Dialogue with Prof. William Happer and Dr. Marie Korsaga

April 25—This is an edited excerpt from the discussion that followed Panel 2, "For a Better Understanding of How Our Universe Functions," of the Schiller Institute's April 25-26 conference, moderated by Jason Ross. Subheads have been added.

Dr. Happer served as director of the U.S. Department of Energy's Office of Science from 1991 to 1993, and was a science advisor to President Donald Trump on climate policy as a member of the National Security Council from the fall of 2018 to September 2019. He is currently Professor of Physics, Emeritus, at Princeton University.

Dr. Korsaga, from Burkina Faso, became West Africa's first female astrophysicist, taking her PhD at the University of Cape Town in South Africa with a dissertation on "The distribution of dark and visible matter in spiral and irregular galaxies."

Jason Ross: Several questions came in for you, Dr. Happer, based on your speech. I'll combine a couple of them.

One of the things that you brought up in your talk was the role of accidents in making discoveries. Even if you weren't really intending to make a discovery, they sort of come up. You had said at the end of your talk that it might be possible, one day, to be able to rapidly react to a virus that arises, and be able to create antibodies or antidotes quickly, but that making that breakthrough might require a fortunate accident.

Could you say more about the role of accidents in scientific discovery? And also the apparent contrast between the ability to have a science-driver program, as when Kennedy said "We are going to the Moon,"—how do you see the relationship between having a crash program to really try and make a scientific discovery, versus the serendipitous nature that some of them take?

Happer: Well, frankly, you can have focused research programs and they can do some good. But the really big breakthroughs historically have usually been some accident or another. For example, the discovery of X-rays was a complete accident: [Wilhelm] Röntgen was perceptive enough to recognize something strange was happening in his laboratory, and he worked hard and he turned it into modern X-ray technology.

It was an accident that fission was discovered. Nobody predicted fission: It was thanks to Lise Meitner and Otto Hahn that when they tried to repeat Enrico Fermi's experiments on transuranics. They did some chemistry but they did not find what they thought should be there. They thought there should be neptunium and plutonium transuranics; that's what Fermi got the Nobel Prize for. But in fact, that wasn't what he was doing. He was splitting the nucleus, and Meitner and Hahn were smart enough to demonstrate that. The radioactivity was really associated with barium, not with plutonium.

There are many cases like that, where the initial breakthrough is just completely unexpected.

The other extreme of that is you take something like the semiconductor industry, you know, there has been systematic investment in better and better equipment, higher resolution, photolithography, better photoresists, better control of the equipment—that also works. But it's a different type of scientific progress than the type that I think will be necessary for example to solve the controlled fusion problem. I think that will be solved by an accident.

Another example of that is not practical, but I think you know that the low-hanging fruit in physics and cosmology today is to discover the nature of dark matter, what makes galaxies rotate a lot faster than they really should be rotating. Some people are desperately trying to figure out what it could be, trying to build detectors that would detect weakly interacting particles, heretofore unimagined—this, again, I think will be a problem that will be solved by a lucky accident and some perceptive person who can tell the difference between an important accident and just the usual mistakes that are made in experiments. I hope that's enough.

Science is Subjective

Benjamin Deniston: Glad to speak to you, Dr. Happer. You've discussed and other people have discussed the benefits of higher levels of CO_2 in the atmosphere, and I've found that to be some fascinating areas of science to look at, just how our biosphere responds to some of these things. And when I've discussed that with other people, what I find is that there seems to be more of a gut reaction, even from scientists, about that, that it doesn't seem to fit a certain narrative; and oftentimes, in the most fundamental sense there tends to be a narrative that human activity is inherently problematic for the planet and human activity inherently causes problems and catastrophes and any idea that it could be good just doesn't fit this perspective.

And people tend to think about science as "objective," "fact based," kind of like a cold just-follow-the-facts process, when in reality it seems like we have these narratives and dogmas that do play a substantial role in affecting where science goes and doesn't go, and what areas of science—which could be incredibly beneficial and interesting, including various factors of natural causes of climate change—are actually affected by this. So, I'd definitely appreciate any thoughts you have on the reality of this social aspect and of these narratives in science, the effect they have, and where we can go to get past some of that.

Happer: I think science has always been much more subjective than scientists would like you to think. Ever since Galileo, and long before, people have been disputing the nature of this or that aspect of science. The idea that scientists are somehow different from other human beings who have prejudices and who have infatuations or are mistaken frequently—that's just not true. Scientists have all those faults, and that's been demonstrated generation after generation.

An example is continental drift: You might remember that this was originally proposed [in 1912] by a very good, very bright German, Alfred Wegener. He was an excellent scientist, but because he was not trained in geology, he was just dismissed out of hand, especially by American geologists. I remember, even when I was a graduate student in the early '60s, he was still being dismissed. But he was completely right. And now, nobody would even think to question continental drift, it's a real fact. But it wasn't easy for the first proposers and first disciples to make headway: You didn't get tenure in the 1950s, for example, if you believed in continental drift.

Coming back to your question: People don't like to admit that CO_2 is a benefit to the world. It actually, clearly is. The geological history is completely clear, and I think the most compelling thing is that if you go to greenhouse operators, they routinely double, triple, quadruple the amount of CO_2 in their greenhouses, not because they're involved in the debate over climate, but because they want to make money! And if you grow cucumbers or if you grow decorative flowers in a greenhouse with more CO_2, you get a better product, and you get a better price. You have to pay for the CO_2—it's not cheap—but it's a good investment.

And so, here we are, getting this free CO_2 that's enriching the entire planet, and we should be very grateful for that. But of course, it doesn't fit the narrative. What can I say? It's the human condition.

Pursuing Science in Africa and Among All Youth

Ross: A question from New York for Dr. Korsaga: "The great historian and physicist, Cheikh Anta Diop, wrote in his 1978 short book on Africa that advanced technologies such as thermonuclear fusion must be pursued in African nations, and that astronomical observatories and elements of space exploration are needed to be put on line as rapidly as possible, to allow African states to enter the 21st century on the same footing as other parts of the world.

This did not occur. In what way do you think we must act to encourage, in particular young people—the people that Professor Happer and others expect to make the new breakthroughs—despite the many hardships that may exist?"

Korsaga: Thank you for this question. It's an interesting one. What I can say is, we have to encourage them even as we need to create more opportunities. We also need to let them know the importance of these sciences, these scientific programs for Africa, for the development of Africa, and the impact of these in Africa.

And what I also want to add, is when you study space science, astronomy and others, even if it does not have the same kind of immediate impact as different kinds of studies, there is, for example, when a student enters an astronomy program, that student will have to develop competence in engineering, mathematics, and physics. All those skills are useful for the development for the country in many sectors. So I think we need to give all this information to young people in Africa, to let them know the importance and the positive impact of these scientific studies.

The Galactic Modulation of Earth's Weather

Megan Beets: Hi, Dr. Happer! Earlier in the presentation that Jason, Ben and I gave, we discussed some of the common threats to the planet, including space weather events like solar coronal mass ejections, asteroid strikes and so forth. As part of my presentation, I raised the fact that our planet is in a galactic system.

I specifically wanted to ask you about Earth's weather system. Nir Shaviv, Henrik Svensmark, and others have demonstrated that cycles of our Solar System's motion through the galaxy and galactic cosmic rays in the atmosphere play a big role in modulating our weather. Could you say a little bit more about that? And also, do you have any thoughts on why that outlook is so rejected and resisted today?

Happer: I'm a big admirer of Henrik Svensmark and Nir Shaviv. They've done absolutely very beautiful work, very interesting work. They're still working hard on actual experiments to see how cloud nuclei form in the atmosphere in response to cosmic rays. So they don't just make theories, they actually do measurements. As they have pointed out, the Earth and the Solar System drift in and out of the spiral arms of our galaxy and this modulates cosmic ray backgrounds on a long-term basis over maybe tens of millions of years. And there's some evidence that that has played a role in the climate of the Earth, if you take these very long periods into account.

If you don't know about their work, I do recommend it to you. Nir Shaviv in particular has written some very accessible summaries of the ideas. It's good physics, good astronomy—and, they may be right! I don't know whether they're right or not, but it looks better than many of the establishment theories of what is controlling climate, which are clearly not working very well.

We Learn from International Cooperation

Ross: Dr. Happer, the next question that came in for you is a combined topic about national science objectives: This is sort of three questions put together. One is that Trump has called for international collaboration in space exploration as the U.S. plans to return to the Moon by 2024. U.S.-Russian cooperation in space science has had a long and productive history. Recently, Putin has outlined a bold plan for multi-nation work to finally realize thermonuclear fusion as an inexhaustible energy source, says the questioner, and they'd like to know what the pathway is to realize those potentials?

I'll combine that with another question, about the social role of science and of scientists.

Another question was about Trump's approach to science and how it may be related to the work of, I believe his paternal uncle, Prof. John G. Trump, who was at MIT doing work during World War II. If you have any thoughts—those are sort of two different questions there—about the cultural aspect of a commitment to science, and how we could learn from working with others internationally?

Happer: I think international collaboration, to the extent that it provides career paths for young people, is very good. For example, the Russians did us in the United States a big favor by launching Sputnik, because science was languishing until that point, and it woke many people in the U.S. up to realize that there are a lot of smart people all over the world, not just in the United States, not just in Europe. There were smart people in Russia and China, even Africa. So, it was time for us to pull up our bootstraps and start moving again.

I think programs like this that inspire young people are important, programs that give them a career path forward, something they can do that gives them some self-respect. I'm convinced that we will solve a number of problems because of the young people of the future having smart ideas, good ideas, and these accidents that I mentioned before. They don't have to come just to young people, but they often do. So having some kind of a goal, even if you don't reach the goal, often it doesn't matter, because you've discovered something else that you didn't expect to discover. And perhaps the type of joint efforts on controlled fusion or on space exploration with other countries will help us to do that. I'm all in favor of that.