Hidden Death:
New Mass Extinction Event Discovered in Plain Sight

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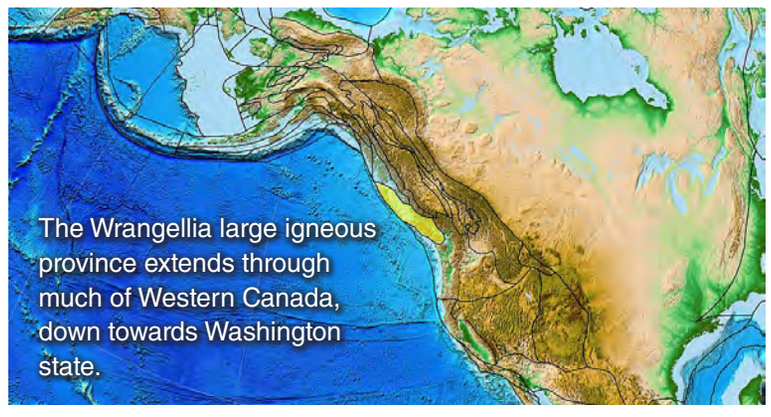
Dinosaurs are one of the most successful groups of animals in the history of life; ironic given that the word 'dinosaur' is often associated with obsolescence. They've been around for over 230 million years, have adapted to live in almost every environment on earth, and come in just about every shape and size imaginable (and then some). There are currently around 10,000 living species of dinosaur on earth today, which is almost twice the number of living mammal species. Most people might not think of things like hummingbirds, flamingos, and penguins as dinosaurs, but features such as wishbones and feathers appeared in dinosaurs long before the first birds ever took to the skies. In fact, *Velociraptor* is more closely related to seagulls, parrots, and storks than it is to *T. rex*.

There's no doubt that dinosaurs have been tremendously successful. What's not as certain is why dinosaurs became so successful compared to other animals that were around at the same time. Dinosaurs did not start out as the gigantic, spectacular, and widely diverse group most people are familiar with. The earliest dinosaurs all looked very similar to one another: small, bipedal predators and omnivores. Many different hypotheses have been suggested over the years as to how dinosaurs became so successful. Unlike most other reptiles, dinosaurs walk with their legs positioned straight underneath their bodies. This may have enabled them to move faster, giving them an advantage. Or perhaps the early dinosaurs simply got lucky; in a close evolutionary race for survival between many different, successful lineages, early dinosaurs may simply have made it out on top. If the tape of prehistory were to be rewound and played back again, perhaps some other group of animals would have made it out on top instead.

New research indicates that dinosaurs may owe at least some of their success to the sudden mass extinction of much of their competition. A new paper published in *Science Advances* claims that a previously unknown large extinction event during the time of the earliest dinosaurs may have paved the way for their dominion of the Mesozoic Era.

The extinction in question took place during what is known as the Carnian Pluvial Event. As the name suggests, it took place during the Carnian Stage of the Late Triassic Period, around 230 million years ago. This was an overall change in the global climate, resulting in increased temperature and rainfall worldwide. While it still isn't known what the cause of this Event was, scientists have noted that it happened at the same time as the formation of a large group of igneous rocks in Western Canada known as the Wrangellia Large Igneous Province. Since igneous rocks form from the cooling of magma/lava, this tells us that there was an enormous amount of volcanic activity in this area during the Late Triassic. Volcanism often results in the release of massive amounts of greenhouse gasses into the atmosphere. In addition to changing the global climate, this can also lead to an increase in ocean acidity, which can devastate many groups of animals who produce calcareous shells. These shells dissolve from the increased acidity, resulting in mass die offs of not only these animals, but the other animals who depend on them for survival.



The Wrangellia large igneous province extends through much of Western Canada, down towards Washington state.

Scientists have known about the Carnian Pluvial Event since the 1980s. What this new study shows is the sheer extent of the climatic shift, and its impact on animal life worldwide. A whopping 33% of marine animal species died out during this period. Some of the most hard-hit groups were plankton such as bryozoans and conodonts, crinoids (often called sea lilies due to their resemblance to flowers), and shelled relatives of squid and octopus called ammonoids. However, just as significant as the die-outs were the radiations that followed. After any period of mass extinction, life on earth experiences a complimentary period of diversification as new life forms evolve to fill in the ecological gaps left behind. In the case of the Carnian Pluvial Event, the groups that we observe increasing in diversity afterwards include crocodiles and their relatives, lizards, turtles, mammals, and dinosaurs.

The group that seems to have gained the most from this extinction event were the crocodiles, which experienced a boon of strange species utterly unlike any alive today; from the armor-plated, pig-snouted herbivorous aetosaurs to the gigantic long-legged predatory rauisuchians. However, the crocs would soon be displaced by the rising dinosaurs, who would once more owe their success to yet another mass extinction, this one even greater than the Carnian Pluvial Event.

The Triassic Jurassic Extinction Event was far more devastating to many land animals, resulting in as much as 42% of all vertebrate species dying out. Many of the ancient croc relatives that had flourished in the aftermath of the Carnian Pluvial Event disappeared completely by the end of the Triassic. Early dinosaurs often competed with these strange crocodile cousins for the same ecological niches, and the removal of their competition paved the way for the beginning of the reign of the dinosaurs.

This particular moment in the history of the earth - the end of the Triassic, the beginning of the Jurassic, and the extinction that delineates the boundary between them - is of special importance to Connecticut because of the exquisite preservation of environmental conditions and animal traces from both sides of the boundary. Triassic rocks from towns like Simsbury preserve evidence of the giant amphibians and bizarre reptiles that were abundant during this time. But these creatures vanish when looking at the fossil record of Rocky Hill, which preserves as many as 2,100 Early Jurassic dinosaur footprints. The Carnian Pluvial Event paved the way for the early diversification of the dinosaurs, while the Triassic-Jurassic Event led to them dominating the earth for 150 million years.

It is interesting to think about how the wealth of diversity seen in many groups of animals is often the result of some rapid period of mass death. Dinosaurs themselves would fall victim to this same cycle of extinction and adaptive radiation at the end of the Cretaceous Period 66 million years ago. The most famous of all mass extinctions, the Cretaceous-Paleogene Extinction Event led to the staggering loss of up to 65% of all living species, including most of the dinosaurs. While one group - birds - did manage to survive, dinosaurs would never again achieve the diversity and disparity they enjoyed during the Mesozoic Era. Instead, we mammals would go on to take over the roles they left behind. Just as the early dinosaurs owe their success to the extinction of their competition, so too do we owe our success to the disappearance of animals like *Triceratops* and *Tyrannosaurus Rex*.

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