Book review: Embryos in Deep Time

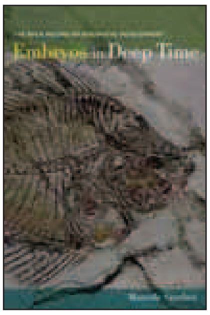
Of Embryos and Fossils

What do palaeontology and developmental biology have in common? Can one of them provide insights into the other? Marcelo Sánchez explores the close but not always recognised relationship between both disciplines.

Photo: Universal Studios

Not exactly an embryo but possibly a teenager: Is *Triceratops* (in the middle) a juvenile *Torosaurus*? The latter, a dinosaur from the Cretaceous period (about 66 million years ago), has long been regarded as a separate genus. Recent research suggests that it might represent *Triceratops* in its mature form.

How would you build your photographic family tree? You'd probably look for photos of all the relatives that you know or have heard about. But given the opportunity, would you choose photos that showed them in their 70s or 20s – or when they were infants? Whatever you choose, it will only represent one stage of the life of the person concerned. Wouldn't it be nicer to allow the tree to share your relatives at different ages? Then it might be easier to notice that you and your cousin were actually extremely similar at 6, or that your aunt was almost identical to your grandma when both were 30.



A similar problem happens with our tree of life, "The organisms portrayed are static entities, usually adults with the recognizable features of their species", argues Marcelo Sánchez, Professor of palaeontology at the University of Zurich. But this stationary portrait of the evolution of life is dramatically changing and today, most scientists are aware that studying different stages of living beings, from fertilisation to death, can help to build a better picture of the complex puzzle that is the history of life.

So developmental biology is key for understanding evolutionary relationships. And no one would deny that palaeontology, the study of fossils, also is. But have you ever wondered how they can both work together?

Digging to find embryos

Going back to our analogy, even if you tried to find photos of your relatives at different ages it would surely be much easier for the younger ones. You might consider yourself lucky to find just one picture of the sister of your great grandmother. A photo of her as a baby? Impossible!

In a situation that is similar for different reasons, finding fossilised embryos is a difficult task. This is not surprising. Even without being a palaeontologist, one can imagine that it must be very hard to find an embryo that existed thousands or millions of years ago. In vertebrates, for instance, the skeleton is not always completely developed at embryonic stages, making its preservation more difficult. No less complicated is, once found, telling a foetus apart from a last meal, as both can be, "a small skeleton inside a larger one", Sánchez explains in his book. Nonetheless, he confirms that fossil embryos do exist. Dinosaurs are the best documented group in vertebrates, followed by other reptilian ones. It's a different story for mammals: given their viviparous nature, embryos of this group are found even more rarely.

Looking into ancient development

But contrary to what the title of the book initially might suggest, we are not just talking about fossil embryos. Throughout the book, Sánchez argues that there are many ways of learning about development through the study of fossils. In one of the chapters, he gives a convincing example regarding the number of vertebrae and how they are distributed in the bodies of different animals. This number and its distribution are known to be determined by two important factors: a segmentation clock during embryogenesis, which results into the formation of blocks called somites; and the expression of the famous *Hox* genes. Given the vast fossil record of vertebrates, looking at the number of vertebrae in different regions of the body can show what was going on during the development of the fossils studied, including how fast the segmentation clock was ticking and the regulatory behaviour of the *Hox* genes in those days. This is a clear example where, without having access to ancient embryos, one can actually ask and answer questions about the development of extinct animals.

The ideas and concepts discussed are definitely influenced by Sánchez's own research, the integrative study of the evolution of vertebrate skeletons being one of his main focuses. But the book is not limited to this. It offers a well-documented diversity of examples, also including invertebrates, which are so difficult to find in the fossil record. His silence regarding embryos outside the animal kingdom, plants for instance, is one of the few complaints that can be made.

A well-documented book

Overall, the bibliographic and scientific research behind the book is appreciated. And so is his style. The book can easily be followed by readers with a basic knowledge of biology.

Finding ancient embryos in the field might be more difficult than digging out photos of your ancestors as babies. But the link between palaeontology and developmental biology comes in many other flavours. Sánchez, in his book, has shown that there is much more to explore and benefit from in this relationship.

Alejandra Manjarrez

Embryos in Deep Time. The Rock Record of Biological Development, by Marcelo Sánchez. University of California Press, 2012. 265 pages, €32.