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Clip from Episode 5: Space

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Guest: David Flannery, associate professor in the School of Earth and Atmospheric Sciences at Queensland University, Brisbane, Australia

The Red Planet

David Christian: Now, I'd like to shift, shift ground a bit and ask really a series of questions about what researchers in astrobiology, what sort of insights they may have about the future of our species. Now, as I understand, we're a migratory species. We migrated around the Earth. So, these are questions about the likelihood of us migrating beyond Earth, first in our Solar System, and then I'll ask about beyond. What are the chances, do you think?

David Flannery: I think space is fundamentally different to the surface of the Earth. That's the first point I'd like to make. And we did do a great job of colonizing the surface of our planet throughout our human evolution. But the living space in space is fundamentally different. And so, I think the exploration of space with humans will have to be driven by some really powerful factors, maybe economic factors, perhaps even religious factors, but they'll need to be there because humans are not good at living in space. And well, you could start with the best place, the best places to go. So, if you want to live beyond Earth, Mars looks pretty good. It's a planet that has surface got water. It's similar to Earth. A lot of people talk about the colonization of Mars. Maybe we could make it like, like another Earth. But there are a few things to consider. We could start by thinking about just getting there in the first place. So, say you wanted to travel to Mars, and this, I think, is something that will happen, maybe within our lifetimes, humans will go to Mars. I don't think we're going to stay very long.

David Christian: Humans will go to Mars?

David Flannery: I think so.

David Christian: In, within a decade or two?

David Flannery: I think it’s likely, and it's going to be driven by geopolitical issues and drivers and competition between nation-states on Earth. If we want to do the science honestly, we could send the robots. And it's a slightly controversial opinion I may have here, but I think if we were going to spend hundreds of billions of dollars, that's what it would cost to send humans, keep them alive long enough to plant a flag on Mars, we could do a lot of really good science robotically. So, it's not going to be science that will drive this. We'll do some great science, I hope, on the coattails of the human exploration programs. But if we send a human, let's say, to be the first to create that presence or plant that flag, what would it be like to be that human? Well, you're going to have to put yourself in a fairly small spaceship, and you're going to have to spend many months on the way to Mars, and along the way, you'll be irradiated fairly

substantially. You'll receive just from the cosmic background, not even from the Sun. You will receive something like your annual background radiation dose on Earth every single day. You'll increase your chances of getting some sort of cancer in the future, and you may actually get sick when you arrive on Mars. On the surface, you'll be receiving a similar radiation dose. If the Sun decides to have a hiccup, you'll have a much larger issue. You might die. Okay, so that's the radiation environment. It's not very, not very nice, particularly if you wanted to live on Mars longer term, you wouldn't be able to spend much time on the surface. You'd need some sort of shielding, which you might conceivably develop on Mars, but in transit, it's much harder. But let's say you get there, and you stay for one Mars year, perhaps on the surface. You'll be continued to be subjected to that radiation environment. You'll also have to deal with a constant flux, this constant rain of micrometeorites, which could erode your space suit, which could be a problem, because you're going to have to wear that space suit all the time. You're never going to be able to take it off outside, because the Martian atmosphere is about 100 times less dense, and there's no oxygen in it to breathe. And it's also really, really, really cold, like 100 degrees Celsius below zero. And every day when the Sun comes up, that temperature could change 100 degrees. So, it's not a nice place to live from the radiation environment, the temperature, the meteorite flux. You've also got to consider the soil. You might want to grow some potatoes or something while you're there, but that soil, as we mentioned earlier, is full of these toxic compounds like bleach. And you'll also be separated, it occurs to me, if I think about going myself from every other human and from the Earth by this very large distance, which means you might want to plug into the internet, but it's going to be a very laggy connection. So, I think it's, in the near term, it's going to be difficult, but definitely achievable, to go there with humans.

David Christian: Okay, so my ambitions of being the first Martian you've just shot to pieces, not a five-star hotel. Are there any more attractive environments in our Solar System?

David Flannery: Well, maybe, if we think about the longer term, say, colonization of Mars is perhaps even harder in one sense, because if we wanted to make a place like Mars, like the Earth, for example, let's get …

David Christian: This is terraforming.

David Flannery: …terraforming. Let's think really big. This is the podcast about big ideas and big timescales. So, let's imagine we've got near infinite resources and time. What can we do?

David Christian: We're going to turn it into a five-star hotel.

David Flannery: Let's turn it into a five-star hotel. Let's make the flowers grow. Let's give it an atmosphere. Let's imagine what that would be like. So, we want to fill the atmosphere with enough greenhouse gas and some oxygen for us to exist, for it to be warm enough and breathable. Well, there are some materials in the ice caps. There's water ice, there's carbon dioxide ice. Let's get that into the atmosphere. It would require a huge amount of energy, but it could be done. It won't last forever, though. And the reason for that is the same reason Mars

doesn't have much of an atmosphere today. It probably did in the past, we think, but it's been stripped away. How? Well, Mars doesn't have a magnetic field like the Earth, an appreciable, a strong magnetic field, which means that the gases in the atmosphere, over geological time periods, they get stripped away. And one example of how this happens is that the water, water vapor in the atmosphere, when radiation interacts with the molecule, turns it into free hydrogen and free oxygen. The hydrogen is very light, and so it floats away up into the upper atmosphere, and it gets stripped away by the solar wind, and eventually that takes away all of your water in the atmosphere. So, could we give Mars a magnetic field to prevent this from happening? I don't think so, because magnetic fields seem to have something to do with the interaction between solid and liquid metal cores in rocky planets. And the Earth is actually the only planet in our inner Solar System that has a strong magnetic field. Mercury doesn't have one. Venus doesn't have one. Mars doesn't really have one. So, could we create one? Well, no, we need a new planet, really.

David Christian: Oh my gosh. So, so not only is it not a five-star hotel, if we manage briefly to turn it into a five-star hotel, pretty quickly, it would, it would cease to be a five-star hotel again?

David Flannery: Not, but if I played the devil's advocate to my own response there, say we got really good at creating our own habitats. I mean, that's conceivable. Maybe we could dig a hole on Mars and underground, we could have self-sustaining entirely, like recycling, sort of Star Trek-like environment. I think that's conceivable given infinite time and enough resources. But if we could do that, I have to wonder, why Mars?

David Christian: Yeah.

David Flannery: Why not the Moon? Why not, say, the International Space Station exists within our own magnetosphere, so you'd be shielded from radiation there. Why not the bottom of the ocean on Earth, so why don't people live there? I think the answer is that they're not very nice places to live.