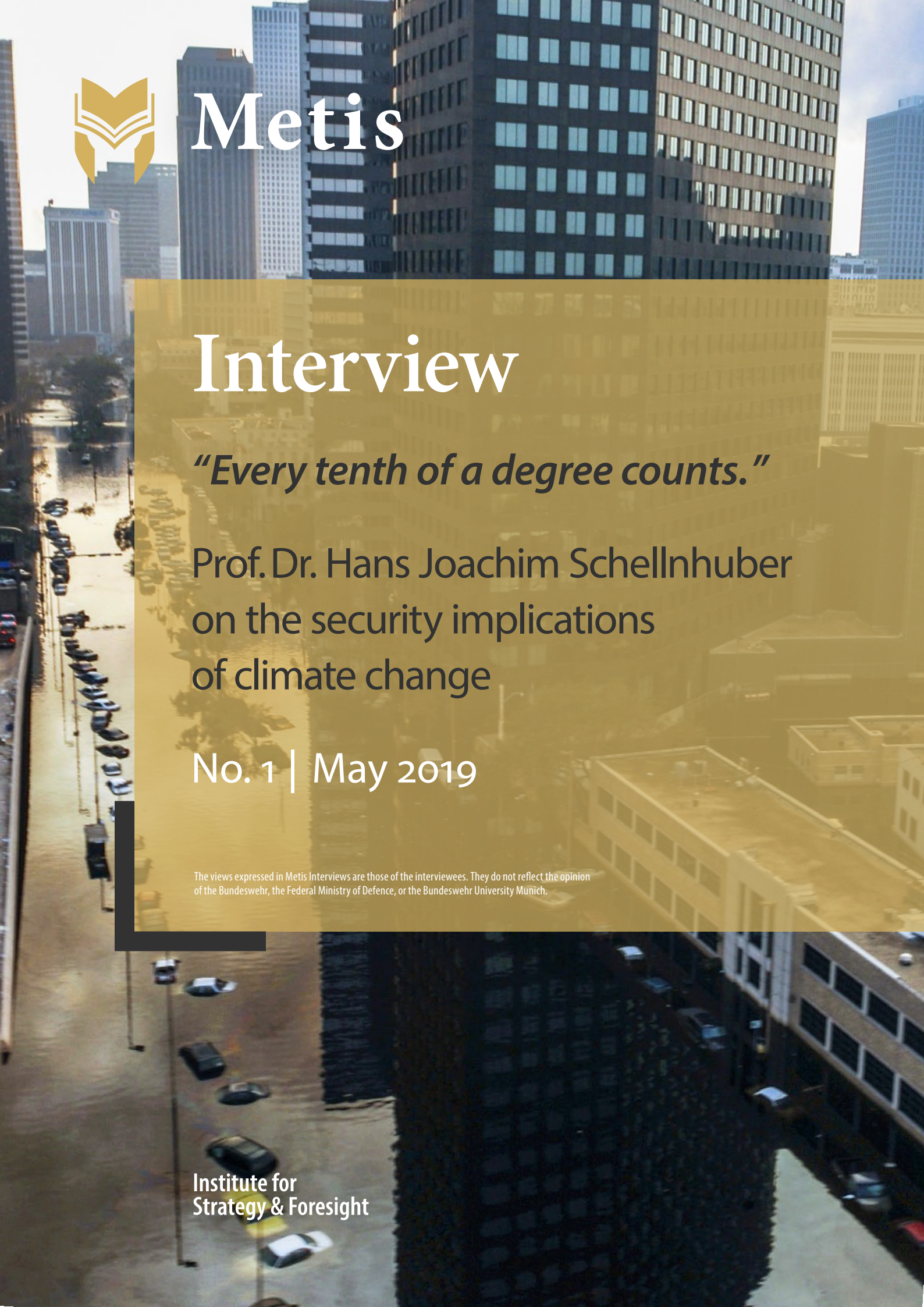

Metis

Interview

"Every tenth of a degree counts."

Prof. Dr. Hans Joachim Schellnhuber on the security implications of climate change

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Interview

Climatologist Hans Joachim Schellnhuber

Interview between climatologist Prof. Dr. Hans Joachim Schellnhuber and Prof. Dr. Carlo Masala, Director of Metis. The interview was recorded at the Potsdam Institute for Climate Impact Research on 9 May 2019. The interview has been abridged and edited for clarity.

Masala
Professor Schellnhuber, can you explain to us in plain English the most important results of the research into global climate change? What exactly is happening – and why? And what is the significance of these 1, 2, 3 and 4-degree increases in temperature?

Schellnhuber
It all has to do with the average global temperature on the earth's surface, measured on the ground and over the oceans. And of course, many people ask: "Why is this so important? We're talking about a change of just 1.5, maybe 2 degrees."

But that's inaccurate in several respects. For one thing, limiting global warming to 1.5 or 2 degrees Celsius would be a major success, but one that would require decisive political action. At the moment, however, we are heading towards 3 to 5 degrees Celsius by the end of this century, and the temperature is not going to stop increasing after that.

For another thing, the earth's average surface temperature is the result of thousands of processes. For example, we have intense solar irradiation over the equator and months of darkness in the polar regions. Atmospheric circulation – redistribution processes of warm and cold air – are happening constantly. We also have sea currents such as the Gulf Stream that carry warm water from the Caribbean and similar regions all the way here. Our forests also have a cooling effect, mainly through evaporation. There are countless mechanisms that balance out the earth's temperature conditions. It is an incredibly complex and delicate balance. And we are brutally disrupting it with our greenhouse gas emissions. That is leading to climate crises, the likes of which we have never experienced before in the history of human civilisation. And now every tenth of a degree counts!

It's quite similar to the internal body temperature of us humans. If you were to leave this room now, the temperature in the corridor might be 3 degrees colder. If you were to leave the building, it might even be 10 degrees colder. But your body temperature doesn't change as a result of that. It is kept within a very limited range through a series of processes – perspiration, respiration, circulation, and so on. Between 36.5 and 37 degrees Celsius if you're healthy. If your body temperature were to increase by 1 degree right now, you'd already start to feel slightly unwell. If it were to increase by 2 degrees, then you'd have

a fever. From 39.5 degrees, things would become downright unpleasant. An increase of 5 degrees, and that's it – game over. And that is exactly what we need to keep in mind when discussing the change in the earth's average temperature. That is why we're raising the alarm over an increase in temperature of 1 degree, 2 degrees, 3 degrees Celsius etc.

This brings us to the issue of CO_2. The fact that the earth is habitable at all is closely linked to what we call the natural greenhouse effect. If we had no CO_2 in the atmosphere, the earth would be an average of about 35 degrees cooler. The average global temperature would be around minus 20 degrees Celsius. There would be virtually no water anywhere in liquid form. But water is the origin of life, which is why atmospheric CO_2 is so important. Atmospheric CO_2 has the phenomenal physical property of allowing the visible spectrum of sunlight, which is of course essentially the energy that powers our life, to pass through freely. When it comes to sunlight from above, CO_2 says: "Nothing for me to worry about." Radiation in the visible spectrum is also reflected back out of the atmosphere, partly from the deserts, the ice sheets etc. But when sunlight strikes dark ground in particular, it warms up the surface of the earth, which then emits thermal radiation in the infrared region. When this radiation tries to leave our atmosphere, however, CO_2 springs into action: It is able to absorb the longer-wave thermal radiation much better than visible light because thermal radiation causes it to vibrate at certain frequencies. In other words, CO_2 works like a crazy doorman who lets in almost anybody who is sober but then won't let people leave again when they're drunk. This complicated warming-up process raises the earth's average temperature. That is why we have a climate that makes life on earth possible in the first place.

But now to the heart of the matter: CO_2 is a trace gas – its natural volume fraction in the atmosphere (measured in ppm: parts per million) is well below one-tenth of a percent. Nevertheless, its influence on the earth's temperature balance is tremendous. Over the last 2 to 3 million years, which is the period in which our present environment developed and during which *Homo sapiens* emerged about 300,000 years ago, there was a constant back and forth between warm and cold periods. For extensive parts of this period, the CO_2 content in the atmosphere fluctuated between about 180 and 280 ppm. But since the Industrial Revolution, we have burnt through enormous quantities of fossil fuels, as a result of which CO_2 levels are now as high as 415 ppm. This means that we humans have increased the long-term maximum value of this environmental indicator for our planetary system by about 50 %!

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Masala
Against this backdrop, can you give us an idea of what a best-case and worst-case scenario would look like?

Schellnhuber
Well in a sense, we are attacking this highly complex system with a sledgehammer. And so it should come as no surprise that something dramatic is unfolding. To come back to my previous comparison: The current temperature increase of more than 1 degree would be enough to cause a slight fever in a human being. If we were to bring all emissions to a halt overnight, the system's delayed reaction and other effects would likely cause the temperature to continue to increase by just under half a degree. This would put us at almost 1.5 degrees. This would be the best case of a fever that is still bearable.

But if we were to double the pre-industrial CO_2 content in the atmosphere – and this will happen as early as the middle of this century unless we take drastic action now – then we would probably see an increase of 3 degrees. And if we were to just carry on after that – which, at present, is looking unfortunately likely – then we could bring about a rise in temperature of 4 or 5 degrees Celsius over the course of this century. That would be the worst-case scenario. To come back to the comparison I drew with the human body: game over.

When it comes to the earth as a system, the equivalent to vital organs that fail when the body overheats is what we refer to as the tipping points. This is of course where the major ecosystems come into the picture: the Amazon rainforest or the Great Barrier Reef, about 40 % of which is already dead as a result of the most recent heat waves in the ocean. Let's

not forget the vast ice sheets that have existed for millions of years. The Greenland ice sheet contains so much ice that, if it were to melt completely, the global sea level would rise by seven meters. Imagine what Europe's coastlines would look like as a result.

Another extremely relevant factor are the major circulation patterns in the atmosphere and the oceans. Take the Indian summer monsoon as an example. About 500 million people depend on this weather phenomenon to occur regularly because almost half of South Asia's population is still employed in agriculture. Then there's jet streams, which flow at high speed from west to east 10–12 km above the surface of the earth. This air current is very important for our weather in Europe. Last year, for example, we had an abnormal situation that led to a summer of drought. The meanders of the jet stream, which are known as Rossby waves, stayed in one place for several months, continuously bringing in heat from the Sahara to Europe. And then of course there is the Gulf Stream in the Atlantic, which gives western Europe its mild climate even though we are on the same latitude as Alaska. If it weren't for this permanent remote hot-water heating, we would have Alaskan conditions here, too.

Unfortunately, the first systems to collapse will be the tropical coral reefs. Around the globe, large parts of these reefs will probably die as a result of a temperature increase of just 1.5 degrees. The Arctic sea ice is also at urgent risk. And then there are large parts of the Western Antarctic ice sheet, where numerous ice basins seem to have already collapsed. But the big question is: When will Greenland begin to melt? Greenland's ice sheet is up to 2 kilometres thick. If the upper layer gradually melts, the surface will sink into warmer regions – and then melt even faster. At the same time, the ice becomes brittle, rough and dirty, which means it can absorb even more sunlight, thus becoming warmer even faster and melting even faster. So we are talking here about a self-accelerating process. And once this process gets going, there's nothing to hold it back. When will we reach this tipping point? Our best estimate at present is that the downward spiral will start once global warming crosses the 1.6-degree threshold. But there are still major uncertainties. Of course I'm hoping that it will only begin at higher temperatures.

The bottom line is that with its aim of limiting global warming to 1.5 to 2 degrees, the Paris Agreement will protect us from some but not all major planetary disasters. But if we fail to achieve the goals specified in the agreement, we will lose our environment as we know it today and will be putting the very basis of our existence at risk.

> ***There's no doubt that tackling climate change is necessary from a geostrategic perspective, too.***

Masala
What effects do you think climate change will have on global security policy?

Schellnhuber
So let's talk about the big issue of international and national security. If the scenario I've just described actually occurs, it is possible that not only large parts of the tropics but also all coastal regions, where the main economic activities on earth take place and where most people live, would eventually become uninhabitable. Billions of people around the world would have to relocate. Not today, not tomorrow, but more and more with every decade. Climate change can contribute to migration in the short term as well, for example when a period of drought leads to crop failures, which can cause latent conflict in the affected region to turn violent.

And so there's no doubt that tackling climate change is necessary from a geostrategic perspective, too. We must fight to prevent every tenth of a degree because even minor changes can push us over the edge towards one of the major elements of the system collapsing. As long as the monsoons in India or West Africa occur somewhat regularly, for example, the agricultural societies there will survive. But if, for example, three years were to pass with no sign of an Indian summer monsoon, only for the phenomenon to return with a vengeance, the food system would collapse. This could destabilise the whole of India as a country.

Idiotically, some decision-makers still take the view that "unless you scientists can guarantee with absolute certainty that all of this will happen exactly the way you say it will, then we don't need to do anything at all." Imagine if the military were to plan like this: "Unless I know with absolute certainty that I'm going to win without any losses, then I won't defend myself in the first place." But this really is how some people actually argue. We are causing massive disruption to the system from which our civilisation was created. This is why we must apply the precautionary principle. We know that an increase in temperature of 3 to 4 degrees Celsius will cause devastating disasters, but at the moment we are still – just about – in a position to maybe fend off the worst and most serious consequences. This is why we must do everything we can to try to prevent any further global warming.

Ultimately, this calls for a rapid and profound transformation of our global economic system. Personally, I don't believe we can sustain the 1.5-degree line without dangerous extensive technological interference with the planetary environment. We can manage the 2-degree line, though, provided we can overcome two essential challenges. Firstly, de-carbonisation, that is to say the rapid replacement of fossil fuels with renewable energies, more efficient procedures, more rational consumer behaviour, and so on – ideally by 2040. We have long had the necessary technical means at our disposal. Secondly, we must stop overexploitation of our natural ecosystems, our powerful friends who protect us from climate change mainly by absorbing and storing a large proportion of the CO_2 we produce. In military terms: if I have a strong ally, I would do well to try to maintain and support that ally. We, on the other hand, are killing our best partners! One example is our practice of cutting down the rainforests in the tropics to make way for soya bean farming. This twofold destruction of the system – firstly, emissions of greenhouse gases and, secondly, overexploitation of nature – is a form of suicide. As awful as that sounds – it's true.

> ***This twofold destruction of the system – firstly, emissions of greenhouse gases and, secondly, overexploitation of nature – is a form of suicide.***

And thirdly – and this is a particularly important point in military and security policy discourse – several

hundred million people are likely to relocate in some way or other even if the climate changes only moderately. Let's hope we have enough time and that we can do all this in an orderly fashion. And hopefully we will be able to develop the tools we need to do it. To believe that we could instead erect an impenetrable barbed wire fence around Germany or the EU is simply naive. Not to mention inhuman …

Masala
From the research you and your institute are doing, are there any results that suggest that climate change is the main cause of violent conflicts within or between countries? I am asking because the debate in my field of research tends to be about the idea that climate change does not actually cause conflicts but escalates already existing ones.

Schellnhuber
We are probably still at a point where climate change is indeed only a co-factor and only has an indirect effect by further destabilising precarious regions. I'll give you an example. Between 2006 and 2011, Syria was hit by one of the worst droughts ever recorded. As a result, harvests failed and a lot of cattle perished. Hundreds of thousands of people in rural areas lost their livelihoods and sought refuge in the outskirts of big cities such as Homs and Aleppo.

California was also hit by a similarly extreme drought recently. Yet there was no civil war there, but there certainly was in Syria. At this point, it's important to emphasize that a conflict can erupt as a result of several factors that are often difficult to quantify. But if there had been a properly functioning social network in Syria and – rather than a brutal autocracy – a civil society with democratic rights, freedom of the press etc., it might still have been possible to avert the crisis. Jordan, for example, is relatively stable. And although the drought in California was unpleasant because people couldn't water their lawns, for example, life otherwise just carried on as normal.

However, we suspect that if we were to enter a world where global temperatures have increased by 4 degrees or more, the impact on the climate would be so drastic that it could become one of the main drivers of conflicts. Once we get to 6 degrees or more, large parts of the tropics would become physiologically uninhabitable, which means there would be areas in which we would not be able to survive outdoors for longer than a few hours.[1] We would have to stay in an air-conditioned environment at all times, something only the privileged would be able to do. Or we would crowd into regions that have a milder climate, with all the consequences that would have in terms of security.

Masala
Most countries in the Western world, as we call it, recognise that climate change is going to affect security policy in some way or another. This is usually debated in connection with adapting our own armed forces, for example in terms of clothing, materiel etc., so

that they can also function in high or low temperatures. But this of course can only be a first step. What consequences do you think there might be for this narrow segment of security policy? More specifically, what does the Bundeswehr have to be prepared for?

Schellnhuber

Important as it is, needing to adapt to changed climatic conditions under which man and material have to act and function almost goes without saying.

The real question is whether the task spectrum of the Bundeswehr will change when geostrategic circumstances change. Where would crises and wars in particular have to be prevented? Where could new threats develop? And where might this make it necessary to operate beyond our own national borders?

Whether it wants to or not, the Bundeswehr is going to undergo further internationalisation as a result of climate change. Science can help, for example by developing an early-warning system for detecting where new tensions or even armed conflicts are emerging, what peaceful conflict resolution approaches can be taken, and where a force contingent may need to be deployed.

As you can see, these are fundamental questions. My answer would of course be that conflict prevention is crucial. In countries that are at the centre of climate change, such as Mali or Niger, we must first and foremost make sure that radical, militant or extreme forces do not exploit a state of emergency.

Finally, let me give you a personal example. The first time I personally experienced the climate problem was when I travelled through Africa between 1972 and 1974. It was my love of adventure that first brought me there. That was at the time of the devastating drought in the Sahel region. The arid conditions were extreme, particularly in the eastern part of the Sahara. I witnessed it all firsthand. Along the few roads through the Sahara desert lay dead cattle, the nomadic people's primary source of capital! It was a harrowing sight: dead camels left and right, and the Tuareg – once proud warriors – stood begging in the streets and sold their silver jewellery for a pound of sugar.

I believe this was the beginning of the destabilisation of Africa north of the equator. The nomads had to flee south to the Sahel and then to Northern Nigeria, Cameroon and Chad. And so I witnessed how a relatively small change – in this case two years of no rainfall – can destroy entire cultures. And that then triggered a domino effect. If it hadn't been for the Sahel drought back then, Boko Haram might not even exist today.

> ***"Whether it wants to or not, the Bundeswehr is going to undergo further internationalisation as a result of climate change.***

Incidentally, we also know what triggered the crisis back then. It was not climate change but air pollution. Aerosols, most likely from power plants in Western industrial countries, suppressed the rainfall. A German or French coal power plant contributing to a devastating drought in Africa and, from afar, destroying the circulation patterns that usually bring rainfall to the region in spring … crazy, isn't it?

Masala

Professor Schellnhuber, thank you very much for this interview.

Interviewee

Prof. Dr. Dr. h. c. Hans Joachim Schellnhuber, Director Emeritus

Hans Joachim Schellnhuber is Director Emeritus of the Potsdam Institute for Climate Impact Research (PIK), which he founded in 1992. He is Distinguished Visiting Professor at Tsinghua University (China), and member of numerous learned societies such as the Pontifical Academy of Sciences, the German National Academy Leopoldina and the US National Academy of Sciences. Since 2019, Schellnhuber has been intensively involved in the creation of a "Bauhaus der Erde" and is currently member of the New European Bauhaus High-level roundtable.

Source: https://www.pik-potsdam.de/members/john

1 See "Inhospitable – A Short Story", Metis Study No. 11 (May 2019).

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