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Two New Discoveries Answer Big Questions In Evolution Theory

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Even as the evolution wars rage, on school boards and in courtrooms, biologists continue to accumulate empirical data supporting Darwinian theory. Two extraordinary discoveries announced this week should go a long way to providing even more of the evidence that critics of evolution say is lacking.

One study produced what biblical literalists have been demanding ever since Darwin -- the iconic "missing links." If species evolve, they ask, with one segueing into another, where are the transition fossils, those man-ape or reptile-mammal creatures that evolution posits?

In yesterday's issue of *Nature*, paleontologists unveiled an answer: well-preserved fossils of a previously unknown fish that was on its way to evolving into a four-limbed land-dweller. It had a jaw, fins and scales like a fish, but a skull, neck, ribs and pectoral fin like the earliest limbed animals, called tetrapods.

Discovered in 2004 on Canada's Ellesmere Island by Neil Shubin of the University of Chicago and Ted Daeschler of the Academy of Natural Sciences in Philadelphia, the 375-million-year-old *Tiktaalik roseae* "blurs the boundary between fish and land animals," said Prof. Shubin. It "is both fish and tetrapod," showing how life made the transition to land, evolving four limbs from fins.

Previously known fossils of ancient "lobe-finned fish" also seem poised between fish and tetrapods, with pectoral fins containing precursors of the humerus, radius and ulna of tetrapod armbones. But *Tiktaalik* (an Inuit word for shallow-water fish) makes a stronger case. Its pectoral fin still has thin, fish-like bones, but also contains the three armbones-to-be as well as a wrist-like structure and a hand-like one. The shoulder and elbow could bend, and the proto-wrist could extend, allowing the fin to support the body and propel it on

land. "*Tiktaalik* shows us the stages in the evolution of the tetrapod body plan," says Dr. Daeschler.

Fossils from 10 *Tiktaaliks* were embedded in rock deposited by a meandering stream system, suggesting where that momentous step occurred.

But creationists, many of whose Web sites declare "there are no transitional forms," are not easily persuaded. John Morris of the Institute for Creation Research in Santee, Calif., says *Tiktaalik* "is just a variety of fish. There is still a huge gap [between fish and land-dwellers] that has to be filled."

Another discovery addresses something Darwin himself recognized could doom his theory: the existence of a complex organ that couldn't have "formed by numerous, successive, slight modifications," he wrote in 1859.

The intelligent-design movement, which challenges teaching evolution, makes this the centerpiece of its attack. It insists that components of complex structures, such as the eye, are useless on their own and so couldn't have evolved independently, an idea called irreducible complexity.

Because only functional structures survive, they say, useless components such as parts of an eye couldn't lie around for eons waiting for dumb luck to assemble them into a (finally) functional unit. These complex structures therefore must have been assembled by a designer.

One such complex structure is a hormone and its receptor. Just as a keyhole has no use without a key and vice versa, a hormone is useless without a receptor that lets it dock with a cell, and a receptor serves no purpose without hormones. *Catch-22*: Neither component could survive without the other, yet it strains credulity to suppose that both structures popped onto the evolutionary scene simultaneously.

To investigate this puzzle, biologists led by Joseph Thornton of the University of Oregon reconstructed an ancestral

receptor. They first analyzed receptors for steroid hormones in 59 species, including primitive jawless fish and skates. Then, in a process called gene resurrection, they worked backward to infer what the gene for the ancestral receptor was, and actually made the receptor in the lab: a molecule that last existed on earth 450 million years ago.

Testing various hormones on the ancestral receptor, the scientists found that both aldosterone and another one fit. The ancestral receptor, therefore, was fully employed acting as the keyhole for this second hormone. When aldosterone appeared on the scene by random mutation, it co-opted the existing receptor, the researchers conclude in today's issue of *Science*.

The findings, says Christoph Adami of the Keck Graduate Institute of Applied Life Sciences, Claremont, Calif., "solidly refute" ID.

But refutation is in the eye of the beholder. No scientific discovery will end the evolution wars. For one thing, adherents of ID call the fact that scientists are studying reducible-complexity at all a victory for their side. "We're delighted they're engaging in a debate that they say doesn't exist," says Stephen Meyer of the Discovery Institute in Seattle, which pushes ID. Moreover, he says, the hormone-receptor system is not really irreducibly complex.

The trouble for ID is that this isn't the first study to show, step by step, how complex structures could have evolved. Recent experiments have shown how irreducibly complex structures such as bacterial flagella and the lens of an eye could have evolved by co-opting existing structures just as the hormone did. More such research is in the pipeline.

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