Six amazing dinosaur discoveries that changed the world

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Taking flight? Deinonychus David Nicholls. Credit: Sedgwick Museum, University of Cambridge, Author provided

Recently, an auction of a dinosaur skeleton, discovered in Jurassic-aged rocks in the US, was held in West Sussex, England. The skeleton was

that of a largely complete, immature, three-metre long carnivorous dinosaur: *Allosaurus fragilis* – "delicate strange reptile". It was anticipated that the specimen would sell for somewhere in the region of £300,000-£500,000. Interestingly, bidding stopped before the reserve price was reached, so the specimen is still on the open market.

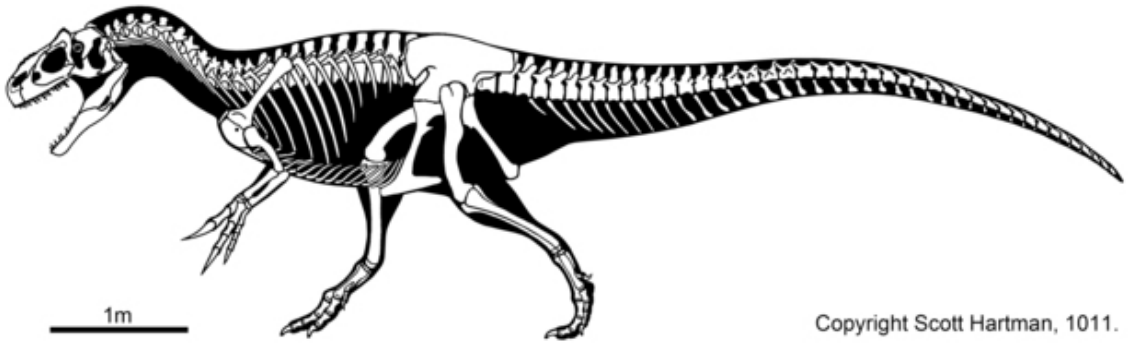
The price or value of fossils has a history that is practically as long as the science of palaeontology (the study of fossils) itself. Believe it or not, the tongue-twister "she sells seashells on the seashore" has its origin in the work of one of the earliest and most celebrated fossil collectors, Mary Anning. Mary lived during the early decades of the 19th century and had the knack of finding fossils, including those of seashells – bivalves, brachiopods, belemnites and ammonites – along the shores of Dorset and in the crumbling Jurassic cliffs, which she then sold.

Dinosaurs are fossils and do have a value, but I am only really interested in their value as scientific objects. Here are some of the discoveries that really have made a difference to science.

Megalosaurus

Pride of place must go to *Megalosaurus bucklandi* "Buckland's big reptile" – because it proved to be the earliest discovered and scientifically described dinosaur.

It's remains, though incomplete, began to be collected from quarries at the village of Stonesfield in Oxfordshire in about 1815. The bones, teeth and jaws were passed to Oxford University Museum, where they still reside, and were studied by the greatest living anatomist of the time Georges Cuvier, who visited Oxford (and its custodian William Buckland) from Paris to see the material.



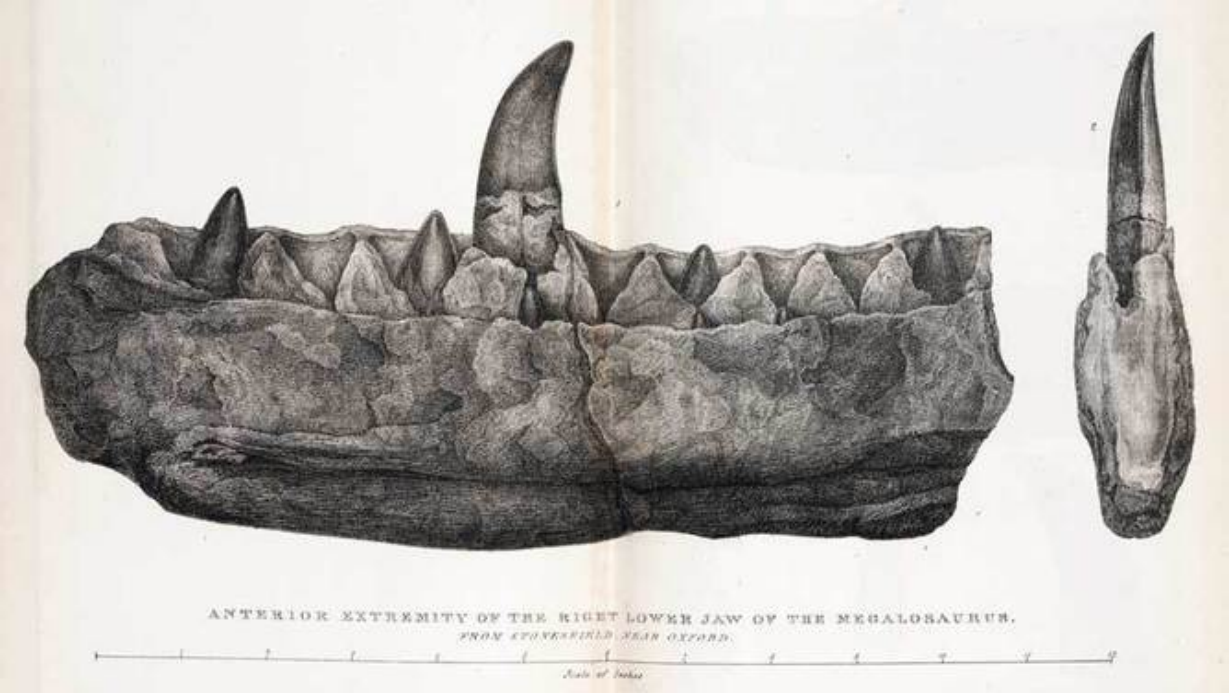
Allosaurus. Credit: Scott Hartman, Author provided

William Buckland (with Cuvier's help) described these fossils in a scientific article published in 1824. Buckland as well as Cuvier deduced that the bones belonged to a gigantic reptile, the like of which had not been seen before. Over the next decade and half more large fossil reptile bones were recovered in England and reviewed by the British anatomist Richard Owen. In 1842 Owen decided that these fossils were so utterly different from any known reptiles that they deserved to be classified as a completely new group of giant fossil reptiles: *Dinosauria* – "terrible, or fearfully great, reptiles". Prior to 1842 nobody had heard of dinosaurs, the rest is, in essence, history. And *Megalosaurus* was the first.

Archaeopteryx

Charles Darwin profoundly disturbed the established Victorian world and galvanised scientific interest in evolution when he published his book On the Origin of Species in 1859. With masterly circumspection, his book laid out the reasons for concluding that organic life had

changed or evolved over the immensity of geological time.



Megalosaurus jaw Buckland

By an astonishing coincidence, a fossil was discovered in a quarry in southern Germany just one year after the publication of Origin. This fossil comprised the major part of the crow-sized, delicately-boned skeleton of a creature that was named by Richard Owen *Archaeopteryx lithographica* ("ancient wing on writing stone").

The fossil was extraordinary because around the bones were seen the impressions of feathers (which of course implied that this was a bird) yet what was also seen in the skeleton were clear traces of teeth (no bird has teeth), hands with three well-developed clawed fingers (no bird has clawed fingers of that type) and its tail comprised a long string of small

bones from which radiated a fan of feathers (no bird has a long string of tail bones).

This animal was an absolutely perfect "missing link" that connected living birds with feathers, to the group of scaly reptiles with teeth in their jaws, clawed fingers and long bony tails. Just a few years after this discovery was announced a friend and colleague of Darwin's, Thomas Henry Huxley, suggested on the basis of the structure of *Archaeopteryx*, that birds and dinosaurs (not just any old reptile) were close relatives.

Not many agreed with Huxley at the time, but he has been proved to have been absolutely correct. Its original remains are preserved at the Natural History Museum, London.

rchaeopteryx restored. Credit: David Nicholls. Sedgwick Museum, University of Cambridge

Diplodocus

Andrew Carnegie was a profoundly wealthy industrialist based in Pittsburgh, Pennsylvania during the latter half of the 19th century. After he had amassed his fortune, Carnegie began to spend his money philanthropically. News came to him of the discovery of impressive dinosaur skeletons in the American mid-west so he decided he wanted one for his new museum (The Carnegie Museum) in Pittsburgh. So he financed expeditions to northern Wyoming and southern Utah to find some more dinosaurs. And find them they did, including a near complete skeleton of the biggest dinosaur discovered to date.

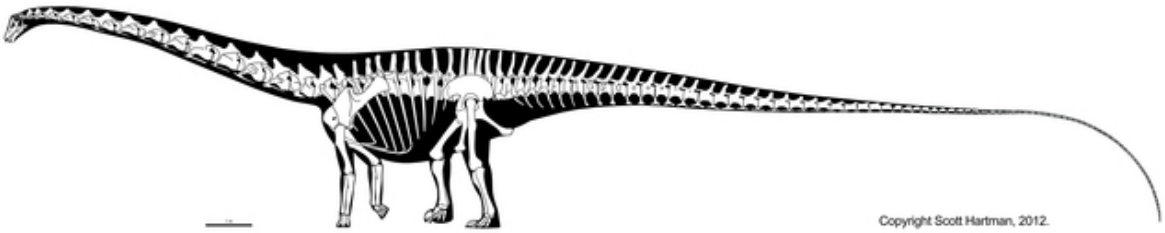
The skeleton was named *Diplodocus carnegiei* – "Carnegie's double-beam". The entire animal, as reconstructed (with just a few additions for completeness, such as "borrowed" front feet from another animal altogether) was over 25 metres long and dwarfed in size and completeness anything discovered up to that date.

Archaeopteryx

So proud of this dinosaur was Carnegie that he had many copies cast in plaster and sent to museums around the world. The giant dinosaur in the main hall of the Natural History Museum in London is a cast of Carnegie's *Diplodocus*.

Deinonychus

In the mid 1960s a young palaeontology professor, John Ostrom from Yale University was exploring the badlands of Montana looking for dinosaur fossils. What he found was to change our understanding of dinosaurs, their biology and behaviour in the most extraordinary way. Ostrom discovered the scattered remains of a medium-sized predatory dinosaur which he studied and then named *Deinonychus antirrhopus* – "Terrible claw with a counterbalance".



Diplodocus Credit: Scott Hartman

He realised that this animal was a fast moving, highly intelligent, keen-sighted predator (not at all the slow, lumbering and slow-witted image of the dinosaur that was current at the time). He also showed that it was remarkably bird-like in its anatomy, and suggested that the bird similarities suggested that birds and small predatory dinosaurs were so closely similar that birds probably evolved from them.

These were highly controversial views at the time, even though they echoed the early ideas of Thomas Huxley in the 1860s. They also posed serious biological questions: if birds and dinosaurs of this type are related could it be that some dinosaurs were more like birds in a biological sense? The debate raged for decades.

Scelidosaurus

I include this dinosaur, which is somewhat less heralded than the others, because it really *ought to have been* a dinosaur that changed the world.

In 1858 dinosaur bones were discovered in the Jurassic cliffs at Charmouth and soon a nearly complete skeleton of this dinosaur was excavated and given to Richard Owen (the person who invented the *Dinosauria*) at the British Museum in London.

In the 1860s, Owen named it *Scelidosaurus harrisonii* – "Harrison's shoulder reptile", but almost inexplicably failed to grasp the importance of its anatomy, or the way in which it pointed to the divisions between differing dinosaur groups and, in fact, why dinosaurs had proved so difficult to understand at the time.

Owen had the equivalent of a Rosetta Stone before him, yet he failed to grasp its importance. The probable reason why such an insightful scientist missed such an important moment is that he was simply too busy, including setting in motion the plans to have an entirely new national museum built. Without Owen the Natural History Museum in London, where the original bones of *Scelidosaurus* still lie, would not have been constructed. In fact, I am studying them at this very moment – hence my undoubted bias.

Sinosauropteryx

In 1996 an astonishing discovery was made in Liaoning, China. It comprised a virtually complete skeleton of a small, predatory dinosaur (smaller than, but generally similar to, *Deinonychus*).

It was described briefly in 1998 and named *Sinosauropteryx prima* – "First Chinese reptile wing" – but the most extraordinary feature associated with this fossil was that on the rocky slab upon which the skeleton was displayed there were traces of a wispy, dark-staining material that formed a sort of fringe following the body outline, as well as forming a dark spot in the area of the eye, and also formed a dark mass in the area of the gut/body cavity. The conditions of exceptional fossil preservation associated with these rocks in Liaoning seemed to preserve some remnant of the body tissues of the original animal.

Most intriguing was the fringe of tissue around the body: it looked like fur. The implication was that it had an epidermal covering (outer coat),

perhaps an insulating layer. Given Ostrom's earlier work on *Deinonychus*, the suggestion was made that this was indeed an insulated dinosaur that was able to keep its body warm (rather like a modern bird using fine down-like feathers that might have been preserved as a halo-like fringe when fossilised).

This and subsequent discoveries demonstrated the wisdom of Huxley's intuition based largely upon *Archaeopteryx* and the validity of Ostrom's work on *Deinonychus*. We now know that many (but not all) dinosaurs were feathered, and that some were capable of flight and some were indeed the progenitors of modern birds.

Source: The Conversation