Book Review: How The Snake Lost Its Legs, by Lewis Held

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How The Snake Lost Its Legs: Curious Tales from the Frontier of Evo-Devo (Cambridge University Press, 2014) is a brand new book by Lewis Held, a developmental geneticist at Texas Tech University with a very cool body of research behind him. If you don't want to read the review, here it is in a nutshell: if you are interested in evo-devo, **get this book, no matter what academic level you are at.** I think it's most suitable for undergraduates, but it can certainly be read by a layman, used by a teacher in mid-high school, and the extensive scope and reference list (2000+!) guarantee its utility as a general reference for a grad student or researcher.

Normally, I would start a book review by explaining what the book is about. In this case, the field of evo-devo. But in the case of this book, I can simply copy-paste some subchapter titles for you to get the idea:

- "How the urbilaterian got its symmetry";
- "How animals decorate their skin";
- "Why the chordate flipped upside down";
- "How the insect got its (stiff) upper lip";
- "Why the fly twirls his penis";
- "How the fly tattoed its arms";
- "How the deer regrows his antlers".

You get the idea. Every subchapter is phrased as a question, and most of them are "How" questions. The answer to each subchapter involves getting into developmental biology, and putting that knowledge into an evolutionary context.

As an example, consider subchapter 2.1: "How the fly got its gyroscopes". It aims to explain how halteres evolved. Halteres are the reduced hindwings of flies, and they act as stabilisation organs. Held introduces flies and their considerable flying abilities, and explains the important role of halteres in their performance.

He then remarks about how very few insect orders have only one pair of wings, making an honourable mention of the Strepsiptera, and then goes on to explain how fly wings and halteres develop, including a very handy illustration (which has duly replaced the previous diagram I had in my stock lecture on the subject!). It's told as a story, from A to B. Neither anatomical terms nor genetic details are shied away from; all are explained in a very readable style.

By the end of the subchapter, you yourself can explain how a fly's wings develop from larva to adulthood. If you are a teacher, you could just read the whole thing out loud to your students. If you are an undergrad or a researcher, you have all the citations you could possibly want – from developmental research to studies of how insects with missing wings and halteres fly.

It's a similar style with all the subchapters in the book. The first five chapters contain detailed answers such as these. Chapter 1 deals with how the last common ancestor of all bilaterally symmetrical animals looked like. Chapter 2 concerns fly development, and Chapter 3 does the same with butterflies and insects in general. Chapter 4 is devoted to the evo-devo of all the snake's anatomical quirks. Chapter 5's sole topic is how various mammals and fish form their patterns, from cheetahs to zebras to zebrafish.

Chapter 6 changes gears somewhat. It's a smörgåsbord of interesting evo-devo questions in the same style as all the previous subchapters. But the difference is that while other chapters had around 4-8 questions for 20-30 pages,

chapter 6 packs around 50 questions into a tight 32 pages. No answer gets more than a couple of paragraphs.

And this format works just fine! The beauty of this section is that if you read the previous chapters, you already know the “rules” of developmental biology and of evo-devo. This allows the author to concisely answer the questions, just providing the facts and the necessary background. I could easily imagine a drinking game among biology undergrads based on this chapter – if you can’t answer “how the remora got its sucker”, drink. The next person then has to explain “how the kiwi almost lost its eyes”. Repeat until all the trivia questions are done. For a school teacher, this chapter will provide a constant source of cool facts to spark student interest.

Evo-devo is a very rigorous research field. The need to combine precise genetic and developmental labwork with phylogenetic systematics and homology inference means that simplifying the whole ordeal for a lay audience is extremely tricky. A lot of facts can be thrown away in the name of brevity and readability, leading to severe misconceptions. For example, ask an interested layman about epigenetics, and you will most likely hear baffling neo-neo-Lamarckian weirdness instead of actual epigenetics.

Lewis Held must be commended for not going down this road of oversimplification, no doubt a product of experience gained with his previous book, *Quirks of Human Anatomy: An Evo-Devo Look At The Human Body* . These two books join with several Stephen J. Gould articles and Sean B. Carroll’s *Endless Forms Most Beautiful: The New Science of Evo-Devo* to make a popular bibliography showcasing the insights that can be gained from this highly-exciting interdisciplinary field.

The importance of books outlining such a seemingly esoteric topic cannot be understated. Nowadays, books popularising evolution come a dime a dozen. Most of them have a section on evo-devo as well. But while evolution is the most important subject, I find that as a scientific community and as science popularisers, we have a duty to present the more obscure or complicated topics of study to the public, rather than keep banging on about something as large and generally well-understood (some geographic areas notwithstanding…) as evolution. One of my favourite pop. sci. books is Richard Fortey’s *Trilobite: Eyewitness to Evolution* , because its main subject was an extinct group of arthropods that most people have as a visual image in their minds, but very little real knowledge of. Not only did *Trilobite* explain all about trilobites, it also used them to demonstrate historical geology, history of life on Earth, and evolution.

The point is that we shouldn’t be afraid to popularise any subject, no matter how complex it is. In *How The Snake Los Its Legs*, Lewis Held gives us a readable, in-depth look at evo-devo and all the questions it can answer, from the important, to the fascinating, to the weird/cool facts you can repeat whenever you’re at the pub. It’s accessible to non-biologists and laymen, useful for teachers and undergrads, and deserving of a place on the bookshelf of any relevant researcher.