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... KLAUS HASSELMANN

1. From your point of view, what are today's most pressing environmental problems?

Climate change is today's most pressing problem. It affects all forms of life and cannot be readily reversed. However, many other environmental problems exist that are directly connected to climate change, from endangered species to pollution and water scarcity. There is an urgent need to address these problems, too.

2. When looking at potential improvements in our environment, what gives you hope?

The positive outcome of the Paris climate conference in December 2015 makes me optimistic that bottom-up public pressure is beginning to overcome the resistance of interest groups that oppose climate policies. The *Paris Agreement*, a milestone in international climate policy, will force governments to adopt more progressive environmental policies.

3. Is there a particular environmental policy reform you admire the most?

Denmark is an inspiring example: thanks to its investment in wind energy, support of electro-mobility, among other measures, it has an impressive climate record. Denmark's carbon intensity of electricity generation, for example, is the lowest within the EU.

4. Which policy instrument do you consider most detrimental when it comes to achieving climate goals?

Subsidies in fossil fuel energy are still widespread, in the US and Australia, for example, but also in many other countries. Estimated worldwide fossil fuel subsidies lie in the 400 billion US dollar range annually. This is over five times greater than current estimated global subsidies in renewable energy! In the wake of the *Paris Agreement*, many countries have now agreed to phase out fossil fuel subsidies. But to achieve the Paris goals, we'll need fossil fuel subsidies to be removed far more quickly than is currently foreseen.

5. Why environmental research?

Many uncertainties still exist regarding the human impact on the environment. But the need for further research should not delay the need to respond now to the currently evident dangers of environmental change. Nevertheless, further research is important in order to continually optimize the response.

6. What has your experience been when it comes to transferring scientific insights into practice?

As a scientist, it's not easy to transfer one's understanding of complex processes to the public and policymakers. The most effective method is through the media. Media reports are read, seen or listened to by far more people – including decision makers – than a single scientist could contact. Although I've personally presented the climate problem to decision-makers such as Angela Merkel and Klaus Töpfer, I suspect they're more influenced by the general public concern regarding climate change than by the complex details of climate processes presented by an individual scientist. An important mechanism for the transfer of knowledge from scientists to the media is the impact of cross-disciplinary journals, such as *Nature* or *Science*. This is why, together with many of my colleagues, I've regularly published overview papers or commentaries in these journals. The reports of the Intergovernmental Panel on Climate Change (IPCC) also serve as an important mechanism for the transfer of scientific climate knowledge to both the media and decision makers.

7. Besides the one you're working in, what field of research in the environmental sciences do you find most exciting?

Beyond my own field of climate change – which indirectly includes nearly all areas of the environment – I'm mainly interested in the political response to climate change, an important research field requiring the close interaction between climate scientists, economists, social scientists and political analysts. The long-term problem of climate change cannot be addressed in isolation from the many other urgent shorter-term problems politicians face.

8. Can you name any person or event that has had a particular influence on your commitment to environmental issues?

Reimar Lüst, former president of the Max Planck Society, invited me to head the new Max Planck Institute for Meteorology in Hamburg, which was founded in 1975 as an institute dedicated to climate research. Apart from creating a climate research program in Germany, this position enabled me to recruit many young scientists, such as Mojib Latif and Hartmut Graßl, who have since gone on to have an important media impact. It also provided the basis for the later foundation of the Potsdam Institute for Climate Impact Research, headed by Hans Joachim Schellnhuber, to complement the scientific research of the Max Planck Institute in the important field of climate impacts and climate policy.

9. What knowledge about the environment would you like to pass on to young people?

Protecting the environment does not require sacrifices, but rather the enhancement of our awareness and appreciation of the world we're privileged to live in.

10. As a scientist concerned with sustainability, what contradictions do you face in everyday life?

I can't understand how some people get satisfaction from displaying extravagant disrespect for the environment by driving large cars or Sport Utility Vehicles, flying to remote places of the Earth for pure enjoyment, or simply wasting energy in a mindless way by heating buildings with open windows.

11. What are you reading at the moment?

The Modern Mind by Peter Watson. The book gives a stimulating overview of the many interwoven strands of thinking in philosophy, science, economics, art, music, the environment, etc. over the last century. The environmental problem is placed in the historical context of the other challenges faced by humanity.

12. Apart from the ones we've raised here, what is the most important question of our day?

Will humanity realize that the climate problem is different from all the other problems we've been used to somehow "muddling through"? If left unresolved, climate change will permanently affect all living creatures on Earth.



Klaus Hasselmann,

Professor Emeritus at the Institute of Geophysics, University of Hamburg, former director of the Max Planck Institute of Meteorology, Hamburg.

Born 1931 in Hamburg, Germany. Studies in physics and mathematics at the University of Hamburg. PhD in 1957. Assistant, then associate professor from 1961 to 1964 at the Institute for Geophysics and Planetary Physics and Scripps Institution of Oceanography, University of California, CA (USA). 1966 to 1975 professor at the University of Hamburg. 1975 to 1999 director of the Max Planck Institute of Meteorology, Hamburg. 1988 to 1999 scientific director at the German Climate Computer Centre, Hamburg.

Research focus: climate dynamics, stochastic processes, ocean waves, satellite remote sensing.

Selected awards/memberships: *Oceanology International Lifetime Achievement Award* | *Symons Memorial Medal*, Royal Meteorological Society | *Environmental Award*, German Federal Environmental Foundation | *Vilhelm Bjerknes Medal*, European Geophysical Society | *BBVA Foundation Frontiers of Knowledge Award* (climate science) | Royal Swedish Academy of Science (*Foreign Member*) | European Geosciences Union (*Honorary Member*) | European Academy of Sciences and Arts | Royal Meteorological Society (*Honorary Fellow*) | American Geophysical Union (*Fellow*).

Selected publications: Nonlinear Interactions Treated by the Methods of Theoretical Physics (*Proceedings of the Royal Society*, 1967) | *Stochastic Climate Models, Part 1: Theory* (Tellus, 1976) | *On the Signal-to-noise Problem in Atmospheric Response Studies* (Royal Meteorological Society, 1979) | *Dynamics and Modelling of Ocean Waves* (Cambridge University Press, 1996; with others) | *Are We Seeing Global Warming?* (*Science*, 1997) | *The Climate Change Game* (*Nature Geoscience*, 2010) | *Reframing the Problem of Climate Change. From Zero Sum Game to Win-win Solutions* (Earthscan, 2012; with others) | *Free-riders to Forerunners* (*Nature Geoscience*, 2015; with others).

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KLAUS HASSELMANN

Every four years, geoscientists gather for a large international meeting of the International Union of Geodesy and Geophysics. In 1974 in Melbourne, Australia, I was listening together with Christian Junge, the then-director of the Max Planck Institute for Chemistry in Mainz, to a keynote lecture on ocean waves by Klaus Hasselmann, professor for theoretical geophysics at Hamburg University. Hasselmann spoke as fast as his train of thought, leaving a number of the scientists in the auditorium behind him – including Junge, a member of the commission charged with appointing the first director of the newly established Max Planck Institute for Meteorology (MPIM). The institute began in 1975 with Klaus Hasselmann as its founding director.

Calling him *the* climate scientist in Germany would be an understatement, as he significantly contributed to global climate research.

In 1976 he showed that the global mean temperature on the Earth's surface would vary by about 0.5 °C over several decades to a few centuries without any external forcing, merely due to the interaction of the slow-reacting ocean and the "hectic" atmosphere. Hence, it became clear that detecting a human influence on average global temperature would be very difficult. The anthropogenic signal would only slowly emerge from natural climate variability.

He is the climate scientist in Germany.

In 1989 the MPIM, under Hasselmann's leadership, was able to assemble the first three-dimensional global coupled numeric atmosphere/ocean model in Europe, the workhorse for climate science. Nowadays, the model serves as the basis for Earth system models, which run on the supercomputer of the German Climate Computing Centre (DKRZ). Two years before, as members of an expert commission on Basic Climate Research at the Federal Ministry of Research, we both succeeded in getting a majority for Hamburg as the location for the DKRZ. Since then, the ministry has financed the supercomputers for climate research in Germany. With his scientific charisma, Hasselmann has established the key tool for German climate researchers.

In 1995 Hasselmann made a breakthrough in global climate research using a new mathematical algorithm of his own creation – the fingerprint method – together with the increase in greenhouse gases, observed by means of regional and height-dependent temperature changes in the 20th century. With the coupled model, Hasselmann and his co-workers were able to show the anthropogenic nature of the temperature changes, at a significance level above 95 percent. On July 27, 1995 in Ashville, North Carolina, a small group of scientists from the Working Group I of the Intergovernmental Panel on Climate Change met. Together they formulated a headline for their very long report: *The Balance of Evidence Suggests a Discernible Human Influence on Global Climate*. The anthropogenic signal had been detected. This sentence served as a stimulus for the Kyoto Protocol.

Without the *Joint North Sea Wave Project (JONSWAP)* field experiment off the island of Sylt, coordinated by Hasselmann, I would not have been able to correctly interpret my observation of the cool skin of the open ocean. I also would not have sufficiently impressed my audience with my presentation at the MPIM in Hamburg in 1976 – and might not have been invited to the institute soon thereafter.

Hartmut Graßl, Max Planck Institute for Meteorology, Hamburg.

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