AirSpace Bonus! There's More to That: Auroras Transcript

Emily: Howdy AirSpace listeners! We are working on brand new episodes for season eleven, but today we've got an aurora-themed treat from our friends at the Smithsonian Magazine podcast *There's More to That.*.

Ari Daniel: Think back to last year, and I bet you fall into one of two categories: either someone who saw impressive auroras lighting up the night sky, or somebody relegated to looking at photos of them on social media. British writer Jo Marchant is the latter.

Jo Marchant: I was actually in the U.S. and got an amazing view of the recent comet, which was fantastic, but all my friends were posting on social media about how amazing the aurora was back home. I would love to see it, but I haven't.

Daniel: Jo is a frequent contributor to Smithsonian magazine and the author of The Human Cosmos, a book about how civilizations throughout history have been shaped by observations of the stars and planets in one way or another.

Marchant: We don't hear quite as much about those stories of the auroras, but there is a rich mythology about them, and you see really interesting differences as well between different cultures who have been located in different places around the planet and therefore got different views of the auroras.

Daniel: The earliest record we have of the same aurora being seen in different places dates back to September 1770.

Marchant: That was during Captain Cook's first voyage down through the Pacific to Australia, and he and his colleagues saw the aurora australis on that night. That's recorded in the journals of Sir Joseph Banks and Sydney Parkinson, who were on board. But the exact same night, we have records from Chinese astronomers who were looking to the northern sky, and they noted down that they had seen the

northern lights. So I just think that that's really lovely to think of those two things happening on the very same night. And today we can look back and see both of those sets of records.

Daniel: This year is forecasted to be a major one for auroras, the best conditions in nearly two decades. The reason why has to do with the sun and how it interacts with the Earth's atmosphere. We may know way more about auroras now than our ancestors did, but our response is likely pretty much the same.

Marchant: We don't just want to see a scientific phenomenon. We want to look at the sky and be in awe and imagine ourselves as we might have looked up and seen that centuries before. So they still hold that fascination for us.

Daniel: From Smithsonian magazine and PRX Productions, this is "There's More to That," the show that takes the bore out of borealis and puts the awe in aurora. I'm Ari Daniel. In this episode, we learn about auroras. What are they? Why do they happen? How can I see one? Someone please tell me! Plus, what ancient people thought about auroras and why researchers still rely on their records today.

Daniel: Have you ever seen an aurora, Carlyn?

Carlyn Kranking: I wish that I'd have seen an aurora.

Daniel: Carlyn Kranking is a digital science editor at Smithsonian magazine.

Kranking: It's a lifetime bucket list item for sure. And since this next couple of years are supposed to be so good for seeing the auroras, I feel like this is my chance. All the auroras are tied to activity on the sun, so the sun is very active. It's our nearest star. It's constantly launching material out into space.

Daniel: These launchings of solar material are called solar storms. They're explosive rearrangements of magnetic fields that result in large releases of stored magnetic energy.

Kranking: They will originate in sunspots, which are regions on the sun's surface where the sun's own magnetic fields are really concentrated. And as a result of all these magnetic fields getting tangled up there, those spots on the sun are cooler than the areas around them. And so they appear darker on the surface of the sun.

Daniel: When a solar storm releases light and radiation, we call it a solar flare. But there's also another kind of solar storm called a coronal mass ejection. This is where plasma and magnetic fields spew outward off the surface of the sun. It's these ejections that most likely cause auroras.

Kranking: And the large solar storm in May was caused by at least seven coronal mass ejections kind of coming together. So that's what really helps to supercharge the auroras.

Daniel: After a coronal mass ejection, those magnetic fields from the sun travel all the way to Earth.

Kranking: When those charged particles hit Earth's magnetic field, they get pulled toward the poles, like a magnet, basically. And at the poles, these charged particles bring energy to the gases that are in Earth's atmosphere, mostly nitrogen and oxygen. And when these gas particles take on that extra energy, scientists will say they "get excited"—that's actually the term. And they'll have to get rid of that extra energy. And they will do that by glowing and giving off that energy as light.

Daniel: The different aurora colors we see in the sky depend on which gas is excited and the altitude of the interaction.

Kranking: So when you're seeing red, that's going to be oxygen at a high altitude. If you're getting oxygen at a lower altitude, then that's going to be green. And nitrogen might be red or blue or potentially even pink. And then sometimes you might see other colors if they're kind of blending together.

Daniel: Auroras are usually spotted in the most northern or southern parts of Earth, near the poles, because of the Earth's magnetism.

Kranking: Really the only time that you're going to be seeing the auroras from other places like the United States or places farther south would be during a large solar storm. That's when there's just like so much energy coming in that it can't be completely confined to the poles, and it's going to supercharge a lot more of the Earth's atmosphere.

Daniel: In very rare cases, an aurora might even produce sounds here on Earth. Kranking: And it kind of sounds like a crackling noise or a snapping noise. Experts called it the "white whale" of all aurora chasers, is to be able to hear that sound.

Daniel: Auroras may seem elusive, but Carlyn says they do happen with some amount of predictability, which brings us to why this year is a big one for auroras.

Kranking: Scientists can predict that this year is supposed to be a great year because the sun goes through an 11-year cycle of activity called the solar maximum. And that is pretty easy to predict because it does fall pretty regularly on schedule. So the last solar maximum was in 2014—so that was about 11 years ago. So we are following the pattern. We are in the solar maximum right now, and we are probably going to continue to be in the solar maximum throughout 2025 and potentially even later than that.

Daniel: That said, we may not know when this ramped -p solar activity actually reaches its peak.

Kranking: Based on the way that previous solar maximums have been, some of the highest activity from the sun actually happens on the later end of the maximum. So potentially later in 2025 or 2026, there might be even more activity.

Daniel: Besides making these displays of riveting lights up in the sky, does the solar activity affect life here on Earth?

Kranking: Geomagnetic storms can have a bit of an impact on human technology. They can sometimes impact satellites, for instance, or anything that might use satellite services such as GPS. There's concern over what they might do to power grids or communication systems. Those are all real concerns for sure, and scientists

are working to predict auroras so that people can react. For example, during October when we had a somewhat large geomagnetic storm, NOAA contacted power grid operators to give them a heads-up so that they could potentially prepare for the influx of solar energy. So I feel like scientists are working on good ways to be able to keep those impacts to a minimum. In 1859, there was a huge geomagnetic storm called the Carrington Event, and it's the biggest geomagnetic storm on record. The northern lights went as far south as Cuba and Hawaii.

Daniel: Wow.

Kranking: Yeah. That was a huge thing that modern technology has never had to experience, because we haven't had a storm of that size since then. Storms like that are really rare.

Marchant: Yeah. So the Carrington Event, that was an incredibly powerful solar storm, and that enabled the British astronomer Richard Carrington to link the lights that he saw with solar activity. That was a really key moment.

Daniel: Jo Marchant again.

Marchant: The day before, he had seen two blinding beads of white light appear briefly just above a sunspot on the sun. So he'd seen essentially the earliest recorded solar flare, and then the next day the aurora, and he made that link between the two. We know that the same aurora was seen at the time in Japan. There's one account—a diary entry that was written that said the sky seemed to be burning, so this was something that was viewed over hundreds of miles. The sky was glowing red, and many assumed it was the light of distant fires.

Daniel: Aurora frequency and color have stirred a desire to explain this phenomenon, long before we had a scientific explanation.

Marchant: We've heard of these stories of omens of death and fires and hostility, but for the people of Sweden, the fishermen saw the dancing lights as a good omen. They saw it as the reflections of giant schools of herring that were swimming nearby. So just that promise of these amazing schools of fish that they

were about to catch. And in Iceland, the lights of the aurora were thought to relieve the pain of childbirth, although the woman was not allowed to actually look directly at the lights or her child might be born cross-eyed.

Daniel: Jo explained that people with frequent views of auroras tended to draw more positive conclusions about them than those who may have been startled by the sight of them. That's not only because these people were used to seeing auroras, but also because they were more regularly observed by those who lived near the North Pole, where auroras were that magical, glowing green as opposed to a fiery red.

Marchant: We have stories both from the Northern Hemisphere, so seeing the northern lights, but then also the Southern Hemisphere, seeing the southern lights, the aurora australis. And in the north, you have quite a lot of places within the Arctic Circle where you've got communities of people who've essentially grown up with that routine almost view of the aurora. So places like northern Scandinavia, Siberia, the northern parts of North America, they're looking straight up through the atmosphere at the northern lights. Because of the chemistry and the gases in the atmosphere, they will tend to see it as green-colored, and you see those characteristics coming through in the kinds of stories that they tell. So in Finland, there's a lovely word, revontulet, which means "fox fires." People there saw the aurora as foxes made of fire essentially sprinting across the snow so fast that sparks are flying up from their tails and igniting the sky.

Daniel: Oh, that's a beautiful image.

Marchant: Yeah, so a kind of positive, quite magical images: Estonia, stories of spirit beings from higher realms. Eastern Canada and Southeast Alaska, stories of dancing souls. In some places, the Lakota Sioux, for example, saw them as spirits of generations yet to be born, and then you also have Viking stories. So they're entwining it into their mythology and stories about Valhalla and warriors. They thought that the god Odin had sent the Valkyries, these female warriors riding horses through the sky, to retrieve the souls of fallen warriors and take them to Valhalla, and that the aurora was the light reflected off the Valkyries' battle armor. So again, a positive story, but you see all the different interpretations that are

coming through, but often to do with spirits, with the afterlife, with this celestial heavenly realm.

But then in the Southern Hemisphere, you see quite different kinds of stories. There, you don't have that same inhabited land really close to the pole. People in Australia or the Maoris in New Zealand, or at the southern tip of South America, these locations where people were watching the aurora in the distance more on the horizon than straight ahead, they're not seeing it as often. And because of the differences in gases in different layers of the atmosphere, they tend to see more of a red color, and you see that feeding through into different kinds of stories. So now you see quite ominous stories relating to fires, evil spirits, blood, death. The Gunai in eastern Victoria in Australia saw the aurora as bushfires in the spirit world relating to the sky god being angry, telling of impending doom. Other groups saw them as fires generated by evil sky spirits. So there's a really rich mythology there, even though we don't hear quite as much about it.

Daniel: I'm wondering, are there more records of the red light in the sky because of just who was doing the record-keeping compared to the green?

Marchant: Yes, I think that that would be true. In terms of the mythological stories, I would say that there is more from the green, because you had those traditional communities who were more likely to be living in the Arctic zone, but they're more oral traditions. If you're looking for the more scientific record-keeping and noting down descriptions of specific events, that seems to occur much more when you're farther away from the poles—possibly because that's where you've got astronomers who are looking at the sky every night. But also because you're farther away from the poles, this isn't an everyday thing. So it's not just something that's just part of life. These were really dramatic, inexplicable, but occasional events. So you can imagine that you're much more likely to make a note of a particular example or a particular time that that's happening if it's just this really just incredible thing that you might only see a couple of times in a lifetime. Whereas if it's something that's happening all the time, you'll have stories about it, but you're not necessarily going to note down every single time that it happens.

Daniel: It's clear that the auroras were making a strong impression on people over the centuries. Did ancient peoples understand much about the science of auroras and what really caused them? I mean, of course not early on, but is there any evidence of an evolution of how people thought about auroras over time?

Marchant: Well, what we do see is a distinction between the general mythology where we have these overall stories about the meaning. And then in certain cultures, what you get is very precise observations of the sky. So they're making records, not just telling stories about auroras, but making records of particular events. And then you start to see those events being dated and described in more precise terms. And that is of interest to scientists and historians today, because then you can actually start to say, "Oh, there was a particular aurora event in this place at that time, and this is what it looked like."

And scientists are quite interested in doing that, because then if you can start to put together a record of when and where auroras were happening, particularly when they're happening farther away from the poles—so cultures who wouldn't normally have been seeing them—that's telling you that that would've been a time of particularly strong solar activity. It gives you information about the solar cycle through history.

Daniel: Now, auroras leave no lasting physical imprint here on Earth.

Marchant: We have ice cores, tree rings, sediments. You can look for clues to past weather or climate change, but there isn't a physical record, usually, of solar storms. So we have to rely on people's observations. And so you have scholars looking at ancient Chinese records, Japanese records, Babylonian records, all of these cultures who were particularly interested in what was going on in the sky.

Daniel: And when you say ancient, how many years ago?

Marchant: Well, there's been a kind of race back in time of trying to identify what is the earliest record that we can find of a dated aurora observation. So we've got a few different contenders. For example, a really lovely one from the Babylonians from the sixth century B.C.E. The Babylonians were really interested in what was

happening in the sky because they saw celestial events as omens, warnings from the gods, essentially telling them about usually bad things that were going to happen on earth. Lunar eclipse often meant the death of a king, for example. They're very interested in when the planets change direction, and then you could conduct rituals to stop the bad thing from happening. So they had astronomers who were watching the sky every night over centuries trying to make sense of what was happening, trying to predict what was going to be happening next.

Daniel: Kind of like astrology.

Marchant: Well, it's kind of an interesting mixture of the two. They wouldn't have differentiated between astrology and astronomy in those days. So, yeah, they had the more magical idea of: These are omens, these can tell us about the future. But through wanting to observe those omens, they developed a very mathematical, almost scientific approach of observing the sky, writing down what they saw every night, coming up with mathematical models, really, that allowed them to predict what the sun, moon and planets were going to be doing. Obviously, auroras are a lot less predictable than that, so they didn't have mathematical equations to tell them when the next auroras were happening, but they did note them down when they saw them.

And one diary in particular, there's a tablet from the night of the 12th to the 13th of March, 567 B.C.E, where the astronomer who was—or astrologer, whichever you like to call it—he was probably in the Tower of Babylon, sort of noting down what he saw. And he talked about an unusual red glow in the sky. The diary entry says, "Night of the 29th, red glow flared up in the west." And the term that was used for this red glow was akukutu. And researchers who've looked at that concluded that that's a really good candidate for an observation of the aurora. But they also have some other really lovely terms as well. So "unusual rainbows" is one that I really liked, that I thought was a really nice description. And that term, akukutu, isn't known elsewhere in astronomical diaries, but they did keep these books of omens. And there is an omen that's written down which says, "If in Sivan," which was a month name, "an akukutu blazes, there will be hostility in the land." So that's suggesting that this would've been seen as a bad omen.

But then there was another study looking at Chinese records—what's called the Chinese Bamboo Annals. They chronicle the history of China, and these annals were actually written down in the fourth century B.C.E., and that talks about a five-colored light in the northern sky. And that account says that this occurred at the end of the reign of King Zhao of the Zhou dynasty, and the researchers conclude that that was in the tenth century B.C.E. So that isn't a record that was written at that time in the tenth century B.C.E., but the researchers think that it's referring to a particular event that happens then.

So that's about as far back as we can push those records. But as researchers look at more historical records, specifically looking for accounts of auroras, hopefully we'll find more. And that can give you, as I said, a sense of when periods of high solar activity were occurring, could also potentially give information about the movements of the magnetic poles. Because the magnetic poles do shift at different times in history, and so you're more likely to see auroras in particular places depending on where the magnetic poles are.

Daniel: It's fascinating, because what you're saying is that even though these ancient peoples didn't know what the aurora was or what caused the aurora, their documentation of the auroras gives us now an ability to look back and reconstruct some of these geomagnetic and solar processes over the years.

Marchant: Yeah, exactly. Like I said, we need those human records, particularly the Babylonians and the Chinese were very meticulous, very interested in what was going on in the sky. And scientists can use their records, their identifying eclipses, for example, supernovas, all these different astronomical events we can see in the records. And that is true for the auroras as well.

Daniel: This year promises to be a really good year for viewing auroras. And I'm wondering whether you have any plans to try to finally see one.

Marchant: I don't have any particular plans for a trip, but I definitely don't want to let another year go by without seeing them. So I am definitely going to be watching any forecasts that are coming up, making sure I've got plans. Maybe travel to somewhere, like—Abisko National Park in Sweden is somewhere that

I've read is extremely good for watching auroras. Because often if you're in the Arctic Circle, you can end up with cloudy skies. But that is a location where you're far enough north, but it's got this microclimate with quite clear sky. So that is meant to be very good. So if I was able, in my dreams, to plan a trip to really see the dancing green all across the entire sky, then I think that is where I would go.

Daniel: Jo isn't the only one thinking of traveling to try to see an aurora. Carlyn Kranking interviewed people who identify as aurora chasers. They gave her some tips we can all use this year as we experienced the solar maximum.

Kranking: Aurora chasers will do basically whatever it takes to be seeing the auroras as often as possible. Sometimes it's for a hobby, sometimes it's for their profession, because they might lead tours. But the aurora chasers who I talked to all are absolutely entranced by the auroras. One person who I talked to had seen auroras more than 300 times in his life.

Daniel: Wow.

Kranking: Yeah, it's a complete lifestyle.

Daniel: Given how passionate some of the people you spoke with, Carlyn, are about auroras, it really feels like the kind of thing that maybe if folks who are listening have the chance and the opportunity to see an aurora, they should try to avail themselves of it. So I'm wondering, what would you suggest people do to put themselves in a position where they could see an aurora?

Kranking: Yeah, absolutely. So I feel like one would be to plan a vacation.

Daniel: An aurora vacation.

Kranking: Yes, an aurora vacation. If you want to do that, and you want to plan a trip up to somewhere in the Arctic Circle to see auroras, I did get a few tips from some of the aurora chasers. And one of them is to dress warmly, because you're going to be there in very cold weather, and you're going to be there for a while. You also should book a trip for several days just in case the weather doesn't work

out, or to be there, try to see the auroras, come home and then get news that there's a massive solar storm or something like that. So you do want to give yourself time.

Oh, they also suggested potentially booking a tour or going with a local guide who might be able to give some more information. Or if you do your research in advance, then you might be able to find out some of the best places to go. They also talked about potentially going around the equinoxes, because the alignment of Earth is just a little bit better at that time. But, I mean, you would be able to see them in the winter at any time, as long as there's enough solar activity to be doing it. And if you are here in the U.S. or in the Northern Hemisphere, you want to try and have a good view of the northern sky, because the auroras will be coming from the North Pole area. And then if you're in the Southern Hemisphere, you'd want to have a good view of the southern sky.

Daniel: So what does that mean, getting up on top of a hill?

Kranking: It could be, or just a place where it's pretty open, like a good field.

Daniel: A beach.

Kranking: Yeah or a beach, that would be great. Yeah. Because if you're looking out over the water, there's probably not a lot of light pollution coming from out there, too. One of the biggest things I heard from the aurora chasers was to manage your expectations. Because we are all seeing those pictures on social media that people have taken. And your phone can actually see the aurora's lights, especially the red lights, much better than the human eye can. So sometimes when you're seeing those pictures that people have posted, that's not exactly what they have seen with their eye. And sometimes, if it is one of those large geomagnetic storms like that, it brings the auroras far south—you might not see the auroras at all, but if you take a picture with your phone, then they might show up there. So your phone can also be a really good tool for helping to find the auroras or helping to see them where maybe you wouldn't see it with your eye.

Daniel: Yeah. How do you take a picture of an aurora?

Kranking: If you can put on night mode or do a long exposure, that might also help so that your phone can try and take in more of the light. When these big solar storms have happened, I think people really bonded over sharing their photos. And even if you couldn't see it with the eye, that doesn't mean that it's not there. And it's neat that your phone can reveal that to you. Just be checking the NOAA Aurora Dashboard to see what areas the auroras are supposedly going to show up at.

Daniel: That's what I was going to ask—if there's a particular website or place to tune in.

Kranking: Yeah. NOAA has, its Space Weather Prediction Center has a dashboard online where it'll show a 30-minute aurora forecast, and then maybe a slightly longer one, too. And then there are some other resources. I talked to someone who works with a NASA program called Aurorasaurus, and it's a citizen science program for people to submit sightings of auroras. And if you sign up for that, you could also sign up for alerts to tell you when auroras are being spotted in your area. And you could also just check social media, see what the aurora chasers are saying, see what people around you are saying. And always go and take a look outside for yourself.

Daniel: Carlyn, I'm wondering, you want this year to be your year to see an aurora, how are you setting up to make sure that that becomes a reality for you?

Kranking: I am working on planning a trip to Iceland.

Daniel: Oh, great.

Kranking: Yeah. I would like to be able to go there and hopefully see an aurora in a more guaranteed type of situation. But if I hear about another large solar storm coming, I can hop in the car, and since I'm in Virginia, I could drive out to Shenandoah or somewhere with less light pollution. Yeah, I'm just going to have to keep on top of the news and commit to driving somewhere to be able to make that happen.

Daniel: Well, I wish you luck. I hope that this is the year that you get to see them finally as a real, true aurora experience.

Kranking: Yeah. Thank you. That'd be great.

Daniel: Thank you so much for sharing your expertise.

Kranking: Anytime.

Daniel: You can read more about the aurora chasers and other celestial sightings from Carlyn Kranking and Jo Marchant online at SmithsonianMag.com. We'll put some links in our show notes, including to the NOAA tracker. You'll also find a link to subscribe to future issues at Smithsonian magazine.

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Our episode artwork is by Emily Lankiewicz. Fact-checking by Stephanie Abramson. Our music is from APM Music. I'm Ari Daniel. Thanks for listening. I'm just so excited to see an aurora this year.