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Templeton Prize Address by Prof. Marcelo Gleiser at the 2019 Templeton Prize Ceremony

The Metropolitan Museum of Art, New York, May 29, 2019

Adapted from the non-scripted original

I want to talk tonight a little bit about human disquietude. We are very peculiar creatures because we have this urge to know and yet we're also limited in our knowledge.

There was a French philosopher from the late 1600s named Bernard Le Bovier de Fontenelle, and in 1686 he published a book, which by the way is the same year that Isaac Newton published his book on gravity that Marilynne mentioned. So Bernard Le Bovier de Fontenelle wrote a book about a conversation on a plurality of worlds, meaning other planets out there and the possibility of life in other places. This book was very interesting because it had two characters only; it was a conversation between a philosopher and a marquise, or a noble woman, which was a very rare if not nonexistent thing to have a woman as a protagonist in a book at that time. And furthermore, she was smarter than the philosopher, who was the author of the book, and she was always asking very difficult questions.

One of the questions that she asked was, "Why do you do what you do? What is philosophy?" And he said, "Well, you can summarize philosophy in two ways, it's just a sum of two things. Philosophy is about curiosity and short-sightedness."

I think that's just beautiful because it encapsulates the whole idea that we, as humans, want to always know more and know more about ourselves, about our lives, about nature, about the world, and yet we can't. I mean, we progress, we move forward as we develop knowledge. But there is always a limit, a limitation of what we can see. That's the short-sightedness.

So what we do is something quite wonderful: we create instruments – I call them reality amplifiers – that will allow us to see farther into the reaches of reality that are hidden to us if we only use the five senses. Because if there is something quite amazing about what's going on right now here – it's not just the ceremony which is this wonderful celebration – but there are trillions of neutrinos coming all the way from the heart of the sun going through your body per second and we have no idea this is happening. And we

never would have known about neutrinos, about the heart of the sun, and how it shines, and how it creates all the energy that makes life on this planet possible, if we had not developed scientific ways of thinking about the world, amplifiers, machines, instruments that allow us to see farther out. We do this in a creative way and we have done this for centuries. In fact, you can even tell the history of astronomy and the history of science in general as the history of scientific instruments.

It is an uncanny coincidence that today, the 29th of May, is the 100th anniversary of the confirmation of Einstein's theory of general relativity. And guess where it was confirmed? In Brazil. So a hundred years ago, two teams of astronomers left England led by Arthur Eddington, who was an eminent astrophysicist at the time: one went to the western coast of Africa to the Ivory Coast, and the other team went to Brazil to the city of Sobral, which is in the state of Ceará.

A hundred years ago to the day there was a solar eclipse, and what Einstein said was something that was going to make us rethink what Newton had said centuries before, that things attract one another because there is some invisible action at a distance. It was a very magical, weird thing to imagine that it was possible for two bodies to have a mass to attract one another instantaneously. So the sun attracts the earth and the earth the sun; how does that happen? Newton was very smart, and when people asked what is going on? How could the sun and the earth attract each other in this way? He would say, "I feign no hypothesis"; I don't know, but I can describe this interaction with my theory.

A long time after, Einstein comes up and says, let's rethink Newton, and he said that actually gravity is the curvature of space. If you have a mass, the space around the mass is going to be curved. Now how can you possibly prove such a crazy idea? One way you can do it is, if you have a star that is very far away and its light is traveling toward us, and if it goes through the sun on its way, the sun is pretty massive and, according to Einstein, the star would have its light path bent because of the gravity of the sun. He calculated exactly how much of a deflection, a very tiny deflection, much smaller than one degree. But astronomers, because of the instruments that had been created at the time, could actually measure that, because there was enough precision.

So the two teams went, and the one that went to Africa got bad weather. In Brazil the weather was not great, but it was good enough on this day to look at it. The problem is that when you look at star it has to be night time; but that doesn't work, because the sun is not there! So what do you do? Well, when there's an eclipse, the moon is going to go right in front of the sun, it's going to block the sunlight, and you have night during day.

I actually led two Dartmouth alumni cruises to see eclipses with Kari, and it's an absolutely spectacular visceral experience, something that really connects you with a part of nature that we really don't know until you actually sense it. It's not something you can explain with words; you have to feel it. That's very important. Sometimes, it's not about the rational explanation of things, but how you relate emotionally to

things. But the astronomers at Sobral that day were on a mission. They really didn't care about the visceral connection with nature and with the natural world; they were there to measure star positions during the solar eclipse and they did.

It is really amazing that this happened 100 years ago because Einstein, as Phil Hanlon mentioned, was the one who said something about the mysterious. And in that quote he said that the mysterious is the fundamental emotion that is at the cradle of all creativity in the arts and the sciences. This speaks to our human disquietude again, the notion that we humans have this urge to understand who we are, where we came from. Where are we going? Are we going to be on this planet forever? Is the sun going to shine forever? What is the history that led from the beginning of the universe to where we are right now?

I'm really proud to have spent more than 30 years now working on these things, thinking about these questions, to learn so much about the universe but also about humans. And one of the things that I learned during this experience is that science really teaches us humility. You may find this kind of surprising, because you do find a lot of arrogant people in academia, right? It reminds me of something my grandfather used to say. He used to say that arrogant people are those people who wear hats that are bigger than their head so their eyes are covered. And I think that's a beautiful image, because it is a form of not seeing and one of the things that we do see when we pursue science is that we really don't know very much.

We have learned a lot and we are learning a lot very quickly in many different fields. The metaphor that I created in the book called *The Island of Knowledge*, I think, speaks to the heart of how this works. The idea is simple. Imagine that everything we know about the world fits in an island, and this island is growing as we learn more and more about the universe and about who we are. As with every good island, this one is surrounded by an ocean, the ocean of the unknown. The paradox of knowledge is that as you learn more, as the island grows, the boundaries between what you know and what you don't know are always growing. Which means that as you learn more you're able to ask questions that you couldn't have even conceived of before.

Just think that now we are talking about the digital era and information and data mining. Fifty years ago this didn't exist. Why did this happen? Because we developed knowledge to do that, that allowed us to reach out for more knowledge.

To me, this is an endless pursuit. And those people who believe that there is an end to science, an end to the way we can think about the world, and that we are going to go out there and conquer knowledge as if this were some kind of war, and human reason is the winner in the end, I think are deeply mistaken. Because one of the things that we learn in the process of doing research is that we don't know enough, and we'll never know enough, and that is actually wonderful because it is the not-knowing that allows us to want

to learn more. It is wanting to know that makes us matter as people. In the search, in this quest for knowledge, we find meaning.

We understand better why we're here. And why are we here? We're here to understand better who we are in this process called the pursuit of knowledge. And another thing I've learned through the years, and this is really coming from modern science, really, the last 15 years, where we have been able to look indirectly at planets that go around other stars; not just our sun, but other stars far away. The more we learn about the universe, the more we learn about these other worlds, the more we realize what a special planet Earth is. It's not just because it has water, and it's in what we call the habitable zone where water can be liquid; other planets will do that too. There can be other Earth-like planets out there: if you think about our galaxy alone, there are about a trillion or more worlds, and so, clearly, just statistically, some of them may look like Earth. But Earth is special because it has all these special properties that allow for life to appear here about 3.5 billion years ago and to evolve in fits and starts, in complicated ways, in ways that could not have been predicted, in ways that if they had been changed, the course of life on this planet would have been different and we wouldn't be here.

So there is a contingency to the human condition which has to do with the way our planet evolved over three billion years. And that is something quite beautiful because it answers this question about what we call the Copernican angst, the notion that Heather mentioned before, that the more we know about the universe – this is what people think scientists are saying – the more we know about the universe, the less important we become. We were the center of everything and then we were pushed aside, and then we were just on a planet, and then the sun is not the center, and then we have a galaxy, but then there are hundreds of billions of other galaxies; it's one indignation after another, we keep being pushed out, and what is the point of all of these discoveries if they are telling us we don't matter?

This conclusion is wrong. Because it's exactly when we look at the other worlds that we understand how rare our planet is, how rare life is. Because if you go to Mars, and if you go to Venus, and if you go to Jupiter, you're not going to find anything. Certainly, if Mars had life it didn't build telescopes or compose Mahler's Fifth Symphony.

There is something very special about this planet, and there is something very special about us, because we are the creatures that are able to understand, or try to understand, our origins. We are self-aware molecular machines capable of wonder and awe. And that, to me, is something that should be celebrated every day. And more than that, given the times that we're living in right now, where the Earth is being stressed by overpopulation and pollution and tornados in New York – this is really crazy, tornadoes in New York – this is a moment for us to reflect on who we are, not as a tribe here against a tribe there. But as a species, one species unified on the planet, and we need to be together now more than ever, and to celebrate and respect life and respect one another.

And respect is not enough. We need to be open to learn from those who think differently from the way we think because only then will we be able to understand one another better, and go beyond the tribal divides that have been a real problem in the modern world. They were very useful ten thousand years ago. They are not very useful anymore. We need to unite as a species so that we have a future. We have to leave the world for the future generations a better place than we found. That, to me, is the moral imperative of our time, what I want to dedicate my next few years and the honor of having the Templeton Prize: to help create the sense of a moral imperative, where we humans work together to try to save this planet and life in it with everything we've got. Thank you.

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