

Pyrotechnology with Dr. Ellery Frahm

Ologies Podcast

September 28, 2021

Oh heeey. Okay, can I tell you a secret at the top of the show? Because I'm going to. Okay, so for the last year and a half I've been working in semi-secret on a Netflix show for Higher Ground, which is a production company owned by Michelle and Barack Obama, and the show I've been working on is called *Ada Twist, Scientist*. It's an animated show, it's for kids, it's about a girl who's a young scientist, and her friends Iggy and Rosie, and all these experiments they do. I've been a consultant on it, having to work on it in secret for a long time and helping figure out the science of the experiments they do, and some plot lines, and suggesting real-life scientists—a lot of them I know through *Ologies*, you know them also—to interview at the end of each episode and the entire team was just the best and I'm so proud of the show. We worked so hard on it for so long and it premieres today... Today! September 28th on Netflix. And I'm only telling you this because the creators of the show and the showrunner and the whole team just worked so hard, and I hope you like it. Anyway, *Ada Twist, Scientist*, it's on Netflix now.

Okay, onto the *Ologies* show. It's me, it's your uncle who travels with a scented candle because he gets homesick on work trips. It's Alie Ward, back with a cracklin', smokin' hot episode of *Ologies*. It's all about fire and campfires, embers, heat, warmth. And when did your ancestors, the ones whose names you're never gonna know, the relatives billions of us have in common, when did they figure out how to use fire? And why? And where did it lead us?

So, there's a lab at Yale University dedicated to researching this hazy history of what our species has been through and this ologist is the director of that lab. He's worked on four continents, published papers spanning half a million years of human history; he got his bachelor's studying Physics and Anthropology at Grinnell College in Iowa, got his Master's and PhD in Anthropology for the University of Minnesota and at the Yale Pyrotechnology Lab, also called Y-PYRO. He and his colleagues study how technology and history can be figured out by tracing our control of heat.

But before we light the fuse, let's thank the folks who support at [Patreon.com/Ologies](https://www.patreon.com/Ologies). You can join them for a dollar a month and submit questions to the ologists before we record. Thank you to everyone who rates and subscribes and reviews. I read 'em all. Here's a little proof; still smoking, LacyFreemn's review this week said,

No flimflam, it's a Freeman fav. As a fellow gross person who likes gross things, please never stop this podcast or cussing.

Lacey, you get me. Okay, Pyrotechnology let's do it. Gather round you naked, apey babies, and listen to tales about sharp rocks, hairy Jell-O, sooty caves, glowing coals, iron sparks, burnt feet, wolf skulls, fluffy fungus, stomping Oprah, molten metal, some disaster movie trivia, ember tending, and more with Anthropologist and Pyrotechnologist, Dr. Ellery Frahm.

Alie: Okay. First off, can I get you to pronounce your first and last name and tell me the pronouns you use?

Ellery: Sure, my name is Ellery Frahm, and my pronouns are he/him.

Alie: That's a great name, by the way, Ellery Frahm.

Ellery: I never have... You know, people don't Google it and end up with the wrong Ellery Frahm.

Alie: [laughs] You have SEO optimization down.

Ellery: Yeah, I mean, I was never able to find, like, pencils or nameplates or anything like that as a kid.

Alie: [laughs] Is it a historical name?

Ellery: No. Well, I mean, you'll see a lot of, like, British, William Ellery Channing and William Ellery... But my parents literally just found it in a book and thought it was good.

Alie: Oh! Have you read the book?

Ellery: I mean, so there's Ellery Queen, the *nom de plume* for mystery writers and I realized just recently that after constantly hearing about, "Are you named for Ellery Queen?" I've never actually read [Alie laughs] any of the books, any of the... I think they were radio mysteries. I've never read a thing of it. I think I just kind of resented it as a kid.

Aside: Okay, I looked up this author, Ellery Queen and it turns out it was a *nom de plume* of two writers, cousins, who worked on a team under one name. They also went by Barnaby Ross and they staged public debates as Ellery Queen and Barnaby Ross, two fictitious people, and they kept their faces covered to keep their fake identities a secret. Which is so much cooler than my childhood dream of publishing sappy books under the pseudonym Dixon Ticonderoga. Anyway, this Ellery is not a fiction writer, he's a factfinder.

Alie: I feel like as a scientist, you're sort of a detective anyway, right?

Ellery: Yeah, yeah, we constantly liken ourselves as, like, Sherlock Holmes, I would think. Just extracting every bit of data out. But the alternative though is that Sherlock Holmes always found the bad guy, right. [both laugh] And we're like, "Eh, it's probably this."

Alie: "Eh... It depends."

Ellery: "It depends."

Alie: A lot of scientists say that their answers, for a lot of things, start with, "It depends." Which is true. How long have you been interested in way, way, way back history? Paleo history?

Ellery: I think as a kid I was interested especially in, like, astronomy being a very deep field. And doing my PhD work, I was focusing more on the Bronze Age, so like 5,000 years ago. And then I was doing that research in Syria, and this was about the time the Syrian Civil War broke out and so all archaeology there just stopped. But I had colleagues who were working in the Caucasus, in what we call the Paleolithic and they said, "You should come here, you'll love it." And obviously, that stuck. [Alie laughs] I kind of caught the bug late, maybe.

Alie: And your background, initially, was in physics, right?

Ellery: Yeah, so I took a lot of both physics and anthropology courses in college. I couldn't make the double major work, there were too many labs. But I basically grew up in a physics department. So, my dad is still a technician in a science building, at a liberal arts college in Wisconsin. So, I literally grew up in a physics department; literally riding my big wheel up and down the hallways, [wheels rolling] being called in when they needed a small person for demos in the lecture hall and stuff like that. [Alie laughs] Riding the fire extinguisher-propelled tricycle was my specialty.

Alie: [laughs] And then you ended up studying fire. That's actually kind of perfect.

Ellery: Yeah, so I mean, it was play. When I started taking a lot of anthropology and archaeology in college while doing a physics major, eventually... Just kinda stumbled across the blend between the two.

Alie: I don't know if this creeps you guys out, but I have known about your lab and your work for years and have always wanted to do a Pyrotechnology episode.

Ellery: Oh, that's fantastic.

Alie: I'm sure you have to explain to people, it is not the study of fireworks, and Black Cats, and like, Screaming... [laughs]

Ellery: Yeah, that's absolutely the question I get asked all the time, "So, you study ancient fireworks?" I'm like, "No, but that would be within our purview, if we were so inclined." So, the general idea with Pyrotechnology is it's a way of kind of reframing human technology, but you can also lump a lot of human behavior, and even human evolution, into the control of fire. And not just controlling fire, but greater and greater control and achieving higher and higher temperatures.

And so, all the way back to, depending on which sites you're so inclined to believe, you could be talking about a million years ago, all the way up through the 20th century, when really, only with the advent of plastics, ["*Plastics.*"] do we start getting technology that doesn't depend on heat. If you're talking about progressing through ceramics, glass, metals, and new metals; it was all about getting hotter forges and controlling how you're altering materials for longer and longer.

Only when you start coming up with things like Bakelite, and causing plastic polymers to form, that suddenly you get a trend in technology that now it's about more like how you control structures; 3D printing, nanotechnology, and stuff like that. But for most of human history, we were dependent on what temperatures we could attain, how precisely we could control them, and for how long we could keep those temperatures going.

Aside: Okay, quick side note, the invention of the first polymer plastic, Bakelite, dates back to the early 1900s and it was also called Artificial Amber or, Polyoxybenzylmethyleneglycolanhydride, for short.

Alie: And from a physics perspective, can we back up and can you explain to me what fire is? Is it too hard a question?

Ellery: No, no, no, it's not. So, fire is a chemical reaction. I think it's easier to even think about a spark. You might think about a spark being made from flint striking a piece of steel, whether it's kind of, an old-fashioned fire-starting kit or on a flintlock gun.

Aside: Flintlock guns, in case you didn't know, came along in the 1600s and relied on a chip of flint striking steel to ignite gunpowder and send a bullet flying with the explosion. So, imagine Revolutionary War guns, or something a pirate would have tucked into their smelly pants. That spark, that's also fire technology, baby.

Ellery: So, when those two substances, that flint stone hits the iron-rich steel, there's a spark; there's light, there's something that can cause an ignition. That little particle that you see glowing is, basically, just a tiny little bit of iron atoms that have been scraped off that steel and are now oxidizing right away. And that is what a spark is; it's that chemical reaction of oxidation extremely quick. So, on a larger scale, that's a lot of what's happening with fire. It's a chemical reaction that is producing energy and gasses, and you get the heat and light out of it as part of those reactions. But in the simplest form, yeah, that's what it is; it's a

chemical reaction. What you typically associate with fire are those photons of light and infrared making something hot. But the chemical reaction, that particular substance undergoing this transformation to ash, perhaps, is the byproduct of that chemical reaction. But the fire itself, it's almost a process rather than a thing.

Alie: And it occurs in nature, obviously... With lightning, with... What, lava catching things on fire? How else does it occur in nature before we as a species understood how to create it versus control it?

Ellery: Yeah, you make an important distinction there between fire users and fire producers. So, we were probably able to capture fire from a natural lightning strike, or like you were saying, from something burning ahead of a lava flow. To the point of being able to create it on demand is an important distinction. And of course, that's one of the biggest challenges then, to try and investigate in the past is distinguishing, "Was there fire but we're not convinced this is human related?" It's just evidence of, perhaps a forest fire or that there might have been sediments that were heated on the ground, but there was a lava flow right nearby and that's what reheated it?

So yeah, I would say you captured a lot of it. Certainly lightning is, I think, what everyone kind of most associates with it. There's even some pictures of early-Paleo art from, like, the '50s of Neanderthals using fire; they've started a fire. To make sure they emphasized that this was related to a lightning strike, the Paleo artist, in the background, has this rainbow. [both laugh] So, you get this juxtaposed, very brutish-looking interpretation, very '50s interpretation of Neanderthals using fire but then this lovely rainbow in the background, which I think is just this fantastic juxtaposition.

Alie: And if we're talking about, kind of, vintage timelines and confusion, could you put on your anthropologist hat—I don't know if you have a literal one, if it's necessary or not—but can you give us a quick timeline of when, as a species, we did what shit? Like, when did we start making fires? When did we start using tools and stuff? Just a quick timeline. [laughs]

Ellery: Yeah... Anthropologists wear scarves.

Alie: Okay! [laughs] Perfect. [*"Duly noted."*]

Ellery: So, the earliest, essentially, stone tools are what we have when we're talking about what the earliest archaeology is. We're going to go with the "it depends." There's debate. The most recent, kind of, oldest site, is what's called Lomekwi 3, in what's now Kenya, and it's dated to a little more than 3 million years ago. That's a bit controversial, but even if you are more conservative and go to the next oldest site, you're still talking about 2.6 million years ago, and that's in Ethiopia.

So, these are very simple stone tools. Very simple in that you're talking about a flake, a chunk has been knocked off of a larger stone, either on purpose, or accidentally at first. But those are the oldest stone tools. There are similarly old, kind of, cut marks on bone as well, in that more than a million-ish years. So, that's how long we've been using stone tools, potentially 3 million-plus years. And if it is 3 million-plus years, we're talking about pre-genus *Homo*, pre- that broad umbrella of humanity.

Aside: So, we as a peoplehood *Homo*, date back roughly 2.5 million years, before this one ape, the grandpapa of taxonomy, Carl Linnaeus, coined the genus *Homo* in 1758. So, making us all one big posse and I guess giving all the other apes... Genus envy... [mutters] That was so— I should erase that.

Ellery: Jump ahead to what are some of the oldest indicators of fire use... Again, we're still looking in Africa so there's Wonderwerk Cave in South Africa that has some evidence for the presence of fire associated with early humans at about one million years ago.

Alie: Wow.

Ellery: By this time, stone tools are getting a little, little more advanced, but they're still just kind of like pebbles with a few sharp edges on them and chopping. When you get to the next threshold of when you start to get some agreement about where and when fire is more common, you're talking about maybe half a million to maybe three hundred thousand years; again, depending on which kind of the debate you're on. And by that time, if we're talking 300,000 years ago, we're talking about the human ancestor called *Homo erectus* and almost transitioning in places like Europe into early Neanderthals.

Aside: So, real quick, Neanderthals were human, they're the same *Homo* genus, but a different species. And they were shorter and stockier, and they diverged from *sapiens* at least half a million years ago. And there's evidence that they could create fire 200,000 years ago. They were also super smart, and they made art and jewelry and we interbred with them a bunch; which means they probably smelled okay and were dope to chill with.

Ellery: And then, you start getting advances, continuing innovations, in how the stone is being used to make tools. There are wood tools, preservation is really bad for wood, you might imagine. There are some spears that are in that timeframe of tens of thousands of years old that have been preserved in Germany because they were trapped in oil sands.

So, then we start to get modern humans on the scene—in Eurasia, there are already modern humans in Africa at this time—but at about the 40,000 years ago, you start to get the replacement, integration, or whichever way you want to interpret it, the replacement of Neanderthals by modern humans, by us, and then spreading throughout the rest of Eurasia. And we don't get things like ceramics until... If we think about ceramics, if we think about pots, that is not until what we call the Neolithic. It's part of the Holocene, so we're talking about after the last ice age, and that's only within the last 10,000 years.

Aside: So, if you wish that you had a cheat sheet of the different “-cene” areas, allow me to be that crib note cradled in your sweaty palm. So, the Holocene started about 11,000 years ago with a glacial retreat that left behind all these cute little lakes... in Minnesota. And in the Holocene, humans started farming things and building stuff.

So then, what is the Anthropocene? Well, it's a debated term introduced in the early aughts, right around the time Gwen Stefani was gluing rhinestones to her face, and the Anthropocene denotes that, “this is the time of humanity, as our species is having an impact on the planet and the geological record,” what with things like; mass extinctions, and atom bombs, and gameshows, and a bunch of space toilets now orbiting the galaxy, Chernobyl. Things like that that stick around in the record. But yes, the Holocene started 11,650 years ago, give or take. Which, in Earth terms is like... yesterday.

Ellery: So, when you're talking about ceramics and everything that's followed; farming, glass, metal, all this sort of stuff, you're talking about no more than 10,000 years ago.

Alie: Ooo, so recent. We're pretty new on the scene.

Ellery: Yeah, absolutely. But then these things build too. This is where, again, the integration of control of heat becomes interesting because you can't, say, smelt metals without having ceramics to pour them into.

Alie: Ahh, ha-ha!

Ellery: They're also integrated as well. You kind of can't get one without the other. So, they all kind of engage like on a gear that you need each threshold to happen.

Alie: Yeah, I mean, I imagine if I were just born a baby in a forest somewhere, there is no way I would be able to A) take care of myself or figure out any of this. So, we're always building on whatever we were left from the last generation, right?

Ellery: Yeah. I mean, there's even a line in one of *The Hitchhiker's Guide to the Galaxy* where the main human character finds himself on a primitive planet that doesn't have technology and he thinks, "I am going to rule them like a God. I, modern human, knower of technology," that Arthur realized he could barely make himself toast, let alone a toaster. So yeah, exactly, you innovate within, kind of, the *zeitgeist* around you and build up on what knowledge has existed before. Humans are also precocious, too. We kind of tinker and that's how there can be multiple places where something like farming can be invented around the world.

Alie: What exactly do they call that, when something's concurrent like that? I forget, there's a word for it.

Aside: Okay, so I looked it up and this phenomenon of concurrent ideation manifests in a sort of cinematic, convergent evolution called... Twin films. So, think: *Armageddon* and *Deep Impact*; *Volcano* and *Dante's Peak*; *Friends with Benefits* and *No Strings Attached*; *The Addams Family* and *The Munsters*; and dueling documentaries about bougie island shitshows, which is a whole different field of Fyre Festival research.

Alie: There's like a word for it when it comes to two screenplays being made at the same time. [*"We're twins." "That's right."*] It's just sort of by happenstance.

Ellery: Yeah exactly, exactly. So yeah, you get that so that farming can be invented in different places, or pottery can be invented in different places. That's always the challenge too. And where we have to start worrying about how well we know the ages of sites to start answering questions like, was the use of fire invented in one place and then it spread from there? (The knowledge of it, not the fire.) Or were there multiple inventions throughout time that early people just kind of, figured this out, and there were multiple nuclei where these sorts of innovations happened?

Alie: Well, how do you think our ancestors first started to create the fire rather than just control it? Do we think it was just a flint and steel? Or was it rubbing two sticks together vigorously? When I watch *Naked and Afraid*, [*"We need to collect a whole lot of wood in a hurry. We cannot lose this fire or we're gonna be right back where we started."*] I'm like, "How did people figure this out, a million years ago?"

Ellery: [*laughs*] Yeah, so that, again, is a fantastic question. And it's hard to have the material evidence that, as archaeologists, we like to have. I mean, one of the oldest fire-starting kits we have is, again, for most of the times we're talking about are fairly recent... But Ötzi the Iceman, so the Bronze Age man who fell into a glacier in the Alps and then was discovered in the '90s. He had a fire-starting kit on him, along with a lot of other accouterments. But he had a piece of Pyrite, so iron sulfide, something that, again, you could free an iron atom from and get a spark; he had plenty of stone tools; and then he also had some really fluffy fungi that was probably for starting the fire, for getting it going.

So, probably something like this... There's been work done looking at what's called use-wear, or marks from if you were to strike a piece of that Pyrite against a stone tool, would it

leave a mark, gauge, or a scratch? Or, if you were doing this on a stone tool, do you see marks on, like, not the business cutting edge? And so, there's been some work done on what are called Acheulean hand-axes or bifaces; they're these lovely, very symmetrical, teardrop-shaped, or pear-shaped stone tools that were the height of technology at the time. And if you look on not-the-cutting edge, in a few places it looks like there might have been... like the middle of it was scratched with Pyrite.

Aside: Okay, so if this French ancient axe sounds familiar, we touched on them in the Atlatl episode. They appeared about 1.5 million years ago and they remained in fashion for about a million years. Archaeologists think that these really simple teardrop-shaped whackers may have played a role in seducing your hairy great, great, great, great, great grandparents, nearly half a million years ago, according to papers like the 1999 study, "Handaxes, products of sexual selection?" which was published in the journal, *Antiquity*.

So, some of these Acheulean stone axes are carved in a way to feature a fossil right in the center of the axe, pretty much like an ornamental choice, like a bedazzling of some kind. And some axes are so large and unwieldy, they seem to defy any utilitarian function, like a Hummer with expensive rims, in the middle of New York City. So, like a flashy car, anthropologists think that these hand axes could have signaled viability as a partner. Like, "This person must have resources and skill, cognitive ability if they're knapping rocks so well, pretty okay eyeballs, you know... that function." Leading a mate to think, "That's a sweet axe and I would definitely like to do the nasty with you."

So, fast forward to now, when horny human apes wear Axe body spray and still offer up very carefully faceted rocks as proof of their value as a mate. I mean, have we really even changed that much? Isn't that cute? And kinda gross? But yes, from these stones' role in matchmaking to match... making.

Ellery: Part of the problem is that Pyrite is not really that stable of a mineral over great time periods and so it can break down. So, there's not to my knowledge been an instance, from Paleolithic, of again, these lovely hand-axes being found with Pyrite chunks. But that's kind of one of the operating hypotheses of what could have been the source of heat.

Alie: Yeah, they weren't going to REI and just getting some waterproof matches.

Ellery: Right, yeah, exactly.

Alie: [laughs] But what about fire and how it changed the way we evolved? Did we develop bigger brains because we started cooking meat?

Ellery: That's certainly one of the hypotheses, yeah. This has been argued, that going back to the species of early humans called *Homo erectus* that 1.8 million years ago, suddenly, our brains started... And again, by 'our', I realize I've called myself a *Homo erectus* there. [Alie laughs] But one thing you'll find that I always have to tell my students, is that if I'm talking about *Homo erectus* or Neanderthals or Denisovans, they're all people to me. So, "Neanderthals are people too," I tell them. [Alie laughs]

Our direct ancestors, *Homo erectus*, that the brains got larger and... Again, none of the soft bits have been preserved so, when we're saying brains got larger, we're looking at the size of inside the skull. And some of the people who study bones in much greater detail than I ever have, have suggested that there's also some structural indications that maybe the intestinal system got a bit different as well. So, the hypothesis was that this change seemed to correlate perhaps with, or a potential mechanism for it was, the use of fire to cook.

There was a book that came out a few years ago, a primate specialist had hypothesized that fire was even responsible for shifting our even deeper time ancestors back to being daytime instead of nocturnal, that we were diurnal instead. They kind of expanded our day and it had an effect on the melatonin in our brains, and so forth. Again, it's an interesting idea. I don't think I buy it in terms of the mechanisms, but the main thing is that it shifts fire so far back that there's really no way to even test whether we were using fire then. It was just kind of an explanation of, "Maybe fire was responsible for us becoming diurnal..."

Aside: But it's so far back, nobody really knows. Because piecing together our history is really like the murkiest prequel of *The Hangover* film franchise, but with, I guess, more dried mud and some isotope tracing... Still some tigers though.

Ellery: It can be a campfire story, that's absolutely what you have. There's ideas about the social lives of early humans. There was a study that came out, again, several years ago, by a famous anthropologist, Polly Wiessner, who had spent a lot of time among the San people in the African bush; so, talking about Namibia, Botswana, and so forth. These are people who to some extent still practice hunting and gathering today. And she observed that when they were gathered around a fire during the day, it was talk about business and, you know, subsistence and that sort of thing. But when there was a fire at night, that's when they were shootin' the shit and just socializing.

Alie: Aha, wow.

Ellery: And again, that's a really interesting idea but we're also... We have to be very, very careful when we're extrapolating from modern people, who are just as modern as you and I, to human ancestors. We can't suggest that hunter-gatherers operating in a modern world are somehow a snapshot of the distant past. If it's inspiring us to think about these things, that's great.

Alie: Have researchers looked into, like, oxytocin levels at all, while you're looking at a campfire? Is there something that is comforting innately to us, even though fire is dangerous?

Ellery: I don't know about that specifically, that's a really good question. But I'd agree there is that kind of satisfaction of it as well. "Is that something like, inherently biological and controlled by hormones," is a really good question. Or if it's something we're essentially conditioned to do. You know, would a baby who hasn't been raised around campfires find this comforting or terrifying?

Aside: Okay, so if you would like some science to explain why you love campfires, I will point you toward the 2014 paper, "Hearth and Campfire Influences on Arterial Blood Pressure: Defraying the Costs of the Social Brain through Fireside Relaxation." Which explains:

Fires involve flickering light, crackling sounds, warmth, and a distinctive smell. For early humans, fire likely extended the day, provided heat, helped with hunting, warded off predators and insects, illuminated dark places, and facilitated cooking. Campfires also may have provided social nexus and relaxation effects that could have enhanced prosocial behavior.

So, this study took 226 subjects and measured their blood pressure, and then they randomly put some people in front of a control image, while others got video of a campfire with the sound down, and other subjects got the full pop and crackle treatment too. So, what happened? Researchers found consistent blood pressure decreases in the fire-with-sound folks; particularly with a longer duration of gazing at the video. And on my website, I

have linked a YouTube that offers 12 hours of free yule log action so you can relax without worrying about a forest fire or having your hair smell like beef jerky.

Alie: What about the importance of cooking food and avoiding parasites? At some point did we learn how to boil water? How has fire contributed to our actual living longer?

Ellery: Yeah, that's a great question. There is some evidence for boiling as being kind of like... Pits in the ground being more the first instance of cooking in like a pot, over a campfire. Again, that's a very recent innovation. In terms of living longer, in a certain way, evolution doesn't care about it that much. [*both laugh*]

Alie: They're like, "You make babies or not? Okay, get out of here, you're done."

Ellery: Yeah, exactly. So, for a Neanderthal, you and I are of a good old age.

Alie: So old. Oh god. Oh, we're fossils. Can you imagine, they're like, "Whaaat? Gray hair? What is it?"

Ellery: Yeah, I did have to just explain this to my students a week or two ago when I showed them replica Neanderthal bones from an old man who was probably around 45, right? So, in a certain way, it doesn't matter in terms of living longer. But even in terms of, like, pest control or something like that in a cave, if you're trying to avoid getting bit by a bat, you could potentially use fire as a way to clear out bats and mice or something like that from a cave. So, there certainly are potential health aspects that, deep in the past, that using fire as a tool could have assisted with. Do I think that humans figured out, like, "If you boil water, it gets rid of the germs"? No, I don't think that was at all on anyone's minds.

Alie: What about your fieldwork? What does that look like? And are you ever gathered around a campfire while you're doing research on Pyrotechnology?

Ellery: In Armenia, there's definitely... A celebration is usually marked with what's called a *khorovats*, which is like a pit barbecue. So, anytime there's a good reason to celebrate, whether it's the end of the season, or it's Tuesday, or just whatever, it involves a big coal pit and cooking meat over it. So, definitely there's that aspect involved in it.

What fieldwork can be like... We kind of move site to site in different years. Sometimes it means spending a month in an Armenian mountain village that's literally the end of the road and has the most spectacular night skies you can imagine. And we have people from all over the world who are specialists in various components.

So, maybe I'm trying to analyze the stone tools and figure out where they came from while someone else is looking at the tiny mammal bones that might have burrowed into the site and died. Other people are looking at the sediments, other people are spending all their time digging, other people are doing all the logistics, and so forth. So, it's a big team that sometimes you can have six different languages spoken and you might need to go between two or three people to get the right word from one language to another. You have to get along with people that you're going to hang out with for several weeks. I'm interested in where potential sources of raw stone might have come from as a way to start tracing how people were moving across the landscape.

Alie: How do you even find those sites? Because I feel like I could just go on a hike right over an old, say, campfire site or stone tool building site, and just not even know.

Ellery: Yeah. I mean, sometimes sites are just visible on the surface. And it doesn't mean necessarily that they've always been exposed on the surface. They could have been

unburied as material erodes away, whether by water or just by wind, especially in a desert. Other times, if we are looking for very old sites, we try to find exposures on the landscape where we know that they are old. So, this is one of the advantages of working in Armenia, is that there are a lot of volcanoes there.

Alie: Woah!

Ellery: So, Armenia is twice the size of Connecticut but has 500 volcanoes.

Alie: What?! Oh my god Armenia, that's amazing!

Ellery: Yeah, they're not all active...

Alie: But still!

Ellery: But they have erupted throughout the time periods we're interested in. I tell my students, imagine Connecticut but with it 250 volcanoes.

Alie: Bananas!

Ellery: Right. So, we get these lava flows all over the place and they've also trapped other sediments between them. So, if we can date the lava flows, which is fairly straightforward for geologists to do, then we know what time period we're kind of looking at when we go to certain areas where it's exposed. What we like to do is especially go to these gorges that have been cut deep into all these past lava flows. So, we can literally see lava flows sandwiched on top of each other and sometimes they have sediments between them. [*"Sandwiches." "I know."*]

And obviously, if they're sandwiched between them, we know that they have to be older than the lava flow on top and younger than the lava flow beneath them. So, we can know that, okay, whatever is in here, hopefully there's stone tools in there, it's between this 440,000-year-old lava flow underneath and between a 200,000-year-old lava flow on top. [*Alie laughs*]

So, the idea is not to just go out and hopefully stumble across things but the more you can find sediments or geological features that you know correspond to certain points in time, the better. And that's why there's exciting things happening in East Africa where there's this continental rift. When you're talking about all these interesting finds of human ancestors there, they're working in areas that they know the sediments are, X number of years old, rather than just, you know, going out randomly.

Aside: So, rather than just hike all over the place and cross their fingers, pyrotechnologists go to sites that have rough timelines established and see what's there to get an estimate and then backtrack. So, these are time capsules made of hardened lava, revealing how you came to be an animal who uses dental floss and drives a machine now. It's bananas.

Alie: Is it ever weird for you that you're using things like microscopy and all kinds of, like, magnetic detection and, in a sense, using a very controlled source of energy to try to find out how fire was used and how energy was harnessed in the past?

Ellery: Yeah, all the time. All the time. So, I mean two examples of how this crosses your mind is, again, going out into the field... For one of the flights to Armenia, I had a middle seat. So, I'm grumbling to myself, "I've got a middle seat, this is gonna stink for the rest of this flight." And then I'm like, "I'm talking about which seat in a *flying machine*, to take my *X-ray gun* over the ocean to go study people that lived in *caves*." [*Alie laughs*]

Another time kind of occurs just, how absurd this is... Again, I work at Yale so we get these email announcements of all the fantastic things being done on campus. So, there will be, like, an announcement of some new quantum computing advance at Yale. Or some modeling of COVID vaccine stuff and I'm like, "I study dead people's trash."

Alie: *[laughs]* But archaeologists really are expert trash-diggers, right?

Ellery: Yeah, yeah that's usually what we're talking about, is the trash that people leave behind and how that represents what was done. You're trying to figure out, from trash that has survived, has potentially been moved around by all sorts of geological and natural forces and animals picking through it and all that sort of stuff, what were people doing in the past?

Alie: Over all of your research, do people ever ask you, "What is the best way to construct a fire?" Is it leaning everything together in a triangle shape? Or is it stacking like a log cabin?

Ellery: Yeah. See, everyone at the party expects me to be the fire tender. *[both laugh]* "Oh Ellery, keep an eye on the fire pit." And, naturally, I usually pass it off to my kids like, "Yeah, just poke at it a bit."

Alie: *[laughs]* Dr. Fire... "Meh, I've got an apprentice."

Ellery: Yeah, yeah. Or I'll occasionally say, "I should have some sort of really cool firing pit in the backyard or something like that." And my wife will be like, "Let's get the house painted first. Finish that job before you start building a kiln in the backyard."

Alie: *[laughs]* Right. Can I fire away with a lot of questions from a lightning round, from listeners?

Ellery: Yes, please do.

Alie: Okay. Ugh, we have so many questions.

Aside: Okay, and just to follow up, what kind of fire you make depends on what you're doing. For long-lasting campfires, the log cabin method might be the best; but for cooking on skewers, roasting stuff on a stick, you might want to lean logs into each other. But either way, make sure you're observing forest ranger cautions and that you are extinguishing things well before you leave. So, listen to the Fire Ecology episodes for more on that.

And before your questions, let's shower a worthy cause with our advertising dollars. So, Ellery asks that a donation be made to ArmeniaFund.org, which does all kinds of humanitarian aid, infrastructure, and sustainability projects, and covers health and medical needs in Armenia. And that donation was made possible by our sponsors.

[Ad break]

Okay, your burning questions.

Alie: Gwenyth Greco wants to know: Have any other animals (outside of primates) developed the ability to create fire?

Ellery: No, no. We don't have any instances of fire creators. You did have, I think, with either... I think it was when you had Gavin Jones on that you talked about the Australian hawks that can spread fire...

Alie: Yes, yes!

Aside: Again, more on this in the Fire Ecology episode and in Corina Newsome's, Wildlife Ecology episodes... Because arson birds.... Somebody needs to make some twin movies about them.

Ellery: ...and use it kind of for hunting. But yeah, producing fire, no.

And that's been one of the ways that we've conceptualized this as something uniquely human. If you go back to the 1940s, you'll see the archaeology books titled like, [*old timey voice*] *Man, The Hunter*. And obviously, other animals hunt. Then it became, man, again, humankind, not man... Humankind, the tool user. And then we realized like, octopi can use tools and crows can use tools. Now, we're the *toolmaker*. We're getting very, very specific. But one thing that is still unique to our species is fire production.

There is a very good short story written by sci-fi/fantasy writer Terry Bisson, called "Bears Discover Fire." [*laughs*] And so, it's like, how screwed humans are when bears discover how to make fire. But yes, so far, we're the only fire producers and really, with the very little exception of those hawks in Australia, the only real documented instance of fire users, outside of training chimps to smoke cigarettes and stuff like that. [*"That's not okay."*]

Alie: Well, Ryan Fischer, patron, wrote in and said: If you haven't yet, read the sci-fi short story, "Bears Discover Fire."

Ellery: Exactly, exactly, thank you.

Alie: So, Ryan Fischer's on that tip.

Ellery: On point Ryan.

Alie: Yes. Aven wrote in: What's the best way to start a fire? Doritos? Dryer lint? What historically did people use as kindling? You mentioned a fluffy fungus.

Ellery: Yeah, yeah. So, any sort of light, fluffy, wooded plant material or something like that will start. Because, again, going back to your elementary school, "the three parts of fire," you need a lot of the oxygen to get to it. Like we were saying with Ötzi, it was kind of this fluffy... Seems to be like a fungus, that would start easily.

Aside: So, in case you're ever in a survival situation, look for Hoof fungus or a mushroom called King Alfred's Cakes, also known as Cramp Balls; they look like balls of coal, or horse poop. But you gotta really dry them out. Are you not hungry now? Incinerate your snacks. Doritos are a proven kindling; just enough oil and dust to sustain your flames. Although, I don't know, Flaming Hot Cheetos seems like a natural contender, I don't know if anyone's ever gone down that road, scientifically.

But also, you could bring along some dryer lint, you can dig some lint out of your belly crevasse; or some campers take a few cotton pads and soak them in either petroleum jelly or hand sanitizer, which is mostly alcohol. And then boom, you just have lighter fluid, in a pinch. Our ancestors would be so proud, and also confused why we are burning food... to make food.

Alie: Abigail Bishop wants to know, first-time question-asker: Have there ever been any human civilizations that have not had fire? How do you research who *didn't* have something?

Ellery: Yeah, this has come up before because, again, I kind of controversially refer to humans as, "obligate fire users" at one time. And someone did come back to me and said, "Well, there was this one missionary, or European explorer account, on this one island... These people didn't have fire," or something like that. I think it's also been... Other people came back and

said like, “No, that’s a really dodgy account.” Or probably what it meant was they just didn’t start fire on demand, when the missionary demanded it. So, with that, like, one really dodgy, probably kind of racist account, no, there’s no real good evidence for human groups who have not had fire.

There is a big debate when you start getting to early humans of: could Neanderthals start fire? Or were they just fire users? And those people would argue that it took modern humans, us, to be able to be on-demand fire users. But once you get to modern humans, we’re pretty much solidly in that technology.

Alie: Aha. Well, let’s talk caves. Chelsea McCann, says: The speleology (cave exploring) society that I belong to, always told us to look up when in new caverns, looking for smoke and soot spots on the roof. If we found any, we called in the archeoanthropolgy team because it was probably inhabited or visited by Indigenous people. Can these soot spots be dated to find out how long ago the fire in them burned?

Ellery: So, the soot, potentially. The soot probably has carbon in it so, if we are talking within... So, if your listener is in the United States or in the Americas, then radiocarbon dating works fine. Because radiocarbon dating is good back to 40 or 50 thousand years ago. So, any archaeological sites that we know of and are uncontroversial in the Americas, radiocarbon dating will work.

Aside: If you’re like, “I’m no anthropologist, when was that?” Well, scientists think folks crossed the land bridge from Siberia to the Alaska area now in the Stone Age. Maybe 13,000 years ago. But that’s been debated because older sites – one nearly 16,000 years old, another in central Mexico – dating back 33,000 years have been discovered. But my point is, this did not happen in 1492. Nobody discovered shit that year. This land had been populated for millennia.

Alie: Rebekah Weinzetl wants to know if there’s a link between humans making campfires and domesticating dogs. Is that a thing?

Ellery: It’s kiiind of a thing. [*Alie laughs*] Yeah, dog domestication has been, again, one of these interesting issues of, when it happened, and was it something that only modern humans did, and it maybe gave them an advantage over Neanderthals, and so forth? We’re probably into enough of kind of like, that fuzzy range of how well sites are dated to be able to know that sort of thing.

Definitely, the only thing I can directly speak to, in terms of the sites where I’ve worked with my fantastic colleagues, is that one of them—at an upper Paleolithic site, so this is a fancy way of saying, “making stone tools that modern humans make,” just before the last ice age—there was a wolf skull recovered and it didn’t have any of the morphology of domestication yet.

Aside: See a wolf’s dorsal skull crest, which acts as an anchor point for its gnashing jaw muscles. Or, the bulbous foreheads of Shih Tzu mixes, like my dog Gremlin, her skull probably looks like a softball and an anglerfish mated. But yes, wolves, not dogs, you can see the Lupinology episode for more on that.

Ellery: There were hearths, the archaeology word for campfires, inside the cave and there was a wolf presence but not domesticated. This is especially hard to investigate because, in certain places, wolves and early humans are going to occupy a similar ecological niche and use caves. So, it might be that in one season Neanderthals or modern humans were there, and in another season, wolves were there using the cave too. So, even if we found wolf

bones or wolves that looked like they were starting to get domesticated, it can be hard to say that they were there concurrently with the earlier modern humans.

Alie: Mm-hm, could've been just one after the other.

Ellery: Yeah, exactly, or alternating. You know, just every spring the humans were there, every fall the wolves were there, something like that. You don't want to be there at the same time as the wolves.

Alie: They got sucked into the same timeshare presentation and now archaeologists are like, "I don't know who was here when," pretty much.

Ellery: Exactly, yeah. Same thing with bears, or hyenas are a big thing. Is that... What's pulled into a cave by hyenas, including sometimes Neanderthals and ancient humans, can really get blurred. So, sometimes a cave might have been occupied, like, overnight by humans, right? So, the time spans that we're dealing with compared to the reality of how long a particular group might have been in a cave or an open campsite is one of the things we need to keep in mind of the vastly different timespans we're talking about.

Alie: And do you have a few more minutes to answer a few more questions?

Ellery: Absolutely.

Alie: Oh my gosh, I'm so sorry I was so late. Literally, there was a marching band practicing across the street for, like, an hour and a half.

Ellery: No, my students will tell you, I will just talk if you don't stop me.

Alie: Oh no, this is great because I have a couple more questions.

Ellery: Yeah, go for it, as many as you want.

Alie: Yay! Okay, so speaking of caves, Natasha Bharj asked: I saw a video of an archaeologist showing how cave paintings were made with the use of firelight and shadows in mind.

[clip from video] "And there's another thing; today, we see cave art with electric lights, but the ancients saw it under flickering candlelight. And I think under the light of a flickering flame, it augments the animation effect."

Is that flimflam or not? Are there any other ways that early civilizations may have used fire to create art?

Ellery: Oh yeah, this is a great question. Yeah, I mean, pigments can change color when exposed to fire. So, these kind of, what's called ochre or these iron oxides, they can be made more reddish, yellowish, or blackish. So, potentially the colors can change. Certainly, there are a lot of cave paintings beyond where sunlight would ever reach. So, certainly if they were going to see what they were doing in there it would have been either a handheld torch or a hearth in the middle or something like that. So, absolutely that's the light source that you would have done that within.

Now, were they taking this to the level of Plato's analogy of the cave shadows? Maybe not, but certainly if that's the light source compared to the headlamp of a spelunker, or something like that, you know, it's worth interpreting it in that sort of way.

And also, there are minerals that can sparkle and stuff like that; engage in light, sparkling micas can shimmer and stuff like that. So, certainly interplay with light, I would imagine that would be an important aspect of what they're doing if they're that deep into a cave.

Alie: Mm-hm. I feel like that goes along with one question from Davis Born that just says: Why does the person across from you always look so attractive? I guess everything's just prettier in firelight.

Ellery: Or the carbon monoxide, one of...

Alie: *[laughs]* That's a good point. Was that ever an issue?

Ellery: Potentially. Probably they were okay. Again, we're not talking about large groups necessarily, especially with Neanderthals.

Aside: Okay, this next one was asked by Coral Taylor, Lauren King, and Nikademus Cuellar.

Alie: Well, a few people asked about Have-Fire-Will-Travel. And Coral Taylor said: I've read that earlier humans would have a fire starter kit, often including a live ember or coal. How did they keep a live ember on their person without burning themselves or their items but not putting it out? And Lauren King wants to hear about how communities have transported fire throughout the ages. And Nikademus Cuellar asked if the advent of fire usage coincided with the expansion of people into areas previously less habitable? Were we on the move because of fire?

Ellery: Okay, so yeah. First, with carrying fire. Yes, that seems to have been a practice that we can see, certainly among Native peoples of the Americas when Europeans first encountered them as being, essentially, in a wooden carved, wooden container; having some sort of slow-burning ember, that had just enough oxygen to keep going, but not so much it's going to flare up and burn everything. So, certainly, carrying of coals... Think of the slow burn of charcoal just being able to be carried in some sort of container, gourd, or something like that.

Aside: Or as the Piikani people, part of the Blackfoot Confederacy of the Western Plains, devised, a buffalo horn, expertly stuffed with a genius parfait of moss, hardwood, softwood, and rawhide that held fire to take from one camp to the next, as a symbol of home and continuity. So, I will link a video about it on my website as elder Marvin Weatherwax, explains it way better than my travel candle in a weird hotel room. But it's a similar sentiment, perhaps.

Ellery: So, certainly there is definitely evidence amongst modern humans of carrying embers around, absolutely. And then the other question was, did it make areas more inhabitable? Again, absolutely, I would say. This is one of the reasons that fire use can be inferred in some areas because we're also talking, not just about space, but this is deep time, so we're talking multiple, multiple ice ages. We tend to think of "The Ice Age" as 15,000-ish, 20,000-ish years ago but there are multiple, multiple glacial cycles.

Especially in Europe, Neanderthals had to survive all of these glacial periods. It's one of the reasons we think that they probably, at the very least, had furs for blankets, or something like that and perhaps even basic clothing, just to be able to survive in these, would otherwise be uninhabitable in terms of cold, areas. It does pose the challenge, again, if you're up in a mountainous area during an ice age, you had to worry about your fuel source as well. Wood is heavy. So, you can't move into an area where it's cold and there's no wood around to burn, or something like that.

Alie: Yeah, it would be like driving your car somewhere without a gas station, or something.

Ellery: Yeah, exactly. There's tradeoffs to doing it. So, the great thing about fire is it keeps you warm and safe to some extent and whatnot. But it's also a lot of work to get the wood,

chop it up as best you can, and then get the fire going. So, in the past, one would also play that in mind, of what's the easiest thing to do.

Alie: Yeah. Speaking of things that are not easy, Madelaine wants to know: How the heck do people walk through fire?

I don't imagine any one of us know anything about that though, right?

Ellery: Well, see this is where the physics undergrad degree comes in handy. [*Alie laughs*] So, we actually learned this in physics class.

Alie: Oh my god.

Ellery: Basically what's happening is, I hate to say it but, your feet are sweaty; especially if you're very nervous about having to walk across hot coals. Literally what's happening is, the sweat on your feet is turning into a gas [*Alie gasps*] as it's hitting the hot coals and you've got this microscopic layer of vaporized sweat, basically, steam, that's between you and the fire.

Alie: Oh, my gosh. How fast do you have to walk? Do you have to just run across it?

Ellery: That's what it always seems like in the movies, I don't know from personal experience. [*Alie laughs*]

Aside: Listen, I'm not going to drag you into the deep rabbit hole/fire pit of my research on Tony Robbins seminars that involve walking through hot coals as a way to change your mindset on what's possible. But I will tell you that thousands of people have walked over glowing embers in parking lots of convention centers as he bellows into a headset mic about destiny. And no, he didn't invent this, it's a religious practice in some parts of the world like Singapore. And yes, sometimes scores of people have minor burns on their feet at his, "Unleash the Power Within" events. And it seems they're becoming more common as time goes on because people stop to take selfies as they firewalk and that really botches the physics of it.

But I will tell you, I could not stop myself from watching Oprah stomp herself over a track of fire nuggets through sheer will and affirmations. But I'm gonna hand it to Tony for the addition of a moist patch of lawn that he starts folks on.

[clip of Tony Robbins video:]

[crowd continually cheering "Yes! Yes! Yes!" in background]

Tony: What's the worst that's gonna happen? Burn your feet off and die? Come on! Step up on the grass first. Okay, I want you to make a move as strong as you've ever been in your life, just scream, "Yes," I want you to do it three times. Your eyes stay up, you storm across. Make a move, scream "Yes" as hard and strong as you can.

[music swells in background]

Man: Yes! Yes! Yes! [screams]

Tony: That's it! You got it!

Hey man, if coals lead to goals, you do you. But just... You gotta step on the wet grass first.

Alie: Mike Monikowski wants to know: What ancient fire-starting method surprised you? For me, it was the fire piston.

I don't even know what a fire piston is. But anything surprise you?

Ellery: Umm... When I first heard about the Pyrite, I was suspicious. Because again, going as a camper as a kid, we always had the flint in steel or something like that. I didn't know if it would work; my skeptical hat went on there. You'll hear about fire-starting ideas, but most are from really dodgy accounts in historical sources or something like that. I haven't encountered anything yet that has made me, just, slack-jawed.

Aside: How about the invention of S'mores? Several of you patrons, Justin So, Maggie Kinney, Jess Swann, Schmitt Thompson, wanted to know: Are they a gift from the gods to apologize for periods and farts and stuff? No, I looked into it and S'mores were likely invented by Loretta Scott Crew. The first-ever recipe was published in 1927, in a recreational guide titled, "Tramping and Trailing with the Girl Scouts".

Also, you should know that Graham crackers were invented by Sylvester Graham, a devoutly religious Presbyterian, who thought that eating vegetables and bland wheat germ crackers was the best way to stop being so fucking horny. Little did he know that a century later, fireside S'more roasting parties would rise in popularity as places to meet someone to flirt with. So, thank a loner with a boner for your favorite campwich.

Speaking of scrumptious riddles, patron Ethan Bottone asks: What's the tastiest thing you have roasted over campfire? And Bálint Novák asked why toasted things are the best things? And Anna Diewiger asks: What's the most unique food you've ever roasted over a campfire?

Alie: Allison D. wants to know if you have any ancient recipes that you have heard of, of cooking over a fire, that have stuck with you?" Why is the Maillard reaction so delicious?

Ellery: I would say, something that has stuck with me, partly because it did not sound terribly appealing, was these instances where it seems like there's essentially a bowl-shaped depression carved out of the ground, it was maybe lined with some sort of clay substance, and then water was boiled in it to help get the marrow in the bones to kind of ooze out. I picture this as some sort of like, ancient, horrible... Jell-O, concoction.

Alie: *[laughs]* Just meat Jell-O.

Ellery: Just meat Jell-O, yeah. So, that has stuck with me as... Yeah. When occasionally people, you know, fantasize about, "I wish I was a caveman." And I'm like, "No..."

Alie: Mm, gritty meat Jell-O.

Ellery: "I've seen what they do."

Alie: *[laughs]* You enjoy the flight in the middle seat all the more. If they served you gritty sandy meat Jell-O on the flight, people would be none too pleased, I imagine.

Ellery: Yeah, I mean a lot of the bones at some of these sites are just really, really broken up to get at that marrow. It's a really important food source, and I don't know if it was desirable in the past. Perhaps an acquired taste. But no, not high on my list of recipes.

Aside: Bone marrow, of course, is full of collagen and fats that can be great for us. We have it as bone broth, pho, ramen stock, soup, it's delicious. Sand and worms in any of the above and sipping it with my cupped, filthy hands. Uh, I'll pass. Let's steer the time machine to an orgy and disco-era Miami instead. Huh?

Alie: Karla Jerez asked: What is an often overseen, not many know about, type of effect that fire has had on humans?

Ellery: You have to think about even like, as a means of communication across the landscape with smoke signals around the world, and stuff like that. So, certainly a way to increase visibility on the landscape. Especially if you think about, potentially, how far apart small groups of hunter-gatherers would have been and how infrequently would they have encountered each other. So, that's of interest to me because that's the ultimate sort of questions that I'm looking at is, when you have an innovation, whether it's stone tool technology, whether it's fire technology, how would that sort of knowledge have spread from one group to another? And increasing your visibility on the landscape certainly would have been one way to more frequently encounter other groups.

Aside: What were people saying with smoke signals you ask? I asked the internet and billowing fires were used by cultures all over the world, they still are; you just pop some green wood on a fire to send a white puff into the sky. And while different configurations had different meanings between groups, the general smoke signal parlance is, one puff meant, "Attention." Two meant, "All is well, thumbs up." And three puffs of smoke or three fires in a line meant, "Danger. Trouble. Someone please come and help me." Zero puffs communicates, "Shoot I ran out of wood, can you bring some more wood?" Probably.

Alie: I mean, it's the first text message, I'm sure, ever sent.

Ellery: Yeah, I mean, think about... Again, you're living in a small group, probably just your extended family and it's like the holidays all the time. *[both laugh]* You don't see many other people that often. You definitely want to find someone else to date and go off and have babies with than, you know, this group that you're constantly with. You're just desperate to find other people and spread your genes around, to not-your-family.

Alie: Yes, yes. Hopefully someone who has a better recipe than the meat Jell-O. *[Ellery laughs]* Gritty, gritty, meat Jell-O. Amy Shuey, Ashleigh Butcher, and Ivelisse Sanchez, all want to know if you employ the saying, "I hate white rabbits." Does that ring a bell to you, at all?

Ellery: ...No?

Alie: Ahh! Even better. Well, consider this your most valuable archaeological tool.

Ellery: Yes, teach me, teach me. What is it?

Alie: Apparently... *[soft laugh]* If smoke from a campfire keeps blowing in your face and you say aloud, "I hate white rabbits," to stop the smoke, it will stop the smoke from blowing in your direction. I didn't know about it either. *[Ellery laughs]* But apparently, if smoke gets in your eyes just say aloud, "I hate white rabbits." Anyone out there at a campfire, you now know. You have a fix for that. Or wear goggles, I imagine.

Aside: PS, I looked into this and this tradition may have started with First Nation stories about smoke resembling white rabbits. But if this is a false legend, I'm sorry, I tried my best. Nobunny get mad at me. Okay?

Ellery: I have now been doomed to my kids trying this incessantly at the next fire that we are exposed to. So, thanks.

Alie: *[laughs]* You're welcs, you're welcs. And speaking of things that are not the best, smoke getting in your eyes. But as a Pyrotechnologist, as a card-carrying Yale researcher who can have a business card that says, "Pyrotechnologist," what thing sucks the most about what you do? What is the hardest part of your job? What is the most vexing? Anything you don't like?

Ellery: Anything I don't like... I mean, it's... One of the challenges in increasingly scientific archaeology and anthropology is you do have to go to deans and explain, "We're running science labs here." And when they see that... They've been extraordinarily receptive and supportive, but there is that kind of initial reaction of, "Oh you're an archaeologist, you need... pencils." [both laugh] And I'm like, "No, I need this X-ray gun. Two of them." But what's been good is when you can get the sort of technology in people's hands, suddenly they realize, "Oh, of course." Again, the nice thing about analytical tools that we can bring into the field with us, it means we can also carry them to the dean's office and say, "Here, try analyzing this stone tool." And by the end, they're like, "This is so cool. Absolutely you need this."

So yeah, sometimes, you know, running an increasingly scientific field in what's traditionally envisioned as a social science instead of a STEM field is probably, maybe, the biggest challenge of this job, but not insurmountable. It's a fun challenge and people have been really receptive to it.

Alie: What about the best? What do you love the most about being a Pyrotechnologist?

Ellery: I have great students. They keep me on my toes. I always want to do really well by these really smart people, who are always bringing me, kind of, new challenges or questions. I never quite know what aspect of ancient technology some student is going to latch onto and want help with. It might be that a student walks in like, "I want to study Shang dynasty bronzes," and I'm like, "Great, I know nothing about that!" [Alie laughs] But my job is not to know everything, it's to *not* know things and then figure out how to answer it. And so, then stepping the students through that process of like, "Here's how we can go about that process to figure this out," is a ton of fun. It's a ton of fun.

Alie: And you really are like a detective. Everything's a mystery.

Ellery: Yeah absolutely. Sherlock Holmes, he had the luxury of things happening days or weeks in advance. We've got to put a layer of hundreds of thousands of years on top of that and deal with, might be this or that. But yeah, I mean, every little bit of evidence, we're like ancient CSI. Usually, our holographic tables don't work as well as on TV.

Alie: [laughs] You gotta get more funding, man.

Ellery: Yeah, yeah.

So, ask dusty people your burning questions because from what I can tell they really do like being grilled. So, to learn more about Ellery's work, his [website](#) and [social media](#) is linked in the show notes. So is [ArmeniaFund.org](#). There's way more links and info up at [AlieWard.com/Ologies/Pyrotechnology](#). That is linked in the show notes. You can follow *Ologies* @Ologies on [Twitter](#) or [Instagram](#). I am [@AlieWard](#) on [both](#).

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And if you stick around until the end of the episode, I tell you a secret. And this morning, on my flight to Canada, I was eating these really good, some kind of gluten-free, chocolate, coconut, like oat, granola bars and they were so tasty, and I dunno what I was thinking but I offered the guy next to me one of them... Like they weren't even individually wrapped, I just had a bag of them, and I was like [*slurs*] "Youwantsomeofthese?" And he was like, "Why? No." And I was like, "I just thought they're so good." And then I felt crazy and I had to sit there for like two hours like, "Why did I have to offer this guy, who wasn't even looking in my direction, these weird oat balls? Why did I think that was a good idea?" But once, I asked a passenger next to me for a Sour Patch Kid and he gave me the whole rest of the bag, saying I was doing him a favor, and I cherished them. So, I don't know, you never know. Anyway, berbye.

Transcribed by Aveline Malek at TheWordary.com

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