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MISTRAL MYERS: You're listening to the "Talks at Google" podcast, where great minds meet. "Talks at Google" brings the world's most influential thinkers, creators, makers, and doers all to one place. I am Mistral, and I'm back to bring you another great episode. Every episode of this podcast is taken from a video that can be seen at [YouTube.com/TalksatGoogle](https://www.youtube.com/TalksatGoogle). This week's episode is all about space, featuring two amazing women. Claudie Haignere is a French doctor, politician, and former astronaut with the Centre National d'Etudes Spéciales, CNES for short, and the European Space Agency. And Ersilia Scarpetta, who's worked with the ESA since 1991 and is currently the space agency's Chief Diversity Officer. In conversation with Sarah Drinkwater, they discuss their passion for space, research, STEM, and diversity, their story of their careers, their views of the ESA and space exploration, and their thoughts on diversity in a traditionally male-dominated field of science.

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Now, here's Claudie Haignere and Ersilia Scarpetta, "European Space Agency, a career in space."

SARAH DRINKWATER: So, Claudie, like many of us in the audience, I grew up dreaming of going into space. And you have this incredible academic record. What made you, you know, after getting a PhD in neuroscience, what made you become an astronaut? What was the original idea behind it?

CLAUDIE HAIGNERE: Okay, thank you very much. I'm very happy to be with you today. It's not really the story, from the PhD in neuroscience to become an astronaut. I will begin with the fact that I was 12 in July '69, for the first human landing on the moon, and it was really, for me, something incredible to have this dream inaccessible becoming a reality. And, at that time, it was, for me, something that fed my imagination.

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CLAUDIE HAIGNERE: I really loved documentaries, science fiction books and everything. And there is no astronaut school. It is not a curriculum that you can enter like that, so I decided to become a medical doctor, I'm a rheumatologist. And I had this chance at the hospital where I was working in Paris to discover a call, an opportunity from the French agency to become an astronaut and taking part in the scientific programs in the space station. So, for me, it was clear. It was for me. And I tried it, and I asked for a file, and I put my candidature, and I go through the selection, and I have been selected. It was in '85. And maybe something that I can share more with the girls than with boys, I decided, having been selected as a scientific astronaut, "Okay, I had a doctorate." I was an MD, and I did clinical research, but I wanted to be sure that I would have all the right assets to be on the path in between astronaut candidate to astronaut assigned to a mission.

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So I decided to do a PhD in order to do work in a laboratory and to have, really, this basic training as a scientist. And, so, I would say that it is maybe a kind of lack of confidence that--it was needed for me to have more than just the first background in order to ensure that I will get all of the assets to be on that path. And it was wonderful to work on this laboratory for neuroscience because I chose the right laboratory in order to be in the team, cooperating on space program and microgravity, functioning of the body, working with NASA, with JAXA, the Japanese agency, and the Russian agency. So that meant it was one element to be sure to be somewhere on the right path after that. And it was obvious for me that I had to try it. It's--

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And, as I said, after that, a long time training because I had been selected in '85, and my first flight was in '96. So a long training in order to become not just a scientist, but also an engineer. My first flight was as a scientist astronaut, and my second flight as a bot engineer. That means in charge of everything, maintenance and of the station and the vehicle. So a long period of training and great impatience--

SARAH DRINKWATER: What is the--

CLAUDIE HAIGNERE: To be the day in August 1986, waiting for the [inaudible] that means the beginning of the adventure. And, really, the adventure, the reality was even more wonderful than the dream I had in mind in my imagination. I'm very lucky.

SARAH DRINKWATER: I have to ask you more about the reality. I mean, you know, a 10-year training period to me is staggering.

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Can you tell us more about like is there a particular moment that, for you, is simply unforgettable, like your first trip into space. Just a moment that made you think, "Wow. This was worth this 10-year journey."

CLAUDIE HAIGNERE: Yeah, I mean I can't say that "Wow" at this time, but I would like to sort of say that, with the time, as I explain, I lived for 10 years in Russia because my two flights were with the Soyuz system. And that mean there was a very "Wow" moment during the flight. But there is also a "Wow" moment with this period of life in Star City in Russia. I went there in '92 just at the beginning of the Russian period after the Soviet Union, and I saw all the transformation, and this was also a cultural shock. And it was something really impressive, and that means that we have wonderful and unexpected moments for the mission but I had a short mission, space mission. But there is also this incredible human adventure that I lived for 10 years with my colleagues, with different culture, diversity of gender, diversity of backgrounds, with military pilots as well as scientists and even a tourist, space tourist at the time.

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So that means all of the landscape were there, full spectrum. So, and for the flight, what can I say? As a rheumatologist and as a sport woman--I am a gymnast, I was really impressed with the new abilities I discovered being in free-floating. I can try to share a little bit, you have seen pictures and movies about that, and that's really exciting to see that we have some hidden, I would say, abilities that will be revealed in this new environment. And this is-- this feeling of freedom-- not completely comfortable at the very beginning because you have to build new reference, new frameworks, and there is this way to reorganize your sensorimotor patterns, but also to rebuild some cognitive references.

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And for example, the first time I looked through the window at this kind of vision that you have on screen, that meant Earth was above the cosmos or the sky. So I was not comfortable with that. I had to do--around the window in order to put everything in the right direction. And the same to see Africa above Spain, for example. It was not comfortable for me also. I had to actively do cognitive rotation in order to be-- so this ability, potential for adaptation of our sensorimotor sensors and the [inaudible] this is really something incredible. And then the glance through the window, that's true too. To have this chance to be in orbit and 400 kilometers from Earth.

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As you know, one orbit is 90 minutes, so that means 16 times a day we have the ability to go through, depending on the kind of orbit. If you're in orbit with the Pacific, for example, it will be 50

minutes water, water, water, water--anything to see? But-- so that's really-- we are very privileged. I think we are about 580 astronauts.

SARAH DRINKWATER: Yeah. It's a small group.

CLAUDIE HAIGNERE: Just 10% female astronauts.

SARAH DRINKWATER: Wow. I didn't realize it was so small.

CLAUDIE HAIGNERE: Ten percent. I think about 60, and we can discuss that after.

SARAH DRINKWATER: Of course.

CLAUDIE HAIGNERE: Ten percent applicants, candidates. That means--

SARAH DRINKWATER: Interesting.

CLAUDIE HAIGNERE: Yes.

SARAH DRINKWATER: So there's lots of potential astronaut candidates in this audience, perhaps.

CLAUDIE HAIGNERE: Ten percent candidates. That means 10% female astronauts. So that's the entry of the pipe. There is a deficit.

SARAH DRINKWATER: Yeah. It's really interesting. I really liked your point around we have abilities that will be revealed in space.

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To me, that sounds wonderfully mystical. And, also, you know, from everything we've read about. I think Tim Peake's diaries have helped a lot of us get a stronger picture of what it feels like there today. How did the two journeys change your thinking when you came back to Earth? How did you-- was there anything that felt different? I mean, obviously, we've all seen the story this week about Scott Kelly and his twin. We know very little about that right now, apart from the fact that seven percent of his genes are now unidentical to his identical twin. But what-- in your thought process, what felt different when you came back?

CLAUDIE HAIGNERE: I had short duration missions. The first one was a sixteen-day mission, and the second one a ten-day mission, so nothing to see with Tim Peake mission, six-month duration, or Scott Kelly, as you said, one-year mission. And personally, I have been surprised by the quick readaptation coming back. So, in a few seconds, you have to use again your extrareception and proprioception in your skin, and sensors in the joints, and also your vestibular apparatus in order to cope with.

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But in less than two minutes, you are okay with that. The first night, it was a little bit strange because I had the feeling of weight during this night because my body was heavy, waking, and all of the objects that I had on my body for monitoring my physical state with sensors, everything was floating in the room. So I was always waking in order to put everything on the same level. So there was a gap in between my personal feeling of coming back and my intellectual, I don't know, cognitive feeling that I was still in microgravity. But it's-- so it's not at all the same for a long-duration mission. As you know, there is this adaptation in microgravity with the muscle relaxants [inaudible] the muscular atrophy and demineralization for the bone structure.

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So that means it's a little bit long process to go into the rehabilitation. It not a question of minutes, it's a question of weeks and months in order to be completely back to yourself. So I have seen already this paper about this difference in gene sequences, so that's a challenging question. We know that there is radiation, there is stress that can change something in the gene expression, so we have to wait a little bit to know more. And what is difficult also in this field of microgravity, for example, I have always a question, but what is the difference in the metabolism between the female astronaut in the male astronaut during a long-duration flight? And as you know, as a researcher, in order to get certain answers, you need to have some cases.

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And we have so few cases of female astronauts for long-duration flights that it's difficult to say, really, something. And the same for this potential gene disruption. We know that there is an anomaly after the flight, but the fact that it can [inaudible]

SARAH DRINKWATER: Yeah. We're lucky he has a twin, really. Ersilia, you have been working at the ESA since 1991. Obviously, your background is in astrophysics, but I'd like to know a little bit more about how you came to space as well. Was it a dream of yours when you're a child? I know you've done so many roles in your time at the agency, but how have you seen the agency evolve in that time?

ERSILIA SCARPETTA: Yes. First of all, I have to say when I was a teenager, I was very tortured teenager. Very much into the poetry, literature, and I really needed something. I wanted to study something that was able to take my center of gravity outside myself and putting a distance for myself. I wanted to feel this sense of freedom, even the sense of being nothing in an indifferent, silent, universe was, for me, very empowering.

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And I have to say I-- actually, something that now in my job as Diversity Officer, I often say to girls there is a powerful of transformation by studying physics, in particular, that is forever. And this is because you have-- you to abandon your experience to understand, and you enter in a different world. And, just to give an example, you have, for instance, the helium superfluid. Helium superfluid is a magic thing, and, if you go below a certain temperature, you lose the third dimension, it becomes flat. So, if you put in a glass, it starts climbing and goes, I mean, as a film on a table. Now, this looks magic. It's something that you never experience normally, but it's true, it's physics. And the same for what concern space, and I was actually studying general relativity and the fact that time feels speed, so change with speed and change with gravity.

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So the time that we feel here is not-- doesn't go at the same pace than on the space station and even further. So all these that looks, again, fiction are actually other laws of physics that are valuable. And this put me in the dimension of really feeling and sense of power as a human being. A power of being the one that can ask questions and feel curious, which, by the way, is the message that Dr. Stephen Hawking passed very strongly all through his life, that the [inaudible] questions is what makes a difference in this universe. I have been with the European Space-- why space? Space because, again, it's the natural-- if you want-- when you have this kind of desire. Actually, desire is a very important word for me.

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You know, desire, "Desiderio" comes from the Latin "De sidera esse" be far from the stars.

SARAH DRINKWATER: Hmm.

CLAUDIE HAIGNERE: Ah.

SARAH DRINKWATER: An amazing fact.

ERSILIA SCARPETTA: So I really believe that, in each of us, there is this tension to reach out to something bigger than us. To something--we want to join back. And it's a big drive, and I felt this drive. I needed this spiritual dimension, you said, and then listening to Claudie, this mystic dimension. And so the European Space Agency also because of its international feature was very the perfect place to be. I also spent four years in Washington, D.C., working in the relations with NASA, which added another dimension. So not just the European, but also to see from the other side. And I-- and this is what I try now to pass also the amazement, the wondering of what we discover. We had the gravitational waves just discovered last year as a big turning point. We have so many mysteries still to solve, and it's really, I mean, this is the sense for me, of being a mind and heart in this vast universe. Yeah.

DRINKWATER: I love it. And so we were really lucky last year in London. We had an amazing exhibit at the Science Museum about the Russian race to space. Star City was a massive feature of it. I don't know if anybody else went to it. But yeah, it was great, right? And anybody who's my age, Challenger, for me, was a massive moment in my childhood. I think the first time as a child that I was ever understood disappointment and failure, and, you know, that kind of immediate pain. I think a lot of kids followed that really closely. And it kind of struck me at the Russian exhibit that that seemed like such a golden age in terms of space. And I would love to get your thoughts on, you know, obviously with the Scott Kelly during the last year, we've seen Tim Peake make the most of media. But it feels like a very different era in terms of space and our desire to explore space. Do you think that's fair? Like, what do you think about the shifting politics of space over time?

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HAIGNERE: You can begin generally, and I'll--

SCARPETTA: I can start to-- yes. Okay. Generally, I have to say it is a perception. Today, we have globally so on the institutional side. We have more than 70 billions that are funded, that are spent in space activities, civil space activities. We have double of actors, so well beyond the usual suspects. So now we have about 75 countries that invest more than 10 million in space. So it's really enlarging and in a way you see that it's not just the economic interest because actually, for this 70 billion spent, you have a downstream activity that is a factor five out of that. But there is again, this tension, this desire of prestige in a way I think that apart from sport, that really makes achievements known to everyone.

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To humanity, only space activities can really give this status and this statement. And of course, there is also the fact the space infrastructure is something that now is part of our daily life. And, you know, also in terms of exploration, if you take U.S., Japan, Russia, Europe, South Korea, India, China, in five years' time, we have about 15 missions moon-oriented. A similar number Mars-driven and then the asteroids, the other planets. So there is a big activities. The problem is the-- of course, what was at that time being really pioneering, but there are still elements of pioneering coming in particular now also from the private sector. So I think the dynamic is really there. It's not a lost interest.

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And ,also astronauts, if we see astronauts, the Twitters and the media coverage. Yeah.

HAIGNERE: Yes, for sure. And you have been in the right place to see the way Tim Peake communicates with Instagram, Twitter. And it's really interesting to share immediately this

adventure. Yes, it's true that there is a new era for space and you have also the private companies that are involved now and are challenging our way to think and to organize. And I have a dream. And this concept I'm working on in the European Space Agency. This concept to about space exploration, human space exploration. To enlarge this concept of exploration to the point of expansion of our humanity on another the surface, the moon surface. And I'm working on a moon village concept.

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That means building a permanent infrastructure with a robotic and then permanent infrastructure where we will live and work and inhabit on that. And that means for me it's an interesting concept because we need to think in terms of new landscape out-of-the-box, out of the atmosphere, new partners on the international side. We share the International Space Station with five partners and we will have a Chinese space station in a few months from now, but with different interests and different way to cooperate. And we have to think this village that men live together for the future of humanity in a new environment with private interest, mining for example, to exploit some resources, tourism, cultural industries.

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And energy, building new materials, a lot of economical expansion also in terms of economy. And economy and the surrounding of the earth economy, that means low Earth orbit economy. The space station for example, we decided to be in this exploitation of the space station with these partners and the public institution until 2024, maybe 2028, and then to begin to think in terms of commercial exploitation of the low Earth orbit. But we have also to think in terms of this expansion and expanding the economical sphere I would say, for earth. So that means that's really an interesting concept in order to rethink everything in terms of government, interfaces, partners that we will be part that kind of activities that will be there. The scientific one on the far side of the moon or a lot of other sciences we can do on the moon.

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And from the moon. Technological developments, robotics, advanced robotics and interaction with-- and this is very exciting to try to reconsider in order to be actively involved with changes, and not just--

DRINKWATER: Passive.

HAIGNERE: To-- Yes. Passive and receiving the changes by the new actors and new economics. So, yeah. So I think we need such visions in order to be really active and to design the future we wish.

DRINKWATER: Yeah. I like that very much. What are the timelines for something like moon village? I mean, I think many of us have long been excited by the idea of going to space as a tourist, but I love the idea of building a new world and kind of testing out an infrastructure that is nationless in some ways on the moon. What would be your kind of timelines for a project like that? I mean, I'm guessing this kind of thing is very long-term.

HAIGNERE: I would say it begins already because there is some probes around the moon.

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There will be soon new probes from the Chinese side on the far side of the moon, and a sample return, and the Indian one, and the Japanese one. So that means the robotic elements in order to make the maps defining or so. Where are some resources that we will have to use because, if you are building something on the surface of the moon, you will try to do with the In-Situ resources relations. That means we have to make the map of the possibilities. So this is already underway.

For the first crew, I would say that, if really we decided to go, in 2030 for me, it's something that can be achievable. We have been already with six missions in the Apollo period on the moon. So, for sure, the techniques have changed, and there is a lot of new element to secure in order to do it.

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And there is also to secure this sustainability because I am speaking not so much in terms of exploration with short period of visits, but living and working on the surface. And that means sustainability as well as the economic sustainability and the sustainability for living there. But for the first crew and I hope a crew with a female astronaut and not just men astronauts, because there was 12 men on the moon, that means it is 2030 20.

DRINKWATER: Yeah.

SCARPETTA: It can be something achievable.

DRINKWATER: How does-- I'm going to pick up back up on this piece around no woman on the moon, but I want to start with, you know, the two of the most well-known figures right now in the race to space, Richard Branson, Elon Musk. How does public and private interrelate in this world? I mean, do public figures like that sending these very audacious goals, does that help this mission if the goal is to raise perception and excitement to run space for the next generation of kids to become astronauts?

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SCARPETTA: Sure. I have to say that actually, what you bring also from what Claudie was saying, is that we are in a moment of many paradigm shifts. So we have, first of all, actually, this move from being explorers to start thinking on being also settlers, which is something new. I mean, it was not this-- the project at the time. It was just going there and come back. So there are two venues that open up. At the same time, the paradigm shifts actually to have this new what we call the Astropreneurs coming in.

DRINKWATER: Oh, I love it.

SCARPETTA: And the Astropreneurs coming in actually driven by two things. On one side, of course, the gold rush, as it's called in the U.S., because you have uncharted territories to discover. At the same time, I mean, there is the infrastructure that I mean, is needed for the booming economy or the digital-- for the booming market of the digital economy.

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So there is this attraction from the business, but also the fact that in a way, you can see a race between the billionaires. And even with the project, you know, Elon Musk with this project of colonizing the solar system with humanities is one of the most daring and ambitious adventures that, in a way, we had put on the table. And of course-- and the same the project for Branson, from Bezos, so there is really now-- sometimes, in a provocative way, I say that what was before the race between nations now is the race between these billionaires. But all this is good for space because it change-- they have-- okay. They have, of course, the weight to challenge the institution and to make rules changing.

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The U.S. with under Obama was preparing for this, for the condition of having this expansion of the economic sphere to low Earth orbit and entering in on the commercial sectors. So it has brought a dynamic that is a very interesting dynamic and very inspiring dynamic in particular for the new generations that are very much looking for-- with the perspective not on the '60, but with the perspective of a digital world of the virtual reality really to get into these kind of adventures. You

know the program from Musk is very ambitious. He wants to build soon this BFR. Do you know what it is?

DRINKWATER: No. What's the BFR stand for?

SCARPETTA: And BFR is this, you know--

DRINKWATER: Okay. I think I worked it out.

HAIGNERE: Like that. It's a big falcon rocket.

SCARPETTA: A big falcon rocket, exactly. And actually he has just announced-- yes.

DRINKWATER: So many symbols in space, right?

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SCARPETTA: Yeah. So he has just announced that he plans to after-- I mean, the successful flight of Falcon 9, the heavy lift, he is planning to have the BFR by 2019, end of 2019. And this should be able to be the vehicle, because, when we talk about exploration, you have always to think about how you get there. So what makes also his plans sensible is that he first starts from "How do we go there?" And then "What do we do there?" And the same also I mean for--

HAIGNERE: And that's why I'm so-- maybe something I'm convinced that's his private landscape is changing, challenging, and it's very useful for the transforming I want to say. But we have also I think on the public side and institutional side to keep some safe rules. And we say, for example, for the moon village, we will have to think in terms of preservation of something that is a patrimoine de l'humanite.

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And the way to work with scientists wanting to do some kind of experiment and other science and mining industries. So we will have to cope and to make the harmony and synergy in between, for example. And then, for Mars exploration, I have been in space. I know-- and we discussed the fact that there is some changes in genes of Scott Kelly, so we know that there is physiological constraints, that there is a radiation difficulties, psychological, speaking about Mars mission. And that means for me it's not at all clear that we will be ready to go to Mars in 10 or 20 years from now. That mean, we need to keep with the understanding that we have for the time being of there. And it's not just a question to access somewhere when we are speaking about human's space flight.

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But access, preserving, leaving, keeping safe, and coming back. And then for the time being never. We had a sample return from Mars. That means that we know how to go there, but we don't know how to come back. That means for me, so I want to keep cool with this kind of Mars zero with zero return mission. I think ethically and institutionally, I cannot be in favor of this kind of thing. So that where I put, also this ability to the public policies to be also keeping some safe paradigm.

SCARPETTA: And think about the European Space Agency. We are 22 member states, coming from all over Europe. And Europe is different. I mean, you have-- we have more than 14 languages. We talked about our member states.

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We have also Canada as a cooperating state. And then we have-- I mean, this international aspect is really a feature of it and it's-- and another feature is the fact that we have multiyear funding, so once we agree on something, we-- it's very difficult. We go back. So we are a very interesting

international partner also for this aspect of in a way, the fact that we don't change. We have no risk to changing plans every year. But we have been able putting all these talents together to do things that a single nation cannot afford. We have been able a few years ago to land a robo on a spinning comment at 400 million kilometers for here-- from here. And all this--

HAIGNERE: The Rosetta mission?

SCARPETTA: Huh?

HAIGNERE: Rosetta.

SCARPETTA: The Rosetta mission that just dropped Philae on the surface of the comet. This was amazing.

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This was, I would say, almost our man on the moon at that time because this was completely an achievement that was completely new. And what's interesting also the fact that we went there to understand how water come-- came on earth. And we found water on the comet on Chury, because too much-- too long name. But this water cannot be the water that we have on Earth, and can never become. So these are little pieces of-- it's very, let's say, heavy water, so it cannot become the water of our oceans.

DRINKWATER: Uh-hmm.

ERSILIA SCARPETTA: But all these moments that brings together the sense of belonging and the fact that, while joining forces, you can achieve something is also the-- And cooperating with international partners--

DRINKWATER: Uh-hmm. Uh-hmm.

ERSILIA SCARPETTA: -- Is the strength of the institutional partners.

DRINKWATER: Uh-hmm.

ERSILIA SCARPETTA: And how, really, you get the citizens feeling the sense of achieving together something. While, in the private sector, the drivers are different. So it's-- There is an element of--

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DRINKWATER: There's definitely something around, you know, a Silicon Valley classic tech entrepreneur going into this field because a lot of the, you know, a lot of the mottos of Silicon Valley are "move fast and break things," and that's not something you can really do with space. Right? It gets a lot more complicated. So I've got a couple more questions, and then I'm gonna to hand it over to the audience for your questions if that's okay. But I would love to go back to BFRs, 10% of astronauts being women. And obviously, if this whole mission is about discovering new worlds and inventing new ways of living.

ERSILIA SCARPETTA: Uh-hmm.

DRINKWATER: And exploring the very unknown, it's really important that we represent the world itself really well in that mission. Obviously, Ersilia, you're the Chief Diversity Officer, and you spoke earlier about the pipeline challenge of not enough--

ERSILIA SCARPETTA: Uh-hmm.

DRINKWATER: -- Women applying to become astronauts. I think first thing's first. I'd love to ask you. For those in the audience, who might be thinking, "Oh, I should become an astronaut." What you need to apply to become an astronaut? I know that's a silly question.

CLAUDIE HAIGNERE:: Uh-hmm.

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DRINKWATER: I think, probably, it's a bit too late for me, but maybe.

[laughter]

CLAUDIE HAIGNERE:: As I said before, there are very different profiles.

DRINKWATER: Uh-hmm.

CLAUDIE HAIGNERE:: You have pilots, engineering aerospace, or researchers doing different fields. I think that the main point is to look for the time of selection. I cannot say today when will be the next selection of the European Space Agency.

DRINKWATER: Yeah.

CLAUDIE HAIGNERE:: The last one was in 2008, but I'm sure that there will be another one. Then that's mainly what you said. It's the desire.

DRINKWATER: Yeah.

CLAUDIE HAIGNERE:: To them. Then the commitment to enter in it. So, what else? And then patience, perseverance, and determination because it is--

DRINKWATER: YEAH.

CLAUDIE HAIGNERE:: -- A long time to go through. And the chance, healthy chance.

DRINKWATER: Yeah.

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CLAUDIE HAIGNERE:: Because for selections, for example, the last selection of the European Space Agency, I think there was 8,000 candidates with 10% female candidates. And six has been selected.

DRINKWATER: Wow.

CLAUDIE HAIGNERE: I'm convinced that there are more than six talented, so that means there is a part of chance. And we have to organize everything in order to build this chance. But one thing I wanted to underline with the discussion with Ersilia about this attractiveness or deficit of attractiveness for science, engineering careers, I think we have, really, to think in terms of science and technology are the two pillars in order to cope with the big challenges that we will have in the 21st century and to find some new solutions.

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CLAUDIE HAIGNERE: But, if we try to speak just about the scientific approach, the hard science, the rigor, it's maybe not so attractive for--

DRINKWATER: Uh-hmm.

CLAUDIE HAIGNERE: -- Males and females, I would say, but for females. Because we need to have a feeling of what we will give entering, engaging in a way.

DRINKWATER: Uh-hmm. Uh-hmm.

CLAUDIE HAIGNERE: That means put that in a context and a sense for the life. That means we have to take the humanities back--

DRINKWATER: Uh-hmm.

CLAUDIE HAIGNERE: -- In science, engineering. Digital culture can be a good link in between this-- Humanities, technology, computing science, that are so-- Responsibility about where we are going, human insight. Okay, so we have to think--

DRINKWATER: Yeah.

CLAUDIE HAIGNERE: -- In terms of responsibility. We have to develop something.

DRINKWATER: Uh-hmm.

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CLAUDIE HAIGNERE: So, for me, what is really needed now, speaking about science, technology, engineering, and mathematics, you have started to put that in culture and coming back with humanities. I think, in the Anglo-Saxon curriculum, it's maybe easier to have this. In France, for example, I don't know in Italy. In France, either you choose the scientific field--

DRINKWATER: Yeah. Same in the U.K. You choose. Uh-hmm.

CLAUDIE HAIGNERE:: Or choose the humanities, I would say. And it's difficult to put that up.

DRINKWATER: Uh-hmm.

CLAUDIE HAIGNERE: And I think it's one of the problems in our curriculum.

DRINKWATER: Uh-hmm.

CLAUDIE HAIGNERE: So, for me, with the time I think it's more and more important to have the humanities, thinking philosophy, sociology. And as Aristotle said a long time ago, he said that there is three pillars. Episteme. Episteme, science, research. Techne, that means technology, engineering. And phronesis.

DRINKWATER: Uh-hmm.

00:39:37

CLAUDIE HAIGNERE: And phronesis, that's, I would say, the wisdom to act.

DRINKWATER: Uh-hmm,

CLAUDIE HAIGNERE: And I'm sure you're aware of this paper from Mark Prensky about digital wisdom.

DRINKWATER: Uh-hmm.

CLAUDIE HAIGNERE: That means we have also in this field of the digital culture that is to keep in mind this phronesis and wisdom.

DRINKWATER: Uh-hmm.

CLAUDIE HAIGNERE: And phronesis will not come strictly from hard sciences and engineering.

DRINKWATER: Uh-hmm. How are you thinking about-- With that in mind, how are you thinking about that pipeline and kind of getting more girls and women into the application process. And I think there is something around often, certainly in the start of world, we focus on hard tech roles, whereas, I would argue, there are many roles that make companies successful, all companies, including this one. How are you thinking about getting more girls and women into the ESA in general and, particularly, into astronauts?

00:40:32

ERSILIA SCARPETTA: Yeah. We have a paradox in Europe where we have now, in almost all countries, girls outnumber boys in terms of graduation so that we have more girls graduating. However, the science field is still a boys' club. We used to say doctors come from Venus, and engineers from Mars. Actually, you see the latest graphs, there is really a much higher expectation for boys to get into STEM--

DRINKWATER: Uh-hmm.

ERSILIA SCARPETTA: -- So science, technology, engineering, and maths, than for girls. And, in the digital world, it's even much worse. You're really a level today most of Wikipedia is written by men, and--

DRINKWATER: Uh-hmm.

ERSILIA SCARPETTA: -- There are very few women in the digital world.

CLAUDIE HAIGNERE: No,no. it's not the case today.

ERSILIA SCARPETTA: Some. But we--

DRINKWATER: And, actually, this is our technical office, too.

ERSILIA SCARPETTA: Yeah.

DRINKWATER: So this is very you know--

ERSILIA SCARPETTA: Yeah. Exactly.

CLAUDIE HAIGNERE: [inaudible]

ERSILIA SCARPETTA: But there is-- And we know today from, I mean, there are many things that influence this, and one of the things is also related to stereotypes.

DRINKWATER: Uh-hmm.

00:41:37

ERSILIA SCARPETTA: And the way also the context brings expectations with respect to the careers of girls and boys. So we are engaging with the [inaudible] industry is engaging to fight these stereotypes, but-- And, really, to be more vocal about this power of transformation that space can bring.

DRINKWATER: Uh-hmm.

ERSILIA SCARPETTA: But, as Claudie was saying, we are trying also to change the narrative with respect to the STEM, in particular, engineering and technology, because we are facing a big revolution. We know the future of work means there will be a polarization of skills.

DRINKWATER: Uh-hmm.

ERSILIA SCARPETTA: So you will need skills that relate to persuasion, empathy, multiple thinking, and I usually get the provocation saying that it looks like, forever, it will be easier to replace men than women, given that there is a kind of--

CLAUDIE HAIGNERE: This is the theory of [inaudible]

00:42:33

ERSILIA SCARPETTA: The stereotypes. But we want to tell the story of this STEM of the future, not the STEM of today.

DRINKWATER: Uh-hmm. Uh-hmm.

ERSILIA SCARPETTA: Because engineering today is something, but, through the digital-- I mean, the coming of the digitalization of robotics and so on, and the new challenges ahead. So with these explorations, the settlers, the climate change, we need a completely new set of jobs--

DRINKWATER: Uh-hmm.

ERSILIA SCARPETTA: That what we call the bridgers, the orchestrator's.

DRINKWATER; Uh-hmm.

ERSILIA SCARPETTA: And these are the jobs in STEM for tomorrow.

DRINKWATER: Uh-hmm.

ERSILIA SCARPETTA: And which also include these aspects of humanities, so not just that thing, but this ability to think at large.

DRINKWATER: Uh-hmm. Uh-hmm.

ERSILIA SCARPETTA: And we're promoting this. We want, really, to get different narrative about what these jobs are. As from is the perception today that these careers are. So we really are investing now in this branding, in a way.

00:43:35

CLAUDIE HAIGNERE: Uh-hmm.

DRINKWATER: Definitely.

CLAUDIE HAIGNERE : And coming back to the profession of astronauts.

DRINKWATER: Yeah.

CLAUDIE HAIGNERE: I would say that it's typically a profession where you need to have abilities to go in different fields. And I say that there is different background at the beginning.

DRINKWATER: Uh-hmm.

CLAUDIE HAIGNERE But then you become an engineer. You become a partner in a crew. You become a diplomat, and you think about humanity when looking through the window.

DRINKWATER: Uh-hmm.

CLAUDIE HAIGNERE: And about the planet.

DRINKWATER: Oh, I love it. Final question, and then I'm gonna hand over to all of you. I always like to end with a fill-in-the-blank question, where I'm going to ask you something, and I would love a very short answer, please. Space is?

ERSILIA SCARPETTA: No limits.

CLAUDIE HAIGNERE: A perspective.

DRINKWATER: A book that I always recommend is?

ERSILIA SCARPETTA: "A Brief History of Time."

[laughter]

CLAUDIE HAIGNERE: "Le Petit Prince" du Saint-Exupery.

DRINKWATER: Oh, I love it. I love that book. The best advice I ever got was?

00:44:37

ERSILIA SCARPETTA: Never take "no" for an answer.

CLAUDIE HAIGNERE: Excuse me.

DRINKWATER: The best advice I ever got was?

CLAUDIE HAIGNERE: Maybe not advice, but when is the last time when you did something for the first time? That means always thinking new.

DRINKWATER: And, finally, Googlers can help the European space station by?

ERSILIA SCARPETTA: For me, it's by stretching the imagination of what can become possible.

DRINKWATER: Uh-hmm.

CLAUDIE HAIGNERE: Coming back to the moon village, by involving everyone in the young generation with, I don't know, avatar and things, virtual reality. You can help me in involving the young generation in it.

00:45:36

DRINKWATER: I love it. What's the URL for the moon village, by the way? Is there a microsite we can look at with information?

CLAUDIE HAIGNERE: We're just beginning in setting that site. Yes, it will be soon.

DRINKWATER: Wonderful.

CLAUDIE HAIGNERE: Yeah.

DRINKWATER: Audience, what would you like to ask?

PERSON: [Speaking Russian] I hope you liked the Star City for your time there. So, as both the astronaut and the scientist, where do you stand on the question of do humans actually need to go in space? Is there a place for human space exploration, or we'll just need to go with robots and telescopes?

CLAUDIE HAIGNERE: Okay.

[laughter]

CLAUDIE HAIGNERE: How long do we have?

[laughter]

CLAUDIE HAIGNERE: No. I'm sure that you share the fact that humans will go further and explore. And it's not just when you have, I would say, astronauts telling this feeling of body freedom in microgravity, of the look through the window and of this embodiment, the incarnation, of the dream that you have.

00:46:49

CLAUDIE HAIGNERE: And humanity will go further and further and explore. But, for me, it's not at all a competition between the automatic universe sciences and this human desire to go further. And I think it is really complementary. I was speaking about, for example, moon village and this shift in between exploration and expansion for humanity going on a another planet, settlers as well as explorers. It's, for me, a way to have an offbeat, I would say, glance and gaze in order to come back to Earth with a new solution because we will ask new problems in this style environment. So, for me, that's something that is completely synergistic, I would say.

00:47:49

And I will not put a priority because science is science with all of the dimensions, and, as I said, not just with the dimension of new knowledge, but also new opportunities. And I think this human space flight is also an opportunity to develop new horizons.

PERSON: This question is for Claudie. You mentioned that looking through the window is all about perspective, and I was wondering if maybe you could share the kind of perspective that gave you.

CLAUDIE HAIGNERE: The reason, I was not just thinking in terms of human space flight when I said "perspective." For me, for example, one of the most powerful conquests of the Space Race in

the beginning, in '57 with the first Sputnik in space, is also this ability to have a new gaze on the planet, for example.

00:48:53

DRINKWATER: Uh-hmm.

CLAUDIE HAIGNERE: And the ecological feeling of consciousness.

DRINKWATER: Uh-hmm.

CLAUDIE HAIGNERE: It's coming from that point. So this is, for me, also a new perspective in order to reconsider Earth.

DRINKWATER: Uh-hmm.

CLAUDIE HAIGNERE: New perspective because it opens opportunities and new developments, and knowledge for humanity, so that's also a new perspective. And, strictly speaking, looking through the window so you see the planet like that, and you see the beauty of the planet, you have this overview effect. So the beauty of the planet, but also the blackness, this mystery. And you put once more humanity and human responsibility vis-a-vis this planet. And it's not-- the very thin layer of atmosphere.

00:50:01

That means the fragility of-- it's also a perspective because, when you're on earth, okay. you have the media saying be careful with this, this, this. Here, really, it's even much more than a perspective. That's a fact, and you have it here.

PERSON: Hello. I just want to say I'm so happy that you're here because, when I was a kid, I saw you on TV, and I was amazed that you would do that.

[laughter]

And so this is great. You talked about responsibility and perspective. I'm just wondering for that moon project, for example, moon village, what do you think the actual objective things that we should be doing to protect the moon, and we're talking-- you said the atmosphere's very thin. When we're here, we don't really care so much or not as much as we should.

00:51:04

What should we put in place to protect where we are exploring, where we may be settling?

CLAUDIE HAIGNERE: That's what's, for me, very interesting in this concept of moon village because we will have to have this kind of question on the table in the different steps of building the concept. For sure there's a technological, I would say, building blocks that we have to put on the table in order to have the right protection for the habitat or the way to extract the oxygen from the ice on the pole of the moon, so this one part. Then, if we really consider the concept as working with private companies with economical interest, and scientist they say, we will have to think in terms of the right cooperation and harmony in between the interests.

00:52:01

Then we will have to cope with what I said already. There is a treaty on the United Nations defining the corps celestes, the celestial bodies, and the moon as a patrimoine de l'humanite. This means to

preserve something as a patrimonial element of humanity, so we will have to keep that in mind for sure. We will have to define also the rules, I would say, for the international government and different partners because, mainly corporations in a global project, but also competition and dealing with some elements and the way to organize the life of the inhabitants of the moon's surface. So there is a lot of things to elaborate and think about. And I would like that to be taken really seriously, progressively.

00:53:03

And the technical element is just one part of the project, but all these aspects means needs also that have with us the jurists, the sociologist, the philosophers, architects, because of the complex architectures to organize. So that's why there is a lot of potential in thinking in that terms. And I said that we have the chance to think out of the atmosphere and not just out of the box.

[laughter]

SARAH DRINKWATER: I love that. I think there was one-- oh, we've just got one over there.

PERSON: I just wanted to pick up a little bit more on what Sarah mentioned a little bit earlier on about your sense of self. Both of you talked about sense of self in a really interesting way. You mentioned that you wanted to change or center of gravity from a very insular person to something more expansive.

00:54:04

And, when Sarah mentioned any changes that you'd felt when you came home from space, you spoke in a very anatomical way about changes you'd felt in your body. And I guess I wanted to ask a question of has a life in space and working in this new world changed your sense of self? Do you now, perhaps, relate more strongly to something greater than to who you are as a person? Have you felt that you've changed your relationship with yourself as a result of this career path that you've taken?

CLAUDIE HAIGNERE: Uh-hmm. Well, that's difficult to say because there is different elements coming in. The first is relation with you, with people, and the look and the questions that you have that really changes the way to communicate, to interfere.

00:55:08

This is the first element. After that, there is, I had the chance to have different life, as it has been said. I have been a medical doctor. I have been an astronaut. I have been a minister. I have been the head of a public establishment. I was closely collaborating with the Science Museum. I was in charge of Palais de la Decouverte and Cite des Science in France. I am deeply involved in the innovation. I have been involved for three years with theologists about digital challenges with humanity. So, age, different ecosystem, different life-- for sure it's something that is building you. And that's interesting in life also. You are not the same at the beginning and the end, with opportunities and meeting and persons you will encounter.

00:56:09

So I have no, really, cues to say that it's just space. Space has been, for me, for sure, a multiplier of this life and the opportunities.

IRSILIA SCARPETTA: If I can say, for me, it's, again, science and space and it's the courage that you get out of this adventure. A different sense of belonging. First of all, on the international side, what does it mean I am an Italian? As well as you ask your questions. But, on his global side, you know, there is a sentence that I love from Thomas Elliott, which is, Prufrock I don't know if you know this poem. Where he says, "Do I dare to disturb the universe?" And, for me, this is really how my own self changed through this adventure, meaning the sense of daring.

00:57:05

Because, actually, no one cares about if you are not doing something while if you do something, then there can be a difference. And, again, this sense of belonging to something big-- much bigger than you and the fact that you are an instance gave me this, I will say, this inconstance, sometimes this courage, not to bother about what the others think, not to bother-- and this is an important message if we want relate also to girls and women because we know that, actually, there is an anxiety that comes up from with respect to scientific subjects, mathematics, and there is a very nice story from Brian Greene, which is a very famous astrophysicist, and he wrote "The Elegant Universe." And explaining and, actually, wondering why, in women, you have this form of you don't want to look stupid. You don't want to ask questions.

00:58:05

And he tells a story that he goes to a primary school, kids five, six-years old and asked everyone to draw something. And there is this little girl, very focused, drawing, drawing, drawing. So he approaches her and say, "What are you drawing?" And she says, "I'm drawing the face of God." "The face of God? But no one knows the face of God." "Oh, in a minute, they will."

[laughter]

And this sense of exactly going back to this sense of I don't care what the others think. It's a moment I have to go and this will-- I mean, bring so much to me and should not be stopped.

SARAH DRINKWATER: I love it. I think we have one question, is it there?

PERSON: My daughter wants to be the first woman on the moon because she is six, and she says, "Well why shouldn't I be?"

IRSILIA SCARPETTA: She's the exact age. Yes.

SARAH Drinkwater: The face of God, right?

00:59:05

IRSILIA SCARPETTA: Yes. Keep this. Yes.

PERSON: So what's the one thing that you think I could do to support her in that?

IRSILIA SCARPETTA: Okay, first of all, and then I leave Claudie to answer. I also have a girl now. She's older than this-- you know, we know from studies that girls don't go, don't apply to positions because they-- if they don't match with the 100 requirements, so they don't go, while the men look at the first row, the last row, and say, "Let's go."

[laughter]

So this sense, actually, it's a perfect question after what I said. There should be a pleasure in going forward. There should be a pleasure in daring, that's something that you don't in any way discourage, even if it goes to a failure. So the sense of failure which should change. You know that, when I was in the U.S., actually, after the Columbia accident, the motto from NASA was "failure is not an option."

01:00:08

Today, the motto of NASA is "Fail early, fail smart." So the value of failing, which doesn't mean that you have lost. You are not losing. You-- t's just something that will bring new things and new strengths, and, if you go through this sense of failure as being part of a path, I'm sure she will be more daring and she will get ready to take these bold steps without feeling-- when I say, "Don't take no for an answer" without thinking, "this is not for-- I'm sure there will be thousands. Why me?" The example of Claudie, in this sense, is very important. The thing is, "There should be 1,000, so it could be me." So work on this sense of what is success and what is failing. Am I lovable, am I capable? Which, for girls, is very strong.

01:01:06

Sometimes they want to be lovable, and then you pass the message you're lovable if you're capable, so be sure that these are different things. And then you get the strength to go from that.

CLAUDIE HAIGNERE: Just I would add what's important for me is more the journey, I would say, of discovery than the goal and the objective. It's important to have a goal and, if you can keep the dream alive for her, that's perfect. Also explaining that, throughout her journey, there will be pleasure and discovery with the curiosity, and she will gain and gain and gain a lot. And, if the goal is really very, very ambitious, we cannot promise to get the goal, but the journey is wonderful.

SARAH DRINKWATER: And then our final question.

01:02:05

PERSON: No pressure. You mentioned that, you know, space is not like "Hey, I want to go to space next week, so, you know--

IRSILIA SCARPETTA: Not yet.

PERSON: Not yet.

IRSILIA SCARPETTA: Unless you [inaudible] space again.

PERSON: And, being an astronaut, is, you know, perhaps a decade or multi-decade kind of ambition, so, throughout kind of these very long journeys, how do you, kind of, pick yourself up when you go, "Oh, my god, it just, you know, this week wasn't as good as last week." You know, how do you pick yourself up over a very, very long time period?

CLAUDIE HAIGNERE: I would say that I had a lot of things, new things, that's why I explained that it's a journey. So I was a medical doctor. I engaged in this PhD, so that meant discovering the working in a laboratory and then discovering the way to cooperate with different partners and then arriving in Star City, as I said at the very beginning, in the shift in between the Soviet Union and so

on. So discovering this military environment and with the blackboards as black-- in order to get my first lesson in Russian in order to make the design of a certain element.

01:03:18

And then, a few years after that, coming here, the Americans, for example, with the Shuttle-Mir program. So that means keeping interested with this mix of culture and also that training with space tourists during-- so every time, there was something new to discover, to learn and that's why the journey is something really fantastic [inaudible] this adventure. So, for sure, I was eager to be on the day of the launch and the launchpad in Baikonur, but I really enjoyed the 16 years of my career. And I enjoyed after that the second life and the third life and the fourth life and then where I am now. And that's--

SARAH DRINKWATER: And I wish we had more time to ask you about the more particularly the political, I'm particularly curious about that, I think. Thank you so much, both of you. This is--

01:04:22

CLAUDIE HAIGNERE: Maybe on the political field.

SARAH DRINKWATER: Yes.

[laughter]

CLAUDIE HAIGNERE: Now, just in the first part, as a medical doctor, because I was bright in my studies, so no problem coming in and with the astronaut also, it was relatively easy, I would say, for me as interesting and-- but with politics, I discovered something that I was convinced before entering in politics that, when there is a will there is a way. And I discovered not always like that.

[laughter]

SARAH DRINKWATER: Thank you both so much for joining us. It's been amazing.

PERSON: Thanks for listening. If you have any feedback about this or any other episode, we'd love to hear from you. You can visit g.co/TalksatGoogle/podcastfeedback to leave your comments. To discover more amazing content, you can always find us online at YouTube.com/TalksatGoogle or via our Twitter handle @GoogleTalks. Talk soon.

[mellow music]