

Key:

I = Interviewer – Dr Alfredo Carpineti

R = Respondent – Dr Seth Shostak

Talking over each other: [over talking]

Hi. I'm Chris from IFLScience, and it's my pleasure to welcome you all to IFLScience – The Big Questions, the brand new podcast series from IFLScience where we invite our expert guests to tackle The Big Question as we investigate the mysteries of science, technology and humanity. Without further ado, I'd like to introduce your host IFLScience's Senior Writer, Dr Alfredo Carpineti. Let's dive straight into the big questions.

I: Hello. I'm Alfredo, and welcome to The Big Questions. In this episode it's my pleasure to be joined by Dr Seth Shostak, Senior Astronomer at SETI Institute. The question this time is, are we alone in the universe? Dr Shostak, it's a pleasure having you here with us. Could you please introduce yourself and tell us a bit about your work at SETI?

R: Well, I'm at the SETI Institute, which is indeed interested in the question of life beyond earth. These days that means not just looking for intelligent life, aliens if you will, but also for life, for example, in our solar system, under the sands of Mars, some of the moons of Jupiter and Saturn. All of which may have biology, but it would require a microscope for you to see it.

I: Wonderful. Obviously, we have to start from the big one and go into the details. Do you think that we are alone in the universe?

R: I don't. But, of course, what I think doesn't seem to matter too much to anybody, including my relatives. When you ask ten scientists do you think that there's life out there, I'm pretty sure that all of them would agree that there is, and they do that simply on the basis of numbers. The number of stars in our galaxy, just our galaxy, there a few trillion other galaxies, but the number of stars in our galaxy on the order of about 10,000 billion billion. Almost all of those stars have planets. Given the huge number of places where there could be life, it would be really strange if there wasn't life there.

I: Thank you very much for that. How do SETI approach this search for extraterrestrial intelligence but also much simpler life?

R: We try and use as many different techniques as we can. A lot of it, believe it or not, is limited by the question of money. Most people don't think about money when they think about this kind of research. They're not interested in the money, but if you're trying to do the work, then you're interested in it. Because if you don't have money, you can't build the equipment, you can't pay people etc. When it comes to looking for life that might not be so intelligent, that might require that microscope, we do many of the things that NASA does. In other words, we search in a half dozen places in our solar system where there might be, in fact, life. We do that of data from NASA's space probes and rovers and so forth. Everybody knows about the Perseverance rover now crawling around Mars. It's looking for places where there might have been life a long time ago, say three or four trillion years ago, and it's storing that evidence in tubes of metal that will get picked up some time in the future and brought back to earth.

Maybe we'll find that Mars has or had bacterial life. That would be very interesting because that would show you that at least life can get started in places we haven't looked.

As far as intelligent life, the traditional method has been to use big antennas. They're called radio telescopes and try to eavesdrop to try to pick up transmissions from other societies that could be quite far away. It could be hundreds of light years away. The other technique that's being used, because we also looked for flashing lasers and just looked for things that have been built...You think about it, if somebody told you go and find the Romans, you know, the classical Romans, you could try and do that, but they're gone now. They've been gone for 1,600 years, but you can find the Colosseum and the Forum and stuff. You can find evidence that they existed even today. Looking for that kind of artefact for aliens, maybe they built something big, is another way to approach the problem.

I: Let's focus on intelligent life for now. When it comes to finding signals from other civilisation, and maybe this could be a little bit controversial, humanity has sent some signals out there in terms of for television and radio transmission, but it's never been with purpose. Do we expect messages to be sent out there with purpose or that we're hoping to, as you said, eavesdrop and catch a transmission that was never meant for us?

R: Actually, Alfredo, who cares? We don't care. If you pick up a message whether they're answering something that we sent, we have sent a few things into space deliberately for the aliens but only a few, or it's just a random transmission that they're making. Like, for example, the radar sets at our airports, we're not trying to signal the aliens every year. But we build these big transmitters that send a very powerful signal, a very intense signal in certain directions, and the aliens might pick that up. It wouldn't be very interesting to listen to, of course, but at least they would know that there was somebody on this planet who could build such things and essentially don't really care. It's hard to pick up things like, for example, television. If the aliens have television networks like we do with transmitters without about the same power as ours, we wouldn't be able to pick those up unless we had a huge antennae the size of Vermont or something like that. We could pick up some of the stronger transmissions. We don't know what the aliens are doing, so any clues are welcome.

I: That is fascinating. I had no idea about the airport radar and how intense they were. That could be going to the extents of light years at this point. I don't know when was the first very intense radar built.

R: That was some time in the Second World War. Maybe the aliens know about La Guardia. Maybe that's what they know about us.

I: Hearing a lot of people complaining about security at airports or something. When it comes to if we're actually getting a signal or if we were to receive something that it was definitely artificial in origin, what would you be doing? What would be the next step?

R: There are protocols. I don't know what I would be doing, Alfredo. Probably asking for a raise. The only real question is remember if we pick up a signal coming from 100 light years away or a 1,000 light years away, there's no danger there. The aliens don't know that we found that signal. But there will be a lot of people that say, hey, look, we want to learn more about that.

There are two ways you can do that. One is you could have different kinds of receivers so you could see if there was a message in the signal. If it's a radar [unclear 00:07:40] no message, but if it's a delivered transmission, then there would be a message. The kind of equipment that's being used today in SETI, it wouldn't be able to pick up that message. We'd probably spend the money to do that.

The other group of people would say, hey, look, there are aliens out there. Let's invite them to dinner or whatever. They would want to send a message, and there are protocols about that. On the other hand, I think that the protocols don't matter too much because people who want to just send a message back would build the equipment to do that and they don't care about protocols. Maybe we'd say we're the earthling, here we are, talk to us.

I: Let's assume that we've found this message and we decide not to send the message back yet, how do we approach this? Would there be a major announcement like who finds it just announces, or do we expect panic in the streets? Not thinking War of The Worlds by [over talking]

R: HG Wells.

I: Yeah.

R: I don't think there would be panic in the streets. To begin with, one third of all Americans and one third of all Europeans and one third of all [unclear 00:08:53], they think that the aliens are already here. They think some of the UFOs are alien [unclear 00:08:58]. I don't agree with that. They do think that, and they're not panicking in the streets about it. They really aren't. I think that if they read a new story, hey, a signal was found coming from this place, they would know that there are no dangers. You're tuning in your favourite talk radio host in your car radio. It's not dangerous. The radio host isn't going to give you a hard time. I don't know that there would be any sort of panic. What would happen, of course, is that you would tell everybody. A lot of people don't believe that. They think that the government will keep it secret. To begin with, the government isn't running those programmes. That's point one. But the other point is that if you find a signal, you would call up other people in other countries with other equipment saying, you guys, check it out. Make sure that we're not kidding ourselves here. That means it would be going around the world.

In our experience whenever the word gets out, well, there could be aliens or maybe you found a signal, immediately the radio, television and newspaper call you up. It would just be a big story, and I personally don't think there would be much panic. I think people would be interested.

I: Absolutely. I think it would be fascinating. I'm glad you mentioned how it would be an international effort. Now, I'm just wondering, for the conspiracy theorists, how many people work in SETI?

R: Well, the total number of people that work for the SETI Institute is about 100 in terms of the scientists. But almost all of them, 98 of those 100 are working what's called astrobiology. They're interested in life and space but, again, the microscopic life and space they might find on Mars. There are very few of us there that actually do SETI. The total number of people in the

world that do SETI is maybe 2,000. Actually, the United States these days...I can even narrow that, actually, even California, which has all the SETI experience, by coincidence that total effort is so tiny that it's perceived as a big project, but it's strictly an American project now. This is the first time in history it's strictly been an American project. For example, the only European effort was Italy. The people at the Bologna Observatory, which is part of the university there in Bologna, had an experiment running for at least 20 years. But they ran out of money too.

I: I think we hear you loud and clear that if we want to expand on the search for extraterrestrial intelligence, we will need some money into the actual search.

R: Let me just add one more thing to that, Alfredo. That's a well-known problem, but there's actually a guy who lives here in the Silicon Valley. A Russian investor, Yuri Milner, and he got interested in this subject and he has given \$100 million over ten years, so \$10 million a year, to the University of California at Berkley to improve their search. That's by far the biggest effort in the world now, and it's because there is real money involved. Of course, the people at Berkley are very clever.

I: We talked about radio signal, but before you also mentioned flashes of light, lasers. Can you expand a little bit on that?

R: Yeah. One of the ways that people communicate in the old western movies, I don't think they do it anymore, the cowboy is surrounded by bad guys and he has a shaving mirror. I don't know why he carries it around, but he has a shaving mirror and he uses it to flash sunlight in the direction of his friends. You know you can send information on a beam of light. People have heard of fibre optics. Actually, you send more information than on a beam of radio waves and light, at least over modest distances up to about 1,000 light years. It's a good way to send information to the galaxy. If you go to infrared, you can even send it further. It could be that the aliens have bypassed radio as a way of signalling and are sending everything on fibre optics but without the fibre part. It could be that they're flashing lasers going off. We wouldn't even have noticed. If somebody told you, hey, I noticed last night in that constellation up there, there was a green flash for a tiny fraction of a second, a millionth of a second, do you think anybody would have noticed that? Nobody would have noticed. Experiments to see if we can find such things are very interesting because we've never tried.

I: Are there specific searches for these lasers or something planned?

R: There are. The SETI Institute has a project underway to build the equipment to do that. The University of California at Berkley also has a laser search scheme underway. There may be others, but those are the two that I know about.

I: That's fantastic. I'm glad that we are sort of expanding the possibilities to search for this extraterrestrial intelligence. Let's go back about the biology. Obviously, we are focusing a lot on Mars. We have lots of rovers there, and there are also searches beyond the inner solar system. We're looking at the moons of Jupiter, the moons of Saturn. What could be possible to learn from what SETI is doing in terms of learning from what we can see from telescope and previous data?

R: The search is for life on Mars. They're very extensive. Mars has got the majority of our attention ever since the 19th century when the director of the Milan Observatory, and then later a guy by the name of Giovanni Schiaparelli, claimed that they could see canals on Mars. Mars has always been interesting from the standpoint of life, but we still haven't found any. Of course, you can get to Mars in seven months with a rocket, so it's relatively easy to do experiments with Mars. The moons of the outer solar system, three of Jupiter, two of Saturn, these are also places that have a lot of water. They've had a lot of water for more than 4 billion years. The water is under ice. It's not on the surface, too cold. If you go maybe a kilometre deep or maybe even less, you might find liquid water on these moons. That water has been there for, as I say, 4.5 billion years. It's possible that something has happened here. That maybe you develop life. I don't think you would find tuna or anything very interesting in terms of a good dinner in those oceans because there isn't very much energy down there. It's hard to get anything to eat. You don't have sunlight causing plants to grow and stuff like that. It would probably be microscopic life. If you found it, at least you could say, hey, look, life is not some sort of miracle - it happened on this moon of Jupiter. That would be very interesting.

I: I am personally fascinated about the possibility of life in the moons of Jupiter, both in terms of if it's something that is similar to earth life but also if something is different. I think it can open such a huge realm of possibility when we are discussing biology.

R: Absolutely. If you found life on one of the moons of Jupiter, Europa, for example, you wouldn't anticipate that it would have DNA. It might have a molecule that does what DNA does, sort of a blueprint for life, but why should it be the same blueprint. It might be a different one. That would be interesting to show you that biology is a very general thing.

I: Obviously, we could find life also beyond the solar system. How are we approaching the search of simpler life and not direct through messages beyond what we can have here in the solar system? Are we looking for life on exoplanets, for example?

R: We are or will, put it that way. Exoplanets are like trying to see a firefly. That's what they usually say around the Hollywood searchlight from 15,000 kilometres away. It's very hard. It's very hard to even find those planets, let alone examine them. There are new telescopes coming online that will make that easier. In particular, the James Webb Telescope which may launch within a year. It's always being delayed, so I don't know. That will have the capability of maybe measuring what's in the atmospheres of some of these distant planets, planets around other stars. If they were to find, for example, methane or oxygen, oxygen is in our atmosphere because of photosynthesis. It's in our atmosphere because of life. If you found oxygen in the atmosphere of another planet, that would be a good clue that there's something alive down there. It's something people think about, how to do it. It hasn't been done very much yet because we can't, but within a couple of years, that will change.

I: I'm glad you mentioned methane and oxygen. Those are two of the things that tend to be for us the biosignature. There's also been a discussion on technosignatures, so looking at the different substances in these atmospheres. Do you think it's on earth we'd be seeing increasing carbon dioxide through the climate crisis or CFCs that kill ozone?

You think it's something that should be investigated more in respect to just the most basic biosignature?

R: I don't think anybody disrespected it. The men for methane wouldn't complain. But keep in mind that oxygen has been in earth's atmosphere in large quantities now for about 2 billion years. That gives the aliens a lot of time to find it. Whereas CFCs, chlorofluorocarbons from hairspray or whatever, those were in the atmosphere for 10 to 20 years. It's a signature, but the signature is very fast and then goes away. It may be that, yes, you can talk about too much carbon dioxide in our atmosphere because of climate change, and that is a signature potentially, but it's very slowly going up. If we ever combat climate change one way or another, it'll go away. Maybe it'll be in the atmosphere for a century or two. That's a very short period of time compared to the history of the universe. I think much better bets are things like oxygen.

I: Thank you very much. I think I only have my final question. What are your hopes for the field of alien search over the next few decades?

R: I hope we find something, obviously, would be the greatest thing. It's hard to predict if and when we'll find anything. It could be that we never find anything. I don't think that would convince me that nobody is out there. That seems too improbable to me, but it would mean that we're not doing the right experiment, so there's always that. To the extent that we are doing the right experiments, to the extent that we're looking for something that other societies would actually do, then I think it should succeed really and we should succeed in finding something. Certainly by mid-century because the experiments keep getting faster and better. At some point either they succeed or you decide this isn't the way to do this.

I: Thank you very much. If you have any final remarks about the search for alien life?

R: Don't judge the extraterrestrials on the basis of what you see in the movies. I mean, I love those movies, but that's probably not the way the aliens are. In fact, given that we are developing technologies today and in this century that are as smart as we are, I suspect if we find the aliens, they'll be machines. Something to keep in mind.

I: Thank you very much.

R: Thank you, Alfredo.

Thanks for listening to IFLScience – The Big Questions. Don't forget to subscribe so you don't miss any future episodes. And join us next time when we'll be discussing ways to stop climate change. Have a great day.

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