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Keynote Address by

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at the occasion of the Award Ceremony of the

National Latsis Prize 2011

on 12 January 2012 at the City Hall, Berne

It is a great privilege and distinct honor for me to address you today and to share with you a few thoughts that are motivated by the research which I have conducted with our team at the University of Bern since 1993, and which has benefitted a lot by the Latsis Prize 1993 which I was fortunate to receive.

I want to talk about the **dilemma** the scientists face when they step out of their ivory tower and communicate results to a wider public. This dilemma arises when new knowledge affects society at large, and when some action may be urgent. Among those topics of current science are gene technology, research of nano-materials, epidemiology, nuclear physics, cancer research, and the chemistry of natural products delivered by organisms – the topic of this year's Latsis laureate.

Also climate science is among these topics and may serve as a showcase of the challenges the scientists are facing when they address the public.

Climate change is a broadly discussed topic: while it is complex and often highly technical, everybody has an opinion on climate, and for some it is even their **small-talk favourite**. The media benefit from this situation and many headlines are based on day-to-day weather events and their possible connection to climate change. A record hot summer is a quick story for a newspaper and the current inundation of the Alpine region with snow will, I presume, produce some juicy articles about the apparently so evident absence of global warming.

But the facts are clear. The world is warming and it has done so since the beginning of the 20th century, glaciers are retreating worldwide, and both Greenland and Antarctica are rapidly melting around their margins. Our ice cores from Antarctica tell us that greenhouse gas concentrations today are significantly higher than ever during the past 800,000 years. Extreme weather events such as the summers 2003 and 2010 in Europe brought record temperatures for weeks, dry soils, empty river beds and depleted groundwater reservoirs. But more important than singular events are their statistics which tell us that in Europe the five hottest summers of the past 500 years all occurred after the year 2001, while the five coldest summers in the same 500 years all occurred before 1924!

Such facts are "inconvenient truths" for many who protect the Status Quo. And consequently climate scientists are increasingly exposed to hostile questions or even baseless accusations.

Is the climate debate nurtured by scientists who communicate their results in the most dramatic way in order to secure financial support for their research?

Will this topic suffer the same fate as Waldsterben when the scientific evidence became equivocal?

Or does there even exist a world-wide conspiracy of climate scientists and environmental activists with the goal to transform the western life-style, as some influential Think-Tanks claim?

It is equally a fact that climate has always changed: Alpine glaciers 2000 years ago were even shorter than today, and after the record warm year of 1998, there followed – who would be surprised – a few colder years. Some used these observations to argue that the current dramatic retreat of the Alpine glaciers is a natural fluctuation and that global warming has come to a halt after 1998. Predictably, such information, if well placed, can influence the political debate. The fact, however, is that 2000 years ago the Earth received about 5 W/m^2 more solar power during the summer than today due to a slightly different orientation of the Earth's rotation axis, and that 1998 was a record warm year because of a coincident El Niño event in the tropical Pacific.

There is a **physical science basis to anthropogenic climate change**. Physics teaches us that this topic will concern us for many decades and centuries because of the slow-responding ocean and ice sheets. The combination of understanding fundamental Earth system processes and climate modelling indicates that past emissions of carbon dioxide will cause further climate change which is not yet realized but which is bound to happen.

This so-called **climate change commitment** is substantial. In addition to the 0.8°C global warming since the year 1900, we are already committed to a further 0.6°C. And this goes on top of any future change caused by continuing emissions of greenhouse gases!

We are thus **living on credit**, a credit that is drawn on the global climate conditions of the future. Credits must be paid back, and it is no different with climate credits. Certainly, generations after us will pay back, but paytime has already started.

Analysis of ice cores from Greenland and Antarctica showed that the Earth system responded to perturbations in an abrupt way. Future changes may not proceed in a smooth way and so it is not difficult to imagine that climate-related disasters will become more frequent, with more severe impacts, or even that so-called tipping points might be crossed. Some call such events the **climate catastrophe**.

Unfortunately, physics is not of much help for me to decide when I should call a future event a "climate catastrophe". This term involves a value judgement, and therefore, most scientists, including myself, feel extremely uneasy with this notion and avoid it in their interactions with the public.

And here is the **dilemma** which I referred to at the beginning of my address. How should complex scientific results, which point at risks, be communicated such that society is in the position to take an informed decision and act to avoid potential harm?

How do you deal, as a scientist communicating with the public, with words that evoke emotions and that are effective, but cannot be scientifically quantified?

Avoiding such terms is to inform more objectively. But others will interpret the information, and the comprehensive and balanced assessment of events and developments is no longer in your hands.

Is it ethically and morally correct that I inform objectively without emotions and strong images about climate change, even if I cannot exclude that a catastrophe could unfold?

What prevents me from informing the public about the possible worst outcomes of the response of the climate system to a further increase of greenhouse gases in the atmosphere?

The public expects unbiased and objective information from an expert. In return, you **maintain credibility,** and this is undoubtedly the highest commodity for a scientist. Those scientists who use highly emotional terms in scientific communication risk their credibility.

However, it is not that easy. In my work I experience more and more situations where the expert knowledge is heard and even acknowledged, but where action would not follow. As experts we are imprisoned in this dilemma: If I inform objectively without emotions, my message may easily be ignored. If I communicate boldly, I loose credibility.

How do I handle this dilemma? There are no straightforward resolutions of this dilemma, but three points are important to me:

First, persistence and coherency are key for your work. Do not give up, continue to research pressing questions, create new knowledge, sharpen your results, and inform regularly. Speak to multipliers from all strands of society: to students, NGOs, lobbyists, teachers, CEOs, pensioners, to people across the board of our society.

Second, use compelling pictures and images to convey complex science. While the statement "*Winters in 2050 will be about 1.8°C warmer*" is identical to "*Grindelwald will be practically snow-free in 40 years*" the latter evokes a clear image of a changing environment. "*Sea level will rise by 15 cm in the next 20 years*" appears less dramatic than "*Tuvalu will not be habitable in 2030*". Do not hesitate to communicate in a lively way which is accessible to the broad public, while meticulously insisting on the scientific basis and always informing about the uncertainties.

Third, do not simply assume fair play when you address fundamental questions and problems of societal relevance. Be aware of the possibility that your critics and detractors may gain information according to standards much different from those you apply as a scientist.

A better ability and sensitivity of scientists to communicate with the public and to talk about their results will alleviate the dilemma. But it cannot be resolved, at least in communicating results about anthropogenic climate change, because there are always **uncertainties** involved, and some use these a excuses for inaction.

But we must not forget that a crucial element in communication is **the receiver of the scientific message**.

Therefore, I would like to close with one more thought, maybe even an appeal.

I strongly believe that we need to start a transition **from the information society to the science society** to be able to face the many challenges of the future: the energy challenge, the water challenge, the resource challenge, and the climate change challenge.

While science is still quite strong in the industrialized countries, I sense that we have lost considerable momentum in the past 20 years. For example, in Switzerland we are no longer able to educate enough scientists and engineers.

But we need a scientifically broadly informed and mature society so that the receiver of our information can understand it. The steady **reduction and dilution of basic science knowledge and skills** in chemistry, biology and physics must be stopped. Let us bring

back these key subjects to the appropriate position in the curricula of higher education. Education needs to provide the space and time for the young generation to recognize the wonders of nature through the view of the disciplines of the natural sciences and mathematics.

I believe that only a **scientifically fluent society** is capable of responsibly using and managing complex technology. Basic scientific literacy is a must so that decisions by policymakers will be rational and science-driven rather than influenced by particular interests or ideology.

The transformation from an information society to a science society requires a change in perception of science and scientists by the wider public. Prestigious awards, such as the National Latsis Prize, play an important role in this regard. They shine a beaming light on outstanding individuals and their achievements, they showcase what science can do, and they honor the individuals behind results from which all of us will benefit directly or indirectly.

The research topic of Karl Gademann is not so far away from climate science as one may think. The major effects of anthropogenic climate change are evident in temperature and precipitation, and those two quantities strongly influence ecosystems. They regulate the ecosystems' capability to deliver natural products to us. This is called **ecosystem services**, most of them delivered to us free of charge. Ecosystem service accounting is yet to be invented!

The research of Karl Gademann will provide us with more knowledge about the basic biochemical processes, indispensable knowledge to assess the **vulnerability of these services** which constitute the life support system of global society.

I congratulate you for this great honor and prestigious award and wish you personally and professionally all the best.

Thank you!

Bern, 12 January 2012