Oklahoma Innovations Radio Show

Air Date: December 5-6, 2015

Guests: **Paul Gignac**, **Holly Woodward Ballard**, **Anne Weil** and **Lindsey Yann** – OSU Center for Health Sciences Anatomy and Vertebrate Paleontology Program

>> From the OCAST Radio Network, this is *Oklahoma Innovations*, a weekly science and technology radio magazine, brought to you as a service of OCAST, the Oklahoma Center for the Advancement of Science and Technology. OCAST is the state's only agency whose sole focus is science and technology. The OCAST mission is to identify and fund promising research and technologies that allow Oklahoma to compete in a global market economy from our own backyard. This program features some of Oklahoma's most gifted scientists, inventors, entrepreneurs, manufacturers, educators and business leaders who all have one common goal: developing technology based economic growth for all Oklahomans. Now, here are your hosts Gary Owen and Chad Mullen.

[Music]

>> **Gary Owen:** Welcome to this edition of *Oklahoma Innovations*. Chad and I are coming to you from OSU's Center for Health Sciences campus in Tulsa. This week's topic is paleontology and we have an impressive panel of guests and experts in various fields and research and paleontology at this campus and what a nice campus it is. Last time we were here they were doing some construction and it's getting along.

>> **Chad Mullen:** Absolutely Gary, it's exciting to see the campus grow here in Tulsa. A lot of good things going on. A new student facility is under construction just to the north of the building that we're in today so a lot of good things happening and I agree with you we've got an exciting panel and guests today. Before we get started I just want to take a moment to talk to all our listeners out there. OCAST as we survey our companies that we work with every year, we survey our clients every year, and we want to survey you as well so we've created a survey so if you're a long time listener of *Oklahoma Innovations* I encourage you to visit ocast.ok.gov, our website, ocast.ok.gov and right at the top there's a picture that says take a survey about *Oklahoma Innovations*. Click on that. Very short survey, four questions, it will take you just a couple of minutes.

>> **Gary Owen:** Oh, okay, awesome. So it's ratings time now, okay let's see how we do. That's good. And we always encourage you through our bumpers and through some of our announcements with Andy to talk about OCAST and go to the website, learn what OCAST does for the state of Oklahoma. So for this particular focus we would like to get your survey input on this radio show so take time to do that and send that along also to some of your friends if they listen to the program. All right let's talk once again about the sciences we're going to talk about today Chad because we're talking about paleontology but we're talking about I guess some of the research projects we're going to talk about today has to do with how it connects to medicine and medical research, right?

>> **Chad Mullen:** Absolutely, and we have Dr. Paul Gignac here from OSU Health Science Center and we're very excited to have him to tell us a little bit about the paleontology program they have and how it connects to the medical school here so I think for many of us the most

famous paleontologist is Ross from Friends and as we know he did not do that good of a job is a paleontologist so we're excited to hear about all the great work that they do.

>> **Gary Owen:** Well let's get Dr. Gignac on the mike. Nice to have you on the program. Tell us a little bit about you. Are you originally from Oklahoma or did you come from out-of-state?

>> **Paul Gignac:** Hi gentlemen, it's great to be here. I'm actually originally from New England. I came here from Stonybrook University Medical School on Long Island just about three years ago and since I've arrived I've been teaching in the anatomy invertebrate paleontology tract and in the first year medical school curriculum specifically in our gross human anatomy course.

>> **Gary Owen:** Tell us what paleontology is. I think most people know what it is but give us just kind of an overview if you will about what the science is.

>> **Paul Gignac:** Sure, so paleontology is the study of fossil organisms and it relies on a number of different kinds of research directions to figure out the ways that fossil animals made a living so this involves finding them in the first place so being geologists and going to where there are good areas for fossils and then excavating those, then cleaning up the fossils that are typically covered in what we call rock matrix and making them so that we can understand what those fossils represent. Typically they're the bones or teeth of long dead animals but in some cases they're trace fossils so they might be imprints of skin or footprints and we use a whole bunch of fossil data from across the world to try to understand how organisms changed over long periods of time.

>> **Gary Owen:** Have Chad seen videos on what paleontologists do out in the field?

>> **Chad Mullen:** No, it's absolutely amazing.

>> **Gary Owen:** Oh my gosh you've got to have patience to do -- , I mean I see them digging with little dental tools and brushes and things like that to uncover because most people don't realize how fragile when you're uncovering something how fragile these bones and rocks are, right?

>> **Paul Gignac:** Oh absolutely. So these bones have been in rocks for sometimes hundreds of millions of years and they've become rocks themselves but they're still brittle and so as we uncover them we're constantly trying to battle the possibility that they might fall apart right in front of our eyes so we use a lot of glues and chemicals to help increase the rigidity and structure of fossils just so that they don't get damaged while we're excavating them and that of course requires a lot of patience, a lot of very fine tools and even some extreme cases really being very delicate with the fossils so that we can get them back from the field and be able to study them in very high resolution for example in CT scans or under microscopes.

>> **Chad Mullen:** Now doctor you've been involved in some excavations that have occurred in some pretty remote places, is that correct?

>> **Paul Gignac:** Yes, that's right. I've done field work in Madagascar as well as in the Arctic Circle. I just got back in August. We were looking for the kinds of animals in that case in the Arctic Circle that lived 70 million years ago in a part of the world that saw three months of total darkness, a lot like Svalbard, Norway today. It's not clear how those animals were able to survive if they migrated and immigrated in order to get around that period where there was no primary productivity. Plant life didn't produce any new resources for herbivores and so there

shouldn't have been a lot of resources for carnivores but they were there and they were surviving. We're not really sure how they pulled that off.

>> **Gary Owen:** How do you find these excavation points? I mean this is interesting. Obviously something leads you to these sites, right?

>> **Paul Gignac:** Yeah we know the kinds of rocks that are amenable to fossilization and those are sedimentary rocks that get layers of rock that get put down over long periods of time like floodplains and so we go and look for those kinds of sediments in order to try to identify which ones might be good for housing fossils. We try to date them to the periods of time we're interested in and then we just go target parts of the world that have those combinations of features and we do a lot of hiking and backpacking and camping and digging with various small tools to try and find just the right places for excavating fossils.

>> **Gary Owen:** Chad you're aware we have something like that in our own backyard in the panhandle or in the northwest part of Oklahoma, the Black Mesa area, right?

>> **Paul Gignac:** That's right, and the paleontologists on this campus do field work primarily in North America including in Black Mesa. We are interested in trying to understand the evolution of vertebrates across long periods of time and across North America and so our research programs each tackle different aspects of the ways that vertebrates have moved about in North America, the ways in which they have evolved and how they've interacted with each other.

>> **Chad Mullen:** Now Gary if you had a basic biology class in high school, alligators and crocodiles are talked about all the time. They are living dinosaurs is the term you hear. Now you've done some work in comparing the fossil records of alligators and crocodiles compared to the living ones, is that correct?

>> **Paul Gignac:** That's correct and it's a little bit of a misnomer to call them living fossils. They've been around for certainly a very long time. The group that's around today derives from about 240 million years ago just at the dawn of the age of the dinosaurs, but they were already their own group of animals when dinosaurs first came about so they are considered a kind of living fossil because they are often thought of as being very primitive but in fact they are very unique in their own right. Crocodiles and alligators have a lot of features that are very different from other kinds of reptiles, ones that align them with birds in fact which are modern descendants of dinosaurs. Yeah, they're reptiles but they have special kinds of ankles and they have physiology like birds in some cases with four-chambered hearts which is more typical of say birds and mammals, not other reptiles. They are a very interesting group to look at and they're related to dinosaurs through the group that they belong to which is called arcasoria [phonetic] and so we use them to try to understand dinosaurs but they themselves aren't quite dinosaurs.

>> **Chad Mullen:** Interesting, now when you look at some of the fossil records, fossils of crocodiles and alligators that you find, how do they compare to the species that's alive today? Are they similar or do they have a lot of differences?

>> **Paul Gignac:** There are a lot of similarities especially within the head and the teeth. This is the area that I focus on so I'm interested in how these animals feed and how they were able to be very successful as predators across this long period of time that they've occupied a predatory role especially at the water's edge so the kind of National Geographic saltwater croc or excuse me Nile crocodile grabbing say a wildebeest at the edge of a river. That kind of behavior is

something we can follow back into the fossil record for quite a long time. That's one reason this group has been successful is that they're very good at exploiting that particular kind of predatory behavior.

>> **Gary Owen:** I noticed here in some of the content that was given to Chad and I that you said that I want to talk about the bite forces because I thought this was kind of interesting when you talk about size I guess.

>> **Paul Gignac:** Yeah so modern alligators and crocodiles can generate up to 4000 pounds of bite force and now I drive a Mini Cooper.

>> **Gary Owen:** Now think about that.

>> **Paul Gignac:** That's the equivalent of putting my Mini Cooper on your leg.

>> **Gary Owen:** Yeah.

>> **Paul Gignac:** And a fossil crocodile that could reach say 40 feet, dinosukis [phonetic], this is an animal that could have generated about 23,000 pounds of bite force which is the equivalent of putting a Mack truck on your leg so you know if you were a very large herbivore say 70 million years ago you would have only been able to be hunted by a very large predator with these really superlative capacities and that's the case is what we see in these crocodiles is that they got bigger to follow the size increases of their prey and along came these very high bite forces.

>> **Chad Mullen:** See Gary even alligators are getting soft these days [laughter].

>> **Gary Owen:** Well look at these guys who go out and catch them. I don't know how they do that. All right we only have a couple of minutes left in your segment. I want you to talk real quickly if you will, highlight about some of the other projects you're working on like the neurological evolution of avian flight, the soft tissue imaging using x-ray, talk about some of those projects.

>> **Paul Gignac:** So a lot of my focus is on biomechanics which is what we've been discussing but I'm also broadly interested in how the head has evolved. This is a very complex area of the body that houses the brain. We have to use it for feeding. We use it for seeing, smelling, hearing, a lot happens in this area and so there's a lot of potential for it to be under evolutionary pressures under ways that will change during long periods of evolutionary time and one of the major areas of interest is how the brain is come to shape the way that the head is organized and functions and in the case of mammals we have very large brains. It's one of our particularly unique attributes but birds also have very large brains about comparable to the size of brains that we have relative to our body mass and so one of my research foci is to try to understand how big brains come about and so we've been looking at the ways that bird brains have evolved along the evolution of flight because that's been a major factor driving how birds have diversified and so we do this by documenting brain activity in bird brains using a technique called positron emission tomography. It allows us to see how the brain metabolizes sugars during flight and we can look at what parts of the brain are active as a result of this visualization technique and trying to put this into a larger context we're now looking at super resolution mapping of bird and mammal brains trying to understand cell to cell interactions and how those to scale up to the whole brain organization and this is an important tie-in to why we're here at the medical school as a lot of our research parallels the kinds of research that's happening in larger contexts. We are as paleontologists educators in medical anatomy and we have to have a great understanding of anatomy to make that happen and so we do a lot of research in areas related to big questions and anatomy, both

human anatomy, invertebrate anatomy, that allows us to be very good at teaching at a medical school level.

>> Gary Owen: Awesome stuff. Dr. Paul Gignac and good stuff. If you liked this segment just wait when we come back from the OSU Center for Health Sciences in Tulsa on *Oklahoma Innovations*.

[Music]

>> Pancreatic cancer is the fourth leading cause of cancer deaths with a median survival range of only six months. As an oncologist I see far too many families suffer from the effects of this terrible disease. We need better treatment options for patients.

>> With the support of the Oklahoma Center for the Advancement of Science and Technology the researchers at Core Biotechnology have what they hope will eventually be a treatment, even a cure for pancreatic cancer. They have identified a protein that if blocked may prevent tumors or keep them from growing. With help from OCAST and I2E the team at Core was recently awarded and SBIR research grant to enable them to continue their research and move closer to a treatment for pancreatic cancer. If you're a researcher or a small business in Oklahoma and are considering applying for federal SBIR funding, contact OCAST toll-free at 866-265-2215 or visit us on Facebook or our website at ocast.ok.gov.

[Music]

>> Now in its 20th year this is *Oklahoma Innovations* on the OCAST Radio Network.

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>> Gary Owen: We are back at the OSU Center for Health Science's campus in Tulsa and we're talking to a very impressive group of scientists who are involved in paleontology.

>> Chad Mullen: Been learning a lot Gary, very exciting show.

>> Gary Owen: Our guest now is, I would call you an exciting science here and one of the things that I want to tell our audience is Dr. Holly Woodward Ballard, her research focuses on some really cool stuff, osteohistology, and we'll tell you what that is in a minute but here's what I want to tell our audience that you studied at Montana State University with Jack Horner. Now people who don't know who Jack Horner was if you saw the movie Jurassic Park, Dr. Jack Horner was the inspiration I understand for the character Dr. Alan Grant in the film, is that right?

>> Holly Woodward Ballard: He was, yeah, he's also been the scientific advisor for all of the Jurassic Park films as well as the Jurassic World film and actually made a cameo appearance in Jurassic World.

>> Gary Owen: Wow. Well tell us about you and then tell us quickly if you will about your studies.

>> Holly Woodward Ballard: Okay, sure. I've always been interested in dinosaurs from way back as long as I can remember and so I definitely knew when I went to college that's what I wanted to study, prehistoric animals, life in the past, and I grew up watching Jack Horner on television and as I went through my undergrad studies I realized I would like to go work with Jack Horner because he's doing the kind of studies that I'm interested in doing especially with paleohistology and I've always been interested in microscopes so the two interests there kind of dovetailed together but to be able to go work with Jack Horner was kind of a lifelong dream of

mine and I was able to achieve that goal. I contacted him. I said I would like to go work with you. Here's what I'm interested in doing and he said if I applied to the program that he would accept me.

>> **Chad Mullen:** Well Dr. Ballard the theme of the show really is paleontology and it's interesting that we're here at the Center for Health Sciences at OSU. Tell us a little bit, how does your research, how does it relate to people? How does it help people? Why are you part of the medical school I guess I should say?

>> **Holly Woodward Ballard:** Okay so paleohistology is the study of fossil bone microstructure or the part of it that I study is fossil bone microstructure and the interesting thing is the more we study this field, the more we examine fossil bone and try to understand what the tissue is telling us the more we realize we really don't have a good foundation yet for making our inferences because the things that we observe in the fossil record we have two base off of observations in modern animals and if we can understand how modern animals' bone is growing and what that bone is telling us then we can use those observations and infer that the same processes were happening in extinct animals but it turns out that we know a lot less about modern animals and how they grow than we should [inaudible] make inferences about the fossil animals or the fossilized bones from extinct animals and it's just kind of a circular thing in that the more we learn about the fossils, the more we learn about modern animals, the more we learn about ourselves and so what I'm learning about with bone microstructure can then be applied not only to our understanding of animals living today but also to medicine.

>> **Gary Owen:** You have it says in your bio here that your endeavors are also to obtain large histological sample sizes, talk about that.

>> **Holly Woodward Ballard:** That's correct. So in paleohistology in particular because we work with fossil bone the fossil record is often very sparse and often what we try to infer from the bone in the fossil record we can't say very much because there's just not much to work with. You're lucky if you find a handful of the same species to make inferences about so what I'm interested in doing is finding both large samples of the same species of fossils from extinct animals as well as using large samples of modern animals as the comparison to get at the variation because if you look at the fossil bone of just a single animal it could be a runt, it could be sick, it could not be growing properly, but you make these inferences based on what you see and then draw it out to an entire population of animals.

>> **Chad Mullen:** Now do you see -- , when you're looking at dinosaurs, they lived for millions of years themselves, do you see an evolution within themselves? I mean were they smaller to begin with or larger? With these large sample sizes would we be able to determine things like that?

>> **Holly Woodward Ballard:** Oh yes, definitely. Some studies done by colleagues of mine have shown that some of the earliest dinosaurs actually had an incredibly large range of body sizes for individuals of the same age so they were very plastic is what we call in their growth which could have helped them succeed and survive and evolve for millions of years.

>> **Chad Mullen:** Very interesting.

>> **Gary Owen:** What do you think about today's student body and their enthusiasm to get involved in this kind of science?

>> **Holly Woodward Ballard:** As far as what I've seen at CHS it's really great that I get to work with the medical students because they always have questions when I'm interacting with them in lab, always asking about dinosaur paleontology. Some of them have even expressed interest in coming out to the field with me in participating in dig sites so it's great that by telling them you know I'm a paleontologist and then they say well why are you teaching me human anatomy, I can start explaining that everything is related, that we're all vertebrate animals and it's a very comparative thing and that you have to understand biology of modern animals to understand biology of extinct ones.

>> **Gary Owen:** That totally makes sense.

>> **Chad Mullen:** It does, it does. What do you see in the future?

>> **Holly Woodward Ballard:** As far as for paleohistology I feel like the large sample analysis is definitely the way to go. We really have to get a handle on the variation within an individual population, and individual species, and by doing that we can then start understanding how dinosaurs grew up, not only how old they were when they died, how big they were, but how they actually grew from hatching out of an egg all the way to adult size.

>> **Gary Owen:** That's just fascinating stuff. I think for me and when talking to our previous guest, Dr. Gignac, is the patience you have in this science because you have to slowly uncover your digs and all of the things and I'm sure the oohs and the wows, I mean to be on-site and see the enthusiasm when you're encircled with students that's just got to be incredible. Dr. Ballard we thank you so much for being on this segment of our program and we know you're doing great work here as an assistant professor of anatomy at the Center for Health Sciences at the Tulsa OSU campus. We'll be back on *Oklahoma Innovations*.

[Music]

From Oklahoma City to Tulsa, Woodward to Lawton, this is your science and technology radio magazine, *Oklahoma Innovations* on the OCAST radio network.

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[Music]

>> **Gary Owen:** We hope you're enjoying our program this week coming to you from OSU Tulsa campus of the Center for Health Sciences and we've been talking about paleontology. Our previous guests were talking about their sciences and research and excitement in studying dinosaur activities and all of the sciences and discoveries they've made but now we have a couple of guests who are going to take us in a little different direction. Dr. Anne Weil who is associate professor of anatomy, and also Dr. Lindsey Yann. She is a senior research assistant and vertebrae paleontology volunteer coordinator. We're going to find out what all that means here momentarily.

>> **Chad Mullen:** Well Gary before we do I've got just a burning question on my mind. Growing up through school I learned about the Brontosaurus, you know the big long dinosaur and I have a daughter now and I bought her the Dr. Seuss dinosaur book -

>> **Gary Owen:** Oh boy!

>> **Chad Mullen:** And they're talking about the Apatosaurus and I said what in the world is -- , what is Apatosaurus? So I had to look it up, it's a Brontosaurus. It's called Apatosaurus now so Dr. Weil tell us a little bit, can you shed some light on why the change because I think a lot of people still outside of your area refer to it as a Brontosaurus.

>> **Anne Weil:** Well, that's an interesting story. Back when the first fossils that were described as Apatosaurus and the first fossils that were described as Brontosaurus were found, communications were not necessarily as good as they are today.

>> **Gary Owen:** In the late 1800's, right? Or early 1900's?

>> **Anne Weil:** Yes, yes. And so the first person who found one of these animals named it Apatosaurus and that first name is the formal name that we use as scientists but the second person who found one of these creatures was either unaware of the first one or believed that they had something different and so they named it Brontosaurus and relatively soon after that actually they were synonymized. It was obvious to people that they were in fact very similar animals if not exactly the same animal and so the older name, the first name Apatosaurus was the proper name to use, however in the interim the name Brontosaurus had been widely publicized and it was really advertised actually well after the synonymization had taken place and scientists were all calling it Apatosaurus that that was really a name that was publicized to the public and it was a huge animal, they were exciting, so it's the name that stuck. Now very interestingly within the last year a research team has approached the original material, which is a little scrappy, of Brontosaurus, of the animal that was named Brontosaurus, and they have proposed that it is indeed different than that of all the animals that have been called Apatosaurus since and that it

probably should revert to being Brontosaurus although most of the very similar animals to that are still called Apatosaurus.

>> **Chad Mullen:** Very interesting, very interesting.

>> **Gary Owen:** There will be a test on this at the end of this [laughter]. I have a question for you and then were going to talk to you about your science but we've talked to all of these guests as we continue this morning, has science come to any kind of conclusion as to what actually happened to the earth or are they still trying to discover what happened to all of these animals back centuries ago? Do we know what the science is about? Was it ice, was it an Ice Age in fact?

>> **Anne Weil:** Are you referring to the extinction?

>> **Gary Owen:** Extinction, yeah, what happened?

>> **Anne Weil:** So I think that we've come a little closer to a consensus there and we're talking about actually a period of time that's very interesting to me in my research that in Cretaceous extinction event 66 million years ago and in that extinction event we lost our non-avian dinosaurs so birds are living dinosaurs. We see them every day. We ate them for Thanksgiving, our revenge on T- Rex. [Laughter] But certainly a large number of dinosaurs went extinct at that period, in that time period and a couple of different things seem to have happened. We know that at what turned out to be the end of the Cretaceous that the climate was very unstable at that point probably due to volcanic eruptions. At that point 66 million years ago some large [inaudible] and asteroid or meteor actually maybe part of a comet entered the Earth's atmosphere and impacted on the earth and that caused a climatic perturbation so it probably was not one thing but the addition of a significant perturbation to an already unstable system.

>> **Gary Owen:** Wow. I certainly hope we don't see that again.

>> **Chad Mullen:** No, no [laughter].

>> **Gary Owen:** Okay.

>> **Chad Mullen:** All right, not for another 60 million years anyway, so -

>> **Gary Owen:** No. Let's get our second guest on the mike, Dr. Lindsey Yann. You're a senior research assistant, invertebrate paleontology volunteer coordinator. What does that mean to us?

>> **Lindsey Yann:** So I help the faculty members in the anatomy invertebrate paleontology group so I'm not directly teaching anatomy like they are but I support them and part of that is the volunteer coordinator and we have community members from Tulsa and surrounding areas that come in three days a week and they work on fossils that we're finding in Oklahoma so the Homestead site that Dr. Gignac talked about, the material that we are finding there comes back to the lab and these volunteers have the opportunity to learn how to prepare dinosaur bones and I teach them everything that they need to know and they help us do science by preparing these specimens.

>> **Gary Owen:** Now Dr. Weil I know we talked before you came on the air that you're involved with the sites up in northwest Oklahoma in the Black Mesa, right? You do some dig work up there?

>> **Anne Weil:** I do. I direct excavation at the Homestead site and some of the educational activities that go on there as well.

>> **Gary Owen:** So are you Dr. Yann involved in some of that as well? Getting volunteers to participate?

>> **Lindsey Yann:** I am. I went out in the field with Dr. Weil this past summer and we collected the specimens that these volunteers are preparing so I'm learning new techniques from Dr. Weil and applying them both in the field and in the lab.

>> **Chad Mullen:** How does one become a volunteer? Do you have to have specialized training or are you in that career field or --

>> **Lindsey Yann:** There are no requirements. Basically an interest in learning something new is all that we ask. I'll teach them everything that they need to know and we've got a variety of backgrounds in our volunteers. We have geologists, we have computer scientists, and we have students, so it's not just senior volunteers. We can also take students. We've had middle school students that have worked in the lab so basically I can teach you whatever you need to know as long as you want to learn something.

>> **Gary Owen:** So Chad if you want to go take a week -

>> **Chad Mullen:** I kind of do actually, so [laughter]

>> **Lindsey Yann:** You should come join us.

>> **Gary Owen:** That would be fun.

>> **Chad Mullen:** Absolutely.

>> **Gary Owen:** Sounds like it.

>> **Chad Mullen:** Well Dr. Weil, quick question for you, well maybe it's not a quick one we'll find out, but you talk a lot about in your research looking at diversification of small mammals. Could you expand on that a little bit?

>> **Anne Weil:** Absolutely. So that [inaudible] extinction event 66 million years ago which is the most recent extinction event in Earth's history, so one we have a lot of good data on, actually also caused the extinction of about half of the mammalian lineages in North America. We think about it as a dinosaur extinction but it was the biggest extinction in mammalian history as well and so what I'm really interested in is what happened after that, how mammals rediversified in the time period immediately following. Ten million years later we had a very diverse mammal fauna and a very different mammalian fauna in North America and I'm very interested in how we got from one point to another.

>> **Chad Mullen:** And do you have any theories on how we arrived there, or -

>> **Anne Weil:** Well I am currently working with colleagues in both New Mexico and in Alberta to both describe new faunas from that recovery period and as we describe these faunas and we describe the new [inaudible] in them I'm building a tree of relationships among them that allow us to understand the structure of that rediversification and I'm interested in working in two different areas at once so I don't get really focused in on one tiny geographic area and act as if it represents all of North America. There are differences between the two areas. There may be more similarities than there are differences but it definitely didn't all happen one way.

>> **Chad Mullen:** Now tell us a little bit, I mean what was the new -- , or do you have an idea of what the recovery time period for the mammals was? I mean was it hundred thousands of years,

was it tens of years, millions of years? What did the earth look like right after the extinction event and then kind of what was the progression afterwards?

>> **Anne Weil:** Well it definitely happened over a period of millions of years. What we see at first in the small mammals is we see a diversification in lineages that were surviving in North America but we also see new lineages that probably came from North America but from areas where fossils weren't preserved during the late Cretaceous and they appear very suddenly in the early [inaudible] and they really take off but that does happen over a period of millions of years and part of this really also depends on the resolution that we get from the fossil record. We get resolution in tens or hundreds of thousands of years, not on very short timescales.

>> **Gary Owen:** Dr. Weil you've got some fascinating dialogue going on here. We've got to come back and talk more about this. I hope you're enjoying our program. We're talking about paleontology and also we're talking a little bit about paleobiology as well so we've got to take a little break. We'll come back and do our final segment here momentarily on *Oklahoma Innovations*.

[Music]

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[Music]

>> **Gary Owen:** We certainly hope that you're getting a better picture of paleontology and what the scientists are doing at the OSU Center for Health Sciences at the Tulsa campus and some good stuff here. Chad Mullen: Gary, exciting stuff to learn and I think most of us as kids and even adults are fascinated with the archaeological record, learning from the past what was life like. You know I heard an interesting study the other day and there was a survey I think of about 3000 or 4000 Americans which is a pretty large sample size and it said if there is one technology you could invent what would it be and something like 40% of the respondents, the vast majority of respondents, said a time machine and they all want to go back and see the dinosaurs. I mean, so there's some sort of innate desire among us all I think to go back in time and our guests here are shaking their heads. I guess they don't want to go back and see the dinosaurs. No thank you. Because they know what we don't [laughter]. Why do you say no?

>> **Anne Weil:** I wouldn't want to be eaten by one [laughter]. I prefer to be on the eating the turkey end of my dinosaur relationship.

>> **Gary Owen:** So just watch Jurassic Park and you'll see why she says that.

>> **Chad Mullen:** Prefer to be at the top of the food chain, right?

>> **Anne Weil:** That's right.

>> **Gary Owen:** And now here's a question for you and Hollywood can tend to take things out of perspective but when you think about the scheme of things really I guess what you're talking about is true. We wouldn't be able to survive in those times obviously and man wasn't around then so at least not the way we know man today. And that's probably an interesting question too, we get back to health sciences and evolution and all those questions I'm sure you have a perspective on the big question is so how from a science perspective how did man evolve into what we know man today? I mean when you look at it from a scientific standpoint.

>> **Anne Weil:** Well anything that we would recognize as being closely related to man is much younger than the dinosaurs so that in the late Cretaceous or in that time period, that recovery time period that I'm looking in, we are seeing the first primates but they are very small primates, they are not very closely related to anything living today.

>> **Gary Owen:** Interesting.

>> **Anne Weil:** And so human evolution really has taken place much more recently within the last five or 10 million years.

>> **Gary Owen:** Wow.

>> **Chad Mullen:** So we're just babies on this planet. Well hey Gary our listeners at home you may have heard some noises in the background there. We are at the OSU Center for Health Science's campus where there doing a lot of construction, expanding, growing, so a lot of things are happening -

>> **Gary Owen:** Train's moving through.

>> **Chad Mullen:** Progress is promise as they say around here. Now Dr. Yann we haven't heard a lot from you. Tell us a little bit about your research. I know you do a lot with stable isotopes and you can actually see changes in the archaeological record using those. Is that correct?

>> **Lindsey Yann:** That is correct. I consider myself to be a stable isotope paleontologist so basically stable isotopes are a variation of elements with a different number of neutrons so I'm interested in carbon and oxygen and I use tooth enamel mostly from mammals in my work and we can figure out what they ate using the carbon isotopes and then we can use that information to reconstruct the environment that these animals might have lived in and if we add in the oxygen we can get an idea of the climate so we get things like relative [inaudible], whether it was warmer or drier than it is today or colder and wetter and what's really neat about this technique is that it can be used throughout time and space. My research is mostly in the Pleistocene so about the last two million years, but I've also done work in the archaeological record so I can see what are the camels eating in the Pleistocene, what are they doing the last 2000 years and then we also incorporate the modern record so Holly talked about, or Dr. Ballard talked about this a bit. We really need to understand the modern record to understand the past so I include this baseline of modern information and that makes it easier for us to interpret what was going on in the past whether it be the archaeological record or the paleontological record.

>> **Chad Mullen:** It's fascinating stuff, now and why teeth enamel? What's the magic behind that?

>> **Lindsey Yann:** The magic is teeth are less likely to alter when they become fossilized so bone is really porous and as water flows through it during the fossilization process it can change the signature of the bone but the tooth enamel is so dense that it records the signal without change so we can look at what was going on during the person or animal's lifetime not during the fossilization process so that dense structure really allows us to look back into the fossil record.

>> **Gary Owen:** Let's talk about animals today compared to animals in the prehistoric time. We talked about reptiles and birds and those kinds of things. Are there other similarities that you've found in your research with animals, carnivorous for example type animals? Can you talk any about that? You know we think about all of that stuff and we say so how far back did dogs evolve, cats evolve, elephants evolve? Do you know what I'm saying? Just take the whole animal world if you will. Can you talk about that a little bit?

>> **Lindsey Yann:** Well I'd like to talk about that from two different perspectives. I mean one is that Mesozoic ecosystems are a lot more similar to today's ecosystem then many people recognize.

>> **Gary Owen:** Really?

>> **Lindsey Yann:** If you're really focusing on Allosaurus for instance you would miss that at something like the Homestead site where we're recovering and ecosystem that is 150 million years old we have three genre of turtles. We have a crocodilian, we have snails, we have ostracods [phonetic] which are little shelled shrimp. We really have some very familiar animals in their along with some Allosaurus and some Apatosaurus and maybe a little ornithipod dinosaur so that some elements of our fauna are very ancient. Now that great mammalian diversification you are asking about started maybe in the late Cretaceous and maybe in terms of the size diversification of Mammalia we started to see large animals fairly soon after that extinction event.

>> **Gary Owen:** I find that Oklahoma history when you look at western Oklahoma in general, I mean I know there's a lot of sites in western Oklahoma where some excavation projects in paleontology have uncovered some really interesting finds. Talk about that. I mean like I know for example out in extreme western Oklahoma we talk about Native American history there. I know there's been like some buffalo pits and things like that have evolved over time that have been found I should say which may not cover your area but I'm just talking about, I'm fascinated with like northwest Oklahoma and western Oklahoma, paleontology is pretty interesting out in that part of the state.

>> **Lindsey Yann:** It really is fascinating. As you say I don't really work with human cultural -

>> **Gary Owen:** Right, I knew that, yeah.

>> **Lindsey Yann:** staff which is archaeology. I really work with the animals but western Oklahoma does have a number of deposits. I'm working right now in the Jurassic Morrison formation which is that [inaudible] County.

>> **Gary Owen:** Yeah what can you tell us about that? Why that particular part of the state? Have we found it in other parts of the state or just -

>> **Lindsey Yann:** No, no actually the Morrison formation only crops out in [inaudible] County in Oklahoma. It has a very broad outcrop running north as far as Montana and west out in Utah which represents a huge Jurassic basin.

>> **Gary Owen:** And Colorado and New Mexico too in the corners there.

>> **Lindsey Yann:** That's right, yes.

>> **Gary Owen:** That's interesting, wow. So where does all this lead to with what's going on here at OSU's Center for Health Sciences? All of this science culminates together with medical science. What are our students getting out of all of this?

>> **Lindsey Yann:** Well our students are getting from all of the anatomists here, all the paleontologists here, a great education in anatomy. People often ask what the two have to do with each other but in fact the roots of vertebrate paleontology as a science are in comparative anatomy and we all enjoy anatomy and we all love teaching it. The students come to us. They can come out into the field with us on some of our projects. They can learn the various applications of the knowledge that they get from us not just in medicine but also in a broader understanding of the world and a broader understanding of why people's bodies work the way that they do.

>> **Gary Owen:** Interesting.

>> **Chad Mullen:** I guess maybe a final thought here. Paleontology has really become relevant I think in pop culture. There's the fossil hunting show on one of the channels, history or something, talk about Ross on Friends as a paleontologist. I know a lot of my friends have started going out and seeking fossils as a hobby. Is that a good thing? Does it create excitement? Is it a bad thing? Are we chipping up good stuff that could be for research Dr. Yann?

>> **Lindsey Yann:** I mean it can be both. I think it's a good thing though. That's what got me interested in paleontology, going to the Smithsonian and then going out in the field doing small day trips with local museums so it really gave me the opportunity to increase my love for something and it does create problems of people going on public lands and illegally collecting material but for the most part I think it's a great educational tool. You can get someone's attention and hopefully keep them interested in science, hopefully paleontology, but -

>> **Gary Owen:** I'm sorry to interrupt you but we're about to run out of time. I wanted to add this. If we want to come and volunteer how do we do that?

>> **Lindsey Yann:** You can email me at lindsey.yann@okstate.edu. I also have a web page with my contact information on the Center for Health Sciences.

>> **Gary Owen:** Okay, and you can learn about all of our guests who were on today, just go to the OSU Center for Health Sciences and check out what they're doing. There's staff information there and you can learn more that way. We're out of time. Thank you so much. We'll talk to you next time on *Oklahoma Innovations*. Have a great week.

[Music]

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