BUTTING HEADS

WERE DINOSAURS THE VICTIMS OF A SINGLE CATASTROPHE?

No, It Only Finished Them Off.

By J. David Archibald

Some 65 million years ago, Murphy's Law applied—almost everything that could have gone wrong did: A huge bolide, or asteroid, struck Earth. Globally, the seas receded. Fissures on the Indian subcontinent spewed forth thousands of cubic kilometers of material. All three events took place in rapid succession, toward the end of the Cretaceous period. Each of them is thought to have been the largest event of its kind in the past 250 million years, and each is thought to have played a role in the demise of the nonbird dinosaurs. Each event left obvious physical and chemical proof of its occurrence in the rock record. That much is clear. But how can paleontologists measure the effects of such events on the creatures living at that time?

The most powerful method is simply to read, in the fossil record, which animals survived and which did not. Only western North America, though, preserves a reasonably continuous fossil record of the land and freshwater vertebrates for the last 10 million years of the Cretaceous and on through the Cretaceous-Tertiary (K/T) boundary. In those last 10 million years of the Cretaceous, but well before the K/T-boundary events, the most recent compilations show an unequivocal decline in the diversity of dinosaur species. In fact, before the time of the boundary is reached, between one-third and one-half of all dinosaur species—mostly such relatively common groups as the duck-billed and horned dinosaurs—had already disappeared.

The analysis of the final million years of the Cretaceous is more problematic, because the precision required is far greater than is discernible in the fossil record. A recent study in North Dakota noted little or no change in the vertebrate fauna throughout the thickness of the Hell Creek Formation. Those data were cited to argue that a bolide impact must have suddenly terminated the nonbird dinosaurs at the top of this formation.

Yet in the uppermost five meters of the formation only two dinosaurs could be identified well enough to specify their generic name. What happened to the other eighteen or so nonbird dinosaur species present in the Hell Creek Formation? No one knows whether they survived to the time of the boundary or became extinct thousands of years before it.

Apart from the problems of detecting rates of dinosaur extinction, we can examine the pattern of total vertebrate extinction. Of 107 species of vertebrates known from Hell Creek, about half had disappeared by the time corresponding to the K/T boundary. Of those extinctions, 75 percent are concentrated in just four groups: lizards, marsupials, sharks (and their relatives), and nonbird dinosaurs. The lizards may have faced habitat loss from increasing rainfall in the Hell Creek region near the end of the Cretaceous. As sea levels fell, the Bering land bridge enabled the precursors of modern hoofed mammals to enter North America and outcompete other mammals, notably the marsupials. The sharks, too, lost their habitat as the seas retreated. And the nonbird dinosaurs? With the loss of inland seas, the low coastal plains, from which almost all of the fossils of these animals are known, shrank and fragmented.

Then the bolide struck Earth. Many consequences of this impact have been proposed—global wildfire, extended periods of darkness, sharp temperature increases, tsunamis, and hurricanes. Other suggested effects—notably acid rain and a sharp drop in the temperature—now seem extremely unlikely, given the fossil record. The most recent proposed consequence has been sudden infrared heating. That might explain why large creatures such as dinosaurs died, whereas smaller species survived by taking refuge in holes, crevices, or under a thin layer of water.

Whatever the results of the impact, though, it only finished a job that earthbound factors had already begun. The dinosaurs and other vertebrate species had already become vulnerable to extinction.

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