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Book Review

Fishing into our Past

A review of Neil Shubin, *Your Inner Fish: A Journey into the 3.5 Billion-Year History of the Human Body*. Allen Lane: London, 2008, 229pp, UK£20, ISBN13: 9780713999358 (Hardcover)

Robert King, Department of Psychology, Birkbeck College, University of London, UK. Email: spiersking@hotmail.com

I am sure that many of us vividly remember the first time we started to *get* evolutionary psychology. For me it was like coming out of the optician's with new glasses and realizing that I had been making do with a terribly short-sighted blur for ages. There is a sort of vertigo attendant on appreciating that the self is not just a few decades old or, as the cultural determinists claimed, centuries old. The realization that our selves could be understood only on the scale of *millions* of years creates dizziness. It is like that first time lying on one's back staring into the time machine that is the star-filled night sky and it's hitting you that many of those stars are now long dead.

Those in Evolutionary Psychology (EP) are used to the concept of Deep Time. Some new term needs to be invented for what is stressed in Neil Shubin's *Your Inner Fish*. Bottomless Time? Unfathomable Time? Shubin invites us to pan back our usual EP scale by three orders of magnitude from the savannah ape and consider ourselves from the perspective of 3.5 *billion* years.

Of course, in doing this, Shubin is taking us back well beyond the "inner fish" of the title, but it is fish that made Shubin famous. At least, one fish/tetrapod, which made a bit of a splash a couple of years back, namely *Tiktaalik*.

Tiktaalik is one of those fossils, like archaeopteryx, destined to become famous because of its possession of clear transitional qualities. It is a fish with legs. It is quite bracing to realize that one's ability (and in my case not that great) to do press-ups depends on a wrist configuration that evolved in *Tiktaalik* some 375 million years ago. *Tiktaalik* needed wrists to push itself about lake bottoms avoiding large predators. Now I use the same basic wrist configuration to try to stop gym instructors shouting at me.

What of the evolutionary journey from *Tiktaalik* to ourselves? Various authors have, at times, emphasized the importance of purportedly non-adaptationist explanations in evolutionary stories (e.g., Gould and Lewontin, 1979). Concepts like exaptations, by-products and spandrels have all been invoked as part of a supposedly pluralistic outlook. However, on closer inspection, all of these concepts are parasitic on the more basic concept

of adaptation. They rely, for example, on knowing what the adaptation *is* that the trait is a spandrel *of*. Or, another example, of knowing how a trait deviates from some idealized optimality in order to explain its evolutionary trajectory. Classic examples include the eye, whose sub-optimality *if one were an actual designer* is well known.

By-product and spandrel hypotheses are not default positions, they need to be demonstrated. It is therefore well worth knowing something of how factors like historical constraint and by-products actually work in practice. Shubin provides vivid evidence, in the form of evolutionary bungling, such as hiccups, hernias, hemorrhoids and heart disease. These examples give a sense of how natural selection works with what it has, achieving often surprising ends, not perfect by any means, but managing to solve fitness problems better than chance. Each "defect" can be seen in terms of adaptive trade-offs where the discomfort of individuals is sacrificed on the altar of increased fitness. In each case a phylogenetic story can be traced where each step is adaptive even if the end result is a less than perfect one. For example hernia risk in males results from testicle descent down a weird and circuitous path dictated by our shark ancestry.

If anyone ever could have been fairly accused of panglossianism (which I doubt) then this book would help to correct this. For example, Shubin traces the origin of the human problems of choking and apnea as costs paid in the trade-offs necessary to produce speech from structures evolved from ancient fish and tadpole gill arches. Here he shows, not only the importance of historical constraint, but also how within these constraints it is *adaptation* that is the driving force. Natural selection is readily seen picking variants to solve fitness problems better than chance. In fact, once one appreciates the sheer level of constraint that natural selection has to work with, one gains a renewed appreciation for the power of adaptation. The gradual tergiversations that our phylogeny traces are mute testimony to that power. At each stage the trait had to achieve a function better than chance or, at least, not interfere with other functions to the extent that it could wait for an appropriate time to become the raw material for evolution. This is, I assume, all that could logically be implied by an exaptation. After all, nothing *arises* as an adaptation. Random mutation just makes variations arise. If they get selected then, by virtue of this, the traits become more and more adapted to local conditions.

For some reason Steven Gould and Ernst Mayr are mentioned on the cover as being Shubin's mentors. Neither individual gets a mention in the main text, index, acknowledgements or bibliography, so I am guessing that they were put on the jacket by publishers keen to exploit celebrity. Knowing Gould's reputation, the jacket mention might have worried readers that they were in for some rehearsal of claims that well-known evolutionary processes are both revolutionary and inimical to an evolutionary perspective on human nature. There is nothing of the kind here. I agree with Dennett (1995) that there is nothing at all wrong with just-so stories. This book contains just-so stories as they ought to be; meticulously researched, ingeniously tested, explanatorily satisfying and well-written. In the absence of (causal) just-so stories (leading to testable predictions) what would we have in science? We would be left only with explanations that do not explain. Perhaps, like Topsy, traits "just-growed". Perhaps the time has come for anti-adaptationist accounts to be called "just-growed" stories?

An example of a just-so story is a fine description of the evolution of color vision.

Shubin gives a convincing explanation of color vision's evolving 55 million years ago, in conjunction with changes in ancient forests, because of the adaptive value of acquiring greater color diversity to respond to fruiting opportunities. From this he moves to a discussion of the common source of eye genes. It is a remarkable fact that the same control gene (Pax-6) occurs in frogs, flies and us, and does the same job: sending messages to create eyes. Take Pax-6 from a fly and insert it into a frog and it will create frog eyes. The discussion of the role of Hox genes may be old news to some, and has been done in more detail in popular works by, for example, Richard Dawkins in *The Ancestors Tale* (2004), but I found it welcome for comparison in this context. The eye story is reverse engineering of the kind we are used to in EP because it asks the question, what might this trait (color vision) be for - i.e. how might it fit with environmental threats and opportunities?

There has been much scholarly ink spilled over whether the reverse engineering model can be appropriately applied to evolutionary stories. Jacob (1977) famously said that evolution does not work like an engineer, but like a tinkerer. As the son of an engineer who spent formative years amidst piles of half-finished, and sub-optimal projects, I would like to say that this statement shows a woeful lack of understanding of how actual engineers work! Let no-one assume that an engineer has a complete design in his or her head before going to build. The house of an engineer, like the history of the world, is littered with sub-optimal projects that might be finished sometime. And an engineering project is never actually finished, more likely abandoned. "If it ain't broke then don't fix it" is a worthy maxim for most of us. "If it ain't broke it doesn't have enough features yet" is the engineer's maxim. Engineers are tinkerers. Let the process of seeking evolutionary explanations be seen as reverse tinkering, rather than reverse engineering, if this seems more satisfying to the scholars. It amounts to the same thing. Shubin shows how cunning tinkering turned fish into hominids.

What about bringing things closer to the timescales that we are used to? Shubin makes explicit reference to problems caused by the switch from an active hunter-gatherer lifestyle to a sedentary one. Included here are diabetes, heart-disease and obesity which he links to the thrifty genome hypothesis (Neel, 1962). In addition, thrombosis and other effects of blood pooling, such as hemorrhoids, are shown as resulting from a switch to a sedentary lifestyle. It is good to see the expanse of time that our ancestors spent as active hunter-gatherers taken seriously as explanatory in humans. This is another sort of reverse engineering. It is a reminder that something that is definitely not currently adaptive might make sense in the light of previous adaptations. As a case in point, leg muscles of an active person help to keep blood pumping. Sitting down causes this to cease and therefore leads to blood pooling around the rectum with consequent hemorrhoids. This could, in principle, lead to testable predictions. Those with more sedentary lifestyles will, for example, have increased hemorrhoid risk. Those who still harbor dualist leanings might be less inclined to dismiss "physical" stories about the importance of our hunter-gatherer past. This provides a useful explanatory wedge to drive into potential skepticism about our evolved psychology.

Shubin tells a good detective story, replete with engaging anecdotes and is generous with praise to his colleagues. He is obviously dedicated to his work and he captures the excitement of scientific discovery in a way that engages and charms.

To finish, I must register a few reservations. The book is, like most popular works,

on the short side. Biology specialists will be left wanting more detail. I (a non-specialist) finished it in a long afternoon and was also left wanting more, which is perhaps deliberate on the part of the author. Secondly, although talk of "our inner fish" may be revealing, because we can see the residue of fish ancestry in our bodies, talk of (for example) our inner fly can mislead. None of our ancestors were flies (although, of course, we share a common ancestor). Finally, some of the information in this book will likely be old news to professional biologists. If someone is seeking further development along similar themes but in much more depth might I suggest Richard Dawkins's (2004) *Ancestors Tale* as a popular but erudite next port of call?

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