

Paleontology Encore Presentation with Dr. Michael Habib

Ologies Podcast

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[2019 Alie] Oh heeey, it's that lady that tries to learn macramé and gives up after, like, four strings, Alie Ward, back with another episode of *Ologies*. So, y'all, this week was supposed to be Vexillology- Vexillology – urgh, I'll get it by next week – which is all about flags and I am just hip-deep in flags right now. I'm editing, researching, and writing this episode and I just wanted one more week with it because it turns out it's a very complex issue with a lot of history and a lot of context. And also, I'm gonna say it up top, happy 50th anniversary to my parents. They're celebrating it on August 31st, so I'm taking a chill week. I'm going to finish flags, it'll be up on Labor Day in America, Monday night of next week.

In the meantime, I'm giving you an encore presentation about dinosaurs. This is from the early days, so you guys, if you haven't listened to this dinosaur episode, it's one of my favorites. Listen to it while I go celebrate my parents' 50th anniversary. Very exciting. If you're like, "How did they make it to 50 years?" hit the Matrimoniology episode; we talk about it a little in that one.

Anyway, dinosaurs, we're going to get into it. I recorded this as one of the very very first *Ologies* episodes I ever did, this was before we even had a Patreon, before we even had Patron questions. I just took a mishmash of questions from people I knew and on Twitter, I think. There's a cameo in-studio from editor Steven Ray Morris who's a big dino fan. You know this from his *See Jurassic Right* podcast.

This remains one of my favorite factoid episodes ever. So, there are some facts in here that blew my mind, they still blow my mind, and if you haven't listened to it, you get kind of a look back at, perhaps, the fossil record of *Ologies* when I was first starting the podcast. I was editing it all myself using GarageBand, but I wanted to serve this one up to you because right now it's field season. There are paleontologists out there in the world – what's up Montana – digging up fossils, so I wanted to redeliver this one in case you haven't heard it or revisit it if you have. This is before I started calling myself – I think – your dad. This is before I had a secret at the end of episodes. So enjoy this antique episode of *Ologies* while I go eat Chinese food with my parents and hug them a lot, and I will be back next Monday night with the Vexillology, all about flags. It is a *doozy* of an episode and you guys are going to love it. So, enjoy. Okay, now onto the old intro.

[2017 Alie] I'm gonna be super, super honest with you. And this pains me to say because it's kind of a point of shame for me as a science enthusiast, but I don't really give a fuck about dinosaurs. At least I didn't for a long time. Flies, turtles, birds' nests, plants, I'm down with all of these because in my brain I'm like, "We share the planet with them. I can look at them. I can watch how they grow. I can look at what they eat, how they get it on." Dinosaurs were always the wing of the museum that I was like, "Eh, I dunno. I'm gonna go to the food court and eat a soft pretzel, but you enjoy."

So, don't judge me. I know people *looove* dinosaurs. People get crazy. And I read *Jurassic Park* in high school. I loved it. I was so into it that I was working at a stationery shop and I couldn't put it down. So much so that on my watch two ceramic bunnies were stolen and I was almost fired. So, whenever I think about Michael Crichton I say to him, "Hey dude. Nice work. Your book was so good it distracted me from someone putting two football-sized porcelain bunnies down their pants, or under their shirt or something." [clip from *Jurassic Park*: "There it is."]

What I loved about *Jurassic Park* was the dinosaur behavior. But I wasn't really all that stoked about fossilized bones. I just didn't connect with it, until last year. I went to this party that was kind of a science salon. And this week's guest stood up and he gave an informal talk about pterosaur wings. Suddenly I thought, "Okay, I think I get it," because I never really thought about dinosaurs in motion like that.

Also, side note for the truly self-congratulatory: You know that pterosaurs – the flying things like Pterri on *Pee-Wee's Playhouse* – are not actually dinosaurs. They're flying reptiles. I learned that this year, too. But paleontology isn't even the study of dinosaurs. It comes from *paleo*, which means old, and *onto*, meaning being. So, it's the study of old beings.

This guest sparked my interest in dinosaurs in a way that I never had before because the way he talks about them and how they move, really puts life to them. He's a Paleontologist and Research Associate in the Dinosaur Institute at the Natural History Museum of Los Angeles County. He's also an Assistant Professor of Anatomy at USC's Keck School of Medicine. So, he has two jobs. One of them involves people who are no longer alive. I know it's irrational and not super death positive, but I'm a little bit creeped out by cadavers. I'm just too sad about people dying. I want to hug them. I also want to run far away. I'm trying to get over it, but our guest is hella chill about it. He spends part of the day cutting up cadavers and part of it being a paleontologist. Please enjoy, Michael Habib.

Aside: Okay, so what is his deal?

Dr. Michael Habib: What's my deal? Well, you're right actually. I did cut up a cadaver this morning.

Alie Ward: Did you?!

Michael: Yes. Actually a few of them. That's how my mornings often start. We had 188 medical students in a room with 35 dead people.

Alie: Oh my god...

Michael: You get a good cup of coffee in the morning; you sit down and then you take apart a human being. So, that's my deal for about half the time. The other half of the time I go and play with dinosaurs.

Alie: There is a wrong way to take apart a cadaver, isn't there?

Michael: There are a *lot* of wrong ways, actually. There are more wrong ways than correct ways, as it turns out.

Alie: Now, you study movement of animals and that's kind of how you got into paleontology? Is paleontology only about fossils? Or is it just about living things of that era?

Michael: So, paleontology doesn't necessarily have to be about fossils, but historically it kind of was. It was considered to be the study of fossils, essentially. Although more literally it is just the study of life in the past. And you mostly do that through fossils. I am one of those paleontologists who does play with fossils.

Aside: Before we go much further, let's define super quick, what a fossil actually is. I didn't know this until just now. Fossils are any trace or remains – like a cast, an impression, or a substitution with rock or even the thing itself – of something that was once alive. They have to be at least 10,000 years old to be considered a fossil. I don't know what they're called if they're younger than that, to be honest. And the word fossil comes from the Latin for, 'obtained by digging', which is kind of adorable. I just picture

people digging around and being like, “I obtained this by digging! It’s a fossil!” Speaking of old things, Michael didn’t decide he wanted to be a paleontologist until later in life.

Michael: I declared at age four that I wanted to be a paleontologist.

Aside: Yeah, okay. Just kidding.

Alie: That’s an early proclamation!

Michael: I like getting in early. That gives me time to procrastinate.

Alie: *[laughs]* So, you waited from the age of four until what, 18 to enroll in college? That’s a lot of stalling.

Michael: It really was! There were all kinds of things that I wasted time doing in the interim such as growth and development. It’s very strange.

Alie: Right. Learning to use a fork.

Michael: Learning to use a fork, yeah.

Alie: Well, what happened at four when that declaration went down? When you were like, “Mom, Dad, sit down. I’m going to be a paleontologist.” Were you in a museum?

Michael: Oh yeah! Absolutely! We were in the Smithsonian Museum of Natural History.

Alie: You know what I told my parents I wanted to be when I was 3?

Aside: *[clip from old cassette tape]*

Alie’s Mom: And you, what do you want to be when you get big?

Baby Alie: A Porky Pig.

Alie’s Mom: A Porky Pig!? Alison Ward!

Porky Pig, side note, was a cartoon character who wore an open blazer with no shirt. He lacked pants.

Michael: There are probably museums for that, you never know.

Alie: It’s just called “Restaurants.” *[laughs]* So, what was your path like when you actually got into the study of it? How much education does it take to be a paleontologist?

Michael: You know, the answer is, it varies. Because it depends on, really, what you’re doing in paleontology, what kind of paleontologist you want to be.

Aside: In Michael’s case, from the time he set out to be a paleontologist, he finished kindergarten, grammar school, middle school, then high school. Then he got an undergraduate and master’s degree in biology, then another five years to get a PhD in functional anatomy.

Michael: And then off to join the “Real World,” which, if you’re a paleontologist who takes apart dead people for a living at a medical school, is not an accurate term. I don’t know what the real world is. I never played in it. I’ve seen it through windows. It looks scary. I’ve decided to avoid it for the time being.

Alie: So, you’ve never walked into an office every day in a tie.

Michael: I don’t think I’ve ever walked into an office in a tie.

Alie: Right. I'm still stuck on the fact that you spent your morning taking apart dead people. I know that we're here to talk about paleontology, but from the anatomy perspective, when did you go down the path of teaching anatomy? What is it like for you in terms of confronting mortality because, paleo: you're dealing with ancient things. Do you ever have any weird existential crises about death and impermanence or anything?

Michael: *[laughs]* I think I got most of those out of the way when I was young. I was a precocious youngster. And by that I mean I had lots of questions about mortality at an uncomfortable age. Or maybe it was uncomfortable for my parents. You know, if you want to be really good at vertebrate anatomy, the model system is basically humans.

Alie: It's like you know more about your car if it sucks because you have to fix it more. Do you know what I mean? I mean we tinker in the human body so much to fix it that it's like, "Well yeah."

Michael: Had those implants redone a few times...

Alie: *[laughs]*

Michael: We see some really interesting prostheses in the lab.

Alie: *[gasp!]* Oh, do you? I bet LA cadavers are pretty tight. I bet they still look pretty sharp.

Aside: I'm so sorry. The conversation accidentally went from automotive analogies back to the generous and probably very attractive people who have donated their bodies to science and the curious things Michael sees with body donors.

Michael: The type of implant that I saw most often...

Alie: Yes?

Michael: Penis implants.

Alie: NOOOOOOO!

Michael: Yeah.

Alie: Where?! More in LA?

Michael: It's about even between Baltimore and LA.

Alie: You. Are. Kidding me. Honestly, I did not know that was a thing.

Michael: We had one donor with one of the old models that were pumpable.

Alie: WOAH!! NOOOOOOO!!

Michael: Usually they're just silicone implants. But in any case... So yeah, we've seen lots of penis implants in the lab.

Alie: But this deep knowledge of anatomy informs your work as a paleontologist a lot. You tend to study a lot of wing movements of pterosaurs, which are *not* dinosaurs, technically.

Michael: That's true. So, yes, it's weird. The guy who makes doctors in the morning, studies pterosaur wings in the afternoon. Go figure. I've been called a physicist-in-denial by Caltech physicists, which I consider to be a compliment, particularly from that crowd.

Alie: That's some complimentary shade.

Michael: Yeah, exactly. I'll take that. I'm particularly interested in how these traits give you motion and how animals move around by taking what is really a pretty limited number of different kinds of materials to work with and making them do amazing things. We have enough trouble making high-performance aircraft, good sailplanes, and everything that can go hundreds of miles with fiberglass, carbon fiber, and all kinds of metals at our disposal. Animals only have a handful of materials, really, to work with.

For hard tissues, you basically got your bone and cartilages that can be reasonably stiff. Also enamels and a hand full of other things. Then a bunch of soft stuff that's basically the density of water and it gives you some really high-performance stuff. Some of the animals that we work on, some pterosaurs had wingspans of 10.5 meters. That's about 35 feet, wingtip to wingtip.

Alie: 35 feet!

Michael: Yeah! These things can kick ass and take names. These are powerful, flying, ground-launching badasses and they're doing it all with just the basics of vertebrate anatomy.

Alie: Do you have to study aeronautics as well as physiology to try to determine how that would give a pterosaur the ability to fly?

Michael: So, I do have a joint background in fluid dynamics.

Aside: Which is the study of how fluids move. Just five minutes ago I learned that fluids are not just liquids. Fluids are anything that has no fixed shape and yields to external pressure, which totally changes the meaning of bodily fluids for me. They could be a liquid or a gas.

Let's change the subject.

Alie: Do paleontologists love puzzles? As someone who has to put bone fragments back together, do you like puzzles or do you hate them?

Michael: I love puzzles. A lot of paleontologists love puzzles. I'm not sure that they all do. I think for some paleontologists it probably feels like taking your work home with you. You know, you get home – I don't have any kids, but I can imagine some that do – and their kid's like, "Hey you want to build this puzzle with me?" And they're like, "Oh god!"

Alie: What amount of time do you spend in the field as a paleontologist and how much is that back in the lab, or looking at spreadsheets, or measuring a fossil's density and stuff?

Michael: In terms of how much of the year I'm in the field, it's a good chunk of the summer. That's usually when I do all my fieldwork. So, basically July and August, a good bit of it, I'll be in the field, mostly in New Mexico.

Alie: Was that a titanosaur?

Michael: That's the titanosaur project, yeah.

Alie: Can you reveal what you're working on with that?

Michael: Sure! Obviously, you excavate whatever you find. It's not like you went out there saying, "We're gonna find a titanosaur." Actually, we kind of went out there going, "I really, kind of, hope we *don't* find a titanosaur."

Alie: Really?

Michael: I mean, we were being glib about it, which is what makes it funny. But there was a part of us that was like, “I really hope we don’t find anything super huge because then we’ll feel compelled to excavate it and it’s going to take forever.” And of course, what we found was *two* individuals of the group that includes the largest land animals of all time.

Alie: *[laughs]* Oh my god!

Michael: In fact, one of our specimens may be the largest dinosaur from North America. Maybe.

Alie: That’s huge! Literally!

Michael: These are animals that... a mid-size titanosaur is, like, 30 tons plus. And the big ones are 60 tons plus.

Alie: How many feet?

Michael: The big guys, you’re looking at a 100 feet-ish.

Alie: Woah! How many times bigger than an elephant are these guys?

Michael: A big, bull African elephant, which would be the largest living land animal, I think the record is 6.2 tons or something like that. The average is more like five and change. So, if a big titanosaur is regularly hitting 60, that’s 12 times.

Aside: So, these titanosaurs are like if 12 elephants were stacked under one giant overcoat and pretended to be a person. *[warped]* That’s so huge!

Alie: This is so exciting! I’m sweating! So, what happened when you’re in the field and someone’s like, “Ohhh, we’ve got a bone over here.” What is that moment like?

Michael: Well, it depends on what the bone is. In the case of the titanosaur project, we saw some bone in the hill and our first thought was, “Oh, that looks really exciting.” We saw some interesting morphology and we could tell it, what we call, pneumatizes. We could tell the animal had all of these air sacs in it. And we were thinking, “Oh cool, that could be like a big predatory dinosaur,” because they had a lot of air sacs in their bones, too. We started excavating around it and we’re like, “This doesn’t really look like it would fit. What could this be?”

You think it’s... because this is a pretty big element going into the hill and you think it’s a, like, relatively big part of a small animal. And then at some point your brain switches and you realize we’re dealing with the small part of an *enormous* animal. And there is that moment where there was a particular rod of bone that we started to see, as we started to work around it with our tools, and we realized that this was a vertebra from the neck. The neck bone.

Aside: I love this part *so* much.

Michael: I literally just looked down and went, “Ah, shit.”

Alie: *[laughs]*

Michael: *[laughing]* And of course, one of the poor volunteers was like, “What? What?? Did I break something?” I’m like, “No, No. This just went from a one-season project to an eight-season project.” And they asked why and I’m like, “Well, if this is articulated...”

Aside: In paleontology terms, ‘articulated’ means ‘found all in the same place’. Just a bunch of bones kicking it together in order, having a bone party under some dirt.

Michael: At this point I was thinking, “Okay, maybe it’ll just be the one element.” It wasn’t, of course. Then we’ve got a 40-ton-plus animal in the hillside. And then you start looking at the hillside and then you go, “Actually, I think it might just *be* the hillside.”

Alie: Oh, god. The hillside is just a mountain underneath.

Michael: Yeah, it’s just sediment loosely sitting on top of a dinosaur.

Alie: Who gets to name it?

Michael: Well, that depends. We don’t know whether or not we *will* be naming it because we don’t know if it’s a new species yet or not. There is a type of titanosaur from North America that is named. Just one. Which is interesting because in the rest of the world there’s a ton of these things. They’re like one of the hot groups of dinosaurs to work on these days. We went from not knowing much about them to 20 years ago, and suddenly there has been this explosion.

Aside: So, sauropods are those really long-necked, round-bellied, plant-munching cuties. Apparently, 20 years ago we didn’t really know much about them because our equipment for scanning and for transport, uh... sucked.

Michael: There’s better equipment and tech these days to work with things this big. Half a century ago, someone finds a titanosaur coming out of the hillside, it’s like, “Well, that’s pretty. Moving on.”

Alie: Do we just have better vehicles now? What’s changed?

Michael: We’ve got good vehicles. It’s more commonplace to be able to use a helicopter. I mean, obviously, half a century ago people could use a helicopter, but they were not something that was regularly available to the kind of budgets that we work at to lift heavy jackets.

Aside: When he says ‘heavy jackets’, he does not mean woolen coats. A jacket is that big plaster lump they smooth around excavated fossils to protect and support it when they’re storing or delivering it. Frankly, it looks like a very fun, rainy day craft project. And if you google, ‘dinosaur jackets’, I dare you... I *dare* you not to go down a rabbit hole looking at children’s hoodies and wonder if you can fit into the largest size offered.

Alie: Even if you don’t get to name the species, you get to actually be like, “This one’s Gary,” or whatever, right?

Michael: Oh sure, so they do get nicknames. So, if this ends up being a new species, we will give it a new technical name in a publication, and it’ll be myself and my colleagues that will name it. But in terms of nicknames, those kind of just happen organically, and our two titanosaurs actually have nicknames.

Alie: Oh, what are they?

Michael: They are Daisy and Duke.

Alie: Awww, look at that!

Michael: And it’s usually the students that are naming these things.

Alie: Where do they come up with Daisy and Duke? It has nothing to do with jean shorts, does it? Like, Daisy Dukes?

Aside: Daisy Dukes, for those unfamiliar, are a type of micro-pant fashioned from truncated denim trousers. They are beneficial in warm climates.

Michael: I actually don't know. I'm assuming that was the joke. But I went out on a scouting trip to check some map info and came back to the quarry and discovered that my two undergraduate students had named them Daisy and Duke. And apparently there had been some multi-hour conversation in which this had occurred. To this day I don't know exactly what went down. I don't know what they came up with. I decided that if I asked, I might receive information I didn't want and so it was better to just let it go.

Alie: That's wise. The idea that there is a titanosaur in a hillside named after jorts is thrilling to me.

Aside: So, when might Daisy and Duke make their museum debut? Please put shorts on them.

Michael: There's only so much exhibit space.

Aside: Here's the deal with museums. It's actually like the shoe department at JCPenney. What you see on the floor is a representative fraction of what they got in the back. So you may see a cool dinosaur, or a weird old knife, or a clay jug, but the museum has literally millions of specimens on site, archived for research. The Natural History Museum of Los Angeles County, for example, has 35 million artifacts in storage.

Alie: But if you did get to name it, genus and species, any idea where you would start?

Michael: There's weird rules about names, and because we might actually be getting to name it, I can't say it on air. But we have a potential name in mind for one of the two specimens in particular that's probably a new species.

Alie: [*squeals!*]

Aside: Yeah, I squealed! [*three repeats of Alie's squeal*]

Michael: What I can say is that it's a cool name that came out of conversations in part with the Native peoples who live in the area.

Alie: That's awesome.

Michael: I don't mean the abrasive white men. I mean actual Native people. We're in Four Corners, so we get a little bit of everything.

Alie: So, the dig site is near Four Corners?

Michael: It is. For the species name, we don't have anything necessarily in mind, although my proposal would be that we name it after the donor that funds the expedition because it is a privately funded expedition.

Alie: That's so baller though, to fund a dinosaur dig. If I were Jay-Z, I'd be like, "Screw a yacht, I'm gonna fund a dinosaur dig." If I had Beyoncé money, I'd be like, "Let's go dig up some bones."

Michael: Well, the funny thing is you don't need Beyoncé money in order to do it.

Alie: Really?! How much money does it cost to dig up a dinosaur?

Aside: This is the most fun game I've ever played.

Michael: Let's have fun with this. How much do you think a field season for us costs?

Alie: Oh gosh. Well, it depends on if you have interns, if you have to pay them or if you just have to buy them like, you know, a bottled water.

Michael: We have a combination of paid employees for the museum, as well as volunteers. But let's look at just the field season and let's assume that salaries for the museum employees, this is part of their yearly work and everything. So just the additional money for the supplies, the trucks to get people out there, to feed them, keep them safe, make the jackets, transport the specimens.

Aside: Pay attention for some huge revelations.

Alie: I would say \$800,000. No, four million dollars! A billion dollars! I don't know.

Michael: Less than \$10,000 per year.

Alie: [*loser horns*] You are kidding me!!!

Michael: No.

Alie: Are you kidding me??!! You could buy a used Toyota Camry or a dinosaur expedition??

Michael: That's right.

Alie: What kind of a world is this?!

Michael: [*laughs*]

Alie: Why haven't we all done this?

Michael: Good question.

Alie: I'm getting shrill. I'm just so... I'm so excited.

Michael: I have yet to run into anyone who underestimates the cost. They always overestimate. There's just this thought that they must be pouring billions of dollars into paleontology. Yeah, no.

Alie: There's no way that anyone could think it was less than \$10,000.

Michael: It can obviously climb from that. But you're still talking about tens of thousands of dollars, not hundreds of thousands, or millions.

Alie: So, less than a wedding these days. People drop some cash on their weddings.

Michael: Yeah, they drop some cash on their weddings. My parents said they went to two weddings last year that each cost over \$65,000.

Alie: Are you serious? You could buy a goddamn dinosaur vertebrae for that. The whole dinosaur maybe!

Michael: Yeah pretty much. I mean, that's six-and-a-half field seasons.

Aside: The average American wedding costs around \$30,000. And the average amount it costs to be a guest in someone's wedding (getting there, buying nylons with no runs in them, presents) is \$888. Everyone: start eloping so we can reallocate that money to digging up more cool, dead stuff.

Alie: So, do you have a favorite dinosaur?

Michael: Do I have a favorite dinosaur? Yes, I have a couple of favorite dinosaurs, depending on what kind of favoritism one has in mind.

Alie: The one that really has a place in your heart, you know which one it is. There's one you really like the most.

Michael: Sure. So, growing up, the one that makes me think, “Ah, childhood,” is this thing: Deinonychus, which is very similar to Velociraptor of *Jurassic Park* fame. Incidentally, the real Velociraptor was about coyote-sized and feathered...

Alie: [*gasp!*]

Michael: ... not giant and scaly.

Aside: Dino enthusiasts love to note that the Velociraptors in *Jurassic Park* were not historically accurate. [*“It’s true.”*] Deinonychus, which means, ‘terrible claw’, was much closer to what was portrayed as a Velociraptor. And I thought this was just someone sleeping on the job, but the confusion is said to have originated from Deinonychus originally being labeled as a subspecies of Velociraptors. Either way, these things should have had feathers. So, imagine a giant, clawed bird wanting to murder you. It’s upsetting, but not as upsetting for some people as a movie getting facts wrong.

Michael: Some of them are. I’ve seen some people get really upset about it. I don’t get that upset about it. But yeah, I mean they’re essentially fantasy creatures. But Deinonychus was particularly important historically because it was one of the first dinosaurs that was specifically used in some of the original hypotheses about the origins of birds. And specifically about them being dinosaurs.

Aside: By the way, all birds are technically dinosaurs. And that may be a thing you’ve accepted, and you’ve processed in your heart or mind, but it still weirds me out.

Michael: It’s also a badass with huge claws. It’s fast, and could leap, and all that kind of good stuff. So obviously, as a kid I was like, “Oooh, I like the one that can go and assassinate things with great prejudice.” Now these days, I might very well say and have said that my favorite might be Changyuraptor.

Aside: Changyuraptor. Now... Woo! What a weird thing. Find it, google it, it took me a while. This was a non-bird, flying dinosaur, but it looks a fuckton like a bird. It’s a bird with wings on its *hind* legs. It has four wings! Four wings! And a tail that was like a foot long, big claws and teeth. What the hell, man?

Michael: Which is not something you hear a lot about.

Aside: Now, Michael was on the team that first analyzed and published the paper naming this a new species. So, you know...

Michael: So, that one has a special place in my heart for that reason.

Alie: How do you feel about the feathered tail that was found recently in amber?

Michael: Very cool! I actually had a little heads up that that was coming.

Alie: You did? Is it like a text thread that all the paleontologists of the world are on? [*laughs*]

Michael: No, no.

Aside: By the way, I had found out by hanging around scientists, that they do have text chains. And they do talk about nerdy news. I was added to one with some scientists and field scientists called Scorpions on our Faces. And I love it.

A little background on this: last year, a paleontologist was trolling some amber markets in Myanmar and saw this apricot-sized piece of plant resin for sale as a jewelry piece. The seller said there was maybe a plant stuck in it? Yeah, no! It was actually a whole baby dinosaur tail, feathered. Like the best episode of *Antiques Roadshow* EVER. They

named it Eva. Eva is 99 million years old and probably got her tail stuck in tree sap and died there, which is currently making me want to cry. So, RIP little feathered buddy, and thank you for not ending up as a random chunky pendant.

Michael: It was a really neat find. It is the beginning of... You'll be seeing more things like that in the future.

Alie: Are we going to be cloning anything?

Michael: No, you're not going to be cloning anything from this because, while it more or less *looks* exactly like it was just preserved yesterday because the soft tissue is there, that doesn't mean that the molecular structure is completely unaltered. DNA has a reasonably short half-life, so you would just get gobbledygook out. You'd probably get DNA, but it wouldn't mean anything. DNA doesn't have to break down much, and it would be very broken down in this stuff. You might not even get any. You might be able to get a small amount, but it wouldn't matter. DNA becomes incomprehensible very quickly because it only has a four-letter alphabet. If you only have four letters in your alphabet, your "words," if you will, have to be very lengthy. If you break them even a few times, it means nothing.

Aside: If you saw the movie *Gattaca*, which was from 1 million years ago, aka 1997, it's about genetic engineering. And I always thought it was so clever that *Gattaca* was only spelled using only the letters of DNA sequencing, so G T C A. Isn't that cool? Anyway, back to old sap chickens.

Michael: Those specimens would be very interesting for understanding anatomy of early feathers, for example. But you're not going to be cloning anything out of that, unfortunately. Although how cool would it have been if Michael Crichton had known about those sites or those had been available when he was writing? He wouldn't even have to use the mosquito thing.

Alie: I know!!!

Michael: Because that wouldn't actually work, but it feels very plausible when you read the book, which is the whole point of science fiction. He found a really nice way of suspending disbelief. But if *this* stuff had been published, he could've just been like, "And they found a bunch of stuff in amber."

Alie: Yeah, they found a whole dinosaur in amber!

Michael: You know, that would have been great. Although, I have to say the mosquito intermediate thing was clever. Very cleverly conceived.

Alie: Clever girl. How do you feel about pop culture and its treatment of dinosaurs? Do you feel like it's good that it stokes people's interest, or do you feel like there's too much mythology and too much fiction?

Michael: Well, I think it's both. I mean, most of it is nowhere even in the ballpark of accurate. But on the whole, I think the advantages outweigh the disadvantages. For the most part, it's awesome. I think it's great. Do you know how many scientists would kill to have their field as popular as paleontology? I mean, how petty would I have to be to complain, [*snobby, whiny voice*] "People are really interested in what I do, but sometimes they get it wrong." You know, that would be awful. That would just make me...

Alie: You would be a real jackass.

Michael: I'd be a real jackass.

Alie: Although, how did you feel about Ross on *Friends* being so pedantic and exhausting? Did you ever feel like he got a bad rap?

Michael: I think he earned it. He's obnoxious.

Alie: Well, okay.

Michael: And he's supposed to be! I mean, the character is supposed to be obnoxious and David Schwimmer did a great job with the character. You know, interestingly enough, there is a paleontologist named David Schwimmer.

Alie: Are you serious?!

Aside: He was, in fact, serious. David Schwimmer is a paleontologist at Columbus State University, and he authored a paper called "Giant Coelacanth *Megalocoelacanthus Dobiei* From the Upper Cretaceous of North America and Its Bearings on The Phylogeny of Mesozoic Coelacanths." He recently posted about working on a study of some "mystery coprolites." A coprolite is a fossilized turd.

From the exhaustive Google Image searching I've done, Dr. David Schwimmer appears to have a salt-and-pepper goatee and a short, wiry ponytail. He looks like your aunt's cool boyfriend and the kind of person you want to sit around a campfire with, drinking a Fresca and talking about the best sunsets he's ever seen.

Alie: Oh, god. Does he love it or hate it?

Michael: I don't know, probably a little bit of both would be my guess.

Alie: I hope he's met David Schwimmer. I hope they hug. I want them to hug.

Did you have any heroes that were paleontologists growing up? Do you have a paleontologist mentor/hero or someone who maybe died that you never got to meet?

Michael: Well, I had a few heroes growing up, but actually there's one in particular that comes to mind. This is actually a really cool story. One of my heroes growing up was a paleontologist who worked in Baltimore, named David Weishampel. He was giving a talk at a nature center near where I lived at the time, as a kid. I was like 9 or 10 or something. I got super excited. I'll never forget that day. It was all adults and me. I was the only kid at this thing, and I asked more questions than everyone else combined and he just rolled with it and he talked to me afterward. And not only did I think paleontology was awesome, but after that day I decided paleontologists were just awesome people.

Alie: Oh, that's so great!

Michael: You know, this heartwarming story. So that gave me this awesome additional passion for the field. But what makes this story really cool is... fast forward a little over a decade later, he became my PhD supervisor.

Alie: Seriously?! Did he remember you at all?

Michael: He didn't until I jogged his memory once. He was like, "Yeah, I remember there was this kid, and wait..." I was like, "That was me!" Which is pretty cool.

Alie: Oh that's adorable! That's like the ending scene of some movie that works out. Everything worked out okay.

Michael: Everything worked out okay, yeah. I basically feel like I get paid to do my hobby, which is awesome.

Alie: What's your least favorite thing about the job? And then we'll follow that with your favorite thing. So, least favorite quick thing about the job.

Michael: Oh, a least favorite thing about the job is the same least favorite thing that a lot of people would probably say about their job, which is even though there is less bureaucracy and less paperwork than a lot of jobs, there's still enough of it to be annoying.

Alie: Yeah. What about flies on the digs?

Michael: We don't have a lot of problems with them in New Mexico, but the other place I do fieldwork these days is in Dinosaur Provincial Park in Alberta, Canada, which is an amazing place. It's incredible. But when we go there, typically in August, the mosquitoes are just terrible. It's terrifying. You can see the swarms from a distance because it looks like smoke hanging over the grass.

Alie: Oh, man. I love bugs, but not en masse like that.

Michael: Yeah. Give blood. Go to Alberta.

Alie: One day they're going to find one of those mosquitoes in amber. They're going to clone you. You're going to be like, "Ta da! We made another!" Well, what's your favorite thing about the job?

Michael: Oh, that one's hard just because the job actually is super fun. I love fieldwork. I love opening drawers in new museums, in the collections, when I travel to do research. I really do enjoy teaching. Now, of course, what I'm teaching isn't really paleontology, but I love anatomy in general. I love teaching anatomy. A friend's dad, years ago, at a social gathering, came up to me and decided he'd give me a little bit of a hard time and he goes, "So, you're an academic, right?" And I'm like, "Yeah." He asked, "So what do you actually make?"

Alie: So, like what do you make salary-wise?

Michael: No, he meant, "What do you produce? What do you make?"

Alie: I think that seems a little rude.

Michael: Oh, he *was* being rude, and I think on purpose. I took a quick second and said, "I make doctors."

Alie: Face!

Michael: *[laughs]*

Alie: What did he do? Did he start crying?

Michael: No, he turned around, popped open a beer and handed it to me. *[laughs]*

Alie: *[laughs]* That's amazing.

Michael: It was like, "Checkmate." It's pretty good. But I do love that component. I love training future physicians. There's just so much talent and brainpower, just wandering around at all times. You could just sit down at the Starbucks at USC and you start talking to people, and you'll learn five new things before noon.

Alie: That's a lot of quality noggins in one area. I have some rapid-fire questions for you from listeners.

Michael: Let's do it!

Alie: Some of them might be ridiculous. Some of them might be too difficult to answer. I'm not sure. Okay, I'm just going to start.

Aside: So, before we get to questions from... not even listeners yet because I recorded this before we even had listeners or a Patreon! For each episode, I donate to a charity of the ologist's choosing and this week it is going to NHM.org. That's the Natural History Museum in Los Angeles which is responsible for so much goodness including an amazing dinosaur program. They have obviously top-notch paleontologists there. So NHM.org gets the donation this week. That donation is made possible by sponsors of the show who I genuinely love, and so here are a few words about them.

[Ad Break]

Okay, let's *dig in* to questions.

Alie: David wants to know: Any new thoughts on what color dinosaurs were?

Michael: It depends on how new you're looking at. But within the last handful of years, yes, there was a significant breakthrough – it's still a little bit controversial, but seems to be accurate – in looking at the impressions of feathers in particular, because feathers store some of their pigments in these little capsules, basically, that do preserve in some of these really well-preserved fossils. You need a microscope to see them, but they are there. They're called melanosomes and they store melanins, which is a family of different pigments. And of course, the original pigment isn't in them anymore, but the shape and size of the melanosome tells you what kind of melanin it had in it. So they can use advanced microscopy and imaging techniques on those feathers to determine where certain melanins were located.

Aside: Oooh, what is microscopy? It's just looking at things with a microscope. Okay.

Michael: It means they can get some blacks, greys, dark browns, and reddish browns, but they can't get other colors. So, we have some idea that some of these things had bold patterns, but we don't know how bold the colors were.

Alie: Interesting. Tony wants to know: If dinosaurs are the ancestors of modern birds, does that mean dinosaurs tasted like chicken?

Michael: They probably did taste like chicken, yes. A way of putting it is, birds are just weird dinosaurs, and they probably did. Keep in mind, the closest living relatives of birds are crocodylians. And if you've ever had alligator, it tastes a little bit like chicken, too.

Alie: So there you go.

Michael: There's what we call a 'phylogenetic bracket' of tastiness there, to be technical about it. So, I imagine it would taste pretty much like chicken. Your typical dinosaur would probably be mostly more dark meat than white meat.

Alie: Because they have more hemoglobin for moving?

Michael: Sort of. That's very close. What turns the dark meat dark is something called myoglobin, which is used for restoring oxygen in muscle.

Alie: My bad.

Michael: Dude, you're on the right track. It's all good. And that's used particularly in aerobic muscles, a muscle that uses a lot of oxygen, It's a high endurance muscle.

Aside: So it's this oxygen storing protein, myoglobin, that makes dark meat dark. Which is why legs, which move around more, are dark meat. And chicken breast, which just sits there, not flapping much, is white. So good luck ever looking at a roasted dinosaur the same.

Alie: Adam has a question: How do you know when to switch brushes when you're digging out a fossil?

Michael: How do you know when to switch brushes? When the one you currently have is unusable. As we already have discussed, paleontologists are cheap, and we will use them until they're, basically, worn to hell.

Alie: And then do you have to get the finer and finer brushes when you're getting tiny grains of sand off?

Michael: You don't usually have to reduce the brush size much, maybe a little bit. It's more things like chisels. Anything sharp. If you're doing some more detailed work, you have to go to the smaller tool. Brushes, any kind of broad soft paintbrush will kind of do. Certain bristle types are better than others. It's not like painting where you're going after detail work. You're not taking off each individual grain of sand. You just have some loose stuff and you brush it out of the way. Then you have more loose stuff and you brush it out of the way. The key thing is to not damage the fossil.

Alie: I always picture you guys going down to like, a watercolor brush with only two hairs, just delicately... It's good to know that you guys are just like, "No, just get the dust off."

Michael: I've used dental tools to etch stuff around a fossil before.

Alie: That seems fun!

Michael: It is for a while. Then it starts to become tedious. But it's mostly fun. I honestly love it. But yeah, we don't go to tiny brushes.

Alie: T.J. wants to know: How many of the fossils on display are actually replicas or casts?

Michael: So, it depends on what museum you're at. And it depends, in large part, what age the museum is, the exhibit in particular, when it was built. If it's a really old exhibit, say it hasn't been changed since the 1920s, it's likely mostly original material because during that time; they didn't do as much casting. They didn't mind drilling through some of these things to put them on exhibit. Then as you got to the mid-to-late 20th century, that fell out of favor because they didn't want to put holes in the research specimen. But now if it's a really recent exhibit, ironically enough, you're going to see more original stuff on display again because we have better armatures now, what we call cradle armatures.

Aside: Armatures are the metal cradles that hold the bones in place externally. That lets you remove pieces for research and put them back. Do whatever. More importantly, you don't have to drill the shit out of fossils to wire them together, which is very old school.

Michael: Now, what percentage of each of the specimens being original is a whole other ballgame. You very rarely find a complete skeleton. So, there's a few different ways of ending up with a complete skeleton for exhibit. One is you create a composite from multiple originals of the same species that are all similar enough in age and size that it will more or less work as an average individual. What you're displaying isn't a single individual

that ever lived, but it's sort of an average of four or five individuals that were very similar.

Alie: So it's like a Frankensaur?

Michael: It's like a Frankensaur, yes. Then if the thing's really incomplete, and this happens quite often, where you found it, you do have enough to know what it is, you have enough to know it's a new animal or what have you, but you only have, say, 15% of the skeleton, you will then fill in the rest with casts.

Alie: But the museums are trying their best. So, do some placard reading. It's interesting to see trends in paleontology. It's interesting to see paleontology itself evolve. Steven, one of our audio engineers, is a really, really big dinosaur nerd. Like, super big.

Aside: You may know Steven Ray Morris from being America's podcast darling and from his own programs such as *The Purrrcast*, which is about cats. And *See Jurassic Right*, which is his podcast devoted solely to the movie and it involves his own childhood *Jurassic Park* fanfic, which is lit as fuck.

Steven Ray Morris: I had a question about the Torosaurus and the Triceratops controversy.

Aside: The controversy here is that sometimes dinos get mistaken for other ones. And dinosaur ghosts *hate* this.

Steven: Is the Triceratops actually just a juvenile Torosaurus or have they decided that it was actually two different species?

Michael: Right, so that is actually still an ongoing debate. The majority of paleontologists that work on horned dinosaurs consider them still to be separate species. There is one research team that has published data indicating that they think that Triceratops is actually what we call a junior synonym. That is, it's really just a juvenile of another animal. I'm personally not entirely convinced, but it's a neat idea. But right now, I'd say the majority opinion amongst paleontologists is still that Triceratops is a valid name. But we'll see how it plays out.

Steven: Thank you.

Michael: No worries.

Alie: What's the hot goss on Brontosaurus?

Michael: So, the short answer is: Brontosaurus is a valid name again.

Aside: Do you like petty gossip? Then this is a beautiful story. So in the late 1800s, two rich dudes, Othniel Charles Marsh and Edward Drinker Cope had a mutual, reciprocal hatred for each other. They tried to outdo each other in terms of paleontological supremacy. They would sabotage each other's work. They would publicly discredit the other one. One of them, Marsh, put the wrong skull on an Apatosaurus and called it a Brontosaurus. In the end, we got a lot of fossils and knowledge out of the rivalry, but they both went broke in the process. Just google, 'bone wars'. It's like a Bravo show but with more monocles. But here's the update on the Brontosaurus:

Michael: The original material that was named Brontosaurus was then later found to have been comprised of multiple animals of different species.

Alie: Whoops!

Michael: So, it was decided that Brontosaurus was not a valid name because it was all known stuff. You can't combine them and say it's a new animal. Researchers recently went through that material again with better knowledge and more data that we now have, because over time you get better and better knowledge of what's out there. They cross-compared a bunch of stuff and what they found was that, yes, a lot of that material was already known species. But some of it didn't match anything and therefore it was in fact new.

Alie: D'oh!

Michael: And that means the original name holds.

Alie: That's some good breaking news on the Brontosaurus fronts. I feel like between Pluto and Brontosaurus, a lot of people got really confused about who is what and what was happening.

Aside: Just over 10 years ago, just to catch you up, Pluto was demoted to a dwarf planet because it doesn't have enough game compared to the objects around it. That is a very casual explanation.

Alie: Like Pluto is somewhere, just butthurt, just crying into a wine cooler being like, "What am I?"

Michael: "What am I?" Right.

Alie: Okay, last question. This is actually from Lila Higgins, who is an entomologist at the Natural History Museum. She wants to know: How does studying ancient fossils help the world today?

Michael: Ah, that's a good question. There's a couple different answers to that one. One answer would be that knowledge, for its own sake, is kind of helping the world. On a more practical side, if the question is really, "What sort of practical applications does it have?" I'll be honest and say that some of it doesn't have any. But some of it does. If you want to know, for example, what kind of shit goes down when global atmospheric energy, i.e., average surface temperature, changes very rapidly. You need to go into the fossil record. This shit has happened before. It's not like the Earth has never seen rapid warming or rapid cooling or things before. It did.

That's one of the reasons why biologists, for example, get scared when you look at the growing temperature spike. It's because, "Oh yeah. Yeah, we've seen this in our records, right about the time a whole bunch of shit died." And it's not, of course, because stuff gets too warm. It's because of the rate. And if you want to know how fast things have to change to be disruptive, you have to look at the fossil record.

Aside: For more info on this, look up 'huge ass meteor that slammed into an area of present-day Mexico over 65 million years ago and changed the climate, leading to mass extinction of 75% of the animals and plants on Earth' (aka, the K-T Event).

Michael: And then lastly, in my particular case, as a bio-mechanist, I do work with engineers on robotics applications. For the most part, if you're interested in an animal model, say you want to make a running robot or something, you want to get inspiration from biological systems. Living things are the first place you would normally go because you can get a lot more data from them, obviously. However, 99.9% of all things that have ever lived are extinct.

Aside: How weird is that? 99.9% of all things that have ever lived are extinct. Just do you. Cut bangs. Text your crush. We're all gonna die.

Michael: So, if you limit yourself to just looking at those things, you're only getting a small fraction of the possible solutions to moving around, or eating, or whatever the thing is that you want to model. So, looking at other ways it's been done is very informative.

Alie: I think that's kind of the basis of why people are curious about science, is that the past can hopefully or possibly inform the future. So, you always have a vested interest in knowledge because it kind of plots your course going forward, it seems.

Michael: Yeah. That's exactly it. That was a much more succinct way of putting what I rambled on about. Well done!

Alie: The idea of us having unmanned aviation that's in the shape of a pterosaur, just like a robotic pterosaur. Can you work on that?

Michael: I could probably work on that. I don't know how useful that would be, but we could probably work on it. That would be pretty funny: a rideable robot pterosaur that you can use to get to work. Beat the LA traffic.

Alie: Yeah, is that okay?

Michael: Yeah, we'll see what I can do.

Alie: Put it on your to-do list.

To very gingerly stalk Dr. Michael Habib, find him on the Twitters [@AeroEvo](#), because aerial evolution is his bag. And to see photos of his fieldwork in the museum, but probably not cadavers, follow him on Instagram [@Habibinator](#).

This podcast is on Twitter [@Ologies](#) and on Instagram [@Ologies](#). I'm on [both](#) of those [@AlieWard](#). If you like this podcast and you like not having to listen to a bunch of ads, consider supporting it for about the price of a coffee per month on [Patreon](#). I'm putting this out myself because I love doing it. Hopefully, you like it. So, join the community on Patreon. Thank you to everyone who's already supporting on Patreon. I want to hug all of you.

Thank you to anyone who's bought merch at [OlogiesMerch.com](#), and to my friend Katie for her amazing animation she's making which you'll see soon and for the feedback she gave me in helping shape the show. Dude, you rule. To my folks who dug up that old tape – I guess that makes it kind of a fossil; it was obtained by digging – and who listen to this even though the language and subject matter can be not safe for parents. But above all else, remember to ask smart people stupid questions before a future urologist is dissecting you or a meteor crashes into the planet and kills us all.

Next week: Gemology!

[clip from the Gemology episode]

Kelly: *So, then we get outside and it's, like, the deepest, biggest boom you've ever felt.*

Alie: *Whoa!*

Kelly: *And it was just like, "Boom!" And I was like, "Oh my god, that's so scary."*

[2019 Alie] Look at this, you guys! This is before I put secrets at the end of episodes, so I gotta add one now! Okay, so this is a modern-day one, this is now late August 2019, two years later and I will

say that my secret for this episode is number one... Okay, I'll tell you this one. I'm recording this entirely in my underwear and I'm getting ready to run out the door to go to the airport. I'm going to go up to my folks to celebrate their anniversary and my suitcase is packed, but open, I'm recording this as fast as I can and I'm going to send this off to Steven Ray Morris to re-zhuzh this episode. Also, he has a secret about, perhaps, some dino panels he might be involved with in the future. He's not allowed to announce yet so I'm putting it in a secret at the very end and I didn't really announce anything. I just teased it so there you go.

And the other secret, I'm going to tell you is that this flag episode ended up so much harder than I thought it was going to be. So, thank you for enjoying this encore episode while I got through the research on that and delivered it in a way that did it justice and had a little bit of a breather this weekend to hang out with my family. So, there you go, there are your secrets.

Alright, we'll be back on Labor Day night, Monday of next week with a brand-new flag episode. I think you're going to like it.

Okay, Berbye.

Transcribed by Lisa

Here are some links which may be of interest:

A donation went to: NHM.org

[Changyuraptor](#)

[K-T event](#) aka oops almost everything died

[Pluto's not a planet](#)

[Bone Wars](#)

[See Jurassic Right](#). Steven Ray Morris's dino podcast

[Feathered Dino Tail](#)

[Be a cheapskate for your wedding](#)

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[Dr. David Schwimmer](#)

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