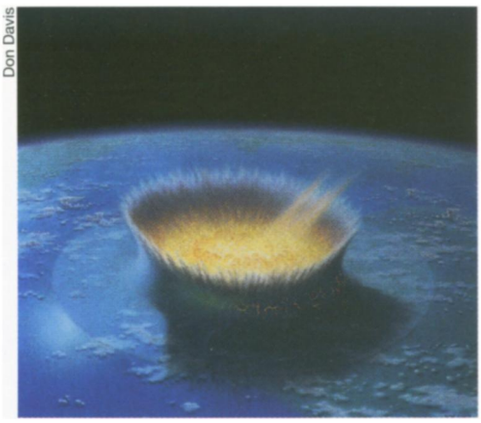
The Call of Catastrophes

By RICHARD MONASTERSKY

In the fall of 1973, a young geologist named Walter Alvarez explored a limestone gorge just outside the medieval walls of Gubbio, Italy. Chipping away at the layers of rock with his hammer, Alvarez stumbled onto something that would revolutionize how scientists view our planet and the history of life.

Alvarez, together with his father, Nobel prizewinning physicist Luis W. Alvarez, and two other researchers at the University of California, Berkeley, discovered a pencil-thin layer of clay containing unearthly amounts of the element iridium. In 1980, the team interpreted the iridium layer as evidence that a huge comet or meteorite slammed into Earth 65 million years ago with a strength 10,000 times the explosive power of the global nuclear arsenal. This planetary concussion, posited the scientists, offered the long-sought explanation for the disappearance of the dinosaurs and many other animals at the end of Earth's Cretaceous period.



Don Davis

The Berkeley team's work focused unprecedented attention on events at the close of the Cretaceous, making this distant time one of the best-studied moments in Earth's history. William Glen, a geophysicist and historian who has tracked the impact debate, counted more than 2,500 papers and books published on the topic by 1993. In terms of its influence on future science, Glen ranks the impact hypothesis even above that of the plate tectonics revolution of the 1960s.

"The Alvarez hypohesis has provided a stimulus to the earth sciences that I think, eventually, will turn out to be virtually unprecedented in this century," says Glen. "The Alvarezes started a new industry. The implications of the idea are enormous."

Initially, the Alvarez hypothesis walloped scientists almost as hard as the Cretaceous cataclysm itself would have. The idea had such a drastic effect because it challenged one of the most revered tenets of geology and evolutionary biology—a concept of gradual change known as uniformitarianism.

Championed by Charles Lyell in 1830, this doctrine supplanted the once-popular theories that cast ancient catastrophes such as floods and volcanoes as the major architects of change on Earth. Uniformitarianism teaches that the history of the world has been shaped by the same slow processes that can be seen today wearing away mountains or replacing one species with another. Because no one has ever witnessed a planet-wrenching impact, uniformitarians regarded such events as an outlandish explanation for past extinctions.

Evidence of the Cretaceous impact mounted quickly, culminating in the discovery in the early 1990s of a giant crater hidden beneath the Yucatán Peninsula. The success of the Alvarez hypothesis has prompted researchers to begin focusing on other crises in Earth's history, some even more devastating than the Cretaceous catastrophe. At least four other times during the last 600 million years, mass extinctions have knocked life for a loop, with the most severe killing off more than 95 percent of all marine species 250 million years ago.

Although paleontologists have known about these biological turning points since the early 1800s, the reign of uniformitarian thinking predisposed them to explain away the mass extinctions as gradual transitions foreshortened by gaps in the fossil record. Now, interdisciplinary teams are starting to investigate each individual mass extinction in detail, searching for signs of impacts or other sudden disasters in the rock record.

If the stock market traded in scientific ideas, catastrophism would be a wise investment.

Decades will probably pass before such studies yield satisfying explanations for the evolutionary upheavals of the past, but the bounty from current and future efforts will profoundly affect our understanding of the history of life on Earth. Evidence gathered from the late Cretaceous hints that mass extinctions are pivotal events during which the regular rules of survival break down. Whether triggered by boulders dropped from the heavens or more down-to-Earth dangers, mass extinctions dethrone the fittest creatures and can let unusual ones rise to prominence.

Unraveling these calamities will help explain some of the most basic evolutionary mysteries, such as how a scrawny group of mammals managed to displace the indomitable dinosaurs.

The importance of meteorite and comet strikes could eventually permeate other realms of science. Geophysicists are starting to examine whether giant extraterrestrial impacts occasionally scrambled the planet's interior, perhaps spawning huge volcanic eruptions and flipping Earth's magnetic field. In the wake of last summer's report of a meteorite bearing possible signs of ancient Martian life, biologists are considering anew the idea that life originated elsewhere and then hitched a ride to Earth on a random rock.

One aspect remains certain, however. Researchers will continue to ponder the rivalry between catastrophism and uniformitarianism. "This issue of uniformitarian vs. catastrophic change stands as one of the grand questions of science, for the debate pervades so many disciplines and bears so strongly upon some of the most profound puzzles of our lives," wrote Stephen Jay Gould in *Dinosaur in a Haystack* (New York: Harmony Books, 1995).

Eventually, some compromise may emerge, culminating in a theory that melds the cymbal crash of impacts with the more measured melody of gradual change. Then again, an Everest-size comet could scream down onto the planet at any moment and silence the debate forever.

We can only look up into the sky and wonder. □

1980 Scientists add a gene to mice

1981 First cases of AIDS recognized

1980 Theory that meteorite impact wiped out dinosaurs

1983–1984 HIV isolated

1985 Buckminsterfullerene, or buckyball, discovered

1985 Antarctic ozone hole discovered

1986 High-temperature superconductivity discovered

1986 Acid rain found to damage U.S. lakes

1987 Last wild California condor captured

1987 First molecular genetic studies of a mental illness, manic depression

1989 Galaxies found to be concentrated in Great Walls