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MH: It is March 06, 2009. I am with Dr. Alan Titus. We are in Escalante, Utah. Alan, would you please introduce yourself, when and where you were born and a little bit about the family you were born into?

AT: My name is Dr. Alan Titus. I am the Monument paleontologist. I grew up in an academic family. My dad was a professor of organic chemistry at University Nevada, Las Vegas, and retired back in the 90s. My mother has a master's degree in organic chemistry and taught his labs. So, she was also involved in academics. So, I grew up in this academic atmosphere at home. Even though I think my parents were hoping I would turn out to be a chemist, one of the more hard science types, I grabbed a hold of a book called The Fossil Book by Mildred Adam and Carol Layne Fenton that captivated me. It was about three inches thick, hard cover and full of beautiful photos of all kinds of fossils from dinosaurs all the way down to little seashells. I knew after reading that book that that was something I wanted to do. I was fascinated by the history of our planet and ancient organisms and their environments and I knew I wanted to be a paleontologist. The next year my Aunt Jane bought me a rock hammer, I was nine years old. I immediately started begging my parents to take me fossil collecting, "Take me please, let's go hunt trilobites

out on Sunrise Mountain. I actually went to the Antelope Springs locality in Utah, the famous Elrathia trilobite beds, collected seashells from all the grey limestone around Las Vegas and the Spring Mountains, and the Sheep Range. I just fell in love with paleontology and I knew that is what I wanted to be. In fact, I waivered very seldom from that vision. One time I thought I might be a computer technician because I thought that would be more money, but I realized I would rather be happy than rich. So, I stuck with paleontology.

I was an undergraduate at UNLV, mostly for financial reasons, because my dad was professor and I got a discount. Then I went on to graduate school and University of Arkansas, Fayetteville, Arkansas, and finished a PhD at Washington State University in Pullman.

MH: How did you find out about the Monument area? Is it a dream job that you became the paleontologist here?

AT: Absolutely. I started…it is ironic I ended up here because I would come up here and vacation in the 80s to rock hound and hike and ride my mountain bike. I came up here to have a good time and rock hound a little bit before it was a Monument. I actually got a teaching position at Snow College right after I graduated from my PhD. Having fallen in love with this place I thought it would be a great place to take students. I graduated in ’96 which was the year the Monument was proclaimed. I thought this would be a great place to take students and teach them about paleontology and geology. I lead field trips down here from Snow College as a geology prof and really fell in love with it all the more.

Shortly after the Snow College job I was offered a position doing paleontology on the Monument, because I was intimately familiar with the rock layers and the fossils already. One thing led to another. That was a contract job and ended up getting a permanent job in 2000 as the Monument paleontologist.

MH: Tell me about the volume of discoveries that has come off the Monument since then. How many species are we talking about?

AT: To be conservative, we probably uncovered twenty species new to science in the last ten years. That is an average of two a year. That includes everything from turtles on up to dinosaurs, mammals, things like that. There were about twenty- five species of mammals named that are endemic to this area before I even started this job, from the fossil record. Our efforts have been focused on bigger animals so all the stuff I am talking about, the twenty species named since 2000 have all been larger animals, not tiny little mammal teeth, but dinosaurs, turtles, crocodilians.

MH: And what about the crocodile head that you were looking at in Colorado was that in Fruita?

AT: Two years ago we found a partial skull of a giant crocodile, whose head would have been about five feet long. We just found the upper jaw and part of the snout and the roof of the mouth all attached together. We got pretty excited because it was the first record of this whole family of crocodilians in Utah. It was the biggest crocodile that had ever been found in Utah as an individual. It was a very well preserved chunk of skull and there had never been skulls for this animal ever found anywhere outside Texas, Georgia, and

Alabama. So, we had a lot of first with this find. We decided, after the scientific paper got underway, that we would go ahead and reconstruct this entire animal's skull, at which point I took the original bone over to Fruita to a guy named Rob Gaston, who has a business called Gaston Designs. His specialty is reconstructing skulls out of pieces of bone and things like that. That is what he is in the middle of doing right now. He is in the middle of recreating this five foot long crocodile head that belonged to a thirty-three foot long individual. It will be an exhibit then, to take around to the local communities once it is finished.

MH: The exhibit will be great for the communities to see. Which brings me to another point, when we were on that site in the Blues I think I asked you this question about eight years ago. …and that is how do the communities stay in touch with those finds here; the finds have to go away to be researched and studied, but will those bones come back? So, how do you see that as part of the natural history …

AT: We can address that in two ways. The county has, Garfield County in particular, has it in their county plan to have a museum here and intend in the long term to be a repository for some of these wonderful fossils so people visiting the area can see the original material, the real bone. In the interim, the official repository for the BLM in the State of Utah is the Utah Museum of Natural History which is the arm of the University of Utah, a state institution. We have been very tightly partnered with them. We support them, they support us. They are providing all the curation and storage space for these specimens. They are providing the bulk of the preparation, which is the time consuming removal of rock off the bone and stabilization. They are also doing a lot of the research on these specimens. Which is all very important for us, because if we just dig them out and throw

them in a basement, then they are useless. The work has to be done; the research has to be done. I think the research is the most important part that has to get finished because it is only then, after you have researched it that the true significant of these resources become apparent. If it is just another bone, well, so what. Now that we know through our research that this is the only place in the world to see all these cool things then it really becomes unique, significant. Even though the real bone would be reposited in Salt Lake, would be to take as many of the really spectacular specimens that we have found, mold them and cast them and make duplicates that are almost indistinguishable from the originals and bring them back down into the communities as a series of traveling exhibits.

MH: And how about the research facility that is adjacent to this building? Do you see any future for the use of that field laboratory?

AT: Yes, I just had a long conversation about that with Carolyn Shelton. It is funny you should ask. The vision for this particular lab is clean, a clean lab. So, it is a place where botanists or water quality people or whoever, can come in and have a fairly clean environment to do preparation for isotope analysis, things like that, that require very clean sterile conditions. The vision is not to ever turn that into a dusty, dirty paleo lab. Paleo labs are notorious for being the dirtiest most awful labs in the science realm, mine included. There are opportunities here in the community to have a place like that. I would really like to see something like that come to pass. There is a local guy, a paleontologist that is retired who actually bought this huge property and intends to turn it into a paleo lab for visiting scientists.

MH: That is what I am interested in, how can communities encourage people coming here to do field work, study and have the place become a Mecca, if it isn't already.

AT: Right. What we are talking about is logistics, where will they stage from, where is their home base going to be. They are going to come. Are they going to be based out of Tropic, Escalante, or Kanab? It is all about making the Monument a science friendly environment. It always has been. If anyone in the Monument loses that vision, they need to reread the Proclamation. It has always been the intent to be an outdoor laboratory to conduct science. Part of our vision to make it more researcher friendly is to have facilities in the surrounding communities where these people can come and take showers and prepare their specimens, fix their samples up and do whatever they need to do to stage and get the work done that they need to do. Also, to make the bureaucracy as pain free as possible. We need lots of people to come help us, 950,000 acres.

Dr. Titus takes a moment to describe a specimen he has brought with him for a presentation.

AT: This knobby lumpy little piece.

MH: How did you know…?

AT: I just know, it is not wood, it is bone.

MH: When I think of all the times I have looked at something like this and thought, "This is a piece of wood."

AT: I'll have to admit, the first time I saw a Tyrannosaur nasal, I thought it was wood. It looks like wood.

Regarding the importance of the study of paleontology on the Monument:

AT: The study of Earth history does a lot. Going along, evolutionarily we have got the appearance of flowering plants which radically alters the ecosystem at this time; we have the flourishing of placental mammals and marsupial mammals at this time which also radically effect the ecosystem. A lot of new players coming in and a lot of old ones

exiting the stage, so it is a very exciting time dynamically for the evolution of life and of the earth and ultimately the story ends with the extinction of the non-avian dinosaurs, which is one of the great mysteries that science is still trying to solve. You add all that up and it makes for one of the most exciting places to do research. On top of that we have one of the best records contained within the rocks here to answer questions about that time in Earth history than can be found anywhere else on the Earth.

MH: Now, you briefly described that during your presentation; it is a convergence at a certain point in time where you have a giant story book, or trough, of all this geology, paleontology. You called it the perfect storm.

AT: Yes, the perfect storm of paleontology where you get all the conditions just right to not only record each chapter in this story of Earth history but you get the conditions that you need to preserve the organisms and the record of the surface environment that existed then as well. In some cases you can record say, for instance, a fairly complete story geologically, but the record is void of fossils. So, you have to speculate about what kind of organisms may have lived here. In cases like Grand Staircase and the late Cretaceous you not only get the story geologically, but you get the fossil story integrated very tightly with the geology story. And you can say much more about ancient environments and ecosystems and trends and conditions over time, climate change, all these sorts of things captured in intimate detail within the rocks here on the Monument.

MH: What is the current research going on here, on the Monument?

AT: Every year we document two to three hundred new vertebrate fossil sites, that represents the total work of about twelve different institutions: University of Montana, Alf Museum, the Museum of Natural History, Utah Geological Survey, University Colorado, Boulder,

Weber State, Oklahoma Museum of Natural History, and on and on…Lots of institutions out there combing the badlands for these fossils. They are systematically surveying the outcrops, trying to find fossils in new places and also trying to fill some of the gaps we have in the stories in some of the better known places.

And we find new species; this is an amazing place, because every year you can lay your money on finding something totally new to science. There are not many places you can still do that in the world. There is so much potential. We have about a million acres of fossiliferous badlands of Cretaceous age alone. That's not even talking about another million acres of Jurassic and Triassic rocks, but we have about a million acres of Cretaceous rocks alone and I estimate we have surveyed about 50,000 of those million acres. Lots to do…we shouldn't be sitting here talking about this, we should go! (Laughter)

MH: Can you tell me about a day in the life of a paleontologist in this region?

AT: I come into to work at eight, I sit in my cubicle until about six o'clock and then I go home. (laughter)

MH: No, no no! Tell me the exciting stuff.

AT: A typical day for a paleontologist; there are generally two different things in the field. You either, one, are looking for new sites and gathering broad scale research information about stratigraphy or environments or context for fossils, that requires a lot of hiking. You have to put on your boots and get your Camelback and stuff your pack full of Power Bars and you hike and hike and hike and you are taking notes and making readings with your GPS and collecting small samples and looking for new sites and that sort of thing. You are really mobile and covering a lot of ground.

The alternative to that is working a quarry. So, these are the two things you typically do; you either are out hiking a lot or you will actually sit in a quarry for eight to ten hours banging on rock with a sledge hammer and a chisel, taking the waste rock off of a bone layer and carefully jacketing or protecting the bones that you expose and getting them ready to actually remove and place into a protective environment to preserve them. So, it is one or the other. There are all sorts of extremes of heat and weather and biting bugs and sticking your hands under rocks and getting stung by scorpions and all the other hazards that go along with this, but it is usually one of those two things; hiking in the hot sun or sitting in the hot sun and breaking rocks with a sledge hammer. (laughter)

MH: Or using a tooth brush.

AT: Not that, that is an archeologist.

MH: One time the school took seventh and eighth graders out to one of the sites in the Blues. We hiked out there..four or five years ago.

AT: Oh, that was the ceratopsid site, I remember that.

MH: It was kind of funny, the guys out there working were plastered with sunscreen, and bits of dirt are stuck to it. All the kids were interested to know what was on the guys' faces.

AT: Dirt. (laughter)

MH: I think there was a volunteer from the Netherlands.

AT: Jella Viersma.

MH: They were using some toothbrushes, I think. But they showed us the Tyrannosaurus Rex teeth…?

AT: Oh, yeah, it was not a Tyrannosaurus Rex, but it was a tyrannosaur's teeth, it was in the femur and you could see the bite marks on the bones.

MH: That was really cool. What kind of dinosaur was that again?

AT: That was Utahceratops, a type specimen for Utahceratops, which was sort of a vanilla horned dinosaur like a horned dinosaur, like a Triceratops. It is the most common horned dinosaur we have here.

MH: What is it like to discover new species, like you have been doing here?

AT: There are so many ways for me to answer that question, because it touches me at so many different levels. There is the aspect of discovery that touches me at the pure treasure hunter level. When you are out looking for that priceless find, and Grand Staircase is the kind of place that will reward you, you will find something like that Tyrannosaur nasal. That is one of a kind. You know, just like the guy (Mel Fisher) who found the Spanish galleon full of gold, you have found a one of a kind specimen. This is the only one that science has ever seen, and so there is almost a bit of an ego trip that starts, "I found the only one!" That is one aspect to it. Then, there is the awe and the wonder of touching the past. I am connecting with an organism that lived and died seventy-five million years ago when earth looked like an alien planet. I am touching the past, but I am touching a different world altogether. There is an inherent awe in me to touch a different world, an alien world, just as if I had gotten in a spaceship and flown to Alpha Centauri and got off on an alien planet.

MH: I love that analogy…May I ask you about the perspective part, you have an interesting and enviable position as a paleontologist, to have all these new finds. It's not just like once in your lifetime.

AT: No, we make them every year. (laughter)

MH: In the world of paleontology how often does that happen?

AT: In the world of paleontology, new finds are made every year in all continents. They are finding new stuff in China still and certainly in Mongolia. Madagascar has seen a slew of very important discoveries. They are finding some really cool stuff in South America right now. But as far as North America, there are not a lot of places you can still go, because we have been hunting bones here for so long, since Cope and Marsh in the 1860s and 70s, since Powell ran the river; we have been combing the west for bones for a hundred and fifty years. There are not a lot of places you can go and still lay money that you will find something new and cool every field season, and this is one of them. This is one of those few places we have left that you can still do that.

MH: And that is lucky, and correct me if I am wrong, but it gives you greater access to interns and researchers, students who want to come here.

AT: Yes. And they want to be a part of that excitement. Believe me, because there are not a lot of places left that you can do this, it gets a bit competitive among the paleontologist. They start to get territorial and say, "You stay out of my sandbox, because I am the one who wants to make the important discoveries here, so I can get my NSF grants and I can keep my research program running strong."

MH: So, who coordinates that aspect?

AT: That is my job. I have had to be the bad guy every once in awhile; I will have to tell a researcher that, "I am sorry, but you can't play in that sandbox, or you need to talk to this person before you go in there", because otherwise there could be bad feelings. I have actually had to take specimens away from people, because it was not appropriate that they were working on it.

MH: Speaking of taking specimens. Why do you move them after millions of years?

AT: Let's explore that. First of all when the police go to a crime scene, they collect the evidence, why? Why don't they leave the spent shell casings and the blood and don't bother to sample the DNA. It is a mystery and they want preserve all of the clues so they can tell the most accurate story as possible in the court room.

The same is true for a paleontologist. When we got out to a site, we have our own paleo CSI. We have a dead animal. The environment that it lived in is only represented as a shadow of its former self. We have to not only reconstruct this animal, put flesh back on him and make him a living breathing organism, but we have to reconstruct his environment. To do so involves taking the bones out of the ground and examining them from every angle, that is the very first step.

Without taking them out of the ground and looking at them from every angle, we can't be sure what critter it really is. You have to take those bones and compare them to the bones of other animals that have been found elsewhere to say definitively is it species A, B, or C? Or a new one. Once we have examined the bones and figured out what kind of animal it was then we need to sample the environment. We need to sample the kind of plants and invertebrates, snail shells, bird claws, turtle shell fragments, fish scales, things like that, that help us to paint a clearer picture of the environment this animal came to rest in. It is like reconstructing a crime. Once you have assembled all that evidence, it would be a mistake to leave it in the field and let it weather away, because it will. Believe it or not, even thought those bones have sat there say for instance seventy-five million years since they were buried, once they get within ten feet of the surface they start to decompose. Plant roots can penetrate ten, fifteen feet into the subsurface and start to break bones apart and extract the nutrition out of them, the phosphorous. When they get even closer then

water seeping in freezes and thaws and busts these bones up into thousands of fragments, all to be slowly washed away. We can lose bones in certain rock types within a couple of years if they are not carefully hardened with glue and preserved. So, even though they have been carefully entombed in a protective rock matrix for seventy-five million years once they get within ten feet of the surface, they have a very finite life. We feel it is up to us to preserve this heritage, this resource so that others that come after us can examine the same evidence that we had access to and see if they draw the same conclusions.

MH: As far as technology goes, might someone in the future have …

AT: …different techniques. Yes. The sure thing is, if we leave it in the field it will be lost to everybody within a matter of a years. These things are very ephemeral, very finite.

MH: Can you tell me a little bit about this most recent find, so we can get the whole story.

AT: Yes, well last week I was sitting in my cubicle (laughter) and I got a call from a volunteer who has worked for me for several years. His name is Scott Richardson. He said, "Alan, I am standing on a Tyrannosaur site." He actually could get cell phone reception from where he was at. I didn't believe him, I said, "No, Scott, you have led me on a couple wild goose chases with Tyrannosaurs before, and they always turn out to be Hadrosaurs or something, not quite so exciting." He said, "No, Alan, I am pretty sure this is a Tyrannosaur. I can see the hollow cores in the bone that are weathering." At that point he got my attention because that is the definitive way to tell. And he knows what he is looking for there. I said, "I'll be out tomorrow." I drove out in the field and met him and we hiked up to the site together and sure enough he was standing on a associated skeleton of a Tyrannosaur. And what was visible right at the surface included a shin bone, two skull bones, a toe bone and a hip bone. I realized at that moment that I was standing on

North America's oldest associated Tyrannosaur skeleton, because we have never found Tyrannosaurs in this formation before, or these age rocks anywhere else in the continent, the Wahweap Formation. It is not one that we have been making most of our finds in, most of the finds come out of the Kaiparowits layers, about fifteen hundred feet up. So, we are way, way down in time, five, six million years older than most of the major finds we have made in the Kaiparowits, so this would be the great, great granddaddy of the Tyrannosaurs we see in the Kaiparowits, and the great, great, great, great great granddaddy of T. Rex. Very exciting find and one of a string that we have made over the last few years.

MH: Is it the current environment on the Grand Staircase make it such a rich place for finds, is it helping you?

AT: Yes, and I will tell you why. It is because the elevation that most of our Creataceous rocks lay at are conducive to sparse vegetation and lower rainfall, in sage brush and PJs, scattered PJ cover (pinyon juniper) but not extensive plant cover, not extensive soil development. If you were to go up in elevation and see these same rocks on Dixie National Forest, which they do occur up there around Pine Lake and places like that, they are just not exposed. If you get too much green, then you don't have the volume of surface outcrop that you need to scour and find lots of stuff. It is just the elevation that all these rocks happen to be eroded to right now; if they were any higher then they would be treed over like they are on Canaan Peak and Upper Valley.

MH: I was thinking of terms of roots, holding soil, but in the same way, a lot of plant life with root systems would damage something in the ground.

AT: Plants destroy fossils, they digest the bones. Now, I got in trouble one time with our botanist for saying this, but, plants are looking for nutrition in the soil, and these bones are a huge reservoir of phosphorous which is a micronutrient that they don't usually have a lot of access to. When a plant finds a bone, it will dissolve it, it will break it up into thousand of little fragments and the rootlets will slowly pull phosphorous out and you end up with a big root ball where the bone used to be.

MH: Which would lead me to ask….

AT: I love plants, plants are great.

MH: If you are out hiking around and looking…

AT: You are looking for bare areas; you want to stay away from plants.

MH: I was wondering if you can tell by looking at a plant if you have…

AT: …if you have a superfeed going on, super green and all the rest are grey and kind of dying…(Laughter) No, it doesn't work that way. We look at bare areas to start. We start our prospecting there, we don't want soil cover, we don't want plants. Once we get in there, then we start looking for bone fragments. You are hoping you will find something that is just starting the twenty to fifty year cycle of erosion and being lost. Rather at coming in at the tail end and finding a hundred yard long stream of bone fragments going down the hill and nothing left in the outcrop, you are hoping to come in and find the first few fragments, that are just starting to poke out of the surface and the whole rest of the animal is still in the hill, not washed away.

MH: If you wouldn't mind indulging me a little bit, would you mind talking about Collett's and the dinosaur tracks that were left there?

AT: The Twenty Mile Wash Track Site, as we have come to call it, was found in 1998 by a guy named Josh Smith who was working for me as an intern. He was looking for slick rock areas to ride his mountain bike on. He found this one yellow slick rock area up Twenty Mile and he was also being paid to look for fossils, so he knew what he was doing looking for fossils. He hauled his bike up there to ride around and immediately saw tracks and got excited and called me and then called Dave Gillette, who was the State paleontologist at the time. We went up there and we were blown away, thousands of dinosaur tracks up on that surface. The rocks date to the end of the middle Jurassic or the every earliest part of the late Jurassic, so about one hundred sixty million years ago. There is almost no skeletal evidence for dinosaurs in North America from that time period, but there are several places we can see their tracks. Because these tracks are the only evidence we have for dinosaurs of this age, this is one of the only track sites we know of in this part of the world for that age, we got pretty excited. We contacted some high-tech people to map the site with sophisticated GPS and stereophoto imagery, created a baseline map. It appears there are three kinds of dinosaurs represented there. Ninety percent of the tracks at that site are one sort of three-toed meat eating dinosaurs. We called the track Megalosauripus, but it probably belonged to a dinosaur that looked similar to something that is known as Megalasaurus or Allosaurus, one of those two types of dinosaurs. There is another site where we see footprints that look like a sauropod or long-neck dinosaur, a little one, and there is a tail drag associated with that particular track that is unique as far as we know. There are no Sauropod tracks with tail drags known anywhere else. I speculated that it could have been a big crocodilian, but that is unlikely, I think it is probably a Sauropod. There is a third track maker that we think

based on the width, the stance and the bluntness of the toes that it is an Ornithopod, actually like an iguanodon, a plant eating dinosaur.

MH: I was fascinated in the tail swag.

AT: It is very rare, very rare in any form, even in Crocodilian track ways, to see tail drags where you would expect them. Some people are skeptical that it even is, but I don't know how else to explain that.

MH: I really appreciate your time. I know you are very busy. I think you have an exciting life and a great perspective and way of communicating that to others.

AT: Well, thank you. I just want people to catch the vision this place is cool, it is outstanding.

MH: You did a good job of that. Thank you again.

(there are some minutes of repeat in the final minutes of the interview.)

Interview ends at 38:11 minutes.