



Episode 801, Story 2: Space Boot

Elyse Luray: Our next story takes us to the moment when humankind first slipped free of earth's gravity.

Archival: JFK: "I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the earth."

Elyse: 1961: U.S. scientists are in a no holds barred race to beat the Soviet Union to the moon. But first they must break free of earth's gravity. In April of 1961, the Soviets launched a man into space, marking the first time that humankind has experienced complete weightlessness. But no one knows what prolonged exposure to weightlessness will do to the human body. President Kennedy's promise means there's no time to lose. Engineers must invent ways to overcome the challenges of living in Zero-G. Fifty years later, Chris Radus of Lucas, Kentucky, thinks he owns a prototype of one of the space-age inventions that helped man travel to the moon.

Chris Radus: When my dad brought this boot home from work and I asked him what it was, he told me he couldn't tell me, but we'd find out later.

Elyse: I'm Elyse Luray, and I've come to meet Chris to check out his father's invention. Hi.

Chris: Hi, Elyse, come on in.

Elyse: So what's in the box?

Chris: This is a boot my father, Raymond Radus, brought home from Westinghouse Electric where he worked as an engineer.

Elyse: And what year did he bring this home?

Chris: It was probably 1963, I think.

Elyse: Well it's a kind of a strange looking boot. Wow. And it's heavy. What are these things?



Chris: These are magnets. Look.

Elyse: Oh neat.

Chris: from what I understand, it was invented for astronauts to use outside the space ship during the Gemini missions.

Elyse: So these magnets would stick the astronauts to the space craft in Zero-G?

Chris: That's what I understand, yeah. That was what our family lore is.

Elyse: Chris tells me that NASA's Project Gemini's purpose was to test equipment for future Apollo moon missions. And his father had always been secretive about his work. What exactly do you want me to find out?

Chris: Was this used by NASA for a zero gravity boot and how did it work?

Elyse: Do you have anything else for me to go on?

Chris: My sister has a box of files and paperwork that we can't make heads or tails of.

Elyse: Chris hasn't seen the documents in years, but says he'll speak to his sister, and ask her to send them to me. This is my first History Detectives story on space so it should be a lot of fun. And uh, here's your spoon.

Chris: Thank you.

Elyse: Okay. As an appraiser and auctioneer I've actually sold space memorabilia before. I've sold flags that have gone to the moon, moon dust, space suits. And I've never seen anything like this before. This looks like an old hiking boot or a skiing boot and it's attached to this crazy concoction down here. It has these strange looking coils on the side. There's actually a plug here in the back. It's really heavy. I think it weighs about 15 pounds. Chris thinks this was a prototype.



It certainly seems handmade. I call the History Detectives office to see if they can find anything in the Westinghouse archives. Meanwhile, I want to look for anything resembling Chris' "gravity boots" in the history of spaceflight. Before we could go to the moon, scientists needed to know how weightlessness would affect an astronaut. They started their tests with animals. The Soviet Union launched Laika the dog into orbit on November 3rd, 1957. The soviet rockets were experiencing a 50% failure rate in 1961 when they launched the world's first manned mission into orbit. Cosmonaut Yuri Gagarin beat the odds. He said he loved the feeling of Zero-G. "Everything is floating. Everything is floating. Beautiful. Interesting." Kennedy requested congress set aside a staggering 7 to 9 billion dollars to fund the race to the moon. That set off a frenzy of invention as engineering firms like IBM, the Martin Company – later known as Lockheed Martin – and Westinghouse Electric sold their inventions to NASA. On February 20th, 1962, 10 months after Yuri Gagarin made history, an American, John Glenn, orbited the earth. The successes kept coming. The first manned Gemini launch was in early 1965. In June, 1965 Ed White exited his capsule 135 miles above earth to become the first American to walk in space. The pictures from the Gemini missions are breathtaking. But the boots White wore certainly look very different from Chris' father's. White floated around for about 20 minutes and when mission control called him inside his only response was, this is fun! White reluctantly ended his spacewalk, saying, "It's the saddest moment of my life." I received an email from the History Detectives' office and they're telling me that the Westinghouse archives were partially lost in the mid-1990's. I'm not even sure how this contraption might have worked. So I'm headed to Carnegie Mellon Engineering School to meet with Dr. Edward Furlani, a research professor from the University at Buffalo. Ed has written a textbook on magnetic materials and devices.

Elyse: Hi Ed.

Dr. Edward Furlani: Hi, Elyse.

Elyse: Nice to meet you.

Ed: Come on, follow me.

Elyse: Ed's unfamiliar with our boot.



Ed: I've never heard of this and I've worked with magnets for many years. And now that I'm looking at it I can see that there are some permanent magnets attached to the bottom of it. And there's also some coils of wire.

Elyse: What's a permanent magnet?

Ed: A permanent magnet is like a household magnet or refrigerator magnet. And when you stick it to metal it stays stuck.

Elyse: Ed thinks the presence of the copper coils indicates the boot operated on something called flux transfer.

Ed: And what I'm going to do is sprinkle the iron filings on top of the magnet. The iron filings align with the magnetic field. And those are called flux lines or lines of force.

Elyse: But what exactly is a flux transfer?

Ed: Flux transfer is a way of turning the pull of a magnet on and off.

Elyse: Was this a new invention in the 1960's?

Ed: No, but the application to the boot especially the use of the coils, if that's how it works, was totally unique.

Elyse: Ed asks me to put on the boot and see if it still works. All right, let's do it. Woo, I'm excited. I feel like Cinderella...all right, here it goes. It fits! Okay, now what do I do?

Ed: You're going to step on the front of this iron bar, and you'll see that it clamps right on it.

Elyse: This is really heavy. I'm definitely stuck to this.

Ed: Okay just a second while I hook up these leads to apply current to the coils.



Elyse: Oh, that's what the plug is for!

Ed: Yeah. And now what I want you to do is just lift your foot up and hold it at an angle.

Elyse: Wow this is so heavy.

Ed: And now I'm just going to apply the current and see if we can get the boot to release...

Elyse: Cool!

Ed: So you can see that it does work on the principle of flux transfer.

Elyse: Wow, so it works! To show me how an astronaut might use the boot Ed sets up another demonstration. I shoot a video for Chris. Woo! All right. Now I see how a man could walk on a space craft. When the boot was off, the magnet would stick him to the craft. When it was on, the magnet would release his foot so he could walk. But I don't understand how a man could hang from these magnets. They don't seem that strong to me.

Ed: Well if the boots were built in the 1960's say, then the magnets on them would have aged over time and they'd be much weaker now.

Elyse: The boot does work. But did it work for NASA? The box of documents Chris's sister has held onto all these years has finally arrived. My office has forwarded them to me. Well there's a lot of files in here. Let's see. Ah, this is someone actually wearing the boots. This looks like Chris's father, Raymond Radus. Looks like he earned some design awards so he must have been pretty good at what he did. This is a picture of a guy wearing the boots hanging upside down. So this shows that the boots really did work and they could support the weight of a man. Here's a newspaper article. It's from the Pittsburgh Press, February 5th, 1963: "New Space Footwear Shoes Human Flies. Magnetic brogans by Westinghouse will tie down rambling astronauts". The article goes on: "This simple system, Westinghouse engineers believe, may provide the answer for men walking around, in, and on the outside of spacecraft in the weightlessness of outer space." So Radus's shoes were made to help astronauts walk in Zero-G. But I find no mention of NASA in his files. This box is full of contacts of Westinghouse employees



that Radus might have known. Maybe I can contact one of them and they can help me sort this thing out. Hi, this is Elyse Luray calling from History Detectives. I'm looking for John. I make several calls before I can find someone Ray Radus worked with at Westinghouse. I find former lab technician Pat Boccardi in Monroeville, Pennsylvania.

Pat: Howdy, Elyse...

Elyse: Hello.

Pat: Nice to see you. Have a seat.

Elyse: Tell me, how did you know Ray Radus?

Pat: Well we happened to be working in the same department. Ray was an electrical engineer.

Elyse: Now have you ever seen this boot before?

Pat: Yeah I think so, I think I worked on that.

Elyse: You worked on it!

Pat: Yeah. And he designed it. It was his idea it was my job to get it all together. I did the coils. I cut the magnets. I took it all down to a local shoemaker shop and had them sew it to the bottom of the ski boot. I haven't seen it for 51 years.

Elyse: Pat says it was a thrilling time to work at Westinghouse, developing radar to help Gemini capsules dock in orbit, and, later, the camera that shot the first footage of Neil Armstrong walking on the moon.

Pat: They gave the engineers assigned projects. But they also gave them the freedom to work 10 to 15 percent of their own time on anything they wanted to do. Any idea, as long as it was on behalf of Westinghouse. It had to be something that Westinghouse would end up with.



Elyse: Pat tells me that Ratus's magnetic boots were born out of this so-called "free inventing" time. Ratus's job at Westinghouse had nothing to do with the space program, but he used this free time to get caught up in the race to the moon. I ask Pat what happened to the boots. Were they sold to NASA? He doesn't know.

Pat: They folded the department up. So Ray went to another department and I went to a television department.

Elyse: I still don't know if the boots found a home at NASA, or if some version of his technology made it into space. So I'm heading to Space Center Houston, next to the site of NASA's legendary "Mission Control." It was here that anxious flight controllers tracked the Gemini spacewalk missions. The astronaut gallery holds the world's largest collection of space suits.

Elyse: Hi, Joe.

Joe Kosmo: Hey Elyse. How are you?

Elyse: Good, nice to meet you.

Joe: Nice to meet you as well.

Elyse: Joe Kosmo has been a NASA spacesuit engineer since 1961. He shows me a flight suit, and boots once worn by Ed White. They are just like the pictures I saw. He illustrates how White used a gas jet to move around outside the capsule. I tell Joe about the boot's magnetic properties, and explain that Chris' family thinks it may have been used in Project Gemini.

Joe: Oh. I've been working with NASA for 49 years and all the space suits and the fact is that I've never, never personally, have seen anything like this. Never encountered it.

Elyse: Do you think NASA ever considered using magnetic boots for the outside of the spacecraft?



Joe: The suits back at that point in time didn't have a high degree of mobility so you really couldn't walk and it was much easier just to do the free body floating and tethering.

Elyse: A spacewalk, Joe tells me, isn't quite the right phrase. Tethering meant Ed White floated outside the capsule attached by nothing other than that thin umbilical cord. But there was another, more elemental reason Chris's father's boots never stepped into space. It's time to report back to Chris...

Elyse: Okay. First of all, thank you. What a fun trip to space that was. I explain how a magnet expert had shown me how the boot was intended to work. Your father developed a unique application for this boot. You could turn the boot on and off again and walk upside down on metal surfaces. You see how it's attached here and then it falls?

Chris: Still works!

Elyse: It still works.

Chris: Cool.

Elyse: I tell Chris his father invented the magnetic boots for the space program. But it wasn't until I'd gone to the Control Center for the Gemini Mission that I understood why the boots had never made it into space.

Joe: If it does work on a magnetic principle it produces a magnetic flux and that could seriously affect some of the guidance and navigation systems, or some of the perhaps the scientific instrumentation. I wouldn't want to be around a magnetic field.

Elyse: I ask Joe why Chris' father wouldn't have taken this into account when he designed the boots.

Joe: How much information he would have had available to him, I'm not quite sure. You got to remember we were still in the Cold War era. A lot of the aspects of the program itself were classified confidential even at a higher level.



Chris: It's still you know impressive to me.

Elyse: I tell Chris that his father was a product of his era, when the nation invented technologies for NASA at a furious pace. Some made it into space; others did not. People like Ray Radus were given the resources and the opportunity to try anything – and sometimes to fail – all in the pursuit of one day putting a man on the moon. Your father obviously thought of a very original way to use these boots. And it put him right smack in the middle of the space race.

Chris: It keeps getting more and more interesting and I'm more and more impressed with his work now. My dad did that. Thanks for figuring out the mystery for us.