DARK MATTER THAT MAY HAVE KILLED THE DINOSAURS

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RICHIE'S STORIES

DARK MATTER THAT MAY HAVE KILLED THE DINOSAURS (AS TOLD BY RICHIE)

Our story starts 65 million years ago.

Richie," said Jackson, "what happened 65 million years ago?"

"That's easy," I answered. "That's when the land dinosaurs died. Now I have a question for *you*. What does a triceratops sit on?. . . Its tricera bottoms."

"Ugh, Richie, you gotta stop with the terrible jokes," said Jackson. "They are getting worse and worse. OK, now tell me this. How did they all die at the same time?"

"Oh, I know all about that," I responded. "It was a giant asteroid that killed them. It hit Earth with such force that pieces of the Earth and asteroid flew out of the atmosphere. Some stuff even went all the way to the moon. And when all that stuff started falling back and hitting the atmosphere, it created so much heat that the air got as hot as a pizza oven, and that killed all the land dinosaurs."

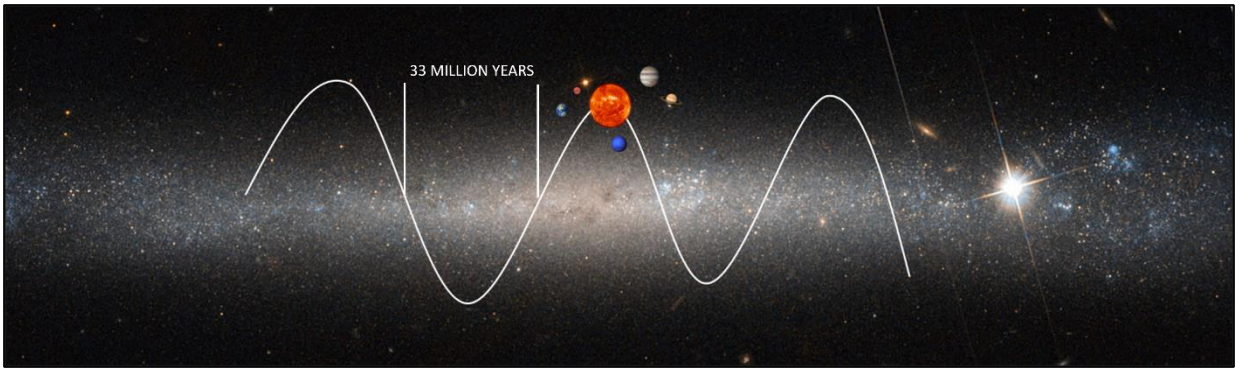
"Great, Richie," continued Jackson. "Now what did that have to do with *Dark Matter*?"

"Huh?" I said. "I have no idea. What?"

"Well, that is our story," responded Jackson. "Or, more exactly it is a story told by Professor Lisa Randall of Harvard University.

"Professor Randall put the story in a book," Jackson continued. "It's called *Dark Matter and the Dinosaurs.* She proposed that *Dark Matter* could have had something to do with killing off the dinosaurs. Her idea goes like this. When scientists look at the fossil records, there appears to be evidence that a major species extinction occurs about every 33 million years. 'So,' she asks, 'is there some event that occurs every 33 million years to explain that?' Yes, there is such an event. Our solar system is in an orbit that circles the Milky Way galaxy. It takes 240 million Earth years to complete one galactic year. As it circles, our solar system oscillates up and down through the plane of the Milky Way. It passes through the plane every 33 million years.

"Grandpa made this diagram to illustrate the solar system going up and down through the Milky Way. Think of the Milky Way as a pancake, and we are looking at the edge.



"Professor Randall's idea," continued Jackson, "is that the passage through the pancake with its higher gravitational field might knock comets and asteroids out of their normal orbits around the sun, and some of these unhinged bodies might hit Planet Earth. But calculations of this effect suggest that gravity from normal matter is not sufficient to dislodge these objects from their orbit. So Professor Randall proposes that there is some extra gravity exerted by a disk of *Dark Matter* that lies within the visible Milky Way pancake. The combined gravity from the normal matter pancake and the *Dark Matter* disk might be enough to do the job."

"What is this *Dark Matter* stuff Professor Randall is talking about?" I asked. "*Dark Matter* is one of the big puzzles in physics," answered Jackson. "*Dark Matter* is what I call a fudge factor. Scientists put it into their theories when the known physics doesn't work. So why do we need *Dark Matter*? Where does our physics not work? The answer is the structure of the universe. Normal physics says it shouldn't look like it does.

"Take a galaxy like our Milky Way," continued Jackson. "It is rotating like pizza dough when the pizza guy throws it in the air. It gets bigger because of a force that wants to push the dough away from the center. You feel that force when you stand at the edge of a playground merry-go-round. If you don't hold on when it is spinning, you fall off. Well, gravity is holding on to the stars at the edge of the Milky Way disk as it rotates. Gravity is also holding galaxy clusters together. But gravity from the visible matter isn't enough to do the job. Our Milky Way would fly apart if the only gravity was from visible matter. So here comes the fudge factor. Let's assume there is enough extra stuff to do the job of keeping the stars from flying off the galaxies and the galaxy clusters from flying apart. But we can't see it, so the name of the stuff is *Dark Matter*. Calculations show that *Dark Matter* makes up more than 85 percent of the total matter in the universe. So the stuff that we *can* see is only 15 percent."

"That's a crazy story, Jack," I said. "What about this extinction happening every 33 million years? Are we due for one now? That is way scary."

"Could happen, Richie," responded Jackson. "But we would probably see a big asteroid heading for us. So maybe we could fire up a rocket and knock it off course. Let's hope so."

GRANDPA'S GLOSSARY

Dark Matter and the Dinosaurs: In her book *Dark Matter and the Dinosaurs*, particle physicist Professor Lisa Randall of Harvard makes a case that dark matter had something to do with killing off the dinosaurs. Her proposal goes like this: When geologists and paleontologists look at the fossil records, there appears to be evidence that a major species extinction occurs every 30 to 33 million years. "So," she asks, "is there a physical reason to explain that?" There is a physical event that has such a period. It is the oscillations of our solar system up and down through the plane of the Milky Way disk as it makes its way around the galaxy during its 225-million-year orbit. Each such orbit makes a galactic year. The idea is that the passage through the plane with its higher gravitational field might knock comets and asteroids out of their normal orbits around the sun, and some of these unhinged bodies might hit our planet. But calculations of this effect suggest gravity from normal matter is not sufficient to dislodge these objects from their orbit. Hence, she proposes that there is some extra gravity exerted by a disk of dark matter that lies within the disk of the visible Milky Way. The combined gravity from the normal matter disk and the dark matter disk might be enough to do the job.

Dark Matter: Dark matter is one of the big puzzles in physics today. Dark matter is what we scientists call a fudge factor. We put it into our theories when the physics we know doesn't work. So why do we need dark matter? Where does our physics not work? The answer is the structure of the universe. Normal physics says it shouldn't look like it does. Take a galaxy like our Milky Way. It is rotating like pizza dough when the pizza guy throws it in the air. It gets bigger because of centrifugal force, which wants to push the dough away from the center. You feel that force when you stand at the edge of a merry-go-round. If you don't hold on, you fall off. Gravity is holding on to the stars at the edge of the Milky Way disk as it rotates, but gravity from the visible matter isn't enough to do the job. Our Milky Way would fly apart if the only gravity were from visible matter— hence, the fudge factor. Let's assume there is enough extra matter to do the job of keeping the stars from flying off the galaxy, but we can't see it—thus, the name dark matter. Calculations show that dark matter makes up more than 85 percent of the total matter in the universe.

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