

Egg Cetera #2: The answer to the riddle of which came first

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This image, from the cover of *Nature* (December 1995) shows the skeleton of the Dinosaur *Citipati* preserved on a nest of eggs. The eggs are arrayed in a circle under the skeleton and are about 18cm long. Credit: nature.com/nature/journal/v378/n6559/abs/378774a0.html

In the second report of our Egg Cetera series on egg-related research, let's begin with the age-old question: which came first, the chicken or the egg? Armed with knowledge of evolution, the answer is straightforward. Eggs came first.

Dinosaurs, the animal group that includes birds and their ancestors, laid eggs. This means that the ancestors of birds laid eggs long before chickens came about. Because we know so much about the evolution of life on Earth, this answer now seems obvious. But without fossils, and

without understanding how evolution works, we could have got it wrong.

My research focuses on the evolution of dinosaurs, and what that tells us about the evolution of the many distinctive features of birds, such as hollow air-filled bones, warm-bloodedness, feathers and flight.

Archaeopteryx, which lived 150 million years ago, shows a mosaic of bird-like features such as feathery wings, alongside distinctly non-birdy features such as teeth and a long bony tail. Fossil remains of archaeopteryx were first found in 1861. However, until recently, there was no consensus about where, evolutionarily speaking, birds came from. Scientists were confident that, among today's animals, they formed a group with crocodiles, but how they fitted in with the vast diversity of extinct groups was not clear.

The idea that birds are descendants of dinosaurs was first proposed by Thomas Henry Huxley in 1869, but received little support until discoveries of the bird-like dinosaur *Deinonychus* (Jurassic Park's 'Velociraptor') by John Ostrom in the 1960s. More recent discoveries include dinosaur fossils from China, preserved in ancient lake beds, complete with feathers.

Many features thought to be characteristic of birds have an ancient evolutionary history. For example, 'pneumatic' air-filled bones first appeared in Late Triassic dinosaurs, 200 million years ago, and were common in saurischians like *Tyrannosaurus rex* and *Diplodocus*.

We can also look at the evolution of eggs from the earliest fossil evidence right up to the egg we might eat for breakfast today. Like crocodiles and some turtles, birds lay hard-shelled eggs, enclosed by a calcitic, mineralised layer. These are unlike the primitive, leathery eggs of lizards, snakes, many turtles, and egg-laying mammals such as the platypus. Bird eggs also have a number of unique features not found in

other reptile eggs. They form long shapes, not spheres, and they taper towards one end rather than being symmetrical. Furthermore, birds incubate their eggs directly using body heat, and they ovulate and lay one egg at a time, whereas crocodiles and other reptiles have two functional oviducts.

Small, bipedal, predatory dinosaurs 1–3 metres in body length, like Citipati and Troodon are among the closest dinosaurian relatives of birds. Like birds, they had feathers (although they didn't fly), and their eggs show several bird-like features. The egg shell microstructure is strikingly bird-like. The eggs are relatively large (15–18 cm long) for their animals' body sizes, as in [birds](#). And they form long, albeit symmetrical, shapes. The fossilised nests of these dinosaurs show that as many as 15–24 eggs were laid, deposited in pairs (suggesting two functional oviducts), in ground nests surrounded by an earthen rim. Fossils reveal that Citipati had a bird-like brooding behaviour, indicated by its posture: its legs re folded under the body, arms stretched to either side, encircling the eggs and providing them with body heat and insulation.

Other dinosaurs show a variety of body plans and ecologies – and an enormous variety of nesting behaviours and egg types may await discovery. One of the most fascinating to have been found in recent years is shown at the fossil site of Auca Mahuevo in Neuquén Province, Argentina. Auca Mahuevo preserves hundreds of sauropod dinosaur nests, buried by a flooding river. Sauropods were the long-necked [dinosaurs](#) (including Diplodocus and Brachiosaurus). Despite the gigantic size of the adults, which weighed up to 40 tonnes, sauropod eggs were only as large as an ostrich egg. The eggs were spherical, each nest contained 15-40 [eggs](#) deposited haphazardly, and individual nests were closely packed, suggesting that brooding did not occur.

Next time you crack open an egg, think of its many unusual features, and

the hundreds of millions of years of evolution that preceded its appearance.

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Provided by University of Cambridge

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