "irreducibly complex" and thus incompatible with gradual evolution by natural selection.

"Our work demonstrates a fundamental error in the current challenges to Darwinism," said Thornton. "New techniques allow us to see how ancient genes and their functions evolved hundreds of millions of years ago. We found that complexity evolved piecemeal through a process of Molecular Exploitation—old genes, constrained by selection for entirely different functions, have been recruited by evolution to participate in new interactions and new functions."

Thornton and coworkers used state-of-the-art statistical and molecular methods to unravel the evolution of an elegant example of molecular complexity—the specific partnership of the hormone aldosterone, which regulates behavior and kidney function, along with the receptor protein that allows the body's cells to respond to the hormone. They resurrected the ancestral receptor gene—which existed more than 450 million years ago, before the first animals with bones appeared on Earth—and characterized its molecular functions. The experiments showed that the receptor had the capacity to respond to aldosterone long before the hormone actually evolved.

Thornton's group then showed that the ancestral receptor also responded to a far more ancient hormone with a similar structure; this made it "preadapted" to be recruited into a new functional partnership when aldosterone later evolved. By recapitulating the evolution of the receptor's DNA sequence, the scientists showed that only two mutations were required to evolve the receptor's present-day functions in humans.

"The stepwise process we were able to reconstruct is entirely consistent with Darwinian evolution," Thornton said. "So-called irreducible complexity was just a reflection of a limited ability to see how evolution works. By reaching back to the ancestral forms of genes, we were able to show just how this crucial hormone-receptor pair evolved."

The study's other researchers include Jamie T. Bridgham, postdoctoral research associate in evolutionary biology and Sean M. Carroll, graduate research fellow in biology. The work was funded by National Science Foundation and National Institutes of Health grants and an Alfred P. Sloan Research Fellowship recently awarded to Thornton.