DUSK OF THE DINOSAURS

Review by Michael J. Benton

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T. Rex and the Crater of Doom

BY WALTER ALVAREZ, Princeton University Press, Princeton, N.J., 1997 ($24.95)

The Great Dinosaur Extinction Controversy

BY CHARLES OFFICER AND JAKE PAGE, Addison-Wesley, Reading, Mass., 1996 ($25)

The extinction of the dinosaurs is one of the great mysteries of evolution, and scientific sleuths are not shy about reconstructing the crime. "A world first dark and frozen, then deadly hot, a world poisoned by acid and soot. This was the global aftermath of the Yucatan impact," Walter Alvarez writes, advancing his theory that an asteroid brought about the dinosaurs' demise. Meanwhile Charles Officer and Jake Page assert: "The Alvarez hypothesis has collapsed under the weight of accumulated geologic and other evidence to the contrary, as well as from an increasingly obvious absence of scientific evidence proffered in its support." How can leading scientists who have been involved in this debate for nearly 20 years arrive at such different conclusions?

The story effectively began in 1980, when Luis W. Alvarez (Walter's father) and his colleagues published a paper in Science asserting that a 10-kilometer-wide asteroid hit the earth 65 million years ago. The impact, they contended, threw up a global dust cloud that blacked out the sun, halted plant photosynthesis and triggered a wave of extinction. With their food gone, the herbivores died out; the carnivores then followed. This simple model was built on limited observational support and was, needless to say, highly controversial.

The main piece of evidence supporting the Alvarez scenario was the now famous "iridium spike." Concentrations of iridium, normally around 0.1 to 0.3 part per billion, shot up to nine parts per billion in sediments from the time of the dinosaur extinction (known as the Cretaceous-Tertiary, or K-T, boundary). On the earth, iridium comes almost exclusively from space--specifically, from meteorites. The low background levels derive from the numerous minor impacts that occur all the time. Alvarez proposed that the spike indicated an unusually high rate of iridium deposition on the earth and, hence, a huge impact. The 1980 Science paper attracted instant and massive press coverage.

Walter Alvarez tells the story leading up to the 1980 paper, and the events since then, in an engaging and witty manner. Although much of the tale is common knowledge, he offers new insights into the published and unpublished stages of the debate. Most geologists and paleontologists initially objected to the Alvarez theory. They argued, **first**, that dinosaurs and other groups died out gradually (over at least a million years) rather than instantaneously; **second**, that the iridium layer was a local feature that represented some minor peculiarity in the sediments; **third**, that Alvarez and his crew were a bunch of physicists and chemists who should stick to their own patch; **and fourth**, that the whole notion was pitched at the press and had no scientific basis. From the start, the debate mixed science and personalities, hype and hypotheses.

Officer and Page, who began as skeptics of the Alvarez hypothesis and never wavered, thread their book with some wonderful gossip, backbiting and accounts of scurrilous deeds by impact proponents. They report extensive evidence for bias in reporting and funding of the pro- and anti-impact viewpoints. They are uncomfortable with the perceived pecking order in science: math and physics good, chemistry a form of physics and so acceptable, biology and geology pretty dodgy, psychology and geography beneath contempt. The authors characterize Luis Alvarez as little more than the devil incarnate, one of the most extraordinary character assassinations of a recently deceased person that I have ever read.

But what of the science? The 1980 Science paper cited iridium spikes from two locales. Such enhancements have now been found at more than 200 sites all over the earth, in sediments deposited in shallow and deep seas, in rivers and on land. The iridium is frequently associated with small,

glassy beads (the results of melting) and shocked quartz and stishovite (the results of high pressures)--pieces of confirming evidence that were not even predicted in 1980. Searchers found the Chicxulub crater in Mexico in 1991. This 150-kilometer-wide depression is surrounded by thick deposits of ejecta and by deposits around the shores of the proto-Caribbean that show the effects of tsunamis set off by the impact.

Alvarez does not dismiss all contrary evidence and allows some role for volcanism in the mass extinction. He is **also** honest in telling of the dead ends that he and his colleagues pursued, such as the failed attempt to use beryllium 10 to calculate rates of sedimentation and studies of the Manson crater in Iowa (an early candidate for the K-T impact but too small). *T. Rex and the Crater of Doom* is strongest in presenting the evidence for the impact and its immediate physical effects **but** rather weaker in explaining just how the dust clouds, darkness, freezing, tidal waves and other environmental challenges actually killed the dinosaurs.

Officer and Page have taken on the task of presenting a cohesive opposition to the prevailing impact hypothesis. They have made things much more difficult for themselves, however, by seeking not only to deny the impact extinction model but also to deny the existence of the impact as well. **As a result**, they fail miserably. They spend most of the book attempting to show that the geologic evidence--the iridium spike, shocked quartz, glassy spherules and other phenomena--points to volcanism. To do so, the authors make selective use of the literature. As they observe, Hawaiian-type volcanoes may emit iridium, some volcanoes produce glassy melt spherules, and certain high-pressure eruptions may give rise to a kind of shocked quartz. **But** no known volcano, ancient or modern, produces all these materials together, with the peculiar characteristics seen at the K-T boundary.

Presentation of the paleontological data should have been a strength of Officer and Page's book. Here the evidence is fairly equally balanced: there are signs that some groups of organisms died out instantaneously, whereas others seem to have become extinct over spans of five to 10 million years. I was staggered to see that *The Great Dinosaur Extinction Controversy* treats the fossil record in only a few pages of mostly obsolete and sometimes misleading data. **For example**, Officer and Page represent the decline of ammonites by illustrations from papers published in 1969 and 1991. The latter diagram, by Peter Ward of the University of Washington, is said to show a gradual decline of ammonites, even though Ward himself interprets it as evidence of patchy collecting. The authors' account of the dinosaurs' disappearance is vague in the extreme and takes little account of extensive research work since 1970. **Moreover**, the two do not mention at all the recent large-scale studies of dinosaur decline through the Hell Creek Beds in Montana.

At the very least, Officer and Page develop their alternative to the impact model fairly well. They outline recent work on what might have been the long-term environmental effects of the events that gave rise to the Deccan Traps, enormous outpourings of lava that occurred at the end of the Cretaceous in what is now India. Without a strong paleontological underpinning, **however**, this argument falls a little flat. Officer and Page cannot make precise links between environmental crises during the past 10 million years of the Cretaceous and specific phases of the extinction. These shortcomings are unfortunate, **because** the impact hypothesis still has significant holes in it. The reality of the K-T impact is now essentially undeniable. How else to explain the iridium layer, the shocked quartz, the stishovite and, above all, the gigantic Chicxulub crater? **Yet** I cannot see how a single impact could produce such a complex extinction event as the one at the K-T boundary. **Furthermore**, there is almost no evidence linking an impact to any of the other mass extinctions. **Equally**, there have been a number of well-dated large impacts, such as the Manicouagan event in British Columbia, that caused no extinctions at all. Read Alvarez first, for an excellent account of the pro-impact position and for insight into how scientists pose questions and seek to resolve them by sometimes roundabout means. Read Officer and Page as a spicy account of the politics of science. But bear in mind that whether or not they are right about Luis Alvarez's character, even abrasive scientists may have the right ideas.