

Our Living Legacy

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

By Neil Shubin (2008) New York: Pantheon Books. 229 p. \$24.00 (hard cover) ISBN: 978-0-375-42447-2.

The Quirks of Human Anatomy: An Evo-Devo Look at the Human Body

By Lewis I. Held, Jr. (2009) Cambridge: Cambridge University Press. 260 p. \$34.99 (paper) ISBN: 978-0-521-73233-8.

Inside the Human Genome: A Case for Non-Intelligent Design

By John C. Avise (2010) New York: Oxford University Press. 222 p. \$19.95 (hard cover). ISBN: 978-0-19-539343-9.

In *Requiem for a Nun*, William Faulkner famously noted, "The past is never dead; it's not even past." The three books listed above demonstrate that this is just as true of the human body as it is for Yoknapatawpha County. The legacy of our evolutionary past permeates every aspect of our biology, from our genes themselves and their organization to virtually all of our gross morphology and the way it develops... especially the way it develops. The fact that our bodies have been cobbled together using a collection of parts and processes that originally evolved for other purposes and have been subject to a wide range of diverse selection pressures is both an exciting challenge for evolutionary biologists to unravel and the source of a plethora of medical problems ranging from annoying to lethal. It is also a compelling argument against the view that humans were designed by a creator with any sense of either efficiency or good will.

As a comparative anatomist, I was both amazed and delighted to learn a decade and half ago that the segments of human vertebrae and limbs are formed using the same HOX genes that form the different segments in the body

of a fly. The study of evolutionary development seemed to be about the most exciting thing imaginable and destined to generate all sorts of wonderful revelations in the next few years. However, since that initial rush, with a few notable exceptions, I have found the field difficult to follow with as much enthusiasm. On one hand, genetics papers are usually very technical and difficult to relate to general features of gross morphology; on the other, papers purporting to apply the lessons of EvoDevo to aspects of gross anatomy or human evolution often seem, well, mostly fanciful or not very enlightening. At least that is the way it seems to a gross anatomist who has difficulty conceptualizing any aspect of biology much smaller than a marmoset molar.

Then I found *Quirks of Human Anatomy*. Lewis Held, a fly geneticist by training and teacher of human anatomy by profession, not only bridges the gap between basic research and comparative anatomy, but does so in a delightful and engaging manner that anyone can understand. Beginning with an historical background on the role of development in evolutionary change that places EvoDevo in context of the insights of Darwin, Bateson, Galton, and Waddington, Held then identifies a series of "epiphanies" about the relationships among genes, development, and evolution. These include "The Circuitry Epiphany," or the universality of covert genetic circuitry despite the overt diversity of external anatomy; the "Inversion Epiphany," the back of a vertebrate is homologous with the belly of a fly; and the "Origami Epiphany," much of our three-dimensional anatomy is formed by folding flat structures rather than sculpting a rounded shape. Most of the book is organized around a series of hypothetical questions designed to engage the readers' curiosity in order to address aspects of development: Why are we symmetric outside, but asymmetric inside? What causes identical twinning? Why are our retinas inside out? In a chapter entitled, "Serious, Stupid, and Dangerous Quirks," Held provides a clever list of "Flaws of Human Anatomy," such as the blind

spot in our eye, the descent of the testes, and the crowding of teeth, in which he identifies problems in human anatomy and discusses, why they are problems, why they are there, and how they "could have been avoided." Despite the light touch of the author's prose, this is a serious book, supplemented by dozens of excellent illustrations and nearly 3,000 references, that has lots to offer anyone interested in evolution.

The other two volumes offer broader perspectives of human development but expand the topic in opposite directions. Shubin's *Your Inner Fish* is very much an autobiographical book aimed at a general audience in which the author describes his work as both a paleontologist and a developmental biologist. The book is organized around the evolution of different systems, such as cranial nerves, eyes, and ears, throughout evolution. He reviews many of the same examples of human anatomical flaws such as testicular descent, but it is the integration of paleontological discoveries of early tetrapods and developmental studies of limb structure that make the book an adventure story.

While Shubin expands the story of human development into the paleontological realm, John Avise's *Inside the Human Genome* describes aspects of human development at the biochemical level and the philosophical implications of the many problems in the organization and function of our genome. Drawing on and expanding earlier compilations from the last century, pioneered by Garrod, Avise offers a large list of metabolic diseases that plague humanity as a result of "genes gone bad." He then discusses problems that arise because of the overly complex nature of our genetic mechanisms and the enormous amount of redundant material that clutters up our chromosomes to no good purpose. More bluntly than the other authors, Avise marshals all of this evidence as a refutation of any indication of either Intelligent or Benevolent Design in the workings of the human body.

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