Ask A Biologist Vol 086 (Guest Tony Falsetti)

Skeleton Secrets

Dead men tell no tales, but their bones can. It just takes a particular kind of scientist to read the clues that tell the story. Dr. Biology sits down with guest Tony Falsetti, a forensic anthropologist who knows his way around a skeleton. They talk about the role of forensic anthropology and some of the mysteries of history Tony has helped to solve.

Transcript

Dr. Biology: This is "Ask a Biologist," a program about the living world, and I'm Dr. Biology. What do century-old mysteries, cold-case files and bones have in common? While you're thinking about that, who are the people that help discover important clues and answers to unsolved cases when there is little left besides a skeleton or a few bones?

If you haven't figured it out, we're going to be entering the world of forensic anthropology. The forensic anthropologists, they're people who can literally piece back together the bones of a person to help give them a name or tell how they died.

Now, if we go to popular culture, there's the television show "Bones." This is where our forensic anthropologist is paired with an FBI agent. Like the character on the television show, the forensic anthropologist has become a key role in solving crimes, and helping to understand more about our history.

My guest today is Tony Falsetti, a forensic anthropologist and Professor of Practice in the Math and Natural Sciences Division of the New College of the Interdisciplinary Arts and Sciences at Arizona State University.

He has served as the Deputy Director in the Forensic Sciences Department at the International Commission for Missing Persons, and is also a Diplomat of the American Board of Forensic Anthropology, and a Fellow of the American Academy of Forensic Sciences. Tony has worked on several historical cases, including identification of the missing children of Tsar Nicholas II.

He's also worked on several major mass fatality incidents, including the Oklahoma City bombing, and the World Trade Center. Today we have a chance to learn more about the world of forensic anthropology, and how he and his colleagues helped to find answers to mysteries with little more than the bones left as clues.

Tony Falsetti, thank you for joining me today, and to talk a little bit about forensic anthropology.

Tony Falsetti: It's my pleasure to be here.

Dr. Biology: I want to talk about something before we jump into the world of anthropology. I want to separate out two things -- anthropology and archaeology -- because they both begin with an A, and there are times when people mix those up. Can we talk about the basic difference between those two?

Tony: Yes, we can. Anthropology, I believe, is the overarching study of anything that has to do with humans, whether it's our evolutionary past, our relative nonhuman primates, our cultural attributes. Then the evidence of our past behaviors is the focus of archaeology. They are our brethren trained in anthropology, but whose focus is on the things we leave behind.

Dr. Biology: The reason why I think there is some confusion is you're often working in the same place.

Tony: Yes, absolutely. As a biological anthropologist -- a subspecialty of that is forensic anthropology -- we use archaeological techniques all the time. In the world of forensic anthropology, what you're trying to do is capture a behavior that happened in the past.

That skeleton, by the very nature of it being a skeleton, arrived before you did, and other behaviors occurred. We use techniques of archaeologists to capture that information.

Dr. Biology: Today, when we think of forensic anthropology -- because I brought up these shows -- we're thinking about them as solving crimes. That's what their main role is. In fact, that's not what forensic anthropology does all the time. There are a lot of other things that are involved. Can we talk a little bit about that? For example, the historical cases that you get involved in?

Tony: Yes. Forensic anthropologists do a lot of different things. Criminal behavior, past criminal behavior, is just one of them. We are able to use the techniques in forensic anthropology and forensic archaeology to look into the past.

I've had the opportunity to work on some pretty interesting cases including Tsar Nicholas and the Romanov family, Samuel Washington -- George Washington's lesser-known brother -- and currently, here at ASU, we're working on the skeletal remains of an Afro-Brazilian historic character, Chica da Silva.

Dr. Biology: What brought you to that case?

Tony: It's a very long story, but the Chica da Silva is a colonial-period person who was a slave, and who was freed by her third and final master. They entered into a relationship for 13 years. It's a love story of sorts, but this was a woman somewhat like the US's Sally Hemings. She is revered in Brazil, and particularly the Afro-Brazilian populations.

Why a forensic anthropologist? There hasn't been an image or picture of her, ever. I was asked, along with my wife who's a forensic artist, to go to Brazil, and we went to Brazil. My wife is Brazilian, so I think that helped. We performed an exhumation this past November.

Now the bones are here at ASU. We will be doing not only a physical reconstruction of her skull, but then an artistic interpretation based on contemporary data, and then some DNA analysis as well, to get a better picture of this woman's genotype, so that we can hopefully compare it to some living relatives.

Dr. Biology: Talk a little bit about genotype.

Tony: The genotype is our genetic profile. It's what we look like inside ourselves. Then our phenotype is what we look like when we walk around -- hair color, eye color, those kinds of things.

Dr. Biology: We've talked about the idea of identifying people. In particular, in your case, with the skeleton structure -- bones. What can forensic anthropology do in order to identify a person? What can you actually ID?

Tony: What we can tell from the human skeleton. I'll talk about two things briefly. There's the identification. There's the positive identification of an unidentified person. Then there's, what can we tell from the human skeleton?

We can determine someone's age, their age at death. There's a number of different indicators on the skeleton. We would look at growth, and we would look at the joints, knees, shoulders, the back, the ribs and, certainly, the teeth. Those are good indicators of age up until a certain development, so up until about 25 years of age.

After that, we look at other indicators like the pubic bone -- a part of our pelvis. We can determine the sex of an individual, after puberty. After about 14, 15 years of age, we will look at the pelvis. The female pelvis is different than the male's. It's designed for the potential for childbirth, it is broader.

We can look at the skull. Males tend to be a little more robust or rugged, so we look above the eye orbits for brow ridges, and there is a bump on the back of the head -- our nuchal crest. They're just more developed in males. There's a lot of other subtle characteristics throughout the skeleton that generally tell us male from female.

Dr. Biology: What about height?

Tony: Height is fairly easy, it depends on what remains you have available. Generally, what we would like is the femur or thigh bone. We want the largest piece of your stature, so we look for one of the long bones of the body, generally our limbs.

The most difficult thing I think it is for an anthropologist is ancestry. We are very good as anthropologists in determining where your skeleton might be from, where your ancestors may have come from.

What is more difficult is to how that person might self-identify. That's where it gets trickier, but we're pretty good at ancestry. Then we can also determine about how long someone's been dead by looking at the condition of the body.

Dr. Biology: What can't it do?

Tony: It depends. We're getting better at certain things. We're now, by looking at teeth, able to determine where someone might have lived for a certain period of time, by looking at the chemistry of your teeth. Whether you have a rice-based or a wheat-based diet, or what kind of chemicals were in the soils where you grew up.

We can't tell eye color. We can't tell hair color. We can't tell how long your hair might have been or a hairstyle.

Dr. Biology: Now you mentioned a bit about what you could find out from a skeleton, and I think you mentioned it depends on how much of the skeleton you have. I suspected it also depends on the condition of the skeleton. When I say condition, it's not always in its normal pieces. Let's take the skull, for example. It often can be in multiple pieces.

Tony: Yeah, the condition of the skeleton is really dependent on the environment the skeleton is found in. It's dependent on things like weathering; to be honest, animal activity; and then the kinds of injury that may have happened to that person can fragment that skeleton, so you don't always have the entire thing to deal with.

Dr. Biology: Would someone in your role be...what would I say...putting together the ultimate jigsaw puzzle when you get some of these bones.

Tony: There have some instances where that's exactly what we're doing, is putting together puzzles, putting together individuals based on...we match fracture patterns, we match edges, much like a puzzle. We know what the picture's supposed to look like before we start.

Dr. Biology: That does help. It's like the puzzle pieces. That if you don't have the cover of the puzzle on a box, it makes it really tough to put it together. In this case, knowing your anatomy is really important.

Tony: Absolutely. Knowing not only the number of bones, but how they articulate, how they are formed in the body, and then knowing the rest of the anatomy is also important.

Dr. Biology: There's another career that's out there that's closely tied to forensic anthropology, and that is the forensic artist. How much science and how much art is in there? This is really an interesting challenge?

I suspect they need to know, again, their anatomy really well; but there are other pieces to it that, when you try to put, basically, flesh back on a skeleton, how do you know how much and where?

Tony: Forensic art is a mix of art and science. Most good forensic artists will have taken anatomy or at least osteology, and some participate in research. Right now, one of the areas that is being examined is what you alluded to, and that is how much tissue to put on any particular part of the face.

They're using technology, such as CAT scans of individuals, and a CAT scan is just a digital picture of a person. Using the computer you can remove the skin. You can remove the tissue, so it's sort of a layered approach. What they're finding is they're able to get more accurate tissue depths.

When the anthropologist tells them that the skull that they are looking at is of a person of African ancestry, it's a female, and this person is five-foot seven, and, more importantly, they're 35 to 40 years of age, then the forensic artist will go to those tissue depth records. They'll have a place to start, a solid anatomical place to start.

They're learning more and more what the underlying skeleton tells us about how we look. Then the art comes in in how they form that face, but they are given a lot of the underlying science -- again, some of them are participating in research themselves -- from the anthropologists, so it's a good working marriage.

Dr. Biology: With all the cases you've done and all the identifications you had to do, I was really curious about the one with Samuel Washington. First of all, I have to admit my history teacher would be upset because I didn't know Washington had a brother named Samuel. My question is why were you drawn into this case? What was the reason for it?

Tony: I was drawn into this case by a man named Jim Starrs. Jim Starrs is an attorney and a professor at the George Washington University in Washington DC. He is a professor in Forensic Science. This instance, this case if you will, was they essentially had lost track of George Washington's brother, Samuel.

They believed he was buried on this particular piece of property just outside of Virginia, so it was just in West Virginia, across the Potomac in Washington County. The Washingtons had had quite a bit of property in old Virginia, before it became divided into two states. There was an issue with the property. It was designated historic and there was some financial issues.

The goal was to find the remains of the president's brother. It was fascinating from the perspective of not only historic archaeology, but forensic anthropology. One of the things that we discovered was that the historic cemetery had clearly been moved over time because, when we were there, there was a cemetery and it had a stone wall around it. Inside the cemetery were headstones.

This should have been a very simple exhumation. We exhumed the one that was believed to be Samuel Washington. There was literally no body there. There was no coffin hardware, no evidence that it was actually a burial, and so while he wasn't there we moved to the next.

What we discovered was that there were no bodies under those headstones. Then we brought out the ground penetrating radar. From a technological point of view, we put everything we had into this. We ultimately found all the skeletons, but they were 20 meters away, all of them.

Either what we believe was the wall was put up well after those bodies had been buried, and the headstones were probably lying down slope from where they were originally. They built this historic cemetery and put all these stones up, but there was no body under them. It was intriguing. The fun thing about the historic cases is there's generally not any real criminal issue.

It's more a matter of using forensic sciences to address historic questions. We worked closely with the Armed Forces DNA Lab and they were able to extract DNA from just small finger bones, which they hadn't done before prior to this. Each one of them you sort of contribute a little bit to either the methodology or the technology of forensic science.

Dr. Biology: Right, I can see it. It would be...what is it? Solving a mystery.

Tony: Yeah, solving a mystery or contributing to the historic record. That was very similar to the Tsar Nicholas. The Tsar and the majority of his family were recovered in 1995, but there were two people missing, and that was believed to be Anastasia and Alexei.

For years there's been this sort of myth that the two youngest bodies were blown up or they were burned in their entirety, and this gets built into the historic record. Disney makes movies about Anastasia. Anastasia escapes and lives in Charlottesville, Virginia, as Anna Anderson.

One of the satisfying things about that case was actually finding those two young bodies in 2007, only about 90 meters away from where the first nine were found, writing a historic fallacy in that instance.

Dr. Biology: Do you have a particular favorite way of identifying a body? Is there something that you go to almost immediately? It's not necessarily the answer, but it's something that you just find works really well?

Tony: Frontal sinuses, and I'll tell you why. The sinuses above our eye orbits. We have sinuses throughout our face, in our cheekbones, and in our forehead, so that when we have a sinus infection that's where the pain is. Frontal sinuses are the anthropologists' fingerprints, if you will. We believe them to be unique, although we obviously haven't sampled all of them in the world.

I go to these in many mass fatality situations because we have antemortem records of the people that we believe to be missing or killed. For an example, in a plane crash. Just sorting through the frontal sinuses is a very quick way to either exclude someone, and then include just a handful of people where you can study it more carefully.

Dr. Biology: Oh, I never knew that.

Tony: Yeah, they're really intriguing and there's been a lot of work done. Because we obviously don't know all of the patterns, we've applied some different statistics to that so that we can be more accurate in our estimations.

Dr. Biology: Let's talk a little bit about bones in general, actually bones and teeth. A lot of people think teeth are bones, and they're not.

Tony: They're not.

Dr. Biology: One, the biggest difference between them is the dentin. They both have calcium, and you mentioned that's one way that you can figure out, sometimes, where people have been living.

Tony: During dental development prior to age of six. We choose the age of six because that's when you get your first permanent molar. Every organic compound that you've taken into your system, whether it's through your diet as being rice-based or wheat-based or depending on where you've live.

If you're living in an area that used to be highly volcanic, it's going to certainly have a different soil composition in the southeastern part of the United Estates. This chemical isotopic signature gets bound up into the sealed part of the tooth.

Dr. Biology: Isotopic?

Tony: Isotopes are just sort of the chemical signatures of anything. For example, the soil by your home might have a certain chemical signature, which means it has a certain amount of, let's say, iron or iron material, so ores or things like that.

That gets embedded into your dentin, and the enamel seals that. If you were to move, [laughs] well there's about six more years until the 12-year molar comes in. If you moved across the world, we'd want a sample both of those teeth, because they will likely have different signatures.

Dr. Biology: Then back to bones. We have a question that comes to "Ask-A-Biologist" a lot. That is, how many bones are you borne with versus how many bones you have today? Now, I'm going to go the easy route here.

I'm going to say how many bones the typical human body has is 206. This is a number that most people would be able to remember from now on because each of your ears has three tiny bones in it. If we take those three bones out -- which typically would fall out if the skeleton is a typical skeleton -- you'll have an even 200.

That's the easy one, so I'm going to leave the hard one for you. How many bones are you born with?

Tony: I think the most honest answer is, what do you consider a bone? [laughs] Because I've seen numbers of 450. It's like, "Well, OK." It's really, at birth, we're basically sort of a cartilage model of what our bones are going to grow into.

One way to tell is, if you find a baby, ask permission and see if it'll stand up. It can't because it doesn't have a hardened skeleton yet. Generally, at about six months when they start to roll over, well that means their upper body is developed, so the humerus or the bones of the upper arm are calcifying and turning to bone.

When they pull themselves up between 9 and 12 months, and they start to take those steps, that's an indicator of what's going on in the lower part of their body. Their skeleton is beginning to calcify, or ossify, and become bone.

Dr. Biology: Right, becoming hard, rigid.

Tony: Yes.

Dr. Biology: It makes sense that, especially for childbirth, giving birth, to have something that isn't quite so rigid going through the birth canal.

Tony: Right. [laughs] That would complicate things greatly, yes it would.

Dr. Biology: Right, so the answer to this big question that everyone wants to know is how many bones are you born with. Well, it could be a wide range, but again, as you said, is the definition. Are we going to actually say calcified bone? Do you have calcified bones when you are born?

Tony: Parts of the skull. Even right at birth most infants, if you have a look at them, they are kind of odd looking, and there's a reason for that. It's because the bone of the skull can overlap one another to fit through the birth canal. Then, usually within 24-48 hours, begins to fan out and look like a skull. Those bones are going through ossification post birth as well.

Dr. Biology: All right, on the "Ask a Biologist" program, no one gets out of here without answering three questions, so I'm going to get started. The first one is, when did you first know that you wanted to be a scientist or, in your case, a forensic anthropologist?

Tony: It was my junior year of college. I took an interim course in between two terms, and it was called, "Human Identification." This was at the University of Tennessee in Knoxville. This course was taught by a man by the name of Bill Bass. Bill Bass was the State Forensic Anthropologist.

Prior to that, I was a political science major, pre-law. I took this class, and it was less about the skeleton and the anatomy, but more of the ways in which science could be used to answer questions. He was very good at communicating this in a compressed period of time.

From that course on, I became a Human Biologist/Anthropologist. It really was just that one course that really swayed me in this direction.

Dr. Biology. Wow, that's amazing, but not all that different from some other stories I've heard. That there can be a really key moment in life that changes your trajectory. Let's move on to the next question.

This is one where I take it all away from you. You can't be a Forensic Anthropologist, and since you're in the university, I'm going to take away your teaching. What would you be, or what would you do, if you could do anything?

Tony: That's a good question. [laughs] If I could do anything, and I couldn't be an anthropologist, I think I would like to rebuild historic cars.

Dr. Biology: Very good.

Tony: I have done a little bit of that. I built an old Jeep one time, and it was so much fun. [laughs]

Dr. Biology: You'd be an antique car restorer?

Tony: Yes, I think so. Yeah.

Dr. Biology: The last question, what advice would you have for a young CSI scientist or someone who wants to be the Forensic Anthropologist? What advice would you have for them?

Tony: My main piece of advice would be to pick a science that you're passionate about. You have to be passionate about what it is you do. I believe that no matter what it is you're doing, but in science in particular. This is kind of an odd thing, but I've grown to respect the ability to speak another language.

Not only does it expands your brain, but it expands the number of persons that you can interact with in the world. It is true that the language of science is primarily English. However, speaking with colleagues about topics in their own language is a wonderful thing to be able to do, because it expands beyond the written, if you will.

I would tell someone to put some energy into that, make sure your passionate about whatever science it is, and, finally, don't into it for the money. [laughs]

Dr. Biology: Actually, it does bring me to another question. What is the career outlook for a forensic anthropologist or just a forensic scientist?

Tony: We'll take anthropologist first. Anthropologists are being hired more and more at the doctorate level by the federal government. We've expanded our efforts into identifying unidentified soldiers from the civil war on. New laboratories just opened up in Oklahoma. They are moving their anthropology lab to outside of Atlanta, however. They call it USACIL now.

Then, at the master's anthropological level, medical examiners and corners around the country are hiring the anthropologists to do not only death investigations, but the anthropological piece to that.

Now for chemist and biologist forensic scientists, labs are hiring. Not only state and federal labs, but private labs as well. I think there's a tremendous upswing in the potential for people to get hired on in those kinds of labs.

Dr. Biology: With that, I'd like to thank you, Tony Falsetti, for visiting with me today.

Tony: Thank you, Dr. Biology.

Dr. Biology: You've been listening to "Ask-A-Biologist," and my guest has been Tony Falsetti, Forensic Anthropologist and Professor of Practice in the Math and Natural Sciences Division of the New College of Interdisciplinary Arts and Sciences at Arizona State University.

For those of you who might like to explore more about bones, we have a companion section on "Ask-A-Biologist" that teaches all about bones. The address is askabiologist.asu.edu/busy-bones. Indeed, once you get there, you'll find out bones are very busy.

The "Ask a Biologist" podcast is produced on the campus of Arizona State University and is recorded in the Grassroots Studio, housed in the School of Life Sciences, which is an academic unit of the College of Liberal Arts and Sciences.

Remember, even though our program is not broadcast live, you can still send us your questions about biology using our companion website. The address is askabiologist.asu.edu, or you can just Google the words ask a biologist. I'm Dr. Biology.

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