

*Book Review***Your Inner Fish**

by Neil Shubin

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We often say that the Centre for Bioscience covers all the bioscience disciplines from Anatomy to Zoology. This new book also does this but with strong emphasis on paleontology (the author is Chairman of the Department of Anatomy, University of Chicago, although he calls himself a paleontologist and still goes digging) and on DNA and Genetics. It is also interdisciplinary. Shubin has a friendly style of writing and one would imagine that he should be good at explaining things in lectures. Although scholarly, the book is easy to read (this does not mean that it is trivial), but here are a couple of examples. About lungfish, he writes: "Scientists . . . found lungfish to be essentially a cross between an amphibian and a fish. Locals found them delicious." And in thinking about the development of limbs, he says, "for arms, think 'one bone—two bones—lotsa blobs—digits pattern'": this leads on to *sonic hedgehog* which is well explained even for the non-geneticist.

The book starts with a couple of chapters about Shubin's archeological expeditions or adventures finding fossils and he conveys the excitement and also the frustrations until, he says, you know what you are looking for. He brings his discoveries back to the lab both physically and metaphorically, and in chapter 3, starts to link them (for example with limb development) and subsequently with genes and DNA, ZPA and the action of retinoic acid. The next two chapters are about teeth, glands and feathers, and about how heads evolved (the chapter is of course entitled "Getting Ahead"). Chapter 6 is about symmetry and body plans – so-called 'higher' animals have a front and a back (unlike jellyfish with which we share a few genes), a spinal cord and guts on the belly side (underneath). As he says there is a mouth and head at the front, the direction the animals typically swim or walk, and an anus at the other end. He says: "As you can imagine "anus forward" wouldn't work well in most settings, particularly aquatic ones. Social situations would be a problem too." This chapter deals with what happens in the embryo from the moment of conception, and is about tubes, notocords, etc., and experiments with, for example, newt eggs and salamander embryos. He is very good on the people who did the fiddly experiments many years ago in the early parts of the century to find out what was happening. He then moves on to relate this to the DNA and *Hox* genes in humans compared with in flies, and organizers, leading on to *Noggin*. Chapter 7 is about building bodies with different types of cells and division of labour, but relating to the early experiments of H.P.V. Wilson on sponges and their reassembly after being passed through a sieve. He also deals with why there are bodies, noting that for the first 3.5 billion years of evolution there were only microbes – and then suddenly bodies appeared – was it just to avoid being eaten? He also reminds us that synthesizing collagen requires oxygen, but that the levels of oxygen in the ancient earth were low hence building bodies would be more difficult.

Chapter 8 is really fascinating up to date stuff about our senses: It's entitled "Making Scents", and is really about the large number of genes we vertebrates have for perceiving smells, starting with the ones that fish have. It seems that about 3% of the vertebrate genome is devoted to genes for detecting different odours. However, in humans (compared with dogs) 300 out of our about 1000 odour genes have been rendered functionless by mutations. This, he says, may be connected with the fact that we humans have traded smell for vision. After the development of colour vision the smell genes became less useful: excellent 3D colour vision allowed us (as monkeys) to swing through the tress, and chapter 9 deals with vision and how eyes as well as

light gathering molecules evolved. Perhaps surprisingly although different groups of animals have strikingly different eye structures, they all use the proteins called opsins, which are quite closely related to parts of molecules found in bacteria. Of course this soon is related to the genes including the genes much studied in fruit flies called *eyeless* (the mouse equivalent is called *Pax 6*). Naturally the following chapter is about ears and how our semicircular canals developed from the gill arches in fish (again our inner fish!).

The final chapter is entitled “The meaning of it all”. It points out the importance of taxonomy – not just from an anatomical point of view but now from looking at the DNA of organisms. The author says that the “Law of Everything” is that every living thing had parents, so that the offspring had some parental genetic information but that this gets modified. This is about family trees and the sharing of characters, but it also allows predictions to be made. In addition there is the question of genetic disease, including heart disease and obesity. However, another example is man’s weak point (and mostly not woman’s), namely the tendency to get hernias. This comes about because in fish the gonads are up near the heart, but because in humans they need to descend to provide a suitably low temperature for spermatogenesis, the plumbing loops round, creating a weak point.

Overall this is an easy read, but one which is very thought provoking and educational for those who wish to become educated in the polymath sense rather than to pass exams. There are some simple pictures and photos, and at the end there are extensive notes and references as well as suggestions for further reading. It is clear that the author is widely read not only in anatomy and paleontology (and indeed in biology generally) but also has an extensive knowledge of the history and of the individuals who made the key discoveries. It would be comprehensible (and I hope interesting) to those taking ‘A’ level Biology as well as to university undergraduates. I am sure that those giving lectures in this general area would find it an excellent source of examples and quotations, some of them irreverent but none the less apposite. It would also be a good book to recommend to your creationist friends (if you have any) who tell you that evolution is “just a theory”.

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