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Fossil Called Missing Link From Sea to Land Animals

By [JOHN NOBLE WILFORD](#)

Scientists have discovered fossils of a 375-million-year-old fish, a large scaly creature not seen before, that they say is a long-sought missing link in the evolution of some fishes from water to a life walking on four limbs on land.

In two reports today in the journal *Nature*, a team of scientists led by Neil H. Shubin of the University of Chicago say they have uncovered several well-preserved skeletons of the fossil fish in sediments of former streambeds in the Canadian Arctic, 600 miles from the North Pole.

The skeletons have the fins, scales and other attributes of a giant fish, four to nine feet long. But on closer examination, the scientists found telling anatomical traits of a transitional creature, a fish that is still a fish but has changes that anticipate the emergence of land animals — and is thus a predecessor of amphibians, reptiles and dinosaurs, mammals and eventually humans.

In the fishes' forward fins, the scientists found evidence of limbs in the making. There are the beginnings of digits, proto-wrists, elbows and shoulders. The fish also had a flat skull resembling a crocodile's, a neck, ribs and other parts that were similar to four-legged land animals known as tetrapods.

Other scientists said that in addition to confirming elements of a major transition in evolution, the fossils were a powerful rebuttal to religious creationists, who have long argued that the absence of such transitional creatures are a serious weakness in Darwin's theory.

The discovery team called the fossils the most compelling examples yet of an animal that was at the cusp of the fish-tetrapod transition. The fish has been named *Tiktaalik roseae*, at the suggestion of elders of Canada's Nunavut Territory. *Tiktaalik* (pronounced tic-TAH-lick) means "large shallow water fish."

"The origin of limbs," Dr. Shubin's team wrote, "probably involved the elaboration and proliferation of features already present in the fins of fish such as *Tiktaalik*."

In an interview, Dr. Shubin, an evolutionary biologist, let himself go. "It's a really amazing, remarkable intermediate fossil," he said. "It's like, holy cow."

Two other paleontologists, commenting on the find in a separate article in the journal, said that a few other transitional fish had been previously discovered from approximately the same Late Devonian time period, 385 million to 359 million years ago. But *Tiktaalik* is so clearly an intermediate "link between fishes and land vertebrates," they said, that it "might in time become as much an evolutionary icon as the proto-bird *Archaeopteryx*," which bridged the gap between reptiles (probably dinosaurs) and today's birds.

The writers, Erik Ahlberg of Uppsala University in Sweden and Jennifer A. Clack of the University of Cambridge in England, are often viewed as rivals to Dr. Shubin's team in the

search for intermediate species in the evolution from fish to the first animals to colonize land.

H. Richard Lane, director of paleobiology at the National Science Foundation, said in a statement, "These exciting discoveries are providing fossil 'Rosetta Stones' for a deeper understanding of this evolutionary milestone — fish to land-roaming tetrapods."

The science foundation and the National Geographic Society were among the financial supporters of the research. Besides Dr. Shubin, the principal discoverers were Edward B. Daeschler of the Academy of Natural Sciences in Philadelphia and Farish A. Jenkins Jr., a [Harvard](#) evolutionary biologist. Casts of the fossils will be on view at the Science Museum of London.

Michael J. Novacek, a paleontologist at the American Museum of Natural History in Manhattan, who was not involved in the research, said: "Based on what we already know, we have a very strong reason to think tetrapods evolved from lineages of fishes. This may be a critical phase in that transition that we haven't had before. A good fossil cuts through a lot of scientific argument."

Dr. Shubin's team played down the fossil's significance in the raging debate over Darwinian theory, which is opposed mainly by some conservative Christians in this country, but other scientists were not so reticent. They said this should undercut the argument that there is no evidence in the fossil record of one kind of creature becoming another kind.

One creationist site on the Web (emporium.turnpike.net/C/cs/evid1.htm) declares that "there are no transitional forms," adding: "For example, not a single fossil with part fins, part feet has been found. And this is true between every major plant and animal kind."

Dr. Novacek responded: "We've got Archaeopteryx, an early whale that lived on land, and now this animal showing the transition from fish to tetrapod. What more do we need from the fossil record to show that the creationists are flatly wrong?"

Duane T. Gish, a retired official of the Institute for Creation Research in San Diego, said, "This alleged transitional fish will have to be evaluated carefully." But he added that he still found evolution "questionable because paleontologists have yet to discover any transitional fossils between complex invertebrates and fish, and this destroys the whole evolutionary story."

Dr. Shubin and Dr. Daeschler began their search on Ellesmere Island in 1999. They were attracted by a map in a geology textbook showing an abundance of Devonian rocks exposed and relatively easy to explore. At that time, the land had a warm climate: it was part of a supercontinent straddling the Equator.

It was not until July 2004, Dr. Shubin said, that "we hit the jackpot." They found several of the fishes in a quarry, their skeletons largely intact and in three dimensions. The large skull had the sharp teeth of a predator. It was attached to a neck, which allowed the fish the unfishlike ability to swivel its head.

If the animal spent any time out of water, said Dr. Jenkins, of Harvard, it needed a true neck that allowed the head to move independently on the body.

Embedded in the pectoral fins were bones that compare to the upper arm, forearm and primitive parts of the hand of land-living animals. The joints of the fins appeared to be capable

of functioning for movement on land, a case of a fish improvising with its evolved anatomy. In all likelihood, the scientists said, Tiktaalik flexed its proto-limbs mainly on the floor of streams and might have pulled itself up on the shore for brief stretches.

In their report, the scientists concluded that Tiktaalik was an intermediate between the fishes Eusthenopteron and Panderichthys, which lived 385 million years ago, and early tetrapods. The known early tetrapods are Acanthostega and Ichthyostega, about 365 million years ago.

Tiktaalik, Dr. Shubin said, is "both fish and tetrapod, which we sometimes call a fishapod."