5.2

HOW WE PROVED AN ASTEROID WIPED OUT THE DINOSAURS

0:12–0:54

PINK LIMESTONE

I think most people are fascinated by murder mysteries. Well, about 30 years ago, I stumbled onto a great murder mystery and the victims were the dinosaurs. And the question was, what had caused them to become extinct?

Well, I was working on a different project in Italy at that time and sort of stumbled on the... on the level in the rock record where the dinosaurs became extinct. Only there weren't any dinosaurs. There were tiny little single-celled organisms called forams. This is a piece of our beautiful pink limestone from Italy.

0:54–1:46

MICROFOSSILS

And, if you look really closely down here, you can see there are lots of little specs about the size of sand grains, and those are forams—single-celled fossils—fossils of single-celled organisms that almost became extinct at the same time the dinosaurs did. And here's what it looks like in a piece of rock in the field.

So this is the last bed of the Cretaceous, which is the time that the dinosaurs were around. And if you look closely again, you can see these little sand-sized specs which are microfossils. This is the first bed of the Tertiary which is the time that was after the dinosaur extinction and after the almost extinction of the forams because the—once that you can see with your naked eye became extinct, up here, there are forams, but they're too small to see. And this is a level of clay in between the two.

1:46–2:50

MEASURING IRIDIUM

Now, it's hard now because this piece of rock has been encased in plastic. But we got interested in that clay and what it might tell us. And we, as a group here at Berkeley, it was my father, Luis Alvarez who was a physicist, and I'm the geologist in the group and Frank Asaro and Helen Michel who were two nuclear chemists who could measure elements at extremely low concentrations.

And we decided to measure the element iridium which is a marker for extraterrestrial material. And we had expected to find either no iridium or a very small amount of iridium in that level. But I'll never forget the day that I got a telephone call from Frank, and Frank said, "Something is wrong. There is far more iridium in this clay "than we had been—than any of our ideas would have predicted." Something was wrong and it turned out to be the clue that led to solving the extinction of the dinosaur murder.

2:50–4:01

MASS EXTINCTIONS

But it took quite a while to figure out what that clue meant. What we finally figured out was that it was telling us that a comet or an asteroid the size of Mount Everest had hit the earth on a particular day, 65 million years ago and caused the extinction, not only of dinosaurs and the forams, but of many other different kinds of plants and animals.

For example, like this coiled-shelled ammonite. This group also became extinct at that same time. And we gradually came to realize how much energy there is in a very big rock falling from the sky. There would have been enough energy to blow debris and rocks and dusts and chunks of things from the impact site all over the entire earth. And when it landed on the top of the atmosphere, there were so much of it that it would have made the earth cold and dark for probably months so that plants would stop growing and animals wouldn't have food and many groups became extinct.

4:01–4:55

LOOKING FOR EVIDENCE

Not all, obviously, because we're still around. Well, this was a catastrophic explanation for the extinction and that did not sit well with most geologists and paleontologist at the time about 1980 because we were used to thinking of all changes in the Earth's history as being slow and gradual and this was the exact opposite.

So there was a huge debate. It went on for ten years, from 1980 to 1990. And meanwhile, people looked for other evidence and they found other evidence of impact, like, spherules and shocked quartz. And all that time, all during that ten years, the big unanswered question was, where was the crater that would have been produced when this comet or asteroid fell from the sky?

4:55–6:29

SOLVING THE MYSTERY

Finally, in 1991, the great breakthrough took place. We learned about a huge crater below the surface of the Yucatan Peninsula that the Mexican oil geologists had discovered. It's the biggest impact crater that's formed on this planet in the last billion years. And the Mexicans drilled it and here's what they found. So this is a thin slice out of a circular core. And this is rock that was melted by the heat of impact. And you can tell that it was melted by impact because the mineral grains in it have features that only form with very great shock effects And so we then had evidence for a giant impact.

We could tell that it was approximately the right age but you couldn't be sure of exactly the right age. So some of us went and looked at other outcrops in other parts of Mexico and we found the debris from this impact—from this crater—at exactly the level of the extinction, right at the boundary between the Cretaceous and the tertiary. And so that was the evidence that can... has convinced almost all geologists and paleontologists that it was indeed an impact that caused the mass extinction.

6:29–7:18

HOW SCIENCE WORKS

Well, this is a pretty good example of how science works and how geologists and paleontologists figure out what happened in Earth history. You start with some unexpected evidence like the iridium. Then you make up a theory to try to explain it. And then other people get interested, and they look for other evidence like spherules and shocked quartz. And there's a great

debate because that's the way we work these things out in science. And finally, along comes the most convincing evidence of all—in this case the crater, which convinces virtually everyone.

And so that's the story of how geologists and paleontologists solved what may have been the greatest murder mystery in all of Big History.