

## BOOKS &amp; ARTS

## Twenty-first-century anatomy lesson

Polymath pieces together the surprising past of the human body from fins, wings, hangovers and hiccups.

**Your Inner Fish: A Journey into the 3.5-Billion-Year History of the Human Body**

by Neil Shubin

Allen Lane/Pantheon: 2008. 240pp.  
£20/\$24

**Carl Zimmer**

Six hundred years ago, anatomists were rock stars. Their lessons filled open-air amphitheatres, where the curious public rubbed shoulders with medical students. While a surgeon sliced open a cadaver, the anatomist, seated above on a lofty chair, deciphered the exposed mysteries of the bones, muscles and organs.

Modern anatomists have retreated from the stage to windowless medical-school labs. They have ceded their public role to geneticists unveiling secrets encrypted in our DNA. Yet anatomists may be poised for a comeback, judging from *Your Inner Fish*. Neil Shubin, a biologist and palaeontologist at the University of Chicago, Illinois, delves into human gristle, interpreting the scars of billions of years of evolution that we carry inside our bodies.

I met Shubin ten years ago while writing a book about major transitions in evolution. At first glance, his lab suggested a person who had yet to make up his mind just what kind of scientist he was going to be when he grew up. Shubin spent much of his time studying fossils of mammals and other creatures he dug up in places such as Canada's Bay of Fundy. He also stained embryos to learn about the mysterious process by which limbs develop into fins, legs, wings and hands.

Actually, Shubin's mix of research had a focus: he wanted to understand how new structures evolve. How, for example, could the tetrapod limb arise from lobe-fin fish that had no trace of hands or feet? Shubin combined information from both fields to identify the genes that changed during these key evolutionary transitions. In the late 1990s, this 'integrative biology' was radical. It ran counter to the long tradition of specialization in the field. Other developmental biologists who had spent decades poring over shark embryos did not think of heading off to the mountains to find fossils to study.



Author Neil Shubin (above) discovered the transitional fossil *Tiktaalik roseae* (below).

A decade later, Shubin has plenty of company. Journals regularly publish reports on the synthesis of fossils, genes and embryos. Fossils of whales with legs have helped scientists figure out which genes changed as whale legs gradually disappeared. Tinkering with bat embryos has suggested how their hands stretched into wings. Shubin's own work on limbs has moved forward spectacularly. In 2006, he and his colleagues made international headlines with the discovery of the transitional fossil *Tiktaalik roseae*. This 370-million-year-old fish had acquired most of the tetrapod limb in its stout

fins, including some wrist bones. And while Shubin and his colleagues were digging up *Tiktaalik* in the Arctic, some of his students stayed behind in Chicago to find equally useful clues about the transition from sea to land in the genes that help build the fins of sharks and paddlefish.

*Your Inner Fish* combines Shubin's and others' discoveries to present a twenty-first-century anatomy lesson. The simple, passionate writing may turn more than a few high-school students into aspiring biologists. And it covers a lot of ground. Shubin inspects our eyeballs, noses and hands to demonstrate how much we have in common with other animals. He notes how networks of genes for simple traits can expand and diversify until they build new complex structures such as heads. Also, that hangovers explain how our ears evolved from sensory cells on the surface of fish. He investigates the hic-

cup, the result of a tortuous nervous system.

Some of the case studies will be familiar to those who have read a lot about evolution, but most readers will find some surprises. I learned that in sharks, the testes sit near the head. As male human embryos develop in the womb,

their testes gradually descend from that ancestral position to wind up in the scrotum. As they migrate, they push down on the body wall, creating a weak spot. It is here that the intestines can slip through during a hernia.

Along the way, Shubin offers some striking examples of how science works. He did not wander in the Arctic hoping to trip over a fossil of a transitional species. He knew from previous discoveries exactly which formations he should look for — mid-Devonian sedimentary deposits. When his colleagues began to unearth *Tiktaalik*, a glance at its distinctively flat skull confirmed that they had found what they had come for. They had learned their anatomy well.

Carl Zimmer is a science writer based in Guilford, Connecticut, and is author of *Microcosm: E. coli and the New Science of Life*.