AirSpace Season 1, Episode 1

Mars Time

Nick:

Hey.

Emily:

Hi.

Nick:

What time is it on Mars?

Emily:

It's complicated, Nick. It depends on where you are in the surface of Mars, it depends on where the sun is in the sky, it depends on how-

Nick:

Okay. There's just one question. Is it five o'clock somewhere on Mars?

Emily:

Gosh, I hope so. Matt's doing the silent laugh.

Matt:

It seems like you've heard that joke today.

Nick:

This is AirSpace, a podcast from the Smithsonian's National Air and Space Museum with support from PRX.

Speaker 4:

For centuries. Science has studied Mars. The only planet where life may exist.

Speaker 5:

I claim this planet in the name of Mars.

Speaker 6:

I got to figure out how to grow four years' worth of food here on a planet where nothing grows.

Speaker 7:

We come in peace.

Speaker 8:

They came in peace.

Nick:

Nearly everyone knows the fictional Mars of Hollywood. One of my favorite things in classic science fiction is time travel, moving at the speed of light, black holes, accounts of going backwards and forwards in time. And there is some truth to the wibbly-wobbly, timey-wimey language that shows up in fiction.

Speaker 9:

We got a blast back at orbital velocity.

Speaker 10:

Warp drive, Mr. Scott.

Mr Scott:

At warp one Mr. [Spock 00:01:14] .

Speaker 10:

Accelerating to warp one, sir.

Nick:

Moving fast enough to cross our galaxy in a human lifetime would require some very speedy time travel. It's pretty hard just trying to reach the planets of our own solar system. And in the case of Mars, once scientists get there, they find another hurdle. Mars has its own time. From the perspective here on Earth, Mars feels like it's constantly shifting forward in time. Not because it's further from the sun or because its orbit is more elliptical, but just because Mars spins on its axis at a slightly different rate than the Earth. So when you're living on Earth and working on Mars time, it's getting later and later every day. That small difference can be hard on earthlings. In this episode of AirSpace, we'll introduce you to people who have lived on Mars time and find out how they did it. That's coming up next. I'm Nick Partridge and welcome to AirSpace.

Phil:

The thing I remember most about Mars time is if you saw the sun starting to rise, you were doomed because your body biological clock said, "Oh, it's morning." So there was this mad dash to get out of the building, get back to the apartment, get in the door, close the windows before the sun came up. We were sort of like a bunch of vampires.

Nick:

That voice you just heard belongs to Phil Christensen. He knows a lot about Mars. No humans have ever touched down directly, but Phil has worked on numerous missions that have successfully landed probes and rovers on the surface of Mars.

Matt:

These folks spend all their time thinking about Mars.

Emily:

Well, but that's because Mars is really, really awesome.

Matt:

Maybe it's also because we've got a lot of data from Mars, which I think you're a little jealous about.

Emily:

I'm a little jealous. As somebody who does not study Mars, I still think Mars is really cool, but a lot of it is data envy. I think there's a lot of data envy.

Nick:

Okay. This is our first episode. So before we get too deep into Mars talk, we should take a minute to introduce everyone. We've got Emily Martin, a planetary geologist and Matt Shindell, a planetary science historian here at the Smithsonian's National Air and Space Museum. Matt, tell us about what you do here at the museum.

Matt:

I am a historian of science and I'm the curator of the planetary science collection here at the museum.

Emily:

What do you think your favorite time period is for space? Planetary science is not exactly the oldest science out there, but what's your favorite mission?

Matt:

I'm a big fan of the Mariner missions, which were our first missions out into the inner solar system. They were really our first closeup views of all of the planets around us: Venus, Mars, Mercury. So they really brought back some cool results.

Nick:

Emily Martin, what's it like being a rockstar? See what I did there?

Emily:

So my job primarily is to do research and hang out with you guys and talk to people about space stuff. But specifically I'm really interested in the icy satellites of the outer solar system. So that would be the moons of the gas giants like Jupiter and Saturn and Uranus and Neptune. But I'm also really interested in things that are even further out than that, like dwarf planets in the Kuiper Belt.

Nick:

All very cool.

Emily:

All very cool. The icy satellites are weird. They're keeping it weird.

Nick:

Hey Matt,

Matt:

Yeah.

Nick:

Emily,

Emily:

Yeah.

Nick:

What comes to mind first when each of you think of Mars?

Matt:

Being there at JPL, the Jet Propulsion Laboratory in Pasadena, when the Rovers sort of rolled out of their landing capsules, I don't know what to call that thing, they landed with-

Emily:

They were like these giant bags of air. They were these giant balloon things. They were sort of like-

Nick:

Air bags.

Emily:

Airbags, that's what they called them, isn't it? But it's like when somebody drops a football, fumbles a football and you've got to try and chase it down and you're kind of running around willy-nilly because it kind of bounces everywhere. If you ever watch an animation of the Mars Exploration Rovers landing on the surface of Mars and these sort of triangular airbag, balloon-shaped... They were weird balloon clusters, they just bounce around on the surface until they stop moving.

Nick:

Maybe it's easier to chase a football in two-thirds gravity. Have either of you ever held a piece of Mars?

Matt:

Yes.

Emily:

I have.

Matt:

And holding them in your hands, it is kind of an experience.

Emily:

Did you get to hold the Moon and Mars, one in each hand?

Matt:

Oh, I haven't done that yet.

Emily:

It's so good. I Instagrammed it.

Matt:

Is there a name for that?

Emily:

We should make up a name for that. When you get to hold a lunar meteorite in one hand and a Martian meteorite in your other hand...

Nick:

Do we want to call it orbiting?

Matt:

Oof, I don't know.

Nick:

No? Okay.

Emily:

Well, but the cool thing is, so if you don't have connections to get behind the scenes, because there are some perks about working with the Smithsonian, you can come over to the National Air and Space Museum in the Mall and actually touch a moon rock that was brought back from the Apollo Missions. But, a lot of people don't know this, if you go to Natural History and you go to the meteorite exhibit right across from where they have all the hand samples from the moon that the Apollo astronauts brought back. There is a Martian meteorite that you can actually touch. It's kind of tucked away in the corner, but it's there. So you can come to the mall and you can touch both, just not at the same time.

Nick:

So given your specialties, you've both got great perspectives on today's topic, which is Mars time. So to get us started, I have a very important question. Do you guys watch West Wing?

Matt:

God years ago! Yes.

Emily:

I watched it once all the way through this one time.

Matt:

Years ago.

Emily:

I'm not as big of a West Wing nerd as you are.

Matt:

No.

Nick:

Let's hear a clip.

Speaker 11:

I don't understand how, if it's noon in the East and 9:00 Pacific, how it's 2:37 on Mars?

Toby:

Well, Mars has a different time zone.

Speaker 11:

Yeah, it's 37 minutes. I was-

Toby:

Mars rotates on its own axis once every 24 hours, 37 minutes.

Nick:

Did Toby have that right? What is Mars time?

Matt:

Well, yeah, mostly right. I think talking about time zones on Mars is not quite accurate, but yeah, Mars' day is about 40 minutes longer than the Earth day because of the speed that it rotates and time is relative to where you are. On Mars, you have a local noon wherever the sun is sort of directly above you during the day, right? So where if you land a Lander and that Lander, the sun is directly above it at a particular moment in the day, that's your noon. But the whole idea of Mars being 37 minutes ahead, it's not entirely accurate, but yeah.

Emily:

But it's not entirely wrong. Back in 2004, when scientists were working at the Jet Propulsion Laboratories to land twin Rovers on opposite sides of the planet, the scientists who worked on those missions were actually working and living on Mars time, effectively adding 40 minutes to their day every day.

Matt:

Yes. So going to bed 40 minutes later each day, getting up 40 minutes later the next day. It really quickly moves you out of the normal Earth day and night cycle.

Emily:

Matt, you were there in person, but was it sort of like living in a perpetual state of daylight savings?

Matt:

Yeah. Everybody who I saw I think was sleep deprived. That was partly because of the time changing every day, but also because no one wanted to miss anything from the MER mission, meaning the Mars exploration Rover mission. From the moment the first one touched down, people tried really hard to be there for both Rovers and they were both operating at sort of opposite schedules from each other. So day on one Rover was night on the other. So you could go directly from one floor of JPL where they were just ending the day and go downstairs to another floor on JPL and start the day right over again at another part Mars.

Emily:

Well, and I think another important point is the fact that the Rovers, the Mars Exploration Rovers were actually being powered by solar power, right?

Matt:

Yeah.

Emily:

They were actually only active when the sun was up. And all this was the reason why scientists were living and working on Mars time for the three months that they expected the rovers to hold up.

Matt:

And, add to that, you need time to make decisions and to upload data to the Rovers, upload commands so they know what they're going to do the next day.

Emily:

Because it's not like there was somebody at JPL whose job it was to hang onto this joystick and literally drive these Rovers around like a remote control car.

Matt:

Right. As we know from science fiction accounts of people living on Mars, like the Martian, there's a time delay between Earth and Mars. So driving a Rover in real time from Earth is pretty much impossible.

Nick:

The three of us aren't nearly the experts that Phil Christensen is. He's the one we heard from a little earlier. Phil is a professor at Arizona State University and a serious Mars veteran. Matt, you actually met Phil through your planetary research and sweet talked him into the studio to talk about how he got his start.

Matt:

That's right. Phil and I go way back and he really got hooked on Mars and on space science through the Viking Mission.

Nick:

The Viking mission reached Mars in 1976. Here's Phil.

Phil:

I started grad school literally the day Viking went into orbit and it's shaped my entire life. That experience and being there when you land on Mars for the first time was truly a life-changing experience for me.

Matt:

What kind of feelings are going through your mind and how do you celebrate that moment?

Phil:

So what was really special about Viking? At that point in time, we had never landed on another planet. We'd never gotten close to another planet. I was literally sitting around in a room the night of the landing with Ray Bradbury and Carl Sagan and a bunch of other people, and they were speculating on whether we would see animals walking across the surface of Mars when Viking landed at 5:00 in the morning. And that excitement, that exploration, that unknown, you can only do that once. And so Viking was just this amazing truly once in a lifetime, we've never seen this before experience. It truly was this sense of the unknown. And it was stunning and exciting.

Matt:

Yeah, I felt a lot like that when I saw the Rovers land on Mars.

Phil:

The rovers was like this whole new adventure because you got in your car and you got to drive over the horizon and just keep going. And so it was more like the Lewis and Clark expedition versus the first time you touched down on the shores of a new continent.

Matt:

So how did you keep track of your day while you were on Mars time?

Phil:

For most of us, the worst time was when your shift was just ending about the time the sun was going to come up and so you could convince yourself it was 11:00 PM, not 8:00 in the morning. You'd go home, you'd sleep for five hours and you'd come back in to work.

Matt:

Can you describe for me how JPL had set up the apartments to help you stay on Mars time?

Phil:

They went to a lot of trouble. They leased out several entire apartment complexes. Those rooms had installed blackout curtains deliberately so that your brain didn't think it was daytime. So you could go into your apartment, close all the blinds, close the blackout curtains, and it was dark. One of my students actually ended up... It wasn't dark enough for him, he ended up sleeping in the closet. There was a walk-in closet that he slept in because he wanted it really, really, really dark. JPL had done a lot of research on sleep and sleep cycles. And they were very much aware of the fact that trying to sleep when the sun is up is extremely hard to do

Matt:

Well, it must be difficult when bedtime is changing by 40 minutes every day.

Phil:

The funny thing was, it was kind of nice because you go home and, "Oh, thank goodness. I can go into work 40 minutes later tomorrow." I honestly believe if the Mars day was 40 minutes shorter, this would not have worked because you can imagine, you've just worked a long shift, you come home, it's like, "Oh my goodness, I've got to go into work 40 minutes earlier tomorrow. I think that would have really killed people. And the other weird thing is you get off work at seven in the morning or whatever, and you'd want to go have dinner. And there were actually restaurants around the got used to all these Martians, these crazy people who were asking for weird things. And so we could have breakfast at 10 o'clock at night. We could have a steak at 5:00 in the morning, and having a beer at seven o'clock in the morning, people in the restaurant look at you like, "What's wrong with you?" We're like, "No, really. We're Martians. It's okay. We can drink at 7:00 in the morning."

Nick:

I love how Phil refers to himself and his team as Martians. I bet I could sell this whole working on Mars time thing to everyone here at the Smithsonian if we emphasize that everyone could come into work 40 minutes later, day by day.

Emily:

No, you have to emphasize the part about the ice cream.

Matt:

Yeah.

Nick:

You lived this history.

Emily:

You are living it.

Matt:

Yeah, so I remember the ice cream. Right outside of the sort of mission rooms, there was this huge freezer of free ice cream, that was kind of a reward for everything going so well in the initial landing and rollout. So-

Emily:
Are we talking pints of ice cream? Are we talking ice cream sandwiches? Ice cream bars?

Matt:
Yeah, we're talking about-

Emily:
Or all the things?

Matt:
Your little drum... Ice cream-

Emily:
With the drumsticks?

Matt:
Yeah, the little drumsticks and the ice cream sandwiches, and Klondike bars.

Emily:
What was your vice? What was the one you were waiting for in there that would like...

Matt:
Oh, I always go for a Klondike bar.

Emily:
Klondike? What would you do for Klondike bar mint?

Matt:
Yeah, I'm classic.

Nick:
What did you do for a Klondike bar?

Emily:
What did you?

Matt:
I lived on Mars time for a Klondike bar, man!

Emily:
That's a no. No, I'm not taking it. I'm not taking it.

Matt:

No, it was really kind of interesting because you're not sleeping on your normal schedule and all you're eating is ice cream. Like Phil was describing, you close the door, you don't know if it's day or night outside. It was really like being inside of a casino. And it kind of helps to create the illusion that you're living on a sort of normal schedule, but it's really easy to fall off.

Emily:

So were you actually living on Mars time when you were there? Because you're a historian and you were there sort of at this historical moment in Martian science, sort of, they're observing all of this stuff happening. Were you actually living on Mars time with all the other scientists?

Matt:

I was not because there was no time to live on Mars time, if that makes any sense, because the two Rovers were working-

Nick:

That sounds like a lack of commitment to me.

Matt:

Yeah, well, because the two Rovers were working on opposite schedules and I was trying to observe people working on both Rovers, I really had to keep switching back and forth and catch sleep whenever I could.

Emily:

So what was your favorite place to catch a couple of Z's when you were at JPL?

Matt:

Well, it gave me a few stiff necks, I think, but there was this beanbag chair in one of the instrument rooms and I fell asleep a few times in that, kind of not on purpose but maybe on purpose because I think I knew anytime I sat down in that thing that I would probably fall asleep.

Emily:

So a Klondike bar and a beanbag chair...

Matt:

Yeah.

Emily:

... kind of kept you going for a couple of weeks?

Matt:

That was probably about it.

Emily:

How long were you there?

Matt:
Three months. So for the three months of the primary mission.

Nick:
Would you characterize this as a sacrifice that you made for the good of space exploration?

Matt:
I do what I can.

Emily:
It's how you do it.

Matt:
Yeah, really.

Emily:
It's how you get through.

Matt:
Spinach is a lie. It's all about sugar.

Emily:
Spinach is a lie.

Nick:
Spinach is a lie.

Emily:
That's going to be the sequel to his autobiography.

Matt:
Yeah.

Nick:
Okay. Yes.

Matt:
Landing sites are garbage, spinach is a lie.

Nick:
I remember the ice cream, spinach is a lie...

Matt:

Yeah.

Nick:

... chapter one.

Let's take a quick break to hear from one of our sponsors, we'll be right back. Exploration is a round the clock endeavor and there are many sacrifices to be made, but the unique nature of the Mars exploration Rover mission and the toll that living on Mars time took on humans was so unique that it came to the attention of anthropologists. Is that right, Matt?

Matt:

Yeah. I want to introduce you to Zara Mirmalek. Zara is a colleague of mine from graduate school at UC San Diego. She did a whole PhD dissertation on the topic of Mars time that meant studying scientists and researchers as they worked on the mission.

Zara:

I conducted a one year ethnography. I lived and worked with this team at the Jet Propulsion Laboratory in Pasadena, California from the fall of 2003 to the fall of 2004.

Matt:

So, like a journalist who embeds herself with a group of troops, she embedded herself with this group of Mars Rover scientists and engineers. Zara was used to looking at the ways that people use devices and technology to do their jobs. She wasn't as used to living in that environment herself.

Zara:

I study human-machine relationships in high-tech work environments. So I look at how people interact with each other and with their tools that we might better develop tools or social systems so that the scientists have the best, most supportive work environment to get their projects complete.

Matt:

Zara's research determined that getting the Earth-based scientists onto Mars time was logical. But not without its challenges.

Zara:

This concept of Mars time was created so that scientists on earth could do their work according to the time of day on Mars. And it really made a lot of sense. It provided a language to talk about a physical experience that they couldn't experience at JPL. So in that, it was very novel and very interesting. On the other hand, though, it was really hard to imagine what time of day it was on Mars without any physical cues.

Matt:

No Martian sun to rise and brighten the sky, no Martian sun to set and bring on the night, just engineers and scientists doing all they can to ignore the Earth sun and unsurprisingly Zara did uncover moments of human fallibility. Luckily, nothing went wrong in operating the Rovers. But at the end of each shift, when there were important group meetings to review the day's data, the impact of Mars time was evident.

Zara:

So the main spot where people are deliberating, bringing their interpretations of data together, discussing what's going to happen the next day, you might see signs of fatigue. You did see signs of fatigue. You might see somebody nod off. And there was a collegial understanding of why this person was nodding off and there'd be the gentle touch to the shoulder.

Matt:

With the prospect of groundbreaking discoveries during many of those long shifting days of work, the scientists Zara lived among were fueled by adrenaline. They pushed through.

Zara:

One of the things you can rely on in this kind of work environment is how committed, enthusiastic, and curious people are. So they'll fight through anything to stay awake and be present in order to make the most out of this time that they have on Mars.

Nick:

Okay. So you're a scientist, you're doing the best, most exciting work of your life and you are living on Earth, but working on another planet, where you don't get to see the sun go overhead. How do you keep track of time for the work day?

Matt:

A few Engineers actually took it upon themselves, seeing that this might be a problem, to go and seek out a jeweler that-

Emily:

So do you think they came in with the specs and the gearing and all that stuff figured out?

Nick:

Do you have any watches in the case that run on a 24 hour, 39 minutes and 35 seconds day?

Matt:

Yeah. It's kind of like you're going in and asking, can you make a bad watch for me? A watch that can't keep Earth time? I presume that a jeweler would have to sort of do a lot of the work because an engineer might know how to land a Rover safely on Mars, but does he really know the gearing of a watch?

Emily:

You know, so there's actually an iPhone app, that's a Mars clock that'll help you tell Mars time. But I do want to point out for all those listeners who haven't paid attention to the years we're talking about, we're talking about the Mars exploration rovers landing on Mars in 2004. 2007 is when the iPhone came out? Right, so...

Phil:

And that Mars watch it's on display here at the museum and it's analog. It has an hour hand and a minute hand.

Emily:

The idea of needing a Mars watch was actually a really practical, really important way of understanding what time we were talking about and when people needed to be back to work and could go home.

Nick:

Could you just not search through thrift stores and discount stores until you found a watch that ran 40 minutes slow?

Matt:

Yeah

Emily:

But would it run 40 minutes slow consistently, accurately, precisely?

Nick:

That's the trick, isn't it?

Matt:

You need a watch that's broken in just the right way.

Emily:

Ain't nobody got time for that.

Nick:

In an era of smartphones, when people are wearing watches less and less, do we think that the first human beings to set foot on Mars will have a wristwatch on the outside of their space suit?

Matt:

Considering all of the astronauts in the International Space Station still today use wristwatches, I don't see that ending as a trend. I know if you watch a lot of sci-fi movies, they tend to have a sort of digital display on their arm or something like this. And maybe that will be the case, but I don't think they'll stop carrying mechanical watches because not only are they a part of the history of exploration, but they also are reliable. You don't have to worry about them shorting out or any kind of power problems.

Nick:

So from everything we've heard living on Mars time is really punishing, takes it out of people within just a couple of months. Is it really that helpful?

Matt:

Well, when you have a mission, the primary phase of that mission typically is just maybe a few months long, like with the Mars exploration Rover mission, they were supposed to accomplish all of their

primary science goals within the first three months. And once that time is up, I think you can kind of stretch out and relax and think this technology is actually going to last a little longer. We can do more, everything after this is going to be just sort of bonus and you maybe get to work into a normal or semi-normal routine.

Emily:

Well, and I feel like the sense of urgency starts to diminish a little bit. I mean, the engineers and the scientists are incredibly passionate people about what they do and what they're studying. So I think there's always going to be that adrenaline to kind of keep them going. But I think Matt you're right, like after your primary mission goals have been met, I think you can kind of take a deep breath and reassess because you've got to tell NASA, "Hey, this is what we think we can do in the secondary mission, in the tertiary mission." And I think until you start putting people on the surface of Mars, I think that three month marker seems to be really important for when humans on the surface of earth living on Mars time. There's that cutoff there.

Nick:

So would you guys live on Mars time for three months? I vote yes because you get to sleep in.

Emily:

For three months?

Nick:

Yeah, for three months.

Emily:

For three months?

Nick:

Yeah, because you get to sleep in 40 minutes later every single day.

Emily:

But also, there's just so much, especially if it were for a mission. I wouldn't do it for giggles. I wouldn't do it just to see what it would be like. I would do it if I had the motivating factor. I think that's what kept everybody going over at the Jet Propulsion Labs. It was the reason everybody would have even considered doing something crazy like that.

Nick:

The spirit of exploration.

Emily:

The spirit of exploration.

Nick:

Absolutely.

Emily:

It's why we do what we do, Nick.

Nick:

It is why we do what we do.

Emily:

Matt is it why you do what you do? The spirit of exploration?

Nick:

Or is it ice cream and beanbags?

Matt:

I mean ice cream and beanbag chairs definitely boost up the spirit of exploration. As for living on Mars time, I did live it once and I think I would do it again, but it certainly helped that I was in my twenties when I did it the first time. And now that I'm in my forties, I enjoy going to bed on time.

Nick:

Outing yourself as a quadragenerian.

Matt:

Yes, I can't hide it.

Nick:

That's all for this episode of AirSpace from the National Air and Space Museum, I'm Nick Partridge.

Emily:

I'm Emily Martin.

Matt:

I'm Matt Shindell.

Nick:

Do you have an idea about what would be a helpful invention for future Mars, explorers or questions about the red planet? Tweet us @airandspace. This episode of AirSpace was produced by Jocelyn Frank, our executive producer is Katie Moyer, special thanks to John Barth and PRX, additional thanks to Sarah Banks, Jason Orfanon, Phil Christensen, Zara Mirmalek, Tim Gluck, and Deanne Rogers. This episode was supported by PRX and the Alfred P. Sloan Foundation enhancing public understanding of science, technology, and economic performance. More information on Sloan at sloan.org.