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Extinction Theory
by Jeff Hecht
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Science Fiction



It was all Wasserman's fault. He got me into this; he and his rock samples. I'm a physicist, with some tricks up my sleeve for counting metal atoms. Ask me about single-atom laser photo ionization spectroscopy and I can tell you how to get isotopic concentrations and ratios to three significant figures. Ask me about rocks, and I can tell you how to turn them into samples for my handy-dandy laser photo ionization spectrometer. Beyond that, all I know is that most of them are grey and have names I never bothered to learn.

I asked Wasserman about rocks. He turned his bleary red eyes to me and picked up one. "This is the boundary clay," he said. "It was laid down at the very end of the Cretaceous, about the time the dinosaurs died out. On top of it are Tertiary sediments. This is a nice little sample," he added, holding up a chunk of rock that looked to me just like any other rock. "I don't know the exact sedimentation rate, but I'd guess that in this two-centimeter thickness we've got the record of a few thousand years." He was in a particularly morose mood, so he added, "Same as from the pyramids to the space age. That's what will be left of us in 65 million years."

Wasserman had been drinking again. He said he drank so much to try to wash away the dust from his field work. He always put down two or three beers when we went out to lunch. I could see the fine edge leave his thinking after the second beer, never to come back until the next morning. I tried to talk with him a couple of times about it, mentioning it gently, but he just snarled that what he drank was his business. I suppose it was, but those of us who have lived with alcoholics always can see the danger signs.

Despite that, I put up with him. His research grant had paid for a new dye laser, and some very fancy single-frequency optics that could resolve isotopic splittings in the megahertz range. Besides, he didn't show up much. The rocks usually came in from the field, in special sealed cases so they didn't pick up any contamination. That was necessary because he had us looking for really rare elements -- things like osmium and iridium that are down at a part per billion or less. All it takes to make the readings can go way off is a finger that's been wearing a wedding ring. We learned that the hard way, after one of the grad students got married, and everything she touched came out wrong. Wasserman is scrupulous in the field, or so he says. I've never had any trouble with contaminants, but we never had to look for anything that might rub off aluminum beer cans.

The purpose of it all was understanding mass extinctions, like the one that got the dinosaurs and lots of other things at the end of the Cretaceous 65 million years ago. Ever since the Alvarezes found the iridium anomaly in

that boundary clay, every geologist in creation has been asking physicists how to count isotopes and measure concentrations of rare metals. I get requests for strontium and neodymium isotope ratios, and wish lists that get ridiculous. Everything has its own meaning. The geologists say that strontium isotopes should tell if there was acid rain after an asteroid impact; neodymium ratios vary from ocean to ocean and change with time.

When it started, I just ran the stuff through the laser, collected the data, and got my name at the bottom of the list of authors. It wasn't a bad way to build up publications. Wasserman gave papers at the big geophysics meetings, and he got into the thick of some of the debates. He argued for the impact theories, but never could convince himself anything was periodic. He told me that he'd seen a statistical analysis that found periodicity in random numbers. Behind his back, I told my grad students that it was his personal experience with the drunkard's walk.

I got into it more when we started running samples from the end of the Triassic, and some of the other major extinction points. Wasserman was selective about his samples; he just wanted certain intervals. Most of the time he went after known extinctions and iridium anomalies. He kept asking for data on more rare elements and isotopes.

"What are you trying to find?" I asked him when he called in from Spain early one morning.

"Patterns," he replied in his most enigmatic voice. The transatlantic phone line was erratic that day, and I couldn't understand most what he said, but "Patterns" echoed back and forth between my ears for the rest of the day.

When he came back from that field trip, he spent two full days staring at my data logs. He had asked me to take isotope ratios for one-millimeter slices of several cores, from well above the boundary clay to well below. All sorts of things varied. The changes were small, but they were real. He scratched his head and walked in circles around the table where he had spread out the readings.

The third day, he came back in the morning sharp and sober as I had ever seen him. He wanted to brainstorm, and his favorite foil in the geology department was on a field trip.

It might have gotten nowhere if Karelski over in chemistry hadn't gotten a fat contract from the EPA to study pollution deposition in coastal waters. She had taken cores that went back hundreds of years in places like Boston Harbor, then asked me to analyze the glop. The variations were striking. The harbor sediments weren't layered as neatly as Wasserman's rocks, of course, but the trends were equally dramatic. Things like mercury and lead residues rose dramatically with the advance of what we call civilization, then started dropping as pollution controls started. I got to wondering if the lead rose and fell with the use of lead in house paint, and I'd been making a few calls trying to track that.

When I mentioned the similarities to Wasserman, his eyes lit up. Had I run anything similar on his samples? I shook my head. Nor had I tried any of his tests on the harbor samples.

"There must have been so many things happening at the time of an impact," he said. "You get acid rain from the oxidation of nitrogen in the air. You might get lots of carbon dioxide if it hit limestone rock. You'd get huge shockwaves from the atmosphere and oceans. You'd get lots of dust. You'd get shocked quartz and carbon particles from fires. You'd have air pollution like you wouldn't believe." He paused, and put his chin in his hands. "You know, there are so many things that could happen that some people doubt anything could have survived a big enough impact."

It was then I asked the fateful question: "Did it have to be an impact?"

He answered "of course" immediately, then lapsed into silence.

I laid the harbor results in his hands. "Just look at those," I told him. "Swings in abundances every bit as large or larger than the ones we found near the boundary clay. But we know where these came from. People!" I pointed

to the start of the rise in the lead curve. "Here's where they started using lead pipes and lead paint. And here's where we figured out that lead was bad stuff and stopped using so much of it."

He had long ago decided I was crazy. Nobody as sober as I am is supposed to have ideas that wild. "But there weren't any people then. You know that!"

"It didn't have to be people. It could have been some other type of creature. Years ago somebody in Canada suggested that if the asteroid hadn't gotten the dinosaurs, they might have evolved into something intelligent."

Wasserman remembered that. He probably had seen it in the proper scholarly journals; I'd seen it in _Omni._ He had counterarguments of course. "It was Dale Russell from the National Museums of Canada, and he said it would have taken 65 million years for them to evolve any kind of intelligence. Besides, there should be some trace in the fossil record."

"But we know the fossil record is very fragmentary," I reminded him. He was the one who had told me how tiny a fraction of living creatures are ever fossilized, and how it was hard to find fossils of small animals. "Homo Sapiens evolved in only a few million years, and we don't have much record of earlier ancestors."

"Hmmm..." Wasserman contemplated. "I will admit that land deposits are scarce from that period. In fact, there's still debate over when the dinosaurs finally died out, but ... no, it's just too ridiculous. Remember, there were earlier mass extinctions, much further back in the Devonian and Ordovician. You couldn't have had intelligent life then; you barely had anything on land at all. What we're looking for in all this extinction business is a pattern, and what we call 'intelligence' is too new to be part of that pattern."

"Suppose we finally blow ourselves up, like you keep saying we're going to do one of these days..."

"We don't need to blow anything up," he muttered. "If you'd get your nose out of your laser, you'd see people can do a damn good approximation of mass extinction without the bomb. Who do you think got the mastadons and other Pleistocene megafauna? What do you think is happening now in the rainforests?"

I tried to convince him that he was just bolstering my argument, but he would have none of it. The best estimate, he insisted, was that nothing at the end of the Cretaceous had more brainpower than an opossum. That left a long way on the IQ scale to match people, even in his cynical view.

The closest he could come to my idea was a catastrophic population explosion of some hitherto obscure creature. It might have eaten everything in sight, causing catastrophic population crashes of other species. It might have excreted something that had dire effects on other living things. One factor in the greenhouse effect that was heating up the globe, he said, was the rapid increase in quantities of methane being farted by cows and rice paddies. Then he reminded me of the iridium anomaly, and dared me to explain it. I said I'd have to think about it.

We went out to lunch, and I kept trying to convince him. Wasserman just kept sipping his beer and smiling. Midway through the third mug, he smiled and looked up at me. "Tell you what," he said. "You sit down and make some predictions of isotope ratios. Then I'll get you some fresh samples to try. That should get this out of your system."

Two days remained before he left for the field again. I turned the laser over to my postdoc and pored through the references in the university library, making a little list. Depleted uranium was on it, with the U-235 removed by some prior inhabitants of the planet to make bombs. The decay of cesium-137 might enrich barium-137 levels, but I doubted we could detect that. I added lead to the list; it got the Romans, so why not somebody long before Rome? But that was about all. No likely products or garbage were likely to last 65 million years. Steel would have rusted away. No matter what the Sierra Club thinks, aluminum and plastics don't last that long. Nor would they leave any obvious signs behind, unless Wasserman hit something he could recognize as a garbage dump rather than an ore deposit. Gold was the only thing that might

last that long, but it was so rare there was no sense in looking.

I gave Wasserman a copy of the list. To say he was not impressed would be an understatement. He was cold sober and he scoffed as he read it. "Look," he said, "didn't I tell you where the sediments we find were deposited? Underwater! Most of them come from the ocean bottom. Some come from places near to the shore or even from lakes and rivers, but most that we find were in the oceans. All the stuff you're looking for is deposited on land, and we don't have many land sediments to look at. I'll look, but I'll tell you right now the stuff you're looking for just plain isn't there!"

By the time he was finished, I was ready to give up. I didn't bother to tell him my explanation for the iridium anomaly. I blamed it on beer cans -- steel beer cans, made with nickel refined from ores from which the iridium hadn't been removed. I had been all set to get one of the grad students to run steel-can samples through the laser spectrometer. I didn't bother. I laid the notebook full of my crackpot ideas on a pile of trade magazines I wasn't ready to throw out yet. There were other things to do. I started working on my own proposal for trace-element detection to the Department of Energy. I got a new batch of Karelski's samples and went to work. One of my doctoral students had a crisis with his thesis; my postdoc quit to double her salary in industry.

I would have forgotten all about it if it hadn't been for Wasserman. It wasn't the samples he sent in from the field. They never came. The postdoc who had worked with him before would have noted their absence, but her replacement didn't. Nor did I.

He was gone for three solid months. I never heard from him, and I don't think anyone in geology did, either. There were rumors he'd fallen off a mountain in Afghanistan, or been arrested for having alcohol in Iran, but his American Express statements still kept coming. He missed a deadline for filing some paperwork that got the accounting department _very_ upset. He was supposed to be teaching a couple of fall courses, and the geology department was about ready to panic about that when he finally returned.

By the time he arrived at my lab, Wasserman had stopped to bathe, shave, and put on some fresh clothes. He had also stopped elsewhere. His eyes were bloodshot, his face burned brown by the summer sun, and his hands were shaking. The summer had aged him, and I had never seen anyone so drunk outside of my family.

"Your little project sent me all over the world," he grumbled in greeting.

I was astounded. "I thought you had..."

"Just because I said it was ridiculous didn't mean I wouldn't investigate it. It was a rational enough idea to test. I didn't for a minute think that there could have been intelligence behind the extinctions at the end of the Cretaceous, but there were plenty of other things happening then, and you'd given me some new ideas."

"You never sent me any samples!"

"They'll come. Slow boat, I'm afraid, but you won't need them now." He patted the sample case in his lap. It was battered and dusty, with a plastic airline ID hanging from the handle. "This should be enough. It hasn't been out of my sight in a week." He popped open the latch.

I watched in uneasy suspense as he unrolled plastic foam packaging material from the rocks in the case. I had no idea what to expect. I knew so little geology that I doubted I would recognize whatever conclusive evidence he had found that I was wrong.

The rock was grey, with bits of slightly lighter rock scattered throughout the parts that peered above the clean white plastic. The lighter rocks were about the size of broken pencil stubs. "Fossils?" I asked.

Wasserman nodded. "You catch on fast for a physicist. They're bones, 65 million years old. I found them just under the K-T boundary layer in a terrestrial deposit. I was trying to calibrate the time scale of extinctions more carefully. We don't have a good way to tie the extinctions in the oceans with those on land. Some people think they happened at the same time. Others

say they were ten thousand or a hundred thousand years apart." He rambled a bit more about people who thought they had found dinosaur teeth shed after the end of the Cretaceous, and why that might not prove anything at all.

I didn't see any pattern to the bones. When he paused in his drunken monologue, I asked, "What do you see in them?"

"What will somebody see of us after we finally kill ourselves?" he grumbled as if it should be obvious. He looked at me, then looked down at the sample and moved the plastic. A glint of yellow metal caught my eye next to one of the bones he uncovered. I stared at it, trying to understand.

"It was a ring," he said. "A sixty-five million year old ring. I don't know whose fingers these were, or if they were fingers at all. But it's better evidence than all the isotopes you could count, even if anybody would believe you." He sighed and shook his head, muttering, "I wonder if we'll leave this much behind."

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