

Aerology Part 2 with Dr. Jennifer Buz

Ologies Podcast

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Oh hello, hi. It's still your stepbrother's girlfriend with the pet rat because ol' Alie Ward is back for yet another episode on Mars. I am not on Mars, because honestly, fuck that. I get lonely on business trips. I'm on a business trip right now in a hotel room outside of Detroit. I'm a little lonely, but I understand there are fireflies outside and I'm just waiting for it to get dark. But yeah, this episode is on Mars. If you haven't heard Part 1 yet, what are you doing here. What are you doing? There are so many spoilers, such as the fact that we just found fish in a dry lakebed on Mars. We talk about that in Part 1.

Wait, is that true? No it's not. But go back and listen to Part 1 anyway. Part 1 will give you all the primers you need on: What is Mars's deal? Why is it cold? Why was it named after the deity of battle? What's up with its two moons, one named after fear and the other the dread that accompany war? And why does one of them crash and reform itself over and over again? And how many Rovers are up there? And what happens when you give birth to a moon rock? And where is the next Rover going? And what's the best Martian sci-fi? All of that in Part 1, but now on to Part 2, all the weird juicy questions you guys asked about Mars and had answered.

But first, I'm going to be quick, OlogiesMerch.com, this is the part where I shout it out. There are hats, and shirts, and totes, and pins, and backpacks y'all; there's bathing suits now for summer, and I decided to have a summer sale. Through July you can enter CampOlogies for 10% off your whole ding-dang order. So get yourself something nice! Sales support the making of this podcast, as does becoming a Patron at Patreon.com. You can do so for as little as a buck a month, because I like to keep thresholds of showing your love pretty low.

Also, if you spent all of your money on Otter Pops and inflatable pool unicorns, that's okay. I get it. You can support *Ologies* by rating, or reviewing, or subscribing via iTunes. That keeps ol' Podcast Von DadWard up in the charts for others to kinda stumble on. Also, you know I read your reviews, I do it every week. I just want you to feel seen, and then to prove it I read one each week, because it's really delightful that you guys even write them. So this week first off, I want to say get well to rah Maya [phonetic] who left a review about snapping her fibs and tibs on a trail run! Phew! Get better man. Also Justin So [ph.] wrote:

Had to go to an Apple store to leave a review. I know how important iTunes reviews are for Uncle Al, so I may or may not have gone to an Apple store, used a MacBook there, and left her this 5-star review. I love this podcast and have been binge listening to it.

Also thank you to NoNicknamesLeft [ph.] who says:

Remember when Discovery channel, The Learning Channel, and the History channel weren't just all aliens and reality TV? Remember when you could randomly find a documentary on the Three Gorges Dam in China and would just be sucked in for the duration? Ologies is that.

Thank you guys so much for leaving those reviews. I just read three of them. I normally just pick one, but today I wanted to say thanks to more than one person. I read all of them that you guys left this week, and you're just charming. You're charming human beings.

But let's get the heck back on Mars. Do you want to? Okay good. First off, many of you were like, "Ward, Aerology, has that that got something to do with nip-slips or what?" And sadly, no. Aerology comes from Ares, the Greek god of War, so Mars is his Roman stage name, and the nipple's areola

region comes from the Latin for 'little garden', which maybe says something about Roman breast hair, I'm not sure. I just wanted to answer that oversight of the Part 1 episode. That should have been the first thing I even talked about. Everyone is like, "How did you not talk about areolas?" So boom; Part 2, I did it.

Speaking of questions, lets now commence the Part 2 of all listener curiosities, answered in very squeaky chairs at CalTech by the very prepared and enthusiastic, wonderful, hilarious, brainiac, interplanetary rock enthusiast, and aerologist, Dr. Jennifer Buz.

Alie Ward: I have one million questions for you. Is it okay if I ask you one million?

Dr. Jennifer Buz: Yeah.

Alie: Okay, so many questions. I love that you... You are a patron; you've looked at some of these. You've looked at all of them?

Jennifer: The ones that were posted as of a few hours ago.

Alie: [laughs] This is what I want in someone who studies other planets, this level of detail and preparation. This gives me faith in the space program.

Jennifer: Well, I didn't want to leave anyone hanging.

Alie: You're amazing. This is amazing! In that case I'm going to do them out of order. Oh my god. You're amazing! You have *notes* written up. Oh my god.

Jennifer: Okay. I'll put my notes away. Maybe.

Alie: All right, you can reference them if you need them. The level of preparation is warming my heart right now.

Jennifer: I was excited!

Alie: Dude, you rule. I am going to do them a little bit out of order.

Jennifer: You go for it.

Alie: Jessica Tubesing wants to know: Was the god of war being named Mars a suitable choice?

Jennifer: I thought about it, and the reason they named it that is because it's red. They were like, "Blood and war," and stuff, and so I was thinking, "Are there other planets that would be more warlike?" And I think maybe not planets but moons that have a lot of volcanoes and are turbulent, they're kinda more angry, but I do like that Mars... I think it's appropriate because it also has volcanoes and it has ash deposits and stuff so you know that stuff was exploding. But it also has these catastrophic flood events that we think happened. Huge amounts of water just flowing over a surface. And it does have some super active processes, and so yeah, I think it is appropriate. I like it and I like that it's red.

Alie: I think a lot of people figure this is... I'm saying a lot of people, I mean me. Because it's red, we associate that with heat, and we associate Mars with fury and fire. I think it's hard to wrap your brain around how cold it is.

Jennifer: Yeah, now it's cold.

Alie: I remember I asked a question of a friend who works at JPL. I was like, “How do these Rovers withstand the heat?” And they were like, “Erm, hey bitch, it’s cold there,” and I was like, “Ohhh yeah.” [laughs]

Jennifer: Well I thought it too. I was like, “Would Venus be better for a war planet?” because it’s really hot on the surface of Venus. But then the volcanoes on Venus are like the lava from Hawaii, which is really flowy and it’s not very explosive, and I was like, “That’s not very warlike, so...”

Alie: That’s a good point. How do you feel about the book *Men are from Mars, Women are from Venus*?

Jennifer: I don’t know anything about that book.

Alie: It’s garbage. Next question. Stu wants to know: What is the latest stance on Mars’s habitability with regards to things such as bone density deterioration and other physiological aspects from reduced gravity and cosmic radiation? Biologically, could we deal with Mars?

Jennifer: I think it takes a lot of engineering, but we could. The moon is like 1/10th the gravity of Earth, I want to say, and Mars is about 1/3 the gravity. So, there’s still gravity on Mars and it’s probably not going to be as bad as other places you go, for example, the space station where there’s no gravity. So, you *can* be a human, I feel, on Mars. But you’ve got to take your other stuff with you, your air and your water and your food.

Alie: It’s like BYOE: Bring Your Own Everything.

Jennifer: Exactly, but it’s not impossible.

Alie: Cool. Greg, Aerial, Craig Curry and Jorge Barnett, all asked the same basic question. This is a super question: In light of the giant dust storm that seems to have knocked out the Curiosity, what is the most useful-to-humanity right now information that it has collected since its arrival to the red planet? So, questions about dust storms, and what’s the best stuff that the Rovers have gotten?

Jennifer: I was thinking about this a lot, what’s the best stuff the Rovers have gotten, and I think that seeing that Mars was habitable in the past was probably the most interesting and maybe useful-to-humanity kind of thing, because we see how Mars has changed with time and how Earth might change with time too, and also what the different extremes that we can have on different planets are. So that’s super interesting. Then the dust storm, I don’t know, it’s just a cool global phenomenon. But for Curiosity, we’re not super worried about it. It’s the other Rovers...

Alie: And this is a pretty big one?

Jennifer: I think it is a global dust storm. There have been global dust storms that have lasted, I think, like months. I don’t know that they know how long this one will last because I think it’s still getting worse. One of the first satellites they sent to Mars, when they got there, it was in a dust storm, so they actually couldn’t even really see the surface, which was so frustrating. And it was a fly-by too, I think. So, it’s not like they could go back.

Alie: It’s like getting your period on your wedding day!

Jennifer: Yeah. Maybe.

Alie: Oh, that sucks. Sorry Mars; red planet indeed. Elliott Anaya and Al Martinez both want to know: Realistically, how close are we both politically and technically to a crewed mission to Mars happening and by 'crewed,' I mean 'crew,' not like a crude mission.

Jennifer: Oh yeah, c r u d e.

Alie: Yeah, like 'crewed' and I'm saying 'crewed' because sometimes people still say 'manned' and let's be honest, it's crude.

Aside: If you're like, "Whaaat?" Okay, 'manned' suggests all dudes, which is not accurate sometimes, and also if we want more women in space, let's not suggest that they do not belong there. 'Manned' is kind of as awkwardly specific as saying 'womaned.' 'Crewed'? Nice and neutral. So, saying "a manned mission to Mars" just FYI in today's day and age is a little crude.

Alie: Because 'manned' is a little old fashioned.

Jennifer: NASA has plans to have humans on Mars by 2033, I think. There's a directive or something, but I don't think that there's actually a lot of stuff happening related to that. I'm not positive about that, but they were like, "We will do this."

[repeated, slowed down, deep and drawn out] "We will do this." And then with SpaceX, they want to be on Mars, like, in the 2020s.

Alie: What?! That's nuts.

Aside: That's so soon! That's within like 10 years. I 100% have underwear older than that. But yes, NASA and SpaceX have crewed Mars missions on their 10-year to-do list.

Jennifer: I think that technologically – I mean I'm not someone who does this kind of engineering work or whatever – but politically I think NASA wants to go there, and technologically, I think we're capable of some pretty incredible things. So, I don't think it's impossible. It seems really soon to me too, though. But like I said, I'm not involved in that kind of stuff, so I don't know.

Alie: Who do you think they should pick for stuff like that?

Jennifer: There is a graduate, she was a postdoc in this department and she was just selected as an astronaut last year. Her name's Jessica Watkins and she studied Mars.

Aside: Oh man, this lady Jessica Watkins. From Colorado; former rugby player; pilot; 30 years old, and officially an astronaut. I tried to see if she had an Instagram upon which I could fangirl, but alas, I could not find her. So maybe the trick to kicking ass is doing less scrolling of memes and not looking at videos of people manhandling slime late at night. I don't know, but if I ever meet Jessica Watkins, I'm going to ask her for all of the life tips. Her tip will probably be, "Just be me."

Jennifer: She's a Mars geologist, now a NASA astronaut. I'd be so psyched if she was the one going on that.

Alie: Does she want to go?

Jennifer: Yeah, she's so into it.

Alie: She's like, "Bye Earth. You're toast." I don't blame her. It's pretty garbage right now. This is a good time to hit the eject button on ole Earth, where it's like, "Well, we fucked this up." Mariner Cosplay [ph.], Al Martinez, Rachel Casha, Stefan Titus, and Justin M. Gifford all wanted to know: What are the biggest hurdles for terraforming and is there an

initiative within NASA or another agency to do so? Also, follow up question from Alie Ward: What is terraforming?

Jennifer: I don't know the definition, but I feel like it's when you make the surface have grass on it.
[laughs]

Alie: Reallly?

Jennifer: No, no, definitely not. That's just what I imagine terraforming is.

Alie: Landscaping. It's Martian landscaping.

Jennifer: You'll have to look that up.

Aside: Quick definition here. Terraforming is mostly, at present, a sci-fi term and it means to transform a planet to be more like Earth, presumably so that we can go live there. I imagine in the future, HGTV will have a whole *Flip or Flop*-esque series dedicated to making over dry barren planets into the lush boho habitats of our dreams. All we have to do is just painstakingly alter what already naturally exists!

Jennifer: Can you repeat the question?

Alie: Essentially, what are the biggest hurdles for terraforming?

Jennifer: That we don't have a lot of water or oxygen in the atmosphere, or that the atmosphere is so thin in general. It's either going to have to be that you make the atmosphere thicker somehow by melting the caps or taking an atmosphere, but then you need a shield for the atmosphere. I think if they existed in bubbles, if we had a big dome, maybe you could start doing that that way, where you could contain your atmosphere and your water and stuff like that. Those are the big hurdles. Radiation is another hurdle.

Alie: Because there's not a lot of atmosphere to shield you from it?

Jennifer: Exactly

Alie: Even though the sun is farther away, you're still sizzling.

Aside: Even if you landscape Mars, you're still gonna get a lot of a high dose of radiation because of a really thin atmosphere. Also, the place is pretty dry, it's pretty sandy. There *is* water trapped in minerals but getting out it would be, in technical terms, a shit-ton of work. Which brings up the age-old question of [as if yelling in the distance] "Why bother?"

Alie: Jeffrey Katz wants to know: Is it worth the trouble and expense to send humans to Mars, or should we put our effort into more sophisticated robots?

[robot voice, with French-themed music in the background: "Hello. I am a sophisticated robot and I like French films and expensive coffee."]

Jennifer: Robots live for a very long time and you can put all sorts of cool instruments on them, and in that sense robots may be the way. But humans, we've gone to the moon and collected rocks, and it's so useful for a person... you walk around, and you know what's cool, and you pick it up and put it in your pocket. Also it'd be super sick to be on Mars. [D] *airhorn*] So that's really cool too, but then if you go to Mars, you can only be there for so long without taking a ton of stuff with you. You probably need just way more stuff with you and so it's going to be way more expensive than just sending a robot that doesn't need food.

Alie: It also seems like a pride thing. Why send humans to Mars when we could have robots?
It's kind of like, "Because we can."

Jennifer: Yeah. Because it would be cool.

Alie: Because we did that.

Jennifer: But robots can accomplish a lot, and we can send ten robots to Mars to ten different spots. It's just way cheaper.

Alie: If you go to Mars and you pee on it, who owns Mars? Do you own Mars if you just peed on it? Is that how it works? Does the world... Does Earth even own Mars? Or does Venus own Mars?

Jennifer: I think it's a big debate. I don't know necessarily if it's debated, but it's a big issue with Mars. There's a whole thing called planetary protection, where when we send stuff we have to go through incredible lengths to make sure that we're not contaminating the planet. NASA is like, "No, you can't do that." You can't even go places that you think there might be water because what if we accidentally took some bacteria and then we accidentally colonized Mars? There's all this debate about that, but then there's all these private companies and they're like, "Well, we're going to do it." So, I don't know.

Alie: We're kind of going to be trespassing.

Aside: There is a wealth of information about planetary protection. This is keeping space microbes off of Earth and also not shipping our gross Earth microbes to Martians. These planetary protections include complex equations of how many spores per square meter are acceptable on equipment so that we can send it into outer space. The whole thing reads like a very long winded, "Employees must wash hands after using the restroom," sign, like, so duh! But also, if these rules weren't in place you know some people would be like, "Ehhhh whatever."

Alie: Guy R Thomas wants to know: My daughter wants to know how many different rocks have been identified on Mars and how long does it take to send commands to the Rover and get a response back?

Jennifer: There are many different types of rocks that have been found on Mars, but they're pretty much all the same as Earth rocks. There's basalt, which is kind of lava-from-Hawaii type rocks. And then there's sedimentary rocks that are from the lake, so layered rocks. There's sandstones, mudstones, and there are meteorites on Mars.

Alie: That came from?

Jennifer: Other places, that we found with the Rovers.

Alie: It's weird to think there's a chunk of Earth on Mars and someone's like, "Whoa!"

Jennifer: Actually, I think that they wanted to send a part of a meteorite back to Mars, just to take it home a little bit

Alie: Like, "You dropped this."

Jennifer: It's harder, I think, to get a rock from Earth to Mars because of their orbits and their distance from the sun. There probably is one though, because there's been a lot of time in history.

Alie: Ooof! Danny Kang wants to know: Is it possible to have a water balloon fight on Mars due to the atmosphere?

Jennifer: Yes, in certain places at certain times. So, the question is related to the fact that water is not stable on the surface for a lot of the time. It's either too cold so it'd be ice, or it's low pressure so it would be gas. Liquid water is not really there. You'd have a baseball or an exploding balloon. But if you go low enough elevation, I think you can get, in some places for brief moments in time, enough pressure and a high enough temperature that you could maybe do that.

Alie: So certain spots and that's why we need to send more Rovers, is to find out where to have the water balloon fights? And also the street value of that water balloon is, like, millions of dollars because it had to be shipped from elsewhere. That's like having a balloon fight with gold dust on Earth. Don't even think about a super soaker; that's asking too much.

Aside: Side note for more information on the inventor of the Super Soaker, who was a NASA engineer, see my minisode about summer that just went up a few weeks ago: Aestatology Should Be a Word. It's all about summer, and the history of water fights, and also melon genetics.

Alie: Laura Mulligan wants to know: If you were to get bored or tired of Mars, what other planets would you like to study and why?

Jennifer: I already studied the Moon and I still think the Moon's pretty cool. It's really cute and we can see it from Earth.

Alie: *[laughing]* It's really cute. I love that. It is.

Jennifer: It's really cute, and it's cool that it's part of Earth. There are a ton of small moons, like the moons of Jupiter and Saturn, that I think are super fascinating, like the icy moons where there's water underneath and super volcanic moons and stuff.

Aside: Quick check-in on Jupiter and Saturn's moons. While Earth has one moon, kind of like a sweet elderly couple who fell in love in high school and have been married for billions of years, Jupiter and Saturn have more 'populous' relationships with their moons. Like just a sexy, consensual poly situation. Saturn has 62 moons. Jupiter has a blessed, auspicious 69, including the icy Europa, which is the star of an upcoming NASA flyby mission and a possible lander way down the line, all on the hunt for interplanetary critters. Despite that these two planets have moon orgies and literally rain diamonds, perhaps the best planet whichever goddamn one you're sitting on.

Jennifer: I really like Earth too. I am a geologist and sometimes I want to spend a little more time thinking about Earth.

Alie: Do you do that on weekends?

Jennifer: All the time.

Alie: You just go hiking and you're like, "Look at that sandstone, and that sediment." That's got to be great because you know how sometimes you'll go on a hike and if you don't know shit about geology, you'll see a bunch of cool rocks, but you kind of need someone to go with you to be like, "Look at that, look at that, look at that."

Jennifer: I know. I have a problem right now, which is I just moved to Flagstaff and I have one friend, so people in Flagstaff should come on a geology hike with me.

Alie: Now I have to visit Flagstaff. I feel like you're gonna have some serious Flagstaff friends after this.

Aside: Flagstaff, hit up Jenn Buz @BugaBuz on Instagram. Be friends, enjoy some rock hikes.

Alie: Yeah you are going to have a whole posse in Flagstaff!

Jennifer: That would be cool.

Alie: Olaf Doschke wants to know: Is it true that the Mars Day, which is 24 hours and 37 minutes, better suits the human biorhythm?

Jennifer: I think that would be really weird if that was the case. But the Rover teams, when the rovers first land, the first 90 sols, they live on Mars time. They artificially make their days that long and they do operations during that. But it's super hard because the Earth is not on that time. So then they'll be awake in the middle of the night. It's hard for me to imagine that that's the case, but... No idea.

Alie: Is it only another 37 minutes?

Jennifer: Yeah.

Alie: But it adds up, to where you start getting off.

Jennifer: Yeah, like two days into it you're already one hour off.

Alie: I think it's interesting that we call them days. They call them sols. That's kind of cute.

Jennifer: Yeah, it is. We celebrate the sols on Mars.

Alie: That's cute. Iolathe just straight up wants to know: Is there life on Mars?

Jennifer: I want to say that there's probably no way that we took every single bug off the Rovers that we sent. So maybe there's some little microbe still alive. And I want to say that maybe there *were* microbes way early on.

Aside: This was a very pregnant pause. Pregnant with moon rocks.

Jennifer: Maybe. I'm not going to say... you know what, I'm just going to say yes.

Alie: Okay. This is a good prediction because later, when they find it, you'll be like, "Please see my 2018 interview where I said, definitively, yes."

Jennifer: I'm just going to say yes. *[laughs]*

Alie: Christopher Barley had a great question that I hadn't considered. He says: I seem to remember that the northern half of Mars is completely smooth while the southern half is full of craters. What's up? Do we understand what caused this and why the inconsistency?

Jennifer: I think that the major idea for this is that there was a big impact that came in at an oblique angle and shaved off the top of Mars, and then it was low. There's also a lot of debate about the northern lowlands and the southern highlands. The southern highlands are way older, super effed up landscapes, and there's, like, what we think were catastrophic floods up there. So, there's some idea that there was an ocean up there too, which may explain that. And then volcanism related to that impact. All things that could have smoothed it out.

Alie: Oh my gosh, that's so odd. I didn't even know that about Mars.

Jennifer: It's called the crustal dichotomy. Half of the crust is high, and effed up, and old, and the other half is low and smooth and young.

Alie: Oh, interesting. It's like it got an acid peel. *[laughs]* It's new, it's exfoliated.

Jennifer: On half its face. *[laughs]*

Alie: It was a Groupon; it was only worth half of an acid peel. Thomas Maher wants to know: Thoughts on Elon Musk and nuking the poles of the planet. What is that question about?

Jennifer: There's this idea that if you want to make the atmosphere of Mars thicker, you could just melt the poles so all that water and carbon dioxide that's trapped in dry ice and water ice will be in the atmosphere. But I love Mars. It's really pretty as it is. I don't really want to do that. So that's my opinion on it.

Alie: And also, now that I'm a Mars expert, there's not going to be an atmosphere to keep all that stuff in or would that give the atmosphere to keep it in? Is there enough of a shield?

Jennifer: You'd have to protect it. It would go away eventually, like the rest of Mars's atmosphere did, if you weren't careful.

Alie: I'm pretty much like your coworker now because I know so much, right?

Jennifer: Mm-hmm. Yeah.

Alie: Okay, cool. Just checking. How do you feel about Elon Musk's fetishizing of Mars?

Jennifer: The same. I'd be really sad if I looked at Mars and it was just another Earth, because it's so old, it's so fascinating. It's like your favorite desert landscape, and then all of a sudden, it's a suburb. It's not the same and it's lame.

Alie: Suddenly there's a Best Buy on Mars and you're like, "The fuck?" There's a Chick-fil-A and you're like, "Who are you, Mars?" Why does Elon Musk have such a boner for Mars?

Jennifer: I don't know.

Alie: He's so horny for it. I'm going to look into that.

Aside: So why does he love it so much? I'm not quite sure but he has said that "Space travel is the best thing we can do to extend the life of humanity," and he said that he wants to die on Mars, just not on impact.

In Part 1 of *Aerology*, I mentioned my hardcore brilliant scientist friends Casey and Christine, both NASA scientists, who introduced me to Jennifer. The day after this episode went up, Casey and Christine happened to have seen their other pal, the science fiction writer Kim Stanley Robinson, who I mentioned. He's the writer of these really beautiful books, the *Red Mars* series, that people love. I naturally freaked out and Casey and Christine were kind enough to conduct an impromptu interview with him that they recorded on one of their phones:

Hi Alie, hi Jennifer. It's Stan Robinson.

... to get his take about interplanetary habitation. What did a brilliant science fiction writer who *owned* describing Mars, say about us being on Mars?

Well, it's a wrong idea, so you don't want a wrong idea hanging out there with the notion that, and I think actually... maybe it's one of these ideas that floats around the internet at the level of commentary that isn't really thinking. So maybe nobody really believes this idea and it's not that much of a moral hazard. But the notion that we have any other place than Earth is clearly false, and it's not that you couldn't terraform Mars, it's just that it might take 10,000 years to do it. And we've got a 100-year

emergency that we're living in. So, the timescales are badly off and you don't want to ever think that we've got any other place than Earth.

One thing that you do keep hearing from people is the idea that if we had 5,000 people on Mars that were living semi-independently of Earth and then Earth was somehow by some mysterious and basically fictional disaster that everybody on Earth died, that after that, those 5,000 people from Mars could come back to Earth and then it would all be okay. That you don't want to have all your eggs in one basket, this is how it's put, that there should be a backup to humanity itself.

To me the badness of that idea is not only the moral hazard that we can go ahead and blow ourselves up, but that that would be any kind of compensation for the loss of so many humans, that humanity isn't that valuable. That if we were to lose all of humanity on Earth and all the rest of the mammals etc. etc., who cares if some humans come back 20,000 years later; we probably should have gone extinct at that moment from our own stupidity. [laughs]

I'm completely against that whole line of thought that we need an emergency population somewhere else in case we accidentally killed everybody off on Earth. You can't kill off everybody on Earth; we're like cockroaches. The only conceivable thing that might do it is a gigantic asteroid impact. To detect and deflect asteroids that are incoming and save ourselves from a big old bang is the obvious first thing that spacefaring work ought to be devoted to.

So... saving our species while kicking it on an annex planet while Earth burns? Maybe not a good idea.

Alie: Sandy Moore wants to know: How much time and money do we spend studying Mars and the Earth's oceans? Should we focus on one more than the other when it comes to making life better for life on Earth? Essentially, why are we studying Mars so much when we are catastrophically fucking up Earth?

Jennifer: There's actually a lot of people saying we know more about Mars than we know about the bottom of the ocean. It's really hard to study the bottom of the ocean. Mars is a thing that makes people so curious and it just broadens our perspective. So does the bottom of the ocean. It's hard for me to really say we shouldn't study the bottom of the ocean.

Alie: Also, there's that necklace from *Titanic* down there.

Jennifer: A lot of the reason that we study Mars is because early on in its history it was so Earth-like, so now it's basically an old version of Earth and it's so fascinating to see how it evolved, whereas I don't know if you could say that about the ocean. Maybe I shouldn't compare them so much.

Alie: Maybe it's like a cautionary tale.

Jennifer: Yeah. That could be us, cold and dusty, if we aren't careful.

Alie: Yeah. Like when you watch *E! True Hollywood Story* and you're like, "Oh man, what happened to them?"

Aside: So, if you ever think your life is kind of slow and boring, just think: we are experiencing a live-fast-die-young crash-and-burn tawdry, cautionary tale every day, just by using plastics and fossil fuels to ruin the planet. (This was meant as a lighthearted

aside but now I'm depressed.) Anyway, Mars exploration is important both scientifically and existentially, Jennifer says.

Alie: I'm gonna say it's a cautionary tale thing.

Jennifer: I think it serves to broaden our perspective of life, and of the solar system, and the evolution of it. It's a great thing for us to think about. I think it gives us a little bit more of a perspective.

Alie: Do you think people have a lot of existential crises thinking about Mars and other planets and that this isn't the only planet? Do you think that psychologically, a lot of people kind of grapple with Mars and other planets as a concept?

Jennifer: Yeah, I think especially when we start to think about life. What does it all mean? You know, we're not alone. Earth's not the only planet, how there's more Earths now, with all these exoplanets being discovered, super-Earths and other types of planets. I think people often feel very small when they think about these things.

Alie: Right. But I think it's almost a relief to feel like you don't matter. There's a relief in that. Like, everything seems so huge. Parking tickets, and "this person didn't follow me back on Instagram," or whatever, and then you're like, "Oh shit. I'm just a tiny microbe that doesn't matter. Maybe I can relax a little bit."

Jennifer: Unless you start to think that we *are* the only life and then you're like, "We're the only life *and* we're fucking it up." You could take it both ways.

Alie: Oh no. You're like an only child who ends up being a hellion. Well, I do think that fostering a new appreciation for other planets maybe does make us look back. At least the question is being asked, Sandy Moore. Should we be paying more attention to our own planet? Maybe appreciating Mars makes us have more appreciation for our own planet too.

Jennifer: I don't think that Mars research is wasted money at all. I think it inspires a lot of people, and it's super fascinating, and we learn a lot about it, and it gives us a lot of perspective. In terms of how much money we spend on it, I think it's worthwhile.

Alie: Do you know how much people spend on hair restoration and Viagra? A lot of money.

Jennifer: Yeah, too much.

Aside: Just a little FYI. The US spends about a billion and a half dollars per year on Viagra. It's like \$70 a pill. I had no idea it was so costly! Did you know that? (Don't tell me.) The US Department of Defense alone spends roughly \$84 million annually on dick pills. So many dollars, so many dicks! Americans spend \$800 million dollars a year on hair restoration, and we collectively spend \$8.5 billion dollars on manicures in the US every year.

So, when it comes to what we spend our money on, I have no answers. I have no answers. It's all confounding. I mean, we should probably spend more on food for people who need it. And clean water. Or corn dogs. Hugs are free. I don't know, I don't have answers.

Alie: Billy Marino wants to know: From the data we've gathered so far, have we learned anything from Mars that has significantly changed the way we understand Earth?

Jennifer: Yeah! We compare Mars a lot to early Earth and so in that sense it is a little bit... We've talked a little bit about it, because it gives us this different perspective of our own planet and how these planets have evolved. But then there's also fundamental differences

between Mars and Earth. Mars doesn't have a magnetic field now. Mars doesn't have plate tectonics. Mars is super iron rich. What do those differences mean for us? Because we only have one data point here. Now we have more info on this other planet and seeing how those things make it different.

Those are the big things that we learned comparatively. Mars gives us a glimpse into the early solar system and stuff that was going on in that early time. And then we learn processes that happened on Earth could have happened on Mars but in totally different ways, like sand ripples. My friend Mathieu [ph.] did this work where he found these ripples on sand dunes on Mars that are sub-aqueous here, but there because the Mars atmosphere is different, they happen.

Alie: Wow! So, we can compare geologic features and realize that they can be created under two completely different sets of conditions.

Jennifer: Exactly. It's kind of mind blowing.

Alie: That's nuts. Because you're like, "Oh, this would lead you to believe it's definitely *this* causing it." And it's like, [*sad tuba wah-wah-wah*] "Not really." That's crazy. That's cool.

Jennifer: I think that's really valuable stuff.

Alie: Beren wants to know: Since once there was water on Mars, is Mars dust as horrifically nasty as lunar dust? Apparently dust on the moon had no water to erode around the edges, and so it was spiky and super damaging to equipment and fleshy bits like, say, lungs.

Jennifer: Mars dust, in terms of it being sharpen and stuff, is not as sharp as moon dust. It's really fine. It's just like Earth... a lot of ways like Earth dust, but it sometimes has salts and stuff in it that are really toxic. So, you don't want to eat it necessarily, but it's not going to kill you, either. I think you probably need to wear a dust mask, but otherwise I think it's probably fine. And actually, there's experiments where they have fake Mars dirt and dust and they grow stuff in it, just thinking about if we could grow stuff on Mars.

Alie: Does it work?

Jennifer: Yeah!

Alie: It does? So, from Andy Weir, taking your desiccated feces and mixing them with Mars dust possibly could work?**Jennifer:** I think they have to do some stuff to it. But the idea is, "Could we?" And I think the answer is yes.

Alie: Do you guys have to put money in a jar every time someone in your lab says, "Let's science the shit out of this"?

Jennifer: No one ever says that.

Alie: Okay, just checking. [*both laugh*] If someone did, would you guys be like, "Oh, come on."?

Jennifer: I think so. I think there'd be some eyerolls going on.

Alie: Catherine Woodrow and Michelle Sullivan both asked about microbial life on Mars: Which type of bacteria do you think would be the most likely to be found? Michelle Sullivan was like: Cyanobacteria?

Jennifer: Yes. Extremophiles for sure. I couldn't tell you a specific bacteria, but extremophiles are things that live in extreme places, so I think that's what we could find there. And I think there are some cyanobacteria that fit that category. The microfossils that they thought

were in this meteorite? Those were magnetotactic bacteria. So, if it were true that they were fossils and maybe we could find that there. Since Mars did have a magnetic field, it's not totally out of the question that they could have used it, and there's a lot of iron there, so that's another possibility.

Aside: I got to tour JPL with my lovely NASA engineer friend Holly Bender (Hi Holly!) and I was particularly struck by the observation deck that looked into a Clean room, which appears to be a scene from *Charlie and the Chocolate Factory* but with more golden Kapton space tape and wires and less candy. And I was like, these people building these rocket ships, like, do they have to shower 12 times a day every time they come in and out of this room? How does this work? If I applied to NASA, would they hook me up to a lie detector test to find out how often I actually wash my hair?

Alie: How do they know when they're building the Rovers and when they're in the Clean room that it's actually clean?

Jennifer: I think they have a bunch of these things that measure how many particles are in the air. They have to be below a certain particle count and then I think they also probably autoclave a bunch of stuff, but otherwise, I don't know.

Alie: Jude Kenny wants to know: What color is the sky on Mars? Are there long sunsets or does it switch to dark quickly, and can you see Earth from Mars?

Jennifer: The color of the sky on Mars is a butterscotch color, which we know from taking pictures of Mars. There's a lot of dust in the atmosphere. It's dimmer. It's way further from the sun than Earth is, so it's dimmer. There's still sunlight, but it's just darker. The days are about the same length, so in a way it gets darker quicker, but only because there's less light to begin with. But then the dust interacts with the atmosphere and the sunlight differently than it does on Earth because it's super iron-rich dust, so I think that's why it's a more butterscotch color. Here we have this blue color.

Aside: I know that asking, "Why is the sky blue?" is a kid question trope and I'm always a little embarrassed that I'm a grown adult and I don't really remember why it is blue. So, if you're like, "Unnnngh me too," I just looked it up for the both of us. According to a NASA webpage made for five-year-olds, all the colors in the visual spectrum add up to white, but blue light is scattered more than other colors because it travels as shorter, smaller waves. So, it scatters, and we see it mostly blue. But on the red planet of Mars, the sky is this butterscotch color because of all the iron dust. Which got me feeling very entrepreneurial.

Alie: Hear me out. What if we open a brunch place called Blood and Butterscotch. It's all Mars themed; everything is made of cast iron skillet. It's very iron-rich. It's red, it's really cold, but we never turn on the heater.

Jennifer: *[laughs]* And we never dust anywhere.

Alie: Never dust anything.

Jennifer: It doesn't sound that appetizing.

Aside: She gets points for honesty.

Jennifer: But it could have that interesting factor.

Alie: Maybe we could only have freeze-dried food. You know what I mean? Composting toilets. I'm gonna workshop it. Kevin McPhillips wants to know... five-year-old Finley McPhillips,

I'm thinking is a relative, wants to know: Would a helium balloon still float on Mars? Also, Finley, I'm sorry if you've heard me say the F-word like 50 times over the course of every podcast.

Jennifer: I think helium is still lighter than the atmosphere of Mars, so it could work. The way we have balloons here is that they're buoyant. So, they're less dense but there has to be enough density difference, including the weight of the balloon itself, the plastic. So, I think if it was designed well, it could work, but it could be better if it was hydrogen. The short answer is yes.

Alie: What is one thing about Mars that people don't know, that would really flabbergast them at a cocktail party?

Jennifer: Just how wet it used to be. People often ask me, like, "Is it true that we found water on Mars?" And yeah, we found that a million times already, but that's the thing that they're often blown away by. I think it's still, for some reason, not common knowledge yet that Mars used to be this awesome place that was not as cold and dry as it is now. It was wet.

Alie: Just lush pools and spas.

Jennifer: Yeah, maybe. Slimy maybe. Well, I was just thinking you said lush and I thought of plants, but in actuality if there was any life there it would probably be microbes, so it'd be slimy.

Alie: That's okay too. What about some flimflam about Mars that you'd like to debunk?

Jennifer: Flimflam?

Alie: What's some real horseshit that you're like, "No."?

Jennifer: Dang, that's a good question.

Alie: Is it that Matt Damon lives there?

Aside: [Matt Damon from *The Martian*: "So I gotta make water, and grow food on a planet where nothing grows... But if I can't figure out a way to make contact with NASA then none of this matters anyway."]

Once again if you didn't listen to Part 1, number one, what is wrong with you? Why didn't you listen to instructions from your old Dad? I'm not mad. I'm just disappointed. Two: *The Martian*, recap, was a book, then a movie, with Matt Damon stranded on Mars.

Jennifer: I think actually that has generated a lot of misinformation about the dust storms. They are global dust storms but they're not destructive like that, because the atmosphere is so thin. There are strong winds, but there's not a lot of atmosphere so it's just a breeze really. So, the whole premise of that, which was the major thing, was wrong. They were stranded because there was that huge dust storm and destroyed all their stuff, right? Not gonna happen.

Alie: Because the winds wouldn't create that much force because it's not pushing a lot of molecules that are in the atmosphere.

Jennifer: Exactly. Things aren't impacting you as much.

Alie: Right. Because there's not a lot of air that's actually whooshing past.

Jennifer: I think it's like 1/100th the amount of stuff in the air.

Alie: Oh my god. Okay. That is some solid flimflam you just debunked. I never would've thought of that because you think about the dust storms and you're like, "It's pretty much a hurricane full of dust," but it's not.

Jennifer: That's what people think. They think it's like this crazy catastrophic thing, but no. It's just dusty.

Alie: Have you been caught in dust storms in Arizona or Mojave, or have you been to Burning Man during a dust storm?

Jennifer: Yeah, pretty much all of those things have happened.

Alie: Really? Have you been to Burning Man?

Jennifer: Yeah.

Alie: How is it?

Jennifer: I went in 2007 and I had a good time, but I... obviously, I haven't been back.

Aside: FYI: Burning Man is a festival set on this big dry lake bed in Nevada and it features a lot of Instagram-worthy chain mail bikinis, and steampunk hats, and furry boots, and glow sticks, and electronic music, and for some people, a real sexy Saturn-and-Jupiter's moon situation, if you catch my drift, kids. So, some people? Really into it. Others, not so much.

Jennifer: I didn't do so many drugs, you know? I think that's how a lot of people have fun. I thought it was a cool experience, but that I could just do that experience and not pay \$400 for it.

Alie: I think it costs even more than that now.

Jennifer: When I went, I even applied for a low-income ticket. I was like, "I'm a student, but I really want to go to this." And then they gave it to me, and I sent them a drawing. I think you can't do that now. I think it's really intense.

Alie: I think it's more intense. But what were the dust storms like?

Jennifer: They were really bad. I remember I was wearing goggles and I had a bandana over my face because that's what you do there. I could've had a dust mask on, but no one has dust masks on; you've got to get bandanas. Peoples tents were blowing over, and I was riding a bike around the playa and couldn't see anything. You would lose your sense of direction really easily, and it was really abrasive on your skin.

Aside: If you need to go down a YouTube rabbit hole (and you do), I highly recommend typing in 'Burning Man + dust storm', also known as a 'haboob' which is appropriate for a festival that celebrates the freedoms of toplessness. A user named Just Joe captured one dust storm ripping into the glamping oasis and turning into a science fiction nightmare: [clip from YouTube, woman shouting over strong wind: "It's a haboob! Oh shit!"]

Also, as long as we're diving into the etymology for areola in this episode, why not follow up with a nugget on boobs? So, 'haboob' and 'boobs': totally different word origins. The metrological event comes from the Arabic for "blowing furiously," while the mammarian features get their names from the German for 'teats' and Grandma, 'bubby.' Is this podcast getting too weird? Is it getting uncomfortable? I'm just here to present facts. I just want to give you facts. What were we talking about? Dust storms.

Alie: Are the dust storms at Burning Man worse than on Mars?

Jennifer: One hundred percent. Way worse.

Alie: More art cars though.

Jennifer: Yeah, but you can't see 'em.

Alie: You can't see them. That's really good to know. I never would have guessed that. What is one thing about your job [*high pitched voice*] that sucks? What do you hate?

Jennifer: I guess some days I don't want to look at pictures on the computer.

Alie: [*laughs*] You said that in such a confessional tone like, "Mom, I don't like your meatloaf."

Jennifer: Yeah, I mean it's really cool sometimes, but other times I want to go outside.

Alie: Can you ever take your desktop and drag it outside or do you have, like, four huge monitors?

Jennifer: No, actually I could work outside. It's more that I'd rather be looking at a rock than a picture of a rock some days.

Alie: I get it. I understand. It's like looking at a picture of your long-lost love. You're like, "I'd rather be just hanging out with you."

Jennifer: Exactly and also, I do get asked a lot, "Is it true we found water on Mars?" That might be my least favorite question, although maybe it should be my favorite question.

Alie: But what do you say to that? The first time are you like, "We did," and now are you just like, "Duh!"?

Jennifer: I try not to, but I'm sometimes a little bit too honest and then I'll be like, [*with teenage girl disdain*] "Yeah." That's the opposite attitude I should have for people who are getting excited about Mars, which I love. So maybe that's why it should actually be my favorite question. I'm working on that.

Alie: You gotta flip the script.

Jennifer: Yeah, I need to dig that. Sorry!

Alie: What's your favorite thing about Mars or your job surrounding Mars?

Jennifer: I love that I can be paid to think about another planet, and what it used to be like, and what we could've been like, and these crazy questions that are really removed from the day to day. That's my job. Because I could have a really practical job, but I instead get to do this really out-of-this-world thing, and it's really cool to be part of these teams.

Alie: So, you're excited about the 2020 Rover? That's the thing that you're stoked about?

Jennifer: I'm stoked about that. I'm stoked about a lot of things.

Alie: Anything else that you're just like [*high pitched, lots of vibrato*] "Eeeeeh!"

Aside: I'm sorry that I turned into what sounded like a drunk dolphin. That was a happy noise.

Jennifer: A thing I really want to look at are dry lakes in the Mojave and relate them to Mars. That's another thing I am super psyched to be able to do, hopefully.

Alie: Any advice to anyone who's like, "I wanna work on Mars."?

Jennifer: There's so many ways to get involved with Mars stuff. One great thing about NASA is that all of our data that we get is publicly available. Anybody with the internet can go look at

dope pictures of Mars for free; download data that the Rover gets. Anybody can have the same data that the scientists who work at NASA have. You can just do that on your own, and you can go to seminars and stuff and meet people, read books... There's tons of podcasts. There's a million ways to get involved with NASA stuff and there's lots of NASA outreach that is pretty accessible, I think, to most people.

Alie: Thank you so much for being on.

Jennifer: Thank you. I was so excited. Thanks for caring about Mars.

Alie: Dude. I do care about Mars. I love Mars even more now.

Jennifer: Great.

Alie: Yay! It worked.

So, there you have it, I am so much more about Mars than I was before meeting the amazing Dr. Jennifer Buz. To become her friend either online or in Flagstaff, again, her Instagram is @Bugabuz, where she posts photos of insects and rocks. Her website, what a destination on this worldwide web! It features a self-portraits of her as a turtle with octopus hair. It's gorgeously perfect. It's [INNER.BZ](#). You can find @Ologies on [Instagram](#) or [Twitter](#). I'm on [both @AlieWard](#), and to support the podcast to make future episodes possible you can head to, if you want to, [Patreon.com/Ologies](#).

For hats, and swimsuits, and pins, and totes, it's [OlogiesMerch.com](#). We have you covered. And once again, the summer sale code is CampOlogies, ten percent off everything in the shop in July. Huge thanks to Shannon Feltus and Boni Dutch for helping me run that. Thank you to Erin Talbert and Hannah Lipow for adminning the Ologies Podcast [Facebook group](#), which is really full of the internet's kindest and most lovable nerds; no turds among them. It's amazing.

Thank you as always to Steven Ray Morris who painstakingly pieces these episodes together from a 30-page transcript and makes each episode so, so much better. The music is by Nick Thorburn of the band Islands. And special thanks to NASA engineer working on the Europa clipper mission, Christine Corbett [@Corbett](#) on Twitter and her husband Casey Handmer [@CJHandmer](#) on Twitter, also of NASA's JPL, for being such wonderful pals and supporters of *Ologies* and conducting that supplemental interview with sci-fi writer Kim Stanley Robinson; what a surprise that was!

Now, if you listen past the credits you may know that I tell a secret at the end of every episode, and this one... This might be the most embarrassing episode. That's not true, I have more embarrassing secrets, I've just not told you them, but this is pretty up there. So a few people asked me this week about Mars being in retrograde until August 27th and, confession, I just read a whole article about it, even though I don't want to believe in it, and I don't, but still, I'm like, "Should I not sign any contracts until after August?" But I also just didn't understand what retrograde even was and it turns out that it just means that it looks like the planet is traveling backwards in the sky but it's kind of an optical illusion.

So, I emailed Jennifer and I asked, "Is there any possibility in any realm, scientifically, that Mars being in retrograde could fuck with anything for real, like electronics, or angering ghosts?" And she said:

I usually say that an apparent retrograde orbit has no bearing on anything physical because it's literally just a change in perspective. The orbits are just still the same. As for ghosts though, maybe they don't understand orbits and they lived their afterlives strictly by apparent motions in the sky, so if Mars decides it wants to go backwards they might also go backwards???

I believe she was humoring me and entertaining my questions about Mars retrograde. I appreciate it.

Keep asking smart people stupid questions because, seriously, I think that they love it. I think it's good for all of us. Thank you for listening. I heart you all very much. Berbye.

Transcribed by Ellesse Oakes - The Manc that talks too fast on your radio while playing songs you've never heard of.

Some links which may be of use to you:

Info on the [2020 rover workshop via JPL](#)

[Rover tracks leave Morse code!](#)

[Basic bitch Mars geology wiki](#)

[NASA JPL control room goes OFF:](#)

[Parabolic flight and hooting French people](#)

[2020 rover 411](#)

[Los Angeles North aka Glendale Hilton](#)

[Walter Frederick Gale](#)

[Sojourner, the pumpkin rover](#)

[Jennifer Buz-approved Mars sci-fi](#)

[Cydonia, home of the Face on Mars](#)

[Pareidolia aka: when you see faces everywhere](#)

[Instagram for Facebook](#)

[Why meteorites look cool](#)

[Okay but really why is the sky blue](#)

[Yes of course we talk about The Martian again](#)

[Get a load of this haboob](#)

[Jupiter's got MOONS](#)

[How much do we spend on dickpills?](#)

[Mars is in retrograde but what does that MEAN](#)

[Elon Musk friggin loves Mars](#)

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