AstronomyCast Episode 243 for Monday, December 12, 2011: The Tunguska Event

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Fraser: Welcome to AstronomyCast, our weekly facts-based journey through the Cosmos, where we help you understand not only what we know, but *how* we know what we know. My name is Fraser Cain; I'm the publisher of *Universe Today*, and with me is Dr. Pamela Gay, a professor at Southern Illinois University – Edwardsville. Hi, Pamela. How are you doing?

Pamela: I'm doing well. How are you doing?

Fraser: Doing really well. We're actually ahead of time now. We're actually recording in early December shows for mid-December and even late December, and that is how dedicated we are to getting this show back on track. We're serious, we're serious; we're sorry, and we're way ahead of schedule now.

Pamela: Yay!

Fraser: And as always we are recording this episode as a Google plus hang-out, and so if you want to participate in a live recording of AstronomyCast, all you have to do is circle me or Pamela in Google plus, and then we'll, sort of, make a mention of when it's going to happen, and then you can jump in and join the hang-out and ask us questions and watch us record the show, and then stick around afterward and we'll answer questions until we're tired. So super-fun, but you gotta be in Google plus to do it. OK, cool. And so today's episode was…came from a fan, and they said they wanted a show on Tunguska and – sorry, I don't remember who it was, but um, I remember someone asked for it, and we said that sounds like a great idea

[advertisement]

Fraser: Ready to roll?

Pamela: I hope so.

Fraser: OK then, so on June 30, 1908 something exploded over the Tunguska region of Siberia flattening thousands of square kilometers of forest and unleashing a force that rivaled the most powerful nuclear weapon ever detonated. What could release that kind of destructive energy, and will it happen again? So Pamela, can you, like, set the stage and tell us about this unbelievable event that happened in Siberia?

Pamela: Well, it was an otherwise perfectly normal summer in an utterly isolated part of the world. This part of Siberia -- it's north of Lake Baikal which is one of the clearest, cleanest lakes in the world, an area where there were still people who lived by herding

reindeer to eat -- no real cities, no real anything, and out of nowhere at 7:14 in the morning, something streaked across the sky, reportedly as bright as the Sun, and then exploded knocking people off their feet, breaking windows. The shock apparently reverberated such that it was detected as far away as Britain, and the thing was, this was World War II (editors note: World War I) time period, this was right before the Russian Revolution, and no one really actually went to see what all the fuss was caused by.

Fraser: For, like, years…

Pamela: For years…it wasn't until the 1920s, and this to me is totally crazy because looking at the various reports, people were talking about the sky glowed at night for a couple of nights, observatories all the way around the world reporting that the opacity – how much light is transmitted through the atmosphere, the atmospheric transparency -- was for months after this was worse than it had been in the past due to all the dust in the atmosphere. The entire planet knew something had happened.

Fraser: And so you say that it took a little while, but an expedition was sent to find…and what did they find?

Pamela: Well, they actually found the weirdest pattern of tree destruction ever known to mankind. So in 1921, using what is perhaps the strangest logic I've ever seen to fund a scientific expedition, Russian mineralogist, Leonard…I wish this was written in Cyrillic because then I could pronounce it correctly, but written in English it looks like it's Leonid Kulik went, and he said to the government -- this is coming off the heels of many wars, "Hey, it's possible that an iron meteorite crashed in Siberia; we can use the iron for industry. Can you fund me to go look?" Now, here's the thing: most meteorites that are found aren't that big. It wouldn't have been enough to do significant industrial work with, but it was still enough of an argument that they got the money they wanted, so this poor man took the train all the way across the country, found guides to guide him through the woods, got to the point where superstition said, "We're going no further," found a different group of guides to take him through the woods, and he found this area where there was essentially a swamp with a bunch of perfectly upright trees surrounded by a bunch of trees that were pushed over, sort of in a bull's eye pattern with the pushed over, they were pushed away from the bull's eye, and the bull's eye, you can imagine, are the trees still pointed straight up. All the trees are scorched, and the ones in the center of the bull's eye have all of their leaves, limbs lopped off, and all around are all of these bog pits that, at the time, he thought might have been caused from debris from an exploding meteorite.

Fraser: And so, you know, if you haven't seen the pictures, you really should take a look at them. You know, the only thing that I've seen that even kind of compares is the destruction after Mt. St. Helens, where you have these slides, where you have just these trees that are completely flattened in all directions, but you can just imagine…and so the…like, how much space was flattened?

Pamela: The entire area of damage was over 800 square miles, so this is a fairly significant area.

Fraser: Yeah. Yeah.

Pamela: So roughly a little under 30 x 30 square…30 x 30 miles is the way to think of it -- under that, but that's like the size of a good-sized town, city.

Fraser: Yeah, and so OK, so then he finds this evidence, and then what does he do? No sign of the rock?

Pamela: Well, he went home because he had to [laughing], but once he got home, he sought funding to go out and do things a little bit more rigorously. So, when he first got out there, there were all these what he called pothole bogs, all of these – it's basically swampy areas, and there were all of these places where there were these deep areas of bog, for lack of a better term, pothole bogs is what he called them, and he didn't have the tools to excavate down into any of these, and so he went back, he got the money to do that, returned and started draining swamps in hopes of finding the meteorite at the bottom of the swamp. So here he is -- huge region of damage, in the center is this one bog that he decides this must be the impact bog. It's in "ground zero," basically, from the destruction. He drains it out completely, and the only thing at the bottom of it, unfortunately, was a just a tree stump. So, that was rather unexciting. So, now he has this really weird situation where there's 830 square miles of damage (that's over 2000 square kilometers for those who are thinking European units, or actually units of everywhere except for the United States), and with all of this destruction, there's no crater that they can identify, and this was completely mystifying to scientists of the time.

Fraser: Right, because they were starting to understand that some of the craters that they were finding on Earth, and the ones that you can see up on the Moon are, you know, were impact. They thought they were volcanism, but now they're starting to discover that they're from these impacts. So that made sense, but yet where's the crater?

Pamela: Right, and so here they had this mystery. So, trying to figure out what it was, they started off with ideas like, "Well, maybe it was a meteorite that exploded in the atmosphere," and so that was one of the models that people were working with, and another model (this one was put forward by Fred Whipple in 1930), he suggested that maybe it wasn't a meteor, maybe it was actually a comet coming in and maybe the comet just happened to melt, ionize, blow up, whatever term you want to give to the transformation of comet to ionized material, water, and dust in the atmosphere, maybe that's what happened instead.

Fraser: So, why, I mean, why wasn't there a crater? I mean, wouldn't you expect that there would be a crater every time?

Pamela: Well, if an object particularly big comes through the atmosphere, the expectation is large things -- and this was estimated to have enough material to generate

an explosion roughly 5 times the size of the explosion in Hiroshima, so this was a lot of energy… It was figured this was a several-meter-across object. How many meters might add a couple factors of 10 depending on what the composition was.

Fraser: Right, if it's made of metal it's one thing. If it's made of rock, it's something else, and if it's made of snow, it's something else.

Pamela: Right, but the expectation was something with that much energy probably would bring something through the atmosphere. Now, what's been interesting is to watch over the past more than 100 years now since this event took place, how our ideas have changed. This is one of my favorite things to look at because I remember, just as a little kid, I had a book on this, like, "World's Greatest Mysteries."

Fraser: Me too! I think I took it out from the library, and it was like "What Caused the Event?" and we'll get to the crazy theories in a second. I wonder if it was the same book. That's funny!

Pamela: It just might have been.

Fraser: You and I both gravitated to the library, grabbed the same book, you know, half a world away. Yeah.

Pamela: I remember sitting on the floor between my bed and my window, like kind of hiding, reading the book with all the scary monster stuff, 'cause like Loch Ness monster was also in the book I had, and it was just these pictures of all these trees destroyed and everything, and back then they were like, "Well, it was probably this, but there's no crater. It was probably a meteor, but there's no crater, but some people think it might have been a comet." And today we think we actually understand what happened. It's neat looking through the history.

Fraser: My book was a lot less rigorous than yours because mine went into the crazy ideas. So maybe we'll get to that later on and dismiss them all. Mine also included black…microscopic black holes, and UFOs and all kinds of…so anyway, we'll talk about that later, wormholes and stuff…let's go to the realm of reality here, so please. Sorry.

Pamela: So in 1978, astronomer Lubor Kresák, um, pardon pronunciations again, he actually made the really astute observation that the Tunguska event happened at the height of the Beta Taurid meteor shower. So, this particular meteor shower was caused by Comet Encke, and he proposed that maybe this was a fragment of the comet that we just didn't realize there was a big ol' chunk still hanging around, and this big ol' chunk decided to come through the atmosphere and aim itself at, well, Tunguska. And when they looked at the most likely path through the sky, based on the reports, when they looked at the timing and everything else, this kind of seemed to make sense. And over the past several years, people have done a variety of different things trying to look at chemicals in the area and different…what's the mineralogy in the sediments, and all of these different things trying to figure out, "Well, what's the answer?" And it's gone back

and forth from meteor to comet, meteor to comet every few years. So, in the 1990s there were some Italian researchers that looked at tree rings, and they looked for the particles that were trapped in the tree rings that grew during 1908, and what they found was that there was a lot of material commonly found in rocky asteroids, but that is found, albeit rarely…but is found in comets, so that pointed the finger at asteroids -- wasn't conclusive -- points the finger at asteroids.

Fraser: So, like, it sprinkled the region with asteroid dust, and then the asteroid dust got incorporated into the trees as they grew? Hey, that's cool. That's really clever. Clever scientists...

Pamela: [laughing] So, this is basically the same thing as the KT Boundary only much, much smaller.

Fraser: In trees, yeah.

Pamela: But the thing is they had all of these different data points they had to explain as well. So they had be able to explain what was up with the noctilucent clouds, the glowing skies, all of the material in the atmosphere, and all of that pointed towards a comet exploding and blowing all of it's materials into the atmosphere, and what was interesting is the reports for what was seen in the atmosphere actually matched the phenomena that we associate with the exhaust plumes of space shuttles launching at night, so there's this new finger that points instead at comet, probably. Then in 2010, Vladimir Alexeev, they went and used ground-penetrating radar to look at the region, and what they found was it looked like there'd been some sort of a violent impact. They found a layer of permafrost on top -- it's Siberia, it's cold, it's still cold…that may be changing; beneath it were damaged layers of materials. So this was the shock wave hits everything and it…what happens when a crater forms is the material goes up, the material from inside the crater gets pushed out of the way, you have the fragments of whatever made the impact comes in, and then the material that got thrown up settles back down on top of it. So you can actually flip the surface material upside down in the process of forming a crater, and so when they used their ground-penetrating radar, they found this evidence for what looked like, well, no large rock, but none-the-less, shredded asteroid. Now, one of the weird things I can throw in that goes into the I-don't- know-if-it's-true-or-not-but-there-was-this-guy category is I was actually a foreign exchange student in the Soviet Union back in 1991, and I was studying at the Six Meter Observatory in the Caucusus mountains, and I met one scientist who had a small jewelry box with like the cotton that you usually get a necklace on in it, and on top of it was this really weird shard of material that he said was slightly radioactive, and he claimed was a shard from the impact at Tunguska, and I remember thinking, "I don't know if this is a crazy dude or not," but it's something that I still remember.

Fraser: Well, and I think that there's been some recent discoveries of hybrid asteroid-comets, so you know, so it's not necessarily that anything is *just* an asteroid or *just* a comet now. You've got these, you know, much more mixed-up, you know, snow and ice and rock and dirt, you know, everything, and so that, I think, really starts to blur the line,

but it could be anything. And I know there was a really interesting…well, we were actually at the AAS -- I think it was in Austin. There was a really great… someone had done a really beautiful simulation of an event, and showed almost perfectly these really amazing almost funnel-shaped impact where it airbursted, but it was almost like a gun, and it just shot the force straight down through the atmosphere creating a kind of pattern that we saw, and it really did sort of explain it, you know, that a lot of it just comes down to the angle, the speed, the direction of the Earth, the direction of the object. You get the right combination of factors together and you get this really interesting pattern. It's interesting. I mean, it makes you think that maybe there were a lot more impacts that we just weren't even aware of.

Pamela: The things is that…

Fraser: Maybe these are more common than we think.

Pamela: Yeah. The more I read, the more I keep noticing this sentence that's just sort of tossed in there, over and over I keep seeing the sentence that, "If these occurred over the ocean, prior to the 60s and 70s prior to when we had satellite monitoring, no one would have noticed." And, you know, that's true. Most of our planet is ocean and no one would have noticed. And there's lots of other places no one would have noticed. Deserts…

Fraser: Like Siberia…

Pamela: Well, Siberia, but there the trees get knocked over. But if you think about some of the deserts, no one would notice; prairie -- unless you set it on fire, no one's going to notice, so we've got all of these places where you just don't notice. Now, one of the more intriguing things that I found looking up this story was there's a lake north of where Tunguska took place. It's about 8 km away; that's, I think, about 4 miles away, and it was realized, you know, this lake it's the right shape to be a crater, but it's a lake, so they then had to go and measure it, and when they measured it and they looked at the thickness of the silt, the thickness of the silt corresponded to a lake that was only a couple of hundred years old, about how old it would be if it were formed by the Tunguska event, and when they mapped it out, it was crater shaped, and they found evidence from magnetic detections for a rock in the bottom that is about a meter in size and could have made sense if you had some sort of an exploding object. I mean, who knows how it's going to distribute itself everywhere?

Fraser: Yeah, and I mean, with the evidence the impact actually jumbled up the terrain, it could have created new lakes, and hiding the impact all over the place, so that's pretty neat. So, OK, so let's go back to some of the crazier theories.

Pamela: [laughing] You just like this!

Fraser: I can't wait. So, I'm trying to think…so microscopic black hole?

Pamela: No.

Fraser: But, why not? You can't just dismiss it outright.

Pamela: So microscopic black hole…in general, it's just not going to produce enough energy. I mean, that's the thing about microscopic black holes is if [missing audio] one – yay! Great! We give Hawking a black hole because we finally observed one, and it's going to evaporate. So, I'm not worried about a microscopic black hole.

Fraser: Right, and if…and so a microscopic black hole would just probably just pass right through the Earth and maybe interact with the occasional atom, but probably not, just go straight through to the other side.

Pamela: And, I mean, the thing is if it was a microscopic black hole, and it wasn't one that happily, spontaneously evaporating over Siberia, if it was passing through, there would have been an exit event. We would have seen something on the opposite side of the planet along some sort of a vector.

Fraser: A crashed alien spacecraft?

Pamela: Yeah, no. We would have found it.

Fraser: Well, what if it was a crashed alien spacecraft made of rock and ice and dirt…

Then it's not exactly going to stand up real well to the vacuum of space.

Right, OK. Alright, I'm trying to think, what were some of the other…if anyone in the chat room remembers -- some of the other wonky theories…what are some of the other crazy theories that you've heard of?

Well, my favorite wonky one and I think this is because I watch "The Sanctuary," which…I'm a connoisseur of really bad sci-fi shows, and I'm a fan of "The Sanctuary" and it qualifies as really, really back science fiction, and it has Nikola Tesla as one of the, like, characters in the show, and so that's long lead-up to one of the theories is that it was caused by, I'm going to mispronounce this, the Wardenclyffe Tower, that was basically a giant Tesla coil that Nikolai Tesla had commissioned to be built, but they ran out of money before it was ever built, so one of the theories is somewhere there was one of these things built and Nikola Tesla was doing an experiment, and this caused it.

Fraser: And the field got away and detonated over Siberia, or he was building it in Siberia.

Pamela: It was just the field got away [laughing].

Fraser: Or anti-matter, right?

Pamela: Anti-matter, that's true, but how did it get there without interacting with something else?

Fraser: Right, like the atmosphere, or dust, or the solar wind, or anything…yeah, yeah.

Pamela: Yeah, unless it's carrying its own containment field that spontaneously broke up, which is another way of saying alien spacecraft. It wasn't anti-matter.

Fraser: Well, that was cool, so I guess the one last thing is we talked about the Torino Scale last week, and I guess, this would be…someone mentioned that this would be a "seven" on the Torino. This would be a regional event with absolute certaintly,

Pamela: Only if we detected it first.

Fraser: Yeah, like a half an hour before, "Seven!"

Pamela: And the thing is, things like this are predicted to be happening every…people debate whether it's every fifty-ish years, or every 300-ish years, so somewhere between those two very different numbers, but these are still time scales of humanity; these are still time scales of civilizations, and so this is the type of thing that could be happening fairly frequently, and we just don't know it because, well, we're mostly made of water and our planet is mostly made of water.

Fraser: Right.

Pamela: Or covered in water, it's not made of it.

Fraser: Right, but were this to have hit Paris, or Moscow, or New York…

Pamela: Bad!

Fraser: It would have been…yeah. I mean, the damage would have been catastrophic.

Pamela: Instead it killed a few reindeer, which is bad, but differently bad.

Fraser: Which is bad, and probably some people somewhere in that region, but [missing audio], but it would have been just probably the worst disaster in natural disaster in modern history. It would have been horrendous.

Pamela: It would have rivaled Haiti, and Chile, and some of the other big earthquakes.

Fraser: The tsunami…

Pamela: I don't think it would have been as bad as the tsunami was. That was horrible over a much larger region than 800 square miles.

Fraser: So, you know, the good folks who are working on the various missions to search out and find various asteroids – thank you very much! Keep at it!

Pamela: LINEAR, LONEOS, Near-Earth Objects Survey (CINEOS) …we're looking at all of you.

Fraser: Right. Alright, well thanks a lot, Pamela.

Pamela: My pleasure.