Dawn of the dinosaurs: understanding the Triassic world

Posted on Thursday 2nd January 2014

In 1853, the renowned sculptor Benjamin Waterhouse Hawkins celebrated New Year's Eve in an utterly unique way: he held a lavish dinner party for twenty of the Victorian great and good inside a model of a dinosaur created for the Great Exhibition of 1851. Hawkins' models (still standing in Crystal Palace Park in South London) were the first ever life reconstructions of dinosaurs: they gripped the public imagination, and dinosaurs have never left it. One-hundred and sixty years later, dinosaurs have become iconic and stereotypical symbols of failure. Although the evolutionary descendants of dinosaurs, birds, are alive and flourishing today, nearly all other dinosaur lineages died out 65 million years ago. This mass extinction at the end of the Cretaceous period, apparently primarily the result of a massive asteroid strike, is one of the most famous events in the fossil record, but its impact negatively skews our perception of the dinosaur story. In fact, far from failures, dinosaurs were a highly successful and diverse group of animals.

Dinosaurs reigned as the dominant large vertebrates on land for 135 million years during the Jurassic and Cretaceous periods, twice the length of time of mammal dominance following the dinosaur extinction.During this time dinosaurs diversified into more than 1,000 ecologically and morphologically diverse species. They lived on all continents including Antarctica and ranged in size from pigeon-sized species weighing less than 1 kg up to 70 tonne herbivorous giants that were the largest animals to ever walk on land. Although most attention has been focused on the dinosaur extinction, arguably a more interesting question is how and why the dinosaurs became so successful in the first place.

Researchers at the University of Birmingham, based within the School of Geography, Earth and Environmental Sciences and the Lapworth Museum, are hoping to unravel the story of dinosaur origins in the Triassic period. Our work benefits from the incredible increase in the rate of discovery of new dinosaur fossils and species over the last two decades; a new dinosaur species is now named every 1.5 weeks, and our research team alone has described 11 new species since 2005. We work in collaboration with dinosaur researchers on six continents, and are hunting for early dinosaur fossils in South Africa, Argentina, Poland and Portugal.

The first dinosaurs appear in the fossil record around 240 million years ago, in the Middle Triassic. Mounting evidence suggests that dinosaur origins may have formed part of the long-term recovery of ecosystems from the Permo-Triassic (PT) mass extinction. The PT extinction was the most severe in the history of Earth, and was probably driven by intense volcanic eruptions and associated rapid climate change. This extinction decimated many of the earlier reptile and amphibian groups, and may have created environmental space for dinosaurs and other new groups to evolve.

For the first 40 million years of their evolution, however, dinosaurs were far from dominant. Other reptile groups – those with obscure names such as therapsids, aetosaurs and rauisuchians – held sway, and dinosaurs were marginal spectators in many Triassic ecosystems. Our research group is currently focused on understanding this 'long fuse' in dinosaur evolution: one key aim is to clearly establish the evolutionary interrelationships and diversity of Triassic dinosaurs and closely related groups of reptiles (together comprising a group called Archosauromorpha). By combining evolutionary trees with morphological data such as body size, we are able to quantitatively and explicitly test hypotheses about the timing, rate and processes of the dinosaur radiation.

At the end of the Triassic, 200 million years ago, many of the other reptile groups died out in the Triassic-Jurassic mass extinction, again linked to massive volcanic activity and climate change. Dinosaurs survived, and rapidly increased in diversity and underwent dramatic size increases, marking the true onset of the age of dinosaurs. Why dinosaurs survived this extinction, but other groups of reptiles did not, is still poorly understood. However, as palaeontologists understand ever more about dinosaur biology, we are beginning to recognise that unique features such as rapid growth rates or highly efficient bird-like lungs may have helped dinosaurs prosper relative to other groups.

The story of dinosaur evolution appears, therefore, to have been driven by three enormous extinctions caused by rapid, traumatic and massive environmental change. The first, at the end of the Permian, created environmental space for dinosaurs to evolve. The second, at the end of the Triassic, allowed dinosaurs to rise to dominance and evolve seemingly unfeasible body sizes. And the third, at the end of the Cretaceous, brought the dinosaurs their doom. As we head into another mass extinction, this time driven by humans, the fossil record, including that of dinosaurs, provides unique insights into the role of mass extinction in shaping and altering the course of evolutionary history.

Dr Richard Butler, Birmingham Fellow and Academic Keeper, Lapworth Museum of Geology, School of Geography, Earth and Environmental Sciences