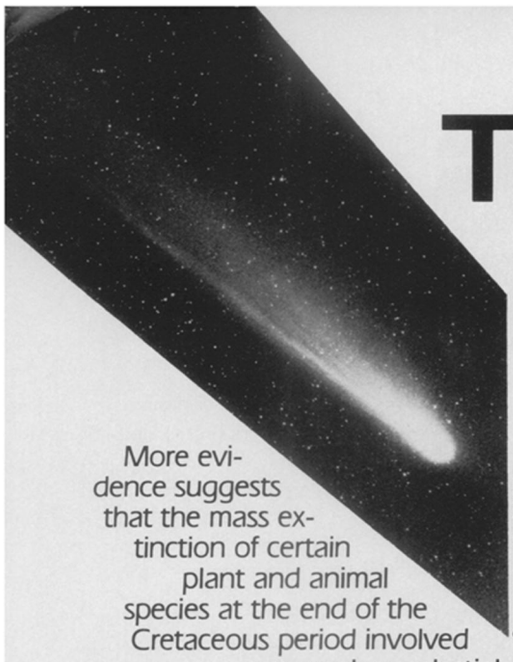

Comet Kohoutek: NASA

THE EMPYREAN STRIKES BACK

More evidence suggests that the mass extinction of certain plant and animal species at the end of the Cretaceous period involved empyreal, or celestial, influence — the impact of an asteroid or comet

BY LINDA GARMON

Geologists are presenting new evidence in one of their favorite "whodunits" — the mystery of the Cretaceous-Tertiary mass extinction.

The Cretaceous-Tertiary mass extinction refers to the more or less — even this is still a matter of debate — simultaneous extinction of 50 to 75 percent of the plant and animal groups of the Cretaceous period. The marine reptiles, the flying reptiles, the dinosaurs, calcareous foraminifera (small, one-celled sea animals with shells) and calcareous nannoplankton (planktonic organisms smaller than 50 microns in diameter) may have been eliminated between the Cretaceous and Tertiary periods, about 65 million years ago.

The search for the cause of this crisis has sent geologists to the sediments — the "history books of geology." From them they have constructed a standard geologic time scale based on stratigraphic principles — the oldest beds of rock are on the bottom, the youngest on top — and the fact that groups of fossil plants and animals occur in these strata in a definite and determinable order. It follows, therefore, that the cause of the Cretaceous-Tertiary mass extinction is somehow "recorded" in the sediment deposited between the Cretaceous and Tertiary periods. And what many scientists think they are finding in the record is an extraterrestrial cause.

Walter Alvarez of the University of California at Berkeley and colleagues reported about a year ago (SN: 6/2/79, p. 356) that they had found support for an extraterrestrial cause — an abnormally high amount of the element iridium in the boundary layer between the Cretaceous and Tertiary sediments near Gubbio, Italy. Iridium — a platinum group element — is a rare occurrence this close to the earth's surface; instead, it would be expected to concentrate in the earth's core where it chemically binds to iron. An extraterrestrial event — such as a nearby supernova or earth-crossing meteor — was proposed as the source of increased iridium at Gubbio.

Alvarez and colleagues then reported the discovery of another iridium anomaly (SN: 1/12/80, p. 22). An excessive amount of the element was found in the Cretaceous-Tertiary boundary layer at Stevns Klint, Denmark. On the basis of their iridium observations and the presumed extinctions, the researchers proposed the following hypothesis: An iridium-containing asteroid struck the earth and formed an impact crater. Dust ejected from the crater spread around the globe in the stratosphere (the atmospheric division extending from about 10 to 16 kilometers to about 50 kilometers above the earth's surface), blocking sunlight from the earth for several years. Because the loss of sunlight halted photosynthesis, most food chains collapsed and the extinctions resulted.

Now, in support of their asteroid hypothesis, Alvarez and co-workers — the Lawrence Berkeley Laboratory team of Luis W. Alvarez, Frank Asaro and Helen Michel — add another iridium anomaly to their list. In the June 6 SCIENCE they report the analysis of high concentrations of iridium in a Cretaceous-Tertiary boundary layer near Woodside Creek, New Zealand.

Add to that a fourth iridium anomaly in the illustrious boundary found by J. Smit of the Geological Institute in Amsterdam, Holland, and J. Hertogen of Fysicochemical Geology in Leuven, Belgium. Results of their analysis of the Cretaceous-Tertiary boundary at Caravaca, Spain — detailed in the May 22 NATURE — indicate not only an anomalous amount of iridium, but also an enrichment of osmium, another element usually not found in the earth's crust.

"The present evidence favours an extraterrestrial cause for the extinctions at the end of the Cretaceous," Smit and Hertogen report. "The impact of an asteroid or comet 5-15 km in diameter is the most attractive."

In the same issue of NATURE, Kenneth J. Hsü of the Geological Institute in Zurich, Switzerland, presents his version of the mass extinction. A fallen comet marked the end of the Cretaceous period, Hsü says. Extinction of the large terrestrial animals resulted from atmospheric heating during cometary impact; extinction of the calcareous marine organisms was caused by cyanide (released by the comet) poisoning and a severe rise in the calcium compensation depth (CCD).

The CCD defines an oceanic line below which calcium carbonate — the stuff of calcareous marine organisms — dissolves due to the corrosiveness of the water. In the ocean there is a constant rain of carbonate-producing surface waters sinking to deeper water masses. At some level in the water, the CCD, the rate of calcium carbonate dissolution — normally in the deeper, more corrosive waters — equals the rate of carbonate falling from the upper, carbonate-producing waters. Partially because of the cometary CO_2 fallout and the fact that CO_2 increases the corrosiveness of ocean water, the CCD catastrophically rose at the end of the Cretaceous period, Hsü explains, "leading to a virtual extinction of the calcareous planktonic life."

Hsü's theory, as well as those of Alvarez's group and Smit and Hertogen, is called a "catastrophic hypothesis for the Cretaceous-Tertiary mass extinction." While other researchers have proposed more gradual processes — changes in atmospheric or climatic conditions, for example — to explain the extinction event, "In the last few years the catastrophists have dominated the scene," writes Finn Surlyk of the Copenhagen University Geological Museum in a May 22 NATURE editorial. But Surlyk is convinced that a recently released study by geologist Forese Wezel "should dampen the enthusiasm of the catastrophists."

Essentially, Wezel has challenged the supposed Cretaceous-Tertiary nature of the critical sequence in Gubbio, Italy. In his study of nearby sediments, Wezel says he has found materials — such as fossils of the Miocene, a sediment younger than the Cretaceous-Tertiary boundary — that indicate a jumbled rather than classic sediment near Gubbio. But the enthusiasm of the catastrophists has not yet been dampened: What Wezel has observed, they explain, is Miocene "contaminants" from a medieval aqueduct that percolate through the older sediments when it rains.

Other questions remain, however, for the catastrophists to answer: Does an impact crater from the, as yet, hypothetical asteroid or comet exist? Where are the vertebrate and invertebrate skeletons of the demised Cretaceous animals?

The sediment searching continues for a solution to the mass-extinction mystery. □