



norden

Top-level Research Initiative



Hot Topic – Cold Comfort

Climate Change and Attitude Change

Gudmund Hernes

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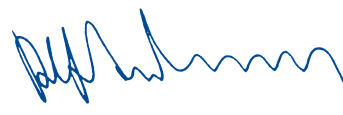
The Swan ecolabel was established in 1989 by the consumer sector of the Nordic Council of Ministers.

Preface

In 2008, following an initiative by the Nordic Prime Ministers, the five Nordic countries joined forces in the largest research and innovation initiative to date within the framework of Nordic cooperation. The Top-level Research Initiative in Climate, Energy and the Environment aims to engage agencies and institutions in the Nordic region to make a Nordic contribution towards solving the global climate crisis. Within a five year programme term, the initiative aims to bring together the best researchers in the region with industry, societal actors and decision makers to produce new knowledge and better innovations related to climate change and energy solutions. The Top-level Research Initiative funds Nordic collaborations within six thematic programmes ranging from the impacts of climate change on society to promoting innovations in environmental technology, energy efficiency and new forms of energy. Interdisciplinary research is encouraged and the social sciences and the humanities provide one of three cross-cutting perspectives, which are to be brought into the activities of the programmes.

It is in this context that the present report was written for the Top-level Research Initiative by Professor Gudmund Hernes. The report is by its author described as a synthesizing scientific essay primarily focused on the changes in peoples' mindsets that have taken place since the Second World War – encapsulated in the catchphrase «The Ecological Revolution» – which has a cognitive, political and ethical component. The term «essay» is deliberately chosen, as its purpose is to bring together existing studies and perspectives on climate change and how they have impacted on opinion change. The report is concluded with a synoptic chapter on possible research themes for the social sciences, which could contribute to interdisciplinary, integrated efforts to address the causes and consequences of climate change

We hope that this report will contribute to understanding how analyses from the social sciences and the humanities can be brought into the debate on climate, energy and the environment as well as provide premises for a horizontal, integrated commitment to research contributions from these disciplines within the framework of TRI and beyond.



Rolf Annerberg

Chair of the Top-level Research Initiative Management Board

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Summary



Creation of Adam, detail. The Vatican, Sistine Chapel ceiling. Michelangelo Buonarroti, 1512
Photo: Science Photo Library/Scanpix

Summary

All through history humans have tried to understand their entire world – the cosmos and their own place in it. Cosmologies have provided accounts of the origin and nature as well as the structure and evolution of the universe. But the big stories of mankind have also included accounts of how humans and their lives can be fitted into the whole – i.e. the relationship between the natural world and the social world.

Throughout history there have been dramatic shifts in such world views. In ancient times humans placed themselves in the center of a universe created by the gods. There were several versions of such a geocentric model of the universe. Greek astronomers added geometric models for describing and calculating celestial motions which were highly advanced when Ptolemy conceived of the universe as nested spheres.

The relationship of the Ptolemaic system to social life can be illustrated by the fact that this system made it possible to compute the position of Sun, moon and planets, as well as to produce a star calendar and almanac. The regular celestial motions could be used to regulate social life; the conception of the universe was translated into key aspects of social organization.

Though almost universally accepted in the then Western world, the Ptolemaic system became increasingly inadequate for explaining the eccentric behavior of the planets – in spite of the fact that epicycles were introduced to account for the discovered complexities. The decisive break with the Ptolemaic system came with Copernicus, who put the Sun at the center of the universe in a heliocentric model – a model which at the same time was the harbinger of the scientific revolution.¹ However, there was no immediate broad acceptance of this new view of the world – indeed, many still believed that the Earth was the center of the universe nearly five centuries after Copernicus' death.

In this essay the argument is made that since the Second World War there has been another major shift in public opinion and awareness – in the way the world and its inhabitants are viewed. In one sense one could argue that this new world view is again geocentric, since it centres on the Earth itself. But it is geocentric by being ecocentric – by addressing how humans are affected by their own impacts on nature. This contemporary change in world view entails a concurrent shift of several outlooks, which over time have become more interlinked. Among them are the shift from the Earth's being seen as boundless to finite; from being considered robustly resilient to alarmingly fragile; from viewing global natural and social processes as being largely decoupled to being tightly linked; from taking nature as the determinant of human conditions to humans being the key agent of climate change; from

the world's being viewed as geographically compartmentalized to being seen as a global commons; from the notion that the welfare of citizens is decided within the borders of nations to the realization that it is increasingly determined by decisions taken abroad and often far away; from the view that what happens in nature is on the whole stable and foreseeable to its becoming increasingly unpredictable; from the notion that individual actions are of little import to the view that collective action is inescapable; from the premise that what happens to the Earth is essentially cyclical to the premise that portentous trends are perhaps irreversible; from the assumption that humans can carry on with business as usual to the foreboding that global action is urgently needed. Taken together these changes could be called the «Ecological Revolution» – a broad change in world view in what could be called a global constituency.

Clearly not all subscribe to all these notions; their development has not been linear nor their integration complete. Inconsistencies have been highlighted, several of the tenets are contested, and there have been reversals of opinion. Yet over time they have, on the whole, taken firmer hold.

People are notoriously loath to change their outlooks and opinions. The question is therefore: If there has been this broad change in cognitions and attitudes – about what is going on and what should be done about it – how has it come about? Here the argument advanced is that *changes in world views have been brought about by changes in the world itself*. Rather than changes in public mindsets on the environment as a slow, cumulative process of making observations and arguments, by reasoning and consensus-building, *changes have been driven by events that are the result of human activities*, events that have jolted the public imagination and called for collective action.

Put differently: After the Second World War flash points have provided flashes of insight. These courses of events became turning points because at the same time they were moments of truth and hours of decision – provoking revision of conventional wisdom and set ways of behavior.

Seven such events and their aftershocks have been selected for discussion: The bombing of Hiroshima; the ecosystem damage from the widespread use of pesticides; the devastating effects of nuclear power plant accidents; the shock of highly publicized famines; the Malthusian specter, i.e. spikes in resource scarcity; global warming and freak weather, and, finally, the impact of the first picture of the «Blue Planet» – i.e. the whole Earth seen from space. So the key argument is that outlooks and opinions have changed as a result of the courses of events themselves – *changes in assumptions and attitudes are event-generated*. The changes consist of the replacement of earlier beliefs and their substitution by a new, broader mental map accompanied by a reordering of priorities. Hence it is a shift not just in how the situation is seen to be but also in views about what must be done.

Theoretically the resistance to change is explained in what is termed *the double embedding of attitudes* – i.e. that *attitudes are lodged in logical lattices as well as in social networks simultaneously*. This makes for mutual reinforcement, continuity and stability: Opinions come in ensembles, friends come in clusters – and both come together.

Thus the reason why broad attitude change is event-driven is because, simply put, dramatic events may simultaneously attack personal beliefs as well as social relations. Rather than being changed by the force of argument, attitudes are changed by the force of circumstance, so to speak. Event-generated change is potent because the two structures are simultaneously impacted: one at the level of conceptualization and experience – the logical lattice; the other at the level of human relations and interactions – the social network. If opinions are doubly embedded, both layers are simultaneously perturbed by dramatic events. When the different links between both types of elements are unhinged, they can be reconfigured.

The report is written as *a synthesizing scientific essay* primarily focused on the changes in people's mindsets that have taken place since the Second World War – encapsulated in the catchphrase the «Ecological Revolution.» It is argued that there has been a broad shift that is at once cognitive, political and ethical.

However, in spite of a long-term growing concern that the climate is changing with potentially dramatic consequences for the human condition, there has paradoxically been a recent decline in the public's belief in climate change.² There have also been political setbacks, such as at the Copenhagen Climate Conference in 2009 – and at the time when this essay goes to print, whether the Durban Climate Change Conference in 2011 was a partial success is being debated.

So even though there is a growing recognition that human actions are more intertwined with each other globally and with the natural world, there is a failure to agree on the actions needed. Is this due to a dearth of knowledge? Is it due to a lack of «knowledge consensus» among different issue publics? To the absence of a shared sense of urgency? Or to a failure to find mutually accepted principles of distributional ethics? These are issues touched upon in this essay on climate change and opinion change.

These questions are of particular interest to the Nordic countries. Environmental issues have been ascendent on their political agendas – the fact that the 2009 Climate Conference was held in Copenhagen is a case in point. But Nordic engagement goes further back, indeed for decades. It was the Swedish government that proposed convening the first United Nations Conference on the Human Environment in Stockholm in 1972 – a turning point in developing international environmental policies. A decade later, in 1983, came the World Commission of the Environment and Development – also called the Brundtland Commission after its chair, the former Norwegian Prime Minister Gro Harlem Brundtland. In 1987 its report, *Our Common Future*,³ was published, launching *sustainable development* as the policy needed to cope with the broad environmental threats: It had to meet the essential needs of the present, particularly the world's poor, «without compromising the ability of future generations to meet their own needs.» The report provided the platform for the convening of the 1992 Earth Summit in Rio de Janeiro, the adoption of Agenda 21, the Rio Declaration and the establishment of the Commission on Sustainable Development. In other words, these engagements – and many others could be mentioned – show that *global* environmental concerns have been high on the political agenda of the Nordic countries for decades.

The term «essay» is deliberately chosen for this report, as it is not based on original research or the collection of new data. Rather its purpose is to bring together studies and perspectives on climate change and how they have impacted on opinion change. The assignment was to give a short synthetic overview, written for readability and accessibility. Hence the line of argument is presented in a compact format and the general ideas are elaborated on, enriched and illustrated by concrete examples.

What is presented is not a definitive text but an invitation for debate, with an inventory of hypotheses and suggestions for further social science research. The intended audience is policymakers and what the British call «the intelligent layman» as much as it is researchers. This also has an important consequence for the references given in the text – overwhelmingly what has been chosen are not the specialized books or technical research articles in scientific journals but what can easily be accessed via the Internet, particularly sites where serious arguments are written for easy reading.

In short, the purpose of this report is not to settle arguments but to encourage them. It is not to list what everybody can agree on but rather to encourage debate. Science not only sets norms for rational discussion – it also provides a background for informed yet intense exchanges. If this is induced by the report, it will have served its purpose.

Gudmund Hernes

[Summary. Endnotes]

- 1 For a recent biography, see Dava Sobel, *A More Perfect Heaven. How Nicolaus Copernicus Revolutionized the Cosmos* (New York: Walker & Company 2011).
- 2 A case in point is a study in Norway published in December 2010, in which a national poll showed that about half of the population (51%) believed that climate change was induced by humans – but the proportion was sinking relative to the proportion in February and June 2007 (58% and 55% respectively). (See *Aftenposten* December 4, 2010. In *Den Store Norske Klima- og Miljøundersøkelsen 2010* it was documented that Norwegians increasingly believed that the environmental crisis was exaggerated and that the world would heal itself without comprehensive interventions. However, it is reported that whereas only 21% of Norwegians were very worried about the damage done by climate change, the percentage in Sweden was 31% and in China fully 58% – more than a doubling since 2007. This latter change in attitudes probably reflects dramatic climatic events in China in recent years, such as earthquakes and floods. An opinion poll commissioned by the BBC in 2010 found that the percentage of Britons who believed that climate change was induced by humans had fallen from 41% in November 2009 to 26% in May 2010. Other countries show similar developments (<http://www.nrk.no/nyheter/verden/1.7140522>). In March 2009 Gallup reported that an «increased number think global warming is 'exaggerated'» <http://www.gallup.com/poll/116590/increased-number-think-global-warming-exaggerated.aspx>. Two years later Gallup reported that «Americans continue to express less concern about global warming than they have in the past, with 51% saying they worry a great deal or fair amount about the problem -- although attitudes appear to have stabilized compared with last year. That current level of worry compares with 66% just three years ago, and is only one percentage point higher than the low Gallup measured in 1997.» <http://www.gallup.com/poll/146606/Concerns-Global-Warming-Stable-Lower-Levels.aspx>. In September 2011 two of the Republican candidates for US President, Texas Governor Rick Perry and Representative Michele Bachmann «talked about how climate change is some fraud perpetrated by scientists trying to gin up money for research.» See Thomas Friedman, «Is It Weird Enough Yet,» <http://www.nytimes.com/2011/09/14/opinion/friedman-is-it-weird-enough-yet.html?src=me&ref=general>. In *Why We Disagree About Climate Change. Understanding Controversy, Inaction and Opportunity* (Cambridge: Cambridge University Press), the author argues that «Climate change is not 'a problem' waiting for 'a solution.' It is an environmental, cultural and political phenomenon which is re-shaping the way we think about ourselves, our societies and humanity's place on Earth.» For another recent study, see *Climate Compared: Public Opinion on Climate Change in the United States and Canada,» Brookings Issues in Governance Studies*, No 39 (April 2011) http://www.brookings.edu/papers/2011/04_climate_change_opinion.aspx .
- 3 *Our Common Future* (Oxford: Oxford University Press, 1987). ISBN 0-19-282080-X

I. Introduction

I. Introduction

In this new century humanity is faced with problems of global scope, scientific difficulty and political complexity which will require unprecedented contributions from the natural and social sciences. Increasingly natural phenomena – global warming, climate change and disasters – are pushing themselves up on the international agenda. And these issues are intertwined.

We know that we cannot change the laws of nature. But we also have learned that the ways the laws of nature work in the world are triggered by human actions, such as energy use, emissions and pollution. AIDS is the result of biological processes caused by a virus – yet its transmission is the result of human interaction and social mores.

If we are to prevent the devastating impacts of our own human actions, we have to know by what processes they have caused the adverse effects and how the negative impacts can be counteracted and harm redressed.

Hence our growing knowledge about natural phenomena must be matched by knowledge about social phenomena – knowledge about our physical world must be matched by knowledge about our constructed world.

More than that: The window of opportunity we have to both understand and to act is fairly short. This is due to the fact that on a human time scale the changes brought about may well be irreversible.

At the same time these very negative challenges for humanity provide positive opportunities for developing the natural sciences, the social sciences and the humanities.

The Natural and the Social Sciences

A few words are in order about what the natural and the social sciences have in common and what divides them.

Natural science is not *nature* – it is *science*, i.e. a specifically human and social activity, governed by explicit norms and imperatives such as the value of knowledge, the dedication to truth, the devotion to discourse, the commitment to testing of hypotheses – and the systematic collegial recognition that rewards new insights, novel interpretations and breakthroughs. Natural science is not a natural activity – it is a social activity.

Concepts are the tools scientists use to get a grasp on reality. For example, nobody can *see* gravity – what we can observe are the *effects* of it: when an apple

falls, a pendulum swings or a planet circles around the Sun. But recognizing that it is the same force underlying these three phenomena – the falling apples, swinging pendulums or orbiting planets – took many centuries, an understanding encapsulated in the concept of «gravity.»

Sometimes scientists forge concepts that do *not* correspond to the way the world works. The disease malaria was known in antiquity – but the name is rooted in a misconception of its causes: that it is due to bad air (*mala aria*). The theory that all flammable materials contained «phlogiston» is another example of a scientific misconception.

If the concepts we use do not correspond to the factual situation, not only will our understanding be erroneous. The actions we take will not produce the intended results. Misconstructed concepts lead to misguided actions.

The social sciences share such problems with the natural sciences. But the social sciences have some problems in addition. The laws of nature are not affected by our understanding of them – we can adapt to and use gravity, but cannot change it even if we understand it. However, whatever we think about society is part of society. Hence there is often controversy about what are appropriate concepts for describing society – for example, whether the concepts of «proletariat» and «exploitation» have any validity in modern welfare states.

This can be put in the following way: Nature is indifferent about our understanding of it – but social groups are not indifferent to how we understand their social relations. It follows that people are not indifferent to how nature is understood since these understandings also affect their welfare in so many ways.

Climate Change: Apocalypse Now?

It is an interesting fact that scientists in the past often have made apocalyptic statements about the course of the world – e.g. that we may be heading towards a collective disaster. Scholars in the 14th century proposed many explanations for why the bubonic plague occurred – that it was the punishment for sinful behavior or for tolerating heretics; that it was the effect of bad air emanating from swamps, etc. And throughout history there have been many «comet scares» – their sudden appearance could be a bad omen and might augur «the end.» Indeed, there is a special part of theology and philosophy – eschatology – which is about the final events of the world. And special names have been coined for the epic events associated with end times, such as Armageddon or Ragnarok. Whole civilizations may decline and fall – and in modern secular versions end times may be encapsulated in phrases such as «Untergang des Abendlandes.»¹

Hence one could argue that the present concern for climate change as a precursor of the end of a habitable Earth is just another variation on an old theme. However, ‘this time it is different’: the documentation and the data, as well as the dire predictions, are more convincing, indeed inescapable.

A caption in *The Economist* put it this way: «Humans have changed the way the world works. Now they have to change the way they think about it, too.»² Yet

much is unknown. Hence the changes in the ways the world works also highlight and underline the necessity of and opportunity for closer collaboration between the natural sciences, the social sciences and the humanities to change the way we think about their tasks and their interaction.

The Message of the IPCC

The reason is simply this: Mother Earth has spoken – loudly, clearly and strongly. Her most prominent professional medium has been the *Intergovernmental Panel on Climate Change*. The IPCC was established in 1988 by two United Nations bodies, the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO), to assess «the scientific, technical and socioeconomic information relevant for the understanding of the risk of human-induced climate change.»³ As a scientific body it has been assigned the task of preparing reports on all aspects relevant to climate change and its impacts and proposing realistic response strategies. Thousands of scientists contribute to the reports, which are rigorously reviewed by researchers from different disciplines and all corners of the world. The first assessment report was presented in 1990. The fourth, «Climate Change 2007,» notes many observed changes in the Earth’s climate including atmospheric composition, global average temperatures, ocean conditions, and other climate changes. It drew two crucial conclusions:

- «Warming of the climate system is unequivocal.»
- «Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations.»

The next assessment report is to be published in 2014. Yet the key message from the IPCC is clear and it is this: Temperatures are increasing, glaciers are melting, oceans are rising and weather is becoming more unpredictable and violent. The effects are inexorable and inescapable. They are our common destiny and common future. For humanity there is no escape route.

The IPCC says more: The global changes are not due to the autonomous workings of the forces of nature. It is true that the *determining processes* are geophysical, chemical and meteorological. And they translate into *life processes* that are ecological and biological – species that are threatened, dislodged or boosted. All forms of life will be affected.

But the strongest forces of nature have been set in motion by human actions. Climate change has, beyond reasonable doubt, *social causes*.

And climate change will incur massive *social consequences*. Agricultural land will erode. The rising oceans will swallow coastal zones and mega-deltas and increase the salinity in coastal regions. Floods and drought will devastate crops. Deserts will expand. All continents and all countries will be affected.⁴

Yet the effects are *unevenly distributed*. Inequalities will be sharpened. Water scarcity will increase and the conflicts about water will become more pointed. Insect-borne diseases will be spread to new areas. More people will be poor. Migration will increase and more people will become climate refugees. Food crises will multiply and conflicts grow.

In short: The problems for the global community will become more acute and our common predicaments will become greater. The people who have contributed least to the new exigencies will suffer the worst blows. Those who have the least resources will face the greatest damage. The poor will be hardest hit.

The laws of nature we cannot change – but human actions we can change. Vastly expanded efforts are needed to know and make known the social causes of climate change, to gauge the impacts, to assess cost and recommend remedies – efforts to map, to measure, to estimate, to negotiate and to organize.

Nature's Voice

Even if many of the complex causal links are poorly understood and there are many lacunas in our knowledge, the IPCC has connected many of the dots. We know enough to act.

More than that: Not only have several thousand scientists reviewed and backed the IPCC assessment reports. Mother Earth is speaking directly to millions, without any intermediaries. Hurricane Katrina of 2005 is but one of many examples of freak weather; the Australian floods of 2011 is another. Glaciers are melting in Greenland and Norway; deserts are expanding in Ghana and Nigeria. The effects are there for all to see on all continents.

Over the last decades, what scientists observe and report or exposed groups experience and tell is deviating grossly from the normal or indeed the «natural.»⁵ So the task humanity is facing is colossal: to reverse the damage that started with the Industrial Revolution by instigating a new revolution that lifts poor countries up to our standard of living while staying within the constraints of sustainable development as the world population increases.

Indeed, humanity has never before faced a project that affects more people or is greater in scope, demanding unprecedented political imagination, economic commitment, technological acumen, political energy and social inventiveness. Measures to replace coal power plants, finding large-scale depositories of CO₂, designing more effective engines for cars, stopping deforestation, harnessing non-polluting energy, redressing falling groundwater levels – all of this demands directed innovation, sharpened restrictions and stricter controls of all industrial activities – indeed, of human activities. In other words: there will have to be more interventions in all markets by political regimes and more changes in the lifestyles of ordinary people all over the world. Authorities at all levels will have to collaborate more closely and citizens hold them more to account. To achieve what we want, we can no longer act as we like.

The key point is simple, but fundamental: The way the forces of nature play themselves out are now more and more contingent on and conditioned by human activities. At the same time, the interconnections between natural and social phenomena are multiplying, becoming stronger and tighter. Indeed, we can talk about *a more potent world-wide web of interdependent natural forces and social relations*. Nature's matter, forces and species are more firmly linked to the actions we take as individuals, as groups, and as societies at all levels – on all continents.

This being so, it would be grossly negligent if social and natural scientists did not urgently and forcefully set a common agenda for how to address the problems. If the processes interact, researchers need to get their act together. The multiplex interconnections between physical processes and social relations require analyses that connect the dots.

If there ever was an argument for interdisciplinary work, this is it: Not only will it yield new insights; it must yield premises for a wide array of measures and impetus for political action now. Mother Earth is talking and we have to listen.

Controversies and the Tasks of the Natural and Social Sciences

Normal science is often about contested hypotheses, alternative models, incomplete data and hence different schools of thought.⁶ Many of the results that scientists have produced about climate change have been highly controversial.⁷

If scientists disagree on the many aspects of climate change, politicians do so to an even greater degree. They represent groups that are differentially affected by climate change, often have divergent interests in paying the cost of remedial action and hence advocate diametrically opposed policies.

Indeed, some business lobbyists have argued that the costly climate measures could push the world into a global recession which would be of little help to developing countries or the poor; others have taken the opposite view that the recent recession is an argument for a green stimulus – i.e. «the possibility of using fiscal packages to push for a greener economy, combating climate change while restoring growth.»⁸ There are also controversies about what types of institutional arrangements should be established to cope with climate change. For example, the International Monetary Fund has argued that a tax on the most important energy-related greenhouse gas, carbon dioxide (CO₂), would be the most economically efficient way of managing climate change, preferable to direct regulation or performance standards.⁹

Given such controversies (about what goes on, what must be done, who should decide and who should pay), what should be the respective roles of the natural and social sciences and how can they buttress each other in the policymaking process?

The natural sciences should identify *relations* and *processes* as well as *possible trajectories* of current trends given specific scenarios for human activities – e.g. on greenhouse emissions, CO₂ concentration, temperature change, rising sea levels,

precipitation, water tables, extreme weather, etc. They should also help assess the likelihood and *physical impacts of possible singular events*, such as disintegration of the Antarctic ice sheet, changes in the major ocean currents, etc. Another important task for the natural sciences is to *assess the ecological and biological effects of such changes* – e.g. on farm land, crop conditions, growth patterns, etc.

A key role for the social sciences in assisting policymaking would be to *map vulnerabilities, identify policies that can ameliorate impacts and suggest institutional designs that can enhance robustness and resilience*. Hence they have to suggest answers to questions such as these:

- How many people will be at risk of, say, food shortages, water shortages, disease, coastal flooding, and extreme weather?
- What is the geographical distribution of risk – where do people live, under what physical exposure (e.g. for earthquakes), under what kinds of humanly constructed infrastructure, and under which social conditions? Which locations are most likely to be affected, for example by floods, landslides, increasing temperatures, heat waves, disease patterns, etc.?
- Which groups are most likely to suffer the most adverse effects and what are their likely responses?
- What can be done to prepare for and ameliorate impacts? What changes in infrastructure and institutions can reduce risk and enhance the capacity to cope
- Who are likely to have to bear the costs – or protest interventions?

The point is that a social structure functions as a prism, so to speak – changes in nature will refract and transmit different social effects in communities with different social structures. Impacts are conditional not just on the geophysical hazards, but on socioeconomic conditions and infrastructure as well. New Orleans was exposed to a great environmental hazard in Hurricane Katrina. But its social repercussions were amplified by specific infrastructure, such as inadequate flood walls and levees or escape roads that quickly were choked, as well as by deficient preparation and poor political organization. The complexity of a social organization can enhance its vulnerability not just because it makes it harder to understand the manifold interactions and hence prepare adequately for them, but also because in emergencies those in charge may quickly become overwhelmed by all the conflicting demands on their attention. The impacts of natural events can be aggravated or ameliorated by the way a system is constructed, and can be abated for example by redundancy, local independence and back-up systems. Hence research is needed on whether the right variables are included in the models of the system as well as on the adequacy of preparation for extreme events.

Clearly one of the big unknowns is how people are going to react. Is panic likely to occur? What simmering social conflicts are likely to be exacerbated? What is the link between hazards and social inequality? For example, during the

catastrophic flood in Bihar, India in August 2007, a fresh illustration was provided of a basic but brutal finding: When communities are hit by disasters, caste prejudice deepens¹⁰ – or more generally: in times of crisis, discrimination intensifies. The reasons are complex: They are partly *structural* (e.g. people of lower castes live outside town centers where aid is distributed; the centers are hard for them to reach, and supplies have dwindled by the time the lower castes make it to town); partly *cognitive* (officials believe that the lower castes can survive on close to nothing); partly *political* (lower castes are excluded from villages and have no representation). The basic point is this: The way natural events translate into social emergencies, catastrophes and devastation is contingent on the social structure through which they are mediated.¹¹ As the title of a book on Hurricane Katrina puts it: «There is no such thing as a natural disaster.»¹² The preparedness, the vulnerabilities and the impacts, as well as the responses and the reconstruction, are a function of social structure. Some are more at risk than others. How a natural catastrophe plays out is conditioned by its social context.

Hence the social sciences have to map the distribution of vulnerabilities for different social groups as mediated by the social structure. Or put differently: They have to identify the origins of different types of risks and assess the social determinants of choices and repercussions, the effective countermeasures – and the likely outcomes when these are weighted by the power of the actors concerned. Along with the humanities they also have to identify and articulate ethical principles that can motivate, justify and make policy choices more coherent.

Over the last decades interconnectivity between changes in the natural environment and the social environment has multiplied and intensified. And while the basic interrelations involved in climate change have been fairly well established scientifically, the social, political and economic impacts and responses are much less known – and much less predictable. Yet the fact that impacts and responses are uncertain or even unknown cannot lead to defeatism – on the contrary, they must lead to more research and better models.

There is another difference here between the natural and the social sciences. The classical natural sciences are primarily about what could be called stationary dynamics – physical or chemical phenomena governed by immutable laws. The biological sciences are evolutionary – they describe systems which are continually being transformed, whether they be individuals or species or ecological systems – though these developments are constrained by the laws of physics and chemistry. The social sciences also describe evolutionary entities, as do the humanities: They address systems that can be transformed – generally irreversibly – whether by intention or as a by-product of purposive action: What in fact comes to pass is the result not of intentions but of actions.

Science and Policy Resolution

So will scientific knowledge quickly clear the fog and resolve the issues? Can experts do the job? Will science save us? In my view not, because science is not only about truths buttressed by clear-cut evidence – it is about hypotheses, conjectures, partial confirmation and conflicting points of view. Establishing consensus is never easy because science is always about challenging the conventional wisdom and proposing alternative explanations.

Hence rather than scientists providing definite conclusions, what decision makers often face are different, indeed competing, schools of thought. Researchers often make it more – not less – difficult for politicians to make informed choices because they present conflicting evidence. Ronald Reagan famously asked for a «one-handed economist» since economists habitually responded to his requests for advice by answering «on the one hand....on the other hand.» Similarly, researchers may make the public not less confused but more disturbed and disconcerted when they point out that there may be more than one explanation of what is going on.

Competing interpretations turn the public arena into a combat zone – with authorities and media often in conflict, particularly in emergencies, when authorities want to consult experts, sift through evidence, assess damage and target response while the media demand full disclosure, open access and clear decisions – quickly.¹³ In recent years this has been aggravated rather than assuaged by the expansion of social media, which can quickly reach thousands, as well as the proliferation of unfiltered blogs with alternative spins and access to YouTube, where anyone can upload a video that can instantly capture the attention of millions and shape their views of what is going on and what needs to be done.¹⁴

The more closely coupled the natural and social systems, the greater the need for the *integration of research carried out by the natural and the social sciences*,¹⁵ cf. below). Clearly the insights from the natural sciences about global changes with impacts related to everything from water shortages to the depletion of marine fisheries, from the threat of pandemics to the risk of tsunamis, will have to draw on as well as challenge the social sciences. Indeed, the present predicaments can be a great source of renewal for the social sciences by overturning some of the basic assumptions about social, economic and political life.

The social sciences have to focus more on the social *processes* that are triggered by environmental changes and are in turn modified by the social structure.

To take but one example: Two decades ago the Intergovernmental Panel on Climate Change (IPCC) wrote in its first assessment report that the «gravest effects of climate change may be those on human migration.»¹⁶ In 2008 the Environmental Justice Foundation estimated that there will be 150 million environmental refugees by 2050 and 10% of the global population is at risk of forced displacement due to climate change.¹⁷ Clearly this is a migration of both a scale and a type never witnessed before. The begs the question of whether acute conflicts will arise if we have passed the point of no return when those who have lost their traditional habitat try to move to other areas with established populations on this crowded planet.

But the social sciences also have to focus on *institutions* – on both how they in fact function and how they can be redesigned.

Again to give but one example: There is a mismatch between the *range* of impacts of climate change (the areas affected by long-term trends, spillovers and natural disasters) on the one hand and the *boundaries* of political systems as well as the jurisdictions of authorities on the other hand. Put differently: There is a disparity between the *externalities of decisions* taken in one country and the *reach of institutions* deciding on such externalities. Hence there is a divergence between those who reap the benefits and those who bear the burdens, pay the costs.

There is also the question of whether we can change present trends or whether we must adapt to changes that are already irreversible. Clearly this also raises important *intergenerational issues* and challenges the humanities to address what ethical principles to apply.

These are not just management problems, but deep political and social quandaries which will challenge and may defy our capacity for *institutional design*.

The more closely coupled natural and social systems raise new issues for the natural sciences as well. Indeed, geologists have coined a term for a new geologic epoch - the «Anthropocene» or the «Age of Man» – in which «humans have become a force of nature reshaping the planet on a geological scale» and a host of «natural processes have been «interrupted, refashioned and, most of all, accelerated.»¹⁸ Again to take but one example: Nearly 50,000 dams constructed by humans have cut the sediment flow from rivers, eroding deltas faster than they can be replenished and jeopardizing the habitats of hundreds of millions of people.¹⁹

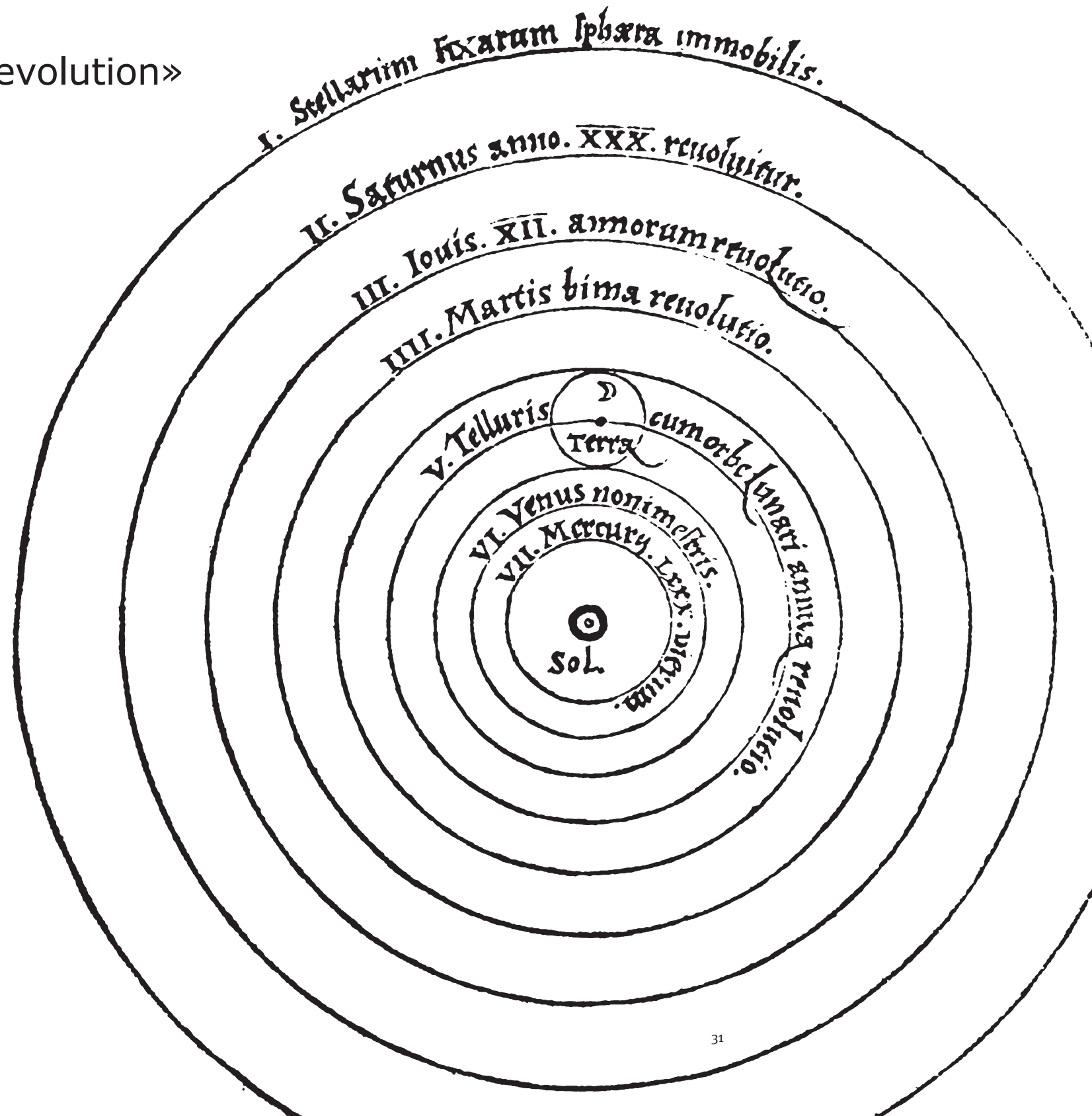
We may welcome or regret these challenges. But there is no way of turning away from them. The power of humans to change their habitat and the repercussions this has had for human welfare has set a new agenda for integrated research. Indeed, human induced change has already changed the way humans think about their interaction with their environment. The question to which we now turn is how this has come about.

[I. Introduction. Endnotes]

- 1 *Der Untergang des Abendlandes* was the title of the German historian Oswald Spengler's analysis of the decline of the West, based on a cyclical theory of the rise and fall of civilizations, published in 1920. A more recent example is the British historian Arnold J. Toynbee's 12-volume metahistory of the rise, flowering and fall of civilizations, *A Study of History*, published between 1934 and 1961.
- 2 *The Economist*, May 26, 2011.
- 3 For updated information, see <http://www.ipcc.ch/>
- 4 For the latest IPCC special report on extreme events, see Managing the Risks of Extreme Events and Disasters to Advanced Climate Change Adaptation. <http://ipcc-wg2.gov/SREX/>
- 5 For a summary, see *A Science Plan for Integrated Research on Disaster Risk. Addressing the challenge of natural and human-induced environmental hazards*. (Paris: ICSU, 2008). <http://www.icsu.org/publications/reports-and-reviews/IRDR-science-plan>

- 6 One recent example is the controversy among economists on whether the present high unemployment is due to a mismatch between the skills people have and the jobs that are available – i.e. that unemployment is structural. The alternative explanation is that unemployment is cyclical, and hence can be reduced by counter-cyclical (Keynesian) public spending.
- 7 A case in point is «the skeptical environmentalist», Bjørn Lomberg. See his home page, <http://www.lomberg.com/>
- 8 *The World Development Report 2010* (Washington, The World Bank, 2010), p. 58.
- 9 *Finance and Development*, 45 (1), March 2008.
- 10 See <http://www.nytimes.com/2007/08/29/world/asia/29iht-letter.1.7299556.html?scp=5&sq=Bihar%20India%20flood&st=cse>
- 11 Similar effects became manifest in New Orleans after Hurricane Katrina. As a curiosity, one might add that when the Titanic went down in 1912, roughly 60% of first class passengers survived, 40% of the second, and only 25% of the third – and a first-class man had a better chance of surviving than a third-class child. See «Demographics of the TITANIC Passengers: Deaths, Survivals, and Lifeboat Occupancy,» <http://www.ithaca.edu/staff/jhenderson/titanic.html>
- 12 Chester Hartman and Gregory D. Squires, *There is No Such Thing As a Natural Disaster: Race, Class, and Hurricane Katrina* (New York: Routledge, 2006)).
- 13 See *Informasjonskriser* (NOU 1986: 19). See also Gudmund Hernes, «Information Crises,» (unpublished manuscript).
- 14 The Arab Spring of 2011 is a case in point.
- 15 Cf. Below the section below, «Long, slow – but irreversible? Global Warming and Climate Change.»
- 16 PCC *First Assessment Report. Report of the IPCC Impacts Assessment Working Group* (Cambridge, Cambridge University Press, 1990)).
- 17 The Environmental Justice Foundation, *No Place Like Home. Where Next for Climate Refugees?*
- 18 See «Welcome to the Anthropocene,» *The Economist*, May 26, 2011. <http://www.economist.com/node/18744401>. The term was coined by ecologist Eugene Stoermer and has been widely popularized by the Nobel Prize Laureate and atmospheric chemist Paul Crutzen. For a short overview, see <http://en.wikipedia.org/wiki/Anthropocene>. For a longer report, see ESF/COST RESCUE, Task force on «Science Questions», «Challenges of the Anthropocene: Contributions from Social Sciences and Humanities for the Changing Human Condition» (2011).
- 19 *The Economist*, ibid.

II. The «Ecological Revolution»



II. The «Ecological Revolution»

This chapter makes a claim: In the second half of the 20th century there was a dramatic change in public awareness and opinion: The view of the Earth and its inhabitants, particularly humans, was fundamentally and irreversibly altered. This was a watershed on a par with what happened in the 17th century when a new vision of the universe was first proposed.

The Copernican Revolution is arguably one of the most dramatic changes in the mindset of Modern Man – indeed, one could argue that it represented the debut and emergence of Modern Man. Not only was the sun placed at the center of the universe. It was at the heart of what came to be called the Scientific Revolution. It entailed not just new observations and a new cosmic model to fit them, but a new way of thinking as well – what came to be called «the scientific method». The old intellectual order was shattered, and a new conception of the universe, as well as Man's place in it, was put forward.

The Copernican paradigm consisted of many critical components contributed by different scholars: the observational records made by Tycho de Brahe, the laws of planetary motions of Kepler, the discoveries of Galileo and the synthesis in physics developed by Newton. Arthur Koestler has summarized this «mutation of the European mind» in the following way:

The revolution in technology which their discoveries triggered off was an unexpected byproduct; their aim was not the conquest of Nature, but the understanding of Nature. Yet their cosmic quest destroyed the medieval vision of an immutable social order in a walled-in universe together with its fixed hierarchy of moral values, and transformed the European landscape, society, culture, habits and general outlook, as thoroughly as if a new species had arisen on this planet.¹

Yet it took centuries before the new conception of the universe was adopted by the public at large – indeed, even today one in five Americans believes the Earth revolves around the Sun, and the situation is not much better in other advanced Western societies.² In passing one may also note that the percentage of people in the US who accept the idea of Darwinian evolution *declined* from 45% in 1985, to 40% in 2005.³ Clearly it takes a long time before scientific ideas become lodged in the minds of the general public.

The last half century has seen another dramatic change in public opinion. It has also been strongly influenced by new concepts and visions developed in the international community of scholars: a change in the perception of the Earth itself. It could be called the «Ecological Revolution.»

This change in world view has several components, among them the shift

1. from the Earth being seen as *boundless* to the Earth being regarded as *finite* – indeed, some resources may be exhausted and that we are «running out of planet to exploit»;⁴
2. from the Earth being viewed as *robustly resilient* and able to rebound from shocks or devastations and to clean itself of ever-growing byproducts such as pollution to the Earth being perceived as *alarmingly fragile* and capable of suffering from breakdowns;⁵
3. from different *natural processes* (such as droughts, hurricanes, emissions) and *social processes* (such as energy use, poverty, emergencies) being considered largely *decoupled or at least only loosely connected* to being construed as inherently *tightly linked and causally integrated*;
4. from Mother Nature being taken as the *determinant* of the conditions of Man to Man being recognized as *determining* the condition of Mother Nature – the new term coined for Man as the key causal agent for environmental and climatic change is *anthropogenic*;
5. from the view that the world is *compartmentalized* into separate entities and systems to the view that the world is aggregated and fused into one vast single complex system – indeed, a global commons where ecological effects cannot be kept within national boundaries but can become regional or even worldwide in scope;
6. from the assumption of citizens that most of their welfare is determined *within the borders of their own country* to the recognition that more and more of *their welfare is the outcome of decisions taken abroad and often far away* – and by agents who have little immediate appreciation or concern for the distant impact of their local decisions;
7. from the consideration that the universe is immutable and the processes on planet Earth on the whole are *stable and predictable* to a realization that processes are increasingly interconnected and constitute a *dynamic complexity* which with increasing frequency can produce *extreme events*, such as freak weather;
8. from the outlook that joint human response to the aggregate effects of multitudinous *human decisions is inessential* and uncalled for – or ineffective – to the recognition that massive collective *countermeasures are inescapable*;
9. from the premise that what happens to the Earth is essentially *cyclical* to the view that the complexities and contradictions can make for *tipping points and perhaps irreversible* changes;
10. from the tacit assumption that humanity – its many peoples and groups – can carry on their *business as usual* to the foreboding that joint action, indeed *global action, is urgently needed*.

Cognitive, Political and Ethical

I do not argue that everybody now shares or subscribes to the whole set of these points of view – nor that the tenets are all logically linked in everybody's mind. Yet the claim is made that since 1945 there has been a *cognitive revolution*: The processes in nature and in society are increasingly envisioned as interconnected not just by the scientific community but also by a broader public. Neither do I argue that there has been a linear, progressive change in attitudes – there have been surges as well as setbacks. Yet there has been a broad change in public outlook where the global human habitat itself is seen by an increasing number of people to be in danger.

More than that: During the same period there has been a *political watershed*: The public agenda has changed and there is growing concern that «something must be done!» This can be documented for example in the increasing number of countries that are establishing ministries of the environment and environmental protection agencies or in adoption of international conventions to protect the environment.

This shift can be characterized in a different way: Man's place on Earth has changed from primarily being seen as an *object* subordinate to the forces of nature to Man being viewed as an *agent* – someone who on an ever-growing scale can act on his environment, yet often with limited knowledge of the ensuing consequences (e.g. overfishing). Or phrased differently: Rather than Man's fortunes being seen as determined by the bounties of Nature, Man's intentional actions to improve his lot are increasingly seen as backfiring through complex social *and* natural processes which are poorly understood but which can have devastating effects on human welfare. Put bluntly, one could call it Mother Nature's retribution for Man's myopic pursuit of self-interest.

But although consensus that «something needs to be done» is on the rise, there is no consensus on what, by whom and how – or on what will be the long-term effects of delay and inaction. There has indeed been a cognitive revolution – but what consequences are to be drawn is controversial. Man is an agent changing his own environment, but only with partial knowledge on the aggregate, indirect and long-term effects and with divergent views on what needs to be done. There is both denial about environmental impacts and lobbying against proposed countermeasures.

In this new view Man is certainly not seen as the Master of the Universe in control of his own destiny or the future course of events – rather the genie is out of the bottle but not under control. The peoples of the planet have not put in place the institutional infrastructure to cope with the problems they have produced. As mentioned in the previous chapter, there is a mismatch between the *range of impacts* generated by human activities and the *reach of social organizations that could cope with them*. Moreover, the problem is not just that information about the consequences of human actions appears too late to affect decisions – the problem is as much that even when information is in place, action is delayed due to fragmented political institutions or conflicts about the distribution of burdens – as illustrated for example by the failure of the Copenhagen Climate Conference of 2009.

The point of the sketch above is to direct the focus of this report towards the changes in people's mindsets that have taken place since the Second World War – encapsulated in the catchphrase the «Ecological Revolution.» It has three key components:

- A *cognitive* component – views about how nature works – particularly the changing views about the predicament of Planet Earth.
- A *political* component, expressing itself in calls for action, the initiation of new movements, changes in legislation, and the establishment of new institutions – locally, nationally, regionally and globally.
- An *ethical* component – manifest in discussions about what principles should guide political action, how responsibilities should be allocated and burdens distributed (e.g. the precautionary principle, the polluter pay principle, the equivalent value principle, etc.)

Attitude Change Driven by Events – but with Fallbacks and Reversals

There is an additional reason to address this broad change in mindsets. The change has not been linear with awareness and concern steadily rising, nor have disparate notions been integrated more and more into a coherent new outlook. As Arthur Koestler wrote half a century ago:

The progress of Science is generally regarded as a kind of clean, rational advance along a straight ascending line; in fact it has followed a zigzag course, at times almost more bewildering than the evolution of political thought. The history of cosmic theories, in particular, may without exaggeration be called a history of collective obsessions and controlled schizophrenias; and the manner in which some of the most important individual discoveries were arrived at reminds one more of a sleepwalker's performance than an electronic brain's.⁶

The history of the «Ecological Revolution» has also followed a zigzag course, in which – after a sudden jolt of awareness – lessons often recede and become less salient, to be triggered anew by some specific event. In this respect the curves of opinion change look a bit like the curves of global temperatures, which have not risen each year, but rather have fallen and risen with an increasing average. So in spite of growing cognizance and concern, there have also, paradoxically, been some sharp recent declines in the public's belief in the climate threat. (Cf. Figure 11, page 139)

Partly this is the result of the contrarian views advocated by what is sometimes dubbed the «climate realists» or more polemically the «climate deniers.» One notable example is «Climategate» – the popular term for the disclosure of several thousand e-mails from the University of East Anglia purporting to document that researchers had manipulated data, withheld information and attempted to suppress

contrary views.⁷ This was found to have had «a significant negative effect on beliefs in global warming and the trust in scientists.»⁸ The decline in the public's belief that climate change is the result of human activities and that global warming is a threat can also be seen in expressions such as «climate fatigue»: Segments of the general public may become fed up and turn indifferent to the prophecies of Cassandra or to the boys who continually cry wolf.

Political failures, such as the Copenhagen Climate Conference 2009 which was not able to conclude with a strong and binding communiqué, have also affected public opinion. If world leaders cannot agree, why should the common man worry? If instead of decisions there is drift, whose lead is to be taken? Moreover, public opinion is not just affected by warnings and admonitions, but also by advocacy of the need for new industry or for jobs even if it has detrimental environmental effects from the ensuing emissions.

So though there is increasing recognition that the environment is adversely affected by human action, there have also been failures to agree on the responses needed. A key question for integrated research is whether this is due to a dearth of knowledge, lack of consensus, absence of a shared sense of urgency or failure to find mutually accepted principles of distributional ethics.

[II. The «Ecological Revolution». Endnotes]

- 1 Arthur Koestler, *The Sleepwalkers. A History of Man's Changing Vision of the Universe* (London: Penguin Books, 1964), p. 9.
- 2 «Probing a more universal measure of knowledge, Gallup also asked the following basic science question, which has been used to indicate the level of public knowledge in two European countries in recent years: «As far as you know, does the Earth revolve around the Sun or does the Sun revolve around the Earth?» In the new poll, about four out of five Americans (79%) correctly responded that the Earth revolves around the Sun, while 18% said it is the other way around. These results are comparable to those found in Germany when a similar question was asked there in 1996; in response to that poll, 74% of Germans gave the correct answer, while 16% thought the Sun revolved around the Earth, and 10% said they didn't know. When the question was asked in Great Britain that same year, 67% answered correctly, 19% answered incorrectly, and 14% didn't know. <http://www.gallup.com/poll/3742/new-poll-gauges-americans-general-knowledge-levels.aspx>
- 3 Miller JD, Scott EC, Okamoto S (August 2006). «Science communication. Public acceptance of evolution,» *Science* 313 (5788): 765–6.
- 4 See Paul Krugman, «Running Out of Planet to Exploit,» <http://www.nytimes.com/2008/04/21/opinion/21krugman.html?ref=paulkrugman>
- 5 One of the most evocative and effective narratives to this effect was put forward by former US Vice President Al Gore, first in a book (*Earth in the Balance: Ecology and the Human Spirit*, Boston: Houghton Mifflin, 1994), then in a slide show and speaking tour which was then made into a documentary film entitled *An Inconvenient Truth*.
- 6 Koestler, *op.cit.* p. 11.
- 7 Fahrenthold, David A.; Juliet, Eilperin, «In e-mails, science of warming is hot debate,» *The Washington Post*, Dec. 5, 2010). (<http://www.webcitation.org/5or5yyZYh>)
- 8 See the Yale F&ES Project on Climate Change Communication.

III. Seven Events that Changed the World



Blue iceberg on a black beach. The ice has calved off the Vatnajökull glacier. Southern Iceland.
Photo: Ashok Rodrigues/iStockphoto

III. Seven Events that Changed the World

The principal theme for this essay is how what was called the «Ecological Revolution» above – the broad if uneven, patchy and sometimes reversible changes in public outlook – have come about.

The core of the argument is this: The changes in public mindsets on the environment after the Second World War did not happen as a slow, cumulative process of making observations and compiling information accompanied by intellectual reasoning, building consistency and forging consensus.

Rather the changes came about by events which jolted the imagination, shook up presumptions, prompted flashes of insight, furnished turning points for awareness, triggered controversies and provided important «take home lessons.» Even long-term trends have been highlighted by episodes of emergency or catastrophe. Between such «moments of truth» attention has often waned, concerns have weakened and momentum has been lost. Yet over time the lessons learned have coalesced into a more coherent and widespread world view and a new, broad narrative about our common destiny.

In this chapter, seven such seminal events will be described, and the more general question about the processes through which attitudes and mindsets change will be addressed.

The Atomic Bomb Dome, the ruins of the former Hiroshima Prefecture Industrial Promotion Hall which was destroyed by the first atomic bomb ever to be used in the history of humankind on August 6, 1945. Photo: Jules Kitano/iStockphoto



1. The Big Bang: Hiroshima and its Aftermaths

If a date were to be chosen for the beginning of what in the previous chapter was called the «Ecological Revolution» – a new perception of the Earth's fragility and the precariousness of the human condition – Monday, August 6, 1945 is the best option.¹

This was the day when the United States, to force Japan to unconditionally surrender, dropped the first atomic bomb on the city of Hiroshima. Three days later, on August 9, another atomic bomb was dropped on the city of Nagasaki. In Hiroshima some 70,000-80,000 people were killed immediately; the additional number that perished during the remainder of 1945 has been estimated between 20,000 and 80,000. Due to the long-term health effects, it is estimated that up to 200,000 of the inhabitants of Hiroshima had died by 1950. In Nagasaki the loss of life by the end of 1945 had risen to 80,000.

Aside from the dreadful loss of life, the atomic bomb became associated with an almost iconic image: The mushroom cloud as the potent symbol of the new weapon of mass destruction. It was a watershed event – the curtain rise for what came to be called the «Atomic Age.»

The bombings, when they became known and publicized, triggered a long lasting controversy both about their role in securing the Japanese surrender and about the ethical justification for exploiting such a weapon. The use of the atomic bombs and the knowledge that they could be made, spread and triggered a new awareness of both human creative potency and human destructive capacity, not only in the international scientific community but also in the international political community – and among the general public around the world. Different types of political responses were prompted – e.g. the arms race as an integral part of the incipient Cold War as well as an anti-nuclear movement which became global in scope. Indeed, one could say that the physical chain reaction resulted in a mental chain reaction.

The basic knowledge of physics needed to develop an atomic bomb had been in the public domain for some time – the theories were in place, even though the formulas had not been turned into factories. In October 1939 Albert Einstein signed a letter which was sent to President Franklin D. Roosevelt, warning that Nazi Germany might develop nuclear weapons. This resulted in the Manhattan Project – which came to employ 130,000 people and involve collaboration with universities and professors in the United Kingdom and Canada – and which eventually produced the bombs used against Japan in August 1945. As early as World War II, research to develop and construct nuclear weapons was being carried out not only in the United States, but also in Germany, the United Kingdom, Japan, and the USSR. Indeed, considerable intelligence efforts were undertaken to keep track of the progress of this research by foes and allies. Military interventions were organized to hamper and block the development of nuclear weapons – such as Norway's efforts to sabotage the heavy water production at Rjukan to prevent the Germans from gaining access. The major Allies in the war against Nazi Germany all developed nuclear weapons, the US during the Second World War, the others after. The Soviet Union first tested an atomic weapon in October 1949, the UK in 1952, France in 1960 and the People's

Republic of China in 1964. The construction of atomic bombs spread further – the knowledge about how to do it could not be contained. India tested one in 1974, Pakistan in 1998 and North Korea conducted a test in 2006. In the meantime Israel, too, had acquired nuclear weapons. A term was coined to describe the spread of these weapons of mass destruction and related technologies: «nuclear proliferation.»

Atomic weapons not only spread to more countries – over time nuclear weapons themselves became more destructive. The «A-bomb» based on atomic fission was followed by the «H-bomb» based on thermonuclear fusion. The first H-bomb (H for Hydrogen) that was tested released 500 times the energy of the bomb that destroyed Hiroshima. The United States tested its first Hydrogen device in November 1952, the Soviet Union three years later, in November 1955. Britain followed in November 1957, France in August 1968. The largest H-bomb ever detonated, by the Soviet Union at Novaja Semlja on October 30, 1961 (code named «The Tsar»), had the strength of 2,900 Hiroshima bombs – more than ten times the strength of the sum total of explosives used during the Second World War.

The development of nuclear weapons also had their associated stories of espionage and drama during the Cold War – the story that gained the most media attention was probably the arrest and prosecution of Julius and Ethel Rosenberg, who were executed in the electric chair in 1953.

The proliferation and potency of nuclear weapons generated several new political concerns.

One was the risk of their being *purposely* used in a conflict, as had been the case in the bombings of Hiroshima and Nagasaki. The fear was that it could result in «nuclear conflagration.» However, strategic thinking developed along with the weapons systems – e.g. by storing nuclear weapons in close to impenetrable concrete silos so that they could survive a «first strike;» by B-52s or other long-range bombers always airborne; or in submarines roaming underneath the seas for months on end which were impossible to track. The key strategic concern behind such measures was to ensure the capacity for a «second strike» – i.e. the possibility to retaliate against a first strike nuclear attack.² The new strategic paradigm developed was encapsulated in the concept of «MAD» – Mutual Assured Destruction. This doctrine encourages both sides, if attacked, to possess the capacity to retaliate with equal or greater force. Thence neither side would dare to attack or have an incentive to do so – it would lead to suicide, so to speak. This doctrine was at the heart of Cold War thinking and the justifications for the arms race between the US and the USSR: both strived to maintain «nuclear parity.» As a strategic doctrine it continued to guide decisions – e.g. about the «Star Wars» program, which was based on the theory that the system could deflect a first strike attack launched by an enemy.

However, there was also the concern that a nuclear conflagration might start *by accident, miscalculation or miscommunication*. Particularly after the Cuban Missile Crisis in October 1962, when the world was on the brink of a nuclear war, there was heightened apprehension that the world might be engulfed in an accidental nuclear war.³ One result was the establishment of the «red telephone» – the hotline between the superpowers linking the White House and the Kremlin on June 20, 1963. Since then hotlines have been established between India and Pakistan in 2004, between the United States and China in 2008 and between India and China in 2011.⁴

The debate on how to think about, develop, produce and control nuclear weapons technology was intense not only in the community of politicians and strategists. Nuclear weapons triggered an extensive mobilization and intense controversies in the community of scholars. Furthermore, scientists played an active role in informing the general public about the dangers posed by nuclear weapons. A case in point is *The Bulletin of the Atomic Scientists* – first produced by former Manhattan Project physicists – which after Hiroshima took it upon itself to inform the public about the perils and destructive potency of an atomic war. Its most noteworthy journalistic device was the «Doomsday Clock» printed on *The Bulletin's* front cover – first set at seven minutes to midnight. Over the years it has moved both closer to and further away from midnight – its most recent re-setting in January 2010 was at six minutes to midnight. The Doomsday Clock, like the «Peace Button,» became a universal symbol of the Atomic Age.

New political organizations were set up to inform public opinion and to mobilize popular action. One prominent example is the Pugwash Conference. It came about as a consequence of the Einstein-Russell Manifesto of 1955,⁵ which was signed by 10 Nobel Prize Laureates (and one prominent physicist who had not received the Nobel Prize). Its moral imperative derives from the new-found capacity of Man to put an end to the human race:

It is stated on very good authority that a bomb can now be manufactured which will be 2,500 times as powerful as that which destroyed Hiroshima. Such a bomb, if exploded near the ground or under water, sends radio-active particles into the upper air. They sink gradually and reach the surface of the earth in the form of a deadly dust or rain. No one knows how widely such lethal radio-active particles might be diffused, but the best authorities are unanimous in saying that a war with H-bombs might possibly put an end to the human race. It is feared that if many H-bombs are used there will be universal death, sudden only for a minority, but for the majority a slow torture of disease and disintegration.

The manifesto had a ringing finale:

We appeal as human beings to human beings: Remember your humanity, and forget the rest. If you can do so, the way lies open to a new Paradise; if you cannot, there lies before you the risk of universal death.

Both the scientists of the world and the general public were invited to subscribe to the following resolution:

In view of the fact that in any future world war nuclear weapons will certainly be employed, and that such weapons threaten the continued existence of mankind, we urge the governments of the world to realize, and to acknowledge publicly, that their purpose cannot be furthered by a world war, and we urge them, consequently, to find peaceful means for the settlement of all matters of dispute between them.

In 1995, the Pugwash Conference was awarded the Nobel Peace Prize.

The broad mobilization of the general public went well beyond the Pugwash Conference. The most prominent example is probably *The Campaign for Nuclear Disarmament* which started in the United Kingdom and organized its public inaugural meeting in 1958.⁶ Along with its famous Aldermaston marches, other protest demonstrations under the slogan «Ban the Bomb,» and the carrying of the «Peace Button,» it became the model for similar movements in many countries.

The threat perceived by the public from atomic weapons was inadvertently reinforced by government policies and information campaigns, such as the building of «fallout shelters,» the advice on how to behave and what to store in case of a nuclear attack and the civil defense sirens that were tested at regular intervals.

It was not only the bigger bombs and nuclear proliferation that were considered to be a growing threat. The *testing* itself of the new weapons of mass destruction, which resulted in «nuclear fallout,» increasingly became a matter of grave public concern. Nuclear fallout refers to the particles or dust which spread after a nuclear explosion. Since thermonuclear plumes from bombs can rise up to 40 kilometers in the atmosphere, this also means that even if the explosion is local, the fallout can be global. It can contaminate drinking water or soil and hence enter and accumulate in the food chain. The general public was introduced to concepts such as «Strontium 90,» «Geiger counter» and «exponential decay.» The general worries about what the threat of a nuclear war entailed were also expressed in popular culture, such as in the protest songs of Bob Dylan and Joan Baez, or in movies such as *On the beach* and *Dr. Strange-love or: How I Learned to Stop Worrying and Love the Bomb*.

The global concern with fallout from nuclear testing can be traced back to specific event⁷ – the calamity when a Japanese tuna Fishing boat, the *Fukuru Maru Drago* or *Lucky Dragon No. 5* was contaminated from the United States testing of a thermonuclear weapon on the Bikini Atoll in the Pacific on March 1, 1954. The fishing boat, its crew and catch were covered by fine white dust – nuclear fallout from the opening explosion in the US test series *Operation Castle*. A few days later the 23 crew members began to feel headaches and nausea, after a week exposed parts of their bodies showed rashes and became sore. Less than seven months later, the chief radioman died, suffering from acute radiation syndrome. The US government refused to disclose the contaminants and issued a series of denials. The Food and Drug Administration however imposed strict controls of tuna imports.⁸

The *Lucky Dragon* incident, first and foremost, heralded the beginning of a global environmental contamination crisis arising from the worldwide reach of radioactive fallout. It laid bare a variety of risks, real and imagined, that the detectable level of residual radioactivity from nuclear tests posed upon air, water, foodstuffs, and human health in the world. In an immediate sense, the *Lucky Dragon* incident triggered a crisis across the Pacific. Japanese and American physicians, disputing the diagnosis and treatment of the *Fukuryu Maru* crew, contributed much to the tension between the two allied nations. The discovery of lingering radioactivity in the environment, however, converted the entire nation of Japan into becoming «another *Fukuryu Maru*» and brought the crisis to a whole new stage.⁹

Several factors contributed to this. A media blitz riveted national attention in Japan: the crew became the third atomic victims after Hiroshima and Nagasaki; diagnosis and treatment became controversial; «atomic tuna» became a public concern and the price of tuna plummeted; where to set safety standards became contentious; later «radioactive rain» and contaminated rainwater, and «radioactive» fish, rice and vegetables became an issue. The general perception of risk was reconfigured, so to speak. The grassroots ban-the-bomb movement was initiated and gained support. These controversies fed into the Cold War conflict between the US and the USSR, and their propaganda campaigns. In Japan, the Prime Minister, Nobusuke Kishi, went along with the public's perception of risk and launched a diplomacy campaign against nuclear tests, partly to regain the public's trust in the government. The time perspective of the risks was expanded from the immediate impact on individuals to the longer term carcinogenic effects for a population, and then to the potential genetic effects for future generations (radiation damage and birth of «monsters»). Controversies among scientists proliferated and the credibility of governmental agencies such as the United States Atomic Energy Commission was undermined. In the US there was a concern that the ban-the-bomb-movement could undermine a security regime based on atomic weapons – «a fear of nuclear fear».¹⁰

So several issues were clustered and crystallized into new opinion structures, so to speak. The newfound risk created new awareness not just in Japan but globally of potential dangers that were man made yet outside the control of nearly all who were exposed to it.

The most important political result of the scientific warnings and popular worries was the discontinuation of nuclear testing. After years of negotiations, the *Partial Nuclear Test Ban Treaty* was signed in August 1963 and went into effect in October that year. Seven years later, in March 1970, the *Treaty on the Non-Proliferation of Nuclear Weapons* came into force. On April 8, 2010, a New Strategic Arms Reduction Treaty (START) was signed in Prague by US President Barack Obama and President Dmitry Medvedev of Russia. It was ratified by the US Senate on December 22, and came into effect on February 5, 2011. Since then, agreement has been reached on the disposal of excess weapon-grade plutonium.

In recent years a new fear has been generated by the threat of *dirty bombs*, particularly in the hands of terrorists. A «dirty bomb» combines radioactive material with conventional explosives. And though such an explosion in itself would not kill many people by its immediate impact, it could contaminate wide areas and have long-term impacts on disease as well as on expenses for decontamination. And it could have considerable short-term effects in the form of fear and even panic. They could also be used for international blackmail.¹¹

Summarizing the argument above one can say: The second part of the 20th century started with a big bang – the atomic bomb dropped on Hiroshima. This event, when it became known, not only gave a jolt to the public mindset – it also highlighted and broadcast that for the first time in history, Man had acquired the capacity to put an end to the human race.

The invention and use of the atomic bomb was an event that changed the world. And the *key take home lessons* were:

- It marked the passing to a *new age* in human history, defined by a new and present danger: With the design and construction of nuclear weapons, humans for the first time in history acquired the *capacity to annihilate the human species*.
- In addition to the threat of universal death and destruction, there was the insidious *danger of nuclear fallout* from the testing of the bombs, even in the absence of conflicts between the «atomic powers.» This was a threat that could not be seen or smelled, seen, heard or felt.
- Nuclear weapons could affect identifiable individuals, some forms of nuclear fallout also, as demonstrated by the *Lucky Dragon* calamity. However nuclear fallout also was circum-global and exposed *everyone to a risk*, albeit small. Yet this risk at the population level would lead to damage with a certain probability, i.e. affect a proportion of the population.
- In the face of this danger, national borders offered no protection – there were *no safe havens*. The whole of humanity could be affected through global fallout.
- Not only the present, but also *the unborn and future generations* might be harmed by radiation due to the long half-life of toxic nuclear fallout.
- The new *awareness* resulted not only in a new military organization and new strategic doctrines, but also, little by little, in *international treaties* to reduce the threat of nuclear conflagration, nuclear proliferation and nuclear radiation. The 1963 *Partial Nuclear Test Ban Treaty* became one of the first examples of a global regulation against what was perceived as a grave environmental threat.
- The growing awareness among the general public about the new threats not only mobilized *a grassroots movement* in many countries, waxing and waning in public support. It also changed *the view of the world*. Indeed, the whole planet was shrunk: It was one, it was fragile – and, indeed, in jeopardy.



2. Silent Spring: Ecosystem Damage

The atomic bomb and nuclear weapons were the results of major breakthroughs in the field of physics – several of them resulting in Nobel Prizes. During the same period, there were also major developments in the field of chemistry, with practical applications also tested out during the Second World War. Like nuclear weapons, they later came to have an enormous impact on the «Ecological Revolution» – the way people came to see the planet and its predicaments.

The single best example is the most widely known synthetic pesticide: DDT. This compound was first made from its constituent elements in 1874, but its effects as an insecticide were not discovered until 1939. However, during the second half of the war it was very successfully used to reduce and control malaria and typhus among military personnel and civilians as well. Indeed typhus was nearly eliminated in many parts of Europe, and the effects of aerial spraying of DDT against mosquitoes in the South Pacific had impressive effects. Hence DDT was welcomed as an «insect bomb,» with reference to the atomic bombs dropped over Hiroshima and Nagasaki. In 1948 the Swiss chemist Paul Hermann Müller was awarded the Nobel Prize in Physiology or Medicine «for his discovery of the high efficiency of DDT as a contact poison against several arthropods.»¹² After the Second World War, DDT was distributed to farmers as an insecticide for agriculture, and in 1955 the World Health Organization introduced a worldwide program to eradicate malaria that relied primarily on DDT. At first it was highly successful, but as resistance developed, some of the early successes were reversed.

However, some scientists early on voiced unease about the possible hazards of DDT¹³, and after a few years the insidious and indirect effects of the widespread use of this insecticide were identified. In 1957 they captured the attention of the American biologist and nature writer, Rachel Carson, who in 1962 wrote what became a best-selling book, *Silent Spring*.¹⁴ It was first serialized in *The New Yorker* and subsequently selected by the Book-of-the-Month Club in October that year. Carson made the argument that the use of DDT and other pesticides had inadvertent and detrimental side effects. First, these effects are non-discriminatory – their overuse can adversely affect not just insect pests, but insects that are beneficial, such as bees, as well. Secondly, poisonous synthetic substances do not easily break down in nature, but are accumulated in the food chain – and DDT is also widely spread across national borders. Hence DDT can adversely and severely affect species that feed on the insects – indeed, «pesticides» might better be characterized as «biocides.» A case in point is birds, for which DDT could cause thinner eggshells and hence lead to death and decimation. The title of Carson's book envisioned and encapsulated in a simple metaphor a future spring when the songs and chirps of birds were muted and extinguished since the birdlings could not hatch. More than that: The negative effects of synthetic pesticides could spread beyond birds and bedevil humans as well – for example, as a possible cause of cancer and other diseases. Carson also foresaw long-term detrimental effects from the resistance insect pests could develop – a more exposed ecosystem that could then succumb to unforeseen invasive species.

Rachel Carson author of the book «Silent Spring», 1962.
Rachel Carson: Photo: © Pittsburgh Post-Gazette/Corbis/Scanpix

Though *Silent Spring* was an instant success, both in terms of readership and in terms of political reactions, Rachel Carson herself was subject to a vicious campaign from the chemical industry that stood to lose from declining sales of a profitable product.

By highlighting that different species could be threatened by human interventions, both directly and indirectly by co-extinctions, Rachel Carson's work also provided both a stimulus to and a backdrop for the incipient debate on biodiversity – the variety of species within an ecosystem or forms of life in their natural habitat. The threats to habitat destruction include pollution, overkill, overharvesting and overgrazing, invasive species, etc. An important case is deforestation, i.e. the removal of forests or strands of trees and the conversion of the land to non-forest use.¹⁵ The destruction of tropical forests is a case in point.¹⁶

International collaborative work starting in 1988 under the lead of UNEP culminated in the Nairobi Conference for the Adoption of the Agreed Text of the Convention on Biological Diversity on 22 May 1992. This convention was also a recognition of the fact that the world is not compartmentalized into fairly protected habitats but interlinked in one complex global system.¹⁷

So on many different levels, *Silent Spring* became an important part of the «Ecological Revolution.» It provided several *key take home lessons*:

- The general public, not only in the United States but globally, was alerted to a *new environmental danger*.
- The message in *Silent Spring* highlighted a threat different from the risks of the Cold War arms race – that the planet, its inhabitants and their habitat could be destroyed through nuclear conflict. Her warning was that it could also be threatened by the slow *accumulation of many small decisions and effects*. The Earth could suffer not only from momentous decisions – or equally momentous miscalculations – resulting in nuclear conflagration: It could also be put in harm's way by the long-term sum total of literally millions of micro-decisions. Many small actors as an ensemble could produce big effects.
- A chemical that at first had been seen as purely beneficial and entirely safe turned out to have severe adverse consequences. This lesson was generalized: Human ingenuity and interventions in nature could have *long-term unforeseen negative impacts*.
- Due to such long-term «sleeping effects» the impacts of the use of new chemicals or technologies can become *devastating before they are discovered and identified*. Another example is provided by aerosol or spray can gases, the use of which had an enormous negative impact on the ozone layer before it was identified in 1974 and restrictions were gradually imposed.¹⁸ Depletion of the ozone layer in the Earth's stratosphere was found to be caused by Freon and Halon gases from the widespread use of spray cans or as coolants in refrigerators. Seemingly innocuous items such as hair spray or shaving cream could trigger profound aggregate long-term devastation.

- Rachel Carson was among the first scientists to make the general public aware that nature is not just an object of action and use. Nature had to be viewed in a different way – as a set of *complex interacting systems*: A new ecological outlook was required. This was beautifully summarized in her «Essay on the Biological Sciences»:

Only within the 20th Century has biological thought been focused on ecology, or the relation of the living creature to its environment. Awareness of ecological relationships is – or should be – the basis of modern conservation programs, for it is useless to attempt to preserve a living species unless the kind of land or water it requires is also preserved. So delicately interwoven are the relationships that when we disturb one thread of the community fabric we alter it all – perhaps almost imperceptibly, perhaps so drastically that destruction follows.¹⁹

So for pesticides or other chemicals the key point was this: It was grossly insufficient merely to consider their immediate effects – their long-term impacts for the whole ecosystem had to be assessed. An important milestone was the Convention on Biological Diversity from 1992.

- Both the atomic bomb and the unforeseen consequences of DDT harbingered a *new view of science*. Rather than scientific advancement resulting in linear progress, a more Faustian notion slipped in: that profound insights and deep knowledge could be put to contradictory uses – i.e. for both good and bad. The optimistic paradigm of science was called into question, not only because it had been demonstrated that knowledge deliberately could be used for destructive aims, but also because it proved difficult to foresee multifarious indirect negative effects even from good intentions. All this helped set the stage for the environmental movement.
- Due to its strong impact on public opinion, *Silent Spring* inspired a *grassroot environmental movement* – many concluded that business as usual was no longer tenable: «Something needed to be done!» This impetus to activism spread far beyond the United States.
- *Silent Spring* resulted in *new political measures*, specifically a Congressional review of pesticides and a report by the President's Science Advisory Committee. Some years later this led to the phase-out of DDT use in the US. *Silent Spring* highlighted the need for new legal constraints.
- Another part of the legacy was the establishment of *new institutions* – in the United States the Environmental Protection Agency was established – which in turn led to the Federal Insecticide, Fungicide, and Rodenticide Act of 1972 and the phasing out of DDT.
- *Silent Spring* sowed the seeds of the *precautionary principle* – the reversal of burden of proof from the *opponents* of the unfettered use of pesticides who argued that they could have harmful effects to the *proponents* and *producers* of the chemi-

cals who claimed that their introduction would not involve risk. The precautionary principle entails *erring on the side of caution* – doing what is safe rather than what is risky. Actions or policies that may cause harm to the environment or to the public are to be postponed or halted even in the absence of scientific consensus, while those who advocate action have to prove that it is harmless. Put differently: The principle makes it harder to initiate and easier to prevent potentially harmful action.

- *Lessons are not learned once and for all.* Sometimes they are forgotten – and sometimes they are rekindled by new but similar experiences. For example, the lessons of DDT were faced anew when the United States used Agent Orange – a herbicide and defoliant – in the Vietnam War during a ten-year period from 1961 to 1971. The purpose was to deprive the guerillas supported by North Vietnam the cover of forests. According to the estimates of the Vietnamese government, some 4.8 million people were exposed to its use, resulting in 400,000 people killed or maimed and 500,000 children born with birth defects.²⁰ In recent years the «seas of garbage» – the pollution of the oceans from oil, plastic, fertilizer, sewage and toxic chemicals has drawn more and more attention.²¹ Another example is the devastating impact of oils spills in the Niger delta.²² In August 2011 the Environmental Protection Agency which grew out of the concerns triggered by *Silent Spring*, banned a new herbicide, Imreliis, used on lawns and golf courses after receiving reports that it caused the death of thousands of trees around the United States.²³ In these and other cases the cumulative impact of many small decisions (such as dropping a plastic bottle or bag at sea or spraying a lawn with a weed killer) proves to have devastating long-term effects – and thus over and over reinforces the original message of Rachel Carson's *Silent Spring*.



Handout satellite image of Fukushima Daiichi nuclear plant after earthquake and tsunami. The No.3 nuclear reactor of the Fukushima Daiichi nuclear plant is seen burning after a blast following an earthquake and tsunami in this handout satellite image taken March 14, 2011. Photo: Digital Globe, Reuters.

3. The Good Turning Bad: Devastating, Unintended Consequences

The bombing of Hiroshima was the greatest military big bang in the history of warfare. It not only shattered a city – it also shattered notions about what humans could inflict upon themselves. It proved irreversibly the huge scale on which they could ruin and raze. Scientists, like the sorcerer's apprentice, had the terrifying knowledge, but did not know how to stop its use and it could wreak unprecedented havoc counted in lives lost or human habitat devastated. Nuclear energy had an appalling potency – now it was in human hands with dreadful consequences for all to see.

The atomic bomb worked by triggering an instantaneous physical chain reaction. But physicists also asked: Could nuclear reactions be harnessed for human benefit and the public good? Among the more farfetched ideas was the «Project Plowshare»: to use nuclear explosions to dig a new Panama Canal – big enough to have room for super-tankers.²⁴

But a more considered question was also posed: Could a technology be devised that harnessed nuclear energy and tapped into it little by little for civilian purposes rather than using its explosive power?

The scientific answer was the idea of the controlled release of nuclear energy in an engine called a *reactor* – and then turning this energy into electricity via a steam-driven turbine. The first reactor was built in 1941 in the US, while the first nuclear power plant was started in Russia in 1954.

Since then many countries have not only built reactors – indeed, many countries have increasingly relied on nuclear power to supply a large part of their energy for civilian purposes. In France fully three quarters of electricity production comes from nuclear power, in Slovakia and Ukraine about half, in Sweden, Finland and several other countries about a third.

In the last decades it has increasingly been argued that atomic energy is environment-friendly – both green and clean. Therefore it could be the long-term solution to the ever-growing energy needs of mankind.²⁵

However the growth in the number of nuclear power plants has been arrested several times. The reason is that this energy source, which was considered safe and sure, has been struck by conspicuous and devastating accidents resulting in radioactive contamination. These accidents, like the Hiroshima bomb, have left an indelible impression on the public mind. Reactors constructed to tap nuclear energy little by little could run amuck in an accident, releasing noxious materials and toxic clouds with deadly short-term as well as long-term effects. What was thought to be under secure engineering control proved in fact on several occasions to be perilous and not fully manageable.

Since the construction of the first reactor in 1941 up until 2007, fully «63 nuclear accidents ... occurred at nuclear power plants, most of them (45) in the United States.»²⁶ The accidents were triggered by different circumstances, ranging from equipment failure and the heat generated to external sources such earthquakes as well as internal sources from human error.

However, some accidents were more conspicuous and devastating than others. The first of them occurred at the Three Mile Island Nuclear Power Plant near

Harrisburg, Pennsylvania, in March 1979.²⁷ There were multiple sources of the accident: minor equipment failures compounded by human error magnified by a lack of training as well as faulty authority lines. This resulted in the public getting conflicting advice which resulted in panic behavior. However, a major health disaster was averted in spite of the fact that the core of one of the reactors melted.

A much worse accident in the history of nuclear power occurred seven years later at the Chernobyl nuclear power plant in Pripyat, Ukraine, on April 26, 1986. Not only was there an immediate effect on the environment of the plant itself. Radioactive fallout was carried at low altitudes over the then western Soviet Union, Eastern Europe, Scandinavia and the United Kingdom – even to the eastern US. It was an accident that «could not happen» – indeed, after the Three Mile Island accident experts had claimed that nuclear reactors were safe, even less dangerous and environmentally risky than other types of power plants. The fact that the Chernobyl accident happened cast doubt from the very outset on the credibility of experts.²⁸

As mentioned in the discussion of the fallout from testing of nuclear weapons, other radioactive contamination from distant fallout cannot be seen, tasted or felt either. Radiation has to be measured by experts with special instruments. So in contrast to natural catastrophes such as hurricanes, oil spills, earthquakes or floods, the general public is entirely at the mercy of specialists to get pertinent information. Moreover, very few in the general public have enough background to personally assess the validity or veracity of the information they are getting, the scale of the threat or the units of measurement used (e.g. for radioactivity becquerels or sievert).

Hence in the wake of the Chernobyl accident there was a sudden and dramatic increase in people's need to know. What followed in many affected countries was an *information crisis* triggered by the massive uncertainty about what had happened, who had been hit, why it occurred, what could ensue and what needed to be done.

Independent of the specific disaster, an information crisis after catastrophes follows a typical pattern. It starts with the shock which shatters people's lives and mindsets, the acute agony from people lost, the overload on the authorities, the confusion about what has taken place, the vacillation and disarray when confronted with a bewildering situation, the anger of people who feel too little information is given and too feeble measures are taken, the controversies between the public and authorities, the loss of trust in political institutions and the loss of legitimacy of politicians.²⁹

All these reactions were manifest during the Chernobyl accident, at the same time as there was a spike in public fear of nuclear fallout and a dramatic decline in the trust in both nuclear power as such as well as in the authorities managing it.³⁰

However, in the 25-30 years since this most prominent nuclear accident, there was growing confidence among both scientists and engineers – and among authorities – that the technical problems that had resulted in the Three Mile Island or Chernobyl accidents had been surmounted by improved technology and stricter regulation. The representatives of the nuclear power industry itself were active both as advocates and lobbyists – and they were successful. More and more nuclear power plants were built.

Then, in March 2011, there was a devastating cooling failure at the Fukushima nuclear power plant in northeastern Japan following a tremendous earthquake (Richter scale 9.0), which was succeeded by a tsunami. The Fukushima reactors had not been built to withstand such a shattering event, so the earthquake resulted in explosions, multiple fires and radioactive fallout in both air and water. On March 31, 2011, it was reported that dangerous levels of cesium 137 had been found 25 miles from the site of the Fukushima power plant, raising questions as to whether the evacuation zone had to be expanded and the land abandoned since cesium has a half-life of 30 years.

The nuclear accident in Japan resulted in a flare-up in public concern and fear about the peaceful use of nuclear power not only in Japan, but globally. More than that: It spilled over into the political realm, prompting complete reviews of the safety of nuclear power plants in countries ranging from Sweden and France to the US and South Africa.³¹ On March 15, 2011, Germany became the first European country to shut down seven nuclear plants.³² On March 27, Chancellor Angela Merkel's party suffered a major defeat while for the first time the Green party came to head a state coalition government. The nuclear catastrophe in Japan and Merkel's subsequent reversal on nuclear power played a key role in the election and its outcome.³³ On May 30, Merkel announced that Germany would shut down all of its nuclear reactors by 2022.³⁴ The European Union followed the same path by ordering a stress test for all nuclear power plants in Europe. In March 2011, China also suspended all approvals of new nuclear power projects.

On April 11, 2011, Japan decided to reclassify the Fukushima nuclear accident to level 7, which puts it on a par with the Chernobyl accident. An official of Tokyo Electric Power Company operating the plant said that the radiation leaks had «not stopped and could eventually exceed Chernobyl.»³⁵ The evacuation zone was also expanded from 20 to 30 kilometers. Later on it was admitted that a meltdown had taken place.

The Fukushima accident illustrated another important aspect of both climate change and catastrophes or disasters. They can be viewed as *inherent* in *geophysical processes* such as earthquakes or volcanic eruptions or in *technological breakdown or engineering failures*. As such they could be characterized as *acts of God*, i.e. events beyond human control such as natural disasters for which no one can be held accountable.

However, the events themselves as well as their consequences must also be analyzed as «*acts of Man*,» i.e. as *embedded in social organization*.

One aspect is that the extent of vulnerability that depends on how human communities are built, in everything from construction requirements reducing the impact of earthquakes, zoning regulations at oceanfronts, evacuation routes in case of tsunamis or floods, etc. As professor Neil Smith has put it:

It is generally accepted among environmental geographers that there is no such thing as a natural disaster. In every phase and aspect of a disaster – causes, vulnerability, preparedness, results and response, and reconstruction – the contours of disaster and the difference between who lives and who dies is to a greater or lesser extent a social calculus.³⁶

Another aspect of «acts of Man» is embedded not in material structure or organization, but in the functioning of social processes. Hence the question arises whether one can say something more specific about *social processes that tend to increase risks and vulnerability*.

An important class of such phenomena has been given different names – e.g. «unholy alliance,» «regulatory capture,» «a culture of collusion» or «a culture of complicity.»

An «*unholy alliance*» generally describes a covert coalition or cabal of outwardly opposed parties who in fact pull together for some hidden gain.

«*Regulatory capture*» is a term that can be traced back to Woodrow Wilson, who in 1913, the same year he was elected President of the United States, warned about the pitfalls of government regulation designed to supervise and control business. He argued that if «government is to tell big business how to run their business,» then businessmen have to get closer to government, indeed capture it, in order not to be too restrained by it.³⁷ Regulatory failures in different industries have since been described in different terms, ranging from the more neutral «lobbying» via the stronger «influence peddling» to outright «corruption.»³⁸ The goal in all cases is to obtain favorable treatment for corporations or other economic actors. More specifically, regulatory failure occurs when a public agency established to act in the public interest instead is captured by the special interests of the regulated. The phenomenon has been described by different social sciences with concepts like «the military-industrial complex,» «iron triangles» between a given ministry, its correspondent legislative committee and the related interest groups. In economics important work on regulatory capture was done by the Nobel Laureate George Stigler.³⁹

A «*culture of complicity*» can be used to identify the *modus operandi* leading to faulty oversight, tacit alliances and collusive ties between firms, civil servants and politicians. It encompasses both tacit and explicit encouragement and assent to actions with proven or possible damage to others.

Looking at several accidents, it is possible to identify the more specific sociological mechanisms through which an industry may be able to capture its regulators or form an unholy alliance:⁴⁰

- A *common outlook* across industry, the regulating agencies and the political community as to the importance of a policy or product – e.g. drilling oil, nuclear energy, new drugs etc. The members of such a community of like-minded – even if one of them is supposed to be a watchdog – are, so to speak, in it together and tend to share and support the same basic values – e.g. promoting nuclear energy.⁴¹
- A *common basis of competence* for the regulated and the regulators built on the same set of assumptions or doctrines, e.g. in engineering, medicine, military affairs, law, petroleum extraction, etc. To the extent that the expertise is grounded in a specialized body of knowledge, it becomes harder for outsiders to understand what goes on or to express criticism which is accepted as valid. Critics can be portrayed as incompetent, branded as extremists or stigmatized as crackpots and may face reprisals from those they criticize – and from both sides, both the regulated and the regulators.⁴²

- A *set of beneficiaries* from the implementation of a policy or marketing of a product, not only directly (e.g. by increased sales) but also indirectly (e.g. by derivatives in terms of new contracts or jobs, local growth from investments or institutional expansion). Those who benefit have scant interest in slowing or stopping a project. Hence beneficiaries are likely to soften or counter arguments against stricter security routines, concerns about new plants, or, say, the introduction of new but not well tested vaccines, etc.
- *Strong and well funded lobbyists* (e.g. for deep sea oil drilling) set against little public attention as well as poor and poorly organized protesters. Lobbying may range from seeking grants, obtaining licenses, obtaining tax breaks, relaxing rules or securing exemptions.
- Politicians and trade unionists with close ties to management, or regulators with a *close – sometimes cozy – relationship with the regulated*.⁴³
- *Crisscrossing career paths* for job incumbents in the regulated and regulating units. Present behavior can then be affected by anticipated rewards for «jumping ship» or «revolving door recruitment.» This can result in laxer enforcement of regulations, as present regulators are less likely to take strong measures against potential future employers. Officials in regulatory agencies can also be attractive as employees of the regulated industry, as they have an insider track of influence – they know the *modus operandi* of the regulating agency and can lobby effectively *vis-à-vis* current incumbents, i.e. their former colleagues and sometimes friends.⁴⁴ The osmosis of personnel between regulators and industry also means that the boundary separating surveillance of and support for an industry is blurred. Statutory obligations to undergo career quarantine before taking a job in the regulated sector is one measure used to counteract this.⁴⁵
- *Inadequate in-house expertise in the regulating agencies*, either in terms of sheer manpower, technical expertise or experience. Regulators then become dependent on industry for both proposed measures and assessment of the effectiveness of diverse and highly complex regulations.
- *Nonexistent, non-transparent, ambiguous, contradictory, opaque or lax rules*. The sorry state of regulation is often disclosed when some catastrophe or crisis occurs.⁴⁶
- Loose or ambiguous rules may in turn lead to a *fear among regulators of over-policing regulations, over-stepping mandates*⁴⁷ or having to take responsibility for costly or loss-making decisions if the premises for them later can be questioned.⁴⁸
- *Weak oversight, non-rigorous inspections, unenforced regulations, few comprehensive reviews or risk analyses*, making for exemptions or extensions in order to avoid costly repairs or improvements – or triggering a panic.⁴⁹
- *Playing down of risks and cover-up of safety problems and wrong-doing* in order to avoid public concern, stricter regulations or unwanted expenditures.⁵⁰ This can go hand-in-hand with obstructing or even stone-walling access for independent media, e.g. by preventing journalists from getting to sources, by providing

selected, scanty – or overwhelming – data. In either case it results in one-sided reporting or in outright under-reporting.⁵¹

- *Unclear areas of responsibility.*⁵² For example, after the Fukushima accident it has been asserted that radiation forecasts «were left unpublicized by bureaucrats in Tokyo, operating in a culture that sought to avoid responsibility and, above all, criticism.»⁵³ This in turn can lead to passing the buck or mutual finger-pointing.
- *Mild sanctions for non-compliance or infractions.*⁵⁴ Prosecution may be lenient and punishments soft. This may be due to lacunas in the law, the complexities of the issues or the asymmetry in the capacity to employ first rate lawyers.
- *Cold-shouldering, isolating or excluding of critics, black-balling and ostracizing of whistle-blowers.* Careers may be aborted, the opportunities for finding new jobs on one's general area of specialization confined.
- *Underfunding of independent academic research.*⁵⁵ Even at universities, programs whose outcome may affect diverse parties may be biased towards those with a pecuniary interest.

Such are the processes by which regulatory capture can take place and a culture of complicity develop. Since the likelihood of regulatory capture increases the closer the regulator and the regulated are, some have argued that more effective control can only be achieved by greater barriers and distance between regulators and regulated – e.g. by organizing regulatory agencies under international or multinational control.⁵⁶ The International Atomic Energy Agency (IAEA) is an example of how such bodies may be constructed.

The nuclear catastrophe that took place at Fukushima provides *several take home lessons* of the accident – lessons that had not been properly learned after the Three Mile Island and Chernobyl accidents. They are buttressed conclusions that can be drawn from other kinds of disasters. Among them are:

- Even the best of technologies – and even in the well-organized countries – are *not fail-safe*.
- The accidents demonstrated that whatever the human skills in developing technologies, they can nevertheless be trumped by the forces of nature and the «*unknown unknowns*» which have not been included in the contingency planning. In the case of Fukushima Japan was hit by three catastrophes at the same time: an earthquake, a tsunami and a nuclear catastrophe.
- Industry often *plays down risks* – which in fact means that risks are increased as safety measures are inadequate and preparedness insufficient. Playing down risks and distorting the assessment of a disaster may take place even as the disaster unfolds. In the aftermath of the Fukushima accident the following analysis was made under the headline «'Safety Myth' Left Japan Ripe for Nuclear Crisis»:

Over several decades, Japan's nuclear establishment has devoted vast resources to persuade the Japanese public of the safety and necessity of nuclear power. Plant operators built lavish, fantasy-filled public relations buildings that became tourist attractions. Bureaucrats spun elaborate advertising campaigns through a multitude of organizations established solely to advertise the safety of nuclear plants. Politicians pushed through the adoption of government-mandated school textbooks with friendly views of nuclear power.

The result was the widespread adoption of the belief – called the «safety myth» – that Japan's nuclear power plants were absolutely safe. Japan single-mindedly pursued nuclear power even as Western nations distanced themselves from it.

The belief helps explain why in the only nation to have been attacked with atomic bombs, the Japanese acceptance of nuclear power was so strong that the accidents at Three Mile Island and Chernobyl barely registered. Even with the crisis at the Fukushima Daiichi nuclear power plant, the reaction against nuclear power has been much stronger in Europe and the United States than in Japan itself.

As the Japanese continue to search for answers to the disaster at the Fukushima Daiichi plant, some are digging deep into the national psyche and examining a national propensity to embrace a belief now widely seen as irrational. Because of this widespread belief in Japanese plants' absolute safety, plant operators and nuclear regulators failed to adopt proper safety measures and advances in technology, like emergency robots, experts and government officials acknowledged.

«In Japan, we have something called the 'safety myth,' » Banri Kaieda, who runs the Ministry of Economy, Trade and Industry, which oversees the nuclear industry, said at a news conference at an International Atomic Energy Agency meeting in Vienna on Monday. «It's a fact that there was an unreasonable overconfidence in the technology of Japan's nuclear power generation.»

As a result, he said, the nuclear industry's «thinking about safety had a poor foundation.»⁵⁷

- «There is no such thing as a natural disaster.» The impacts of a disaster are not just a question of the potency of the natural forces unleashed – the impacts can be *amplified or modified by social structure* at the point of impact (e.g. the destruction of mangroves in coastal areas or lax building permits along geological fault lines, magnifying the destructiveness of earthquakes).
- Risks can be systematically *amplified by of social processes*. Particularly important is regulatory capture and a culture of complicity. The relationship between industry and its regulators can become too cozy – indeed, this was claimed for both Japan and the US after the Fukushima accident.⁵⁸

- When disasters such as Chernobyl or Fukushima happen, they not only *have impacts on a large scale but also in the long-term* – for example, many of those who were mortally injured by the Chernobyl accident are not yet dead but will eventually die from the accident.
- Coping with and compensating for the damage done is *extremely costly*, not just in terms of lives lost, the traumas of survivors or infrastructure and property damaged, but also in terms of the long-term benefits foregone. The casualties include the political *loss of trust and legitimacy*.
- Finally the accidents – Fukushima being the last of them – clearly have had *major, though differential impacts on public opinion worldwide*. The reactions and responses are not just found at the point of impact or in the country struck – responses have been triggered in many countries, indeed, often globally. Again the most recent example is the changes in nuclear policy that have taken place after the Fukushima accident.
- These take home lessons are not valid just in the case of nuclear accidents. *The same problems have also shown up in other types of disasters* triggered or mediated by natural forces. Technologies have turned out to be defective, regulations distorted, enforcement dissatisfactory and preparedness deficient. Both separately and in sum they have been no match for the stark power of the forces of nature on social conditions.
- *Low probability events are not zero probability events*. Examples of such unexpected catastrophes are the industrial accident at Union Carbide's pesticide plant in Bhopal, India in 1984, where the immediate death toll was 2,259 and the long-term toll some 13,000 people, in addition to more than half a million injuries. Another example is the Exxon Valdez tanker which ran aground in Prince William Sound in Alaska in March 1989. A third is the blowout at the BP/Macondo well in the Gulf of Mexico in April 2010 when the drilling rig «Deepwater Horizon» exploded and triggered a catastrophe.

Such unforeseen but devastating accidents at technology's edge brought about by the combination of greed, technical malfunction, social vulnerabilities and human error not only can have devastating impacts in terms of human toll and economic loss. They have also been accidents that have changed public attitudes – indeed also legislation and regulation, policy as well as institutions. As Dickens wrote in *Oliver Twist*: «Surprises, like misfortunes, seldom come alone.» All around the globe they have left people more worried and insecure – indeed troubled that what was presented as solutions and progress mask hidden danger that makes the modern condition precarious.

So clearly, these and similar misfortunes has played a very important role in the development of the ecological mindset, having been too severe to be ignored and too devastating to be forgotten.



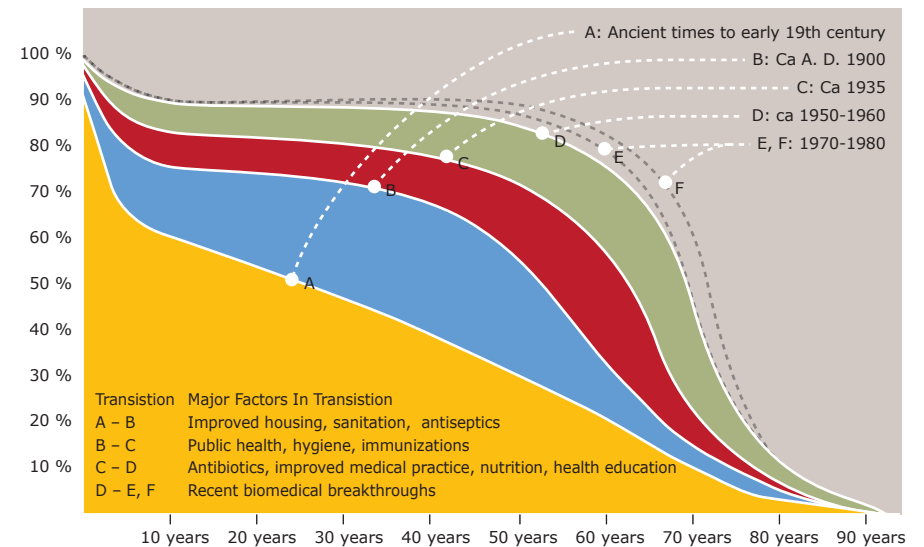
4. Poverty, Inequality and Uneven Development: Biafra and Ethiopia

One of the greatest success stories of the human race is the rise in people's life expectancy. For example, at the beginning of the 1600s life expectancy in England was only about 35 years and two-thirds of children had perished by the age of four.⁵⁹ Survival curves had typically a triangular form: first falling very sharply due to infant mortality during the first years after birth, then sloping downwards diagonally with roughly the same percentage dying during each year – but often with spikes in deaths due to epidemics, hunger and war. Only about a quarter of the population could expect to reach the age of 60. (See the lower curve in the figure below.)

Figure 1. Historical Changes in Survivorship Curves

Percentage of survivors

A-D: Male or female survivorship. E: Male survivorship. F: Female survivorship



(Figure Adapted from Strehler, B. L. [1975] 1975 Implications of aging research for society. Proceedings Federation of American Societies for Experimental Biology, 34, 6)

Since then infant mortality has dramatically declined, as more and more live until what would have been called old age only a century ago – i.e. to the age of 50 or 60. Now in many industrialized countries the population pyramid has been inverted, with the bulk of the population being above 35. And several industrial countries are moving towards a state where there are more old people than children – for example, in the US by 2034 there will be more people 65 and older than children under 15.⁶⁰

The main reasons for this dramatic change in industrializing countries, particularly during the 1800s, were primarily improved sanitation, alimentation and

Ethiopia 1984: Mother and child are among Ethiopian drought victims being cared for at relief center here.
Photo: Bettmann/Corbis/Scanpix

housing. Dwellings in turn became less crowded as families were reduced in size, due to what has been called the «demographic transition»: Parents found that the children they conceived in fact survived to adulthood; hence they were less dependent on breeding many for their own insurance during old age – so fewer children were conceived. Clearly new methods of contraception also played a role.

The period up to the Second World War also saw improved public health, cleaner environments, and a reduction in contagious diseases such as smallpox and tuberculosis due to more extensive immunization programs.

In the decades around the mid-20th century work hours were reduced, WCs, showers and bathtubs increasingly became a part of homes, while nutrition and medical services were further improved. Machines cut the physical strain of labor – e.g. by bulldozers, cranes or excavators – but also within homes by running water or washing machines. The result was that in the period from 1950 to 2000, infant mortality worldwide was reduced to almost a third – from a rate of 152 per 1000 to 57. This number is projected to be further cut in half, to 23, by 2050.⁶¹

Since the 1970s, numerous medical breakthroughs have been translated into new health programs – such as the triple vaccine against diphtheria, whooping cough and tetanus, and regular health checks for the general population by an increasing density of doctors armed with new science, new instruments and new drugs. Expanded medical knowledge has been translated into new general habits as well, such as reducing the eating of fatty foods, leading a less stressful life, quitting smoking and exercising more. Health education became compulsory, and public health programs were buttressed by making available more beneficial products, such as low-fat milk as well as information such as the nutrition pyramid. The result is that the death toll from major chronic afflictions, such as coronary disease and heart attacks, has been reduced. Life expectancy has continued to rise not just in developing countries but also in the industrialized countries even after 2000.

In advanced countries this has resulted in what has been called the «rectangularization of the survival curve»⁶² (cf. the upper curve in the figure above). This means that most people survive until they are about 70-80, but then rapidly and roughly within the same age span die off. Put differently: At this age, if the elderly are not struck by one condition, such as a heart attack, there is likely to be another, say cancer.

«Longer lives» is the big story – but not the whole story. Though infant mortality has declined and life expectancy risen globally, there remain huge disparities. Some 800 million people are malnourished and 24,000 die each day from hunger, two-thirds of them children under five. While people in wealthy nations have a life expectancy of 70 years or more, those living with chronic hunger have a life expectancy of 38.⁶³

With increasing living standards in industrialized countries after the Second World War, the poverty and backwardness in the «Third World» was pushed up on the international agenda, particularly after the period of rapid decolonization from about 1960.

The flip side to improved living standards has been the brutal devastations of hunger. Throughout history, famines have been a regular part of the conditions of

life on all continents, with some being particularly destructive. One example is the drought and famine after the Taiping Rebellion which is thought to have decimated the Chinese population by more than 60 million people in the period between 1850 and 1873.⁶⁴ Equally disastrous was the famine in China between 1958 and 1961, when an estimated 45 million people starved to death as a consequence of Mao Zedong's Great Leap Forward.⁶⁵ In Europe the memory of the Great Irish Famine (1845-1849) is still a political reality: Its immediate effect was one million dead and another million who emigrated, mostly overseas, resulting in a population decline in Ireland by about one fourth. The Soviet famine (1932-1933) after Stalin's collectivization program cost an estimated six million lives. The list of famines is long, indeed.

It is noteworthy that many of the most devastating famines were caused as much by human actions as by natural catastrophes – e.g. the policies of Stalin or Mao or the policies of the British government during the Irish famine. This was also the case with one of the until then most publicized famines in modern times – the Biafra famine during the Nigerian Civil War in the late 1960s, during which one million civilians died in fighting and from famine.⁶⁶

Even though there have been many famines in Africa since then – e.g. in Ethiopia in 1973, in Karamoja, Uganda, in 1980 (the worst in terms of population loss when one-fifth of the population died), in Sudan in 1998 – the photographs of starving Biafran children with bloated stomachs shocked and horrified people all around the world. Indeed, the famine in Biafra was a watershed in its impact on public opinion. It was a defining event that left an indelible impression. Likewise, the reports and TV footage from the famine in Ethiopia in 1984 renewed this impact – described by the BBC as a «biblical famine» – resulted in a global popular mobilization by such initiatives as the Live Aid Concerts championed by the Irish singer Bob Geldof. The ensuing rallying of public outrage is believed to have saved several million lives.⁶⁷

When the United Nations General Assembly in 2000 adopted the Millennium Development Goals, at the top of the list was to «eradicate extreme poverty and hunger» and cut in half the proportion of people living on less than one dollar a day by 2015. Since then there has been movement towards realizing this goal. For example, the proportion of the world population living in extreme poverty has declined at a fairly stable rate since 1980 – from about 40 % to about 30 % in 2000 and to about 20% in the decade since then. Most of the improvement has taken place in East and South Asia – notably China – but also in several Latin American countries.

So not only have global *perceptions* of the extent of poverty and hunger changed – often as the result of concrete events such as the famines in Biafra and Ethiopia. So have the *views* on what could be effective policies as well as the UN *agenda* about what needs to be done.

However, in recent years a new and potentially devastating challenge to the further reduction in poverty and improvement in food security has been identified. Again this has been highlighted by specific events and their ramifications, such as the food riots of recent years. Perhaps more ominous is a constellation of factors and a confluence of crises that are likely to become more salient in the coming years due to long-term trends in increasing food scarcity and rising prices. They have been made visible by climate change and natural catastrophes with broad impacts on

food prices as well as news flash points from food riots and political eruptions. Some examples of such recent or pending natural catastrophes which have also drawn attention to what may be in store are the following:

- *Global warming*: A recent study at Stanford University found that a temperature rise of a single degree Celsius would cause yield losses for 65% of the present maize-growing region in Africa – provided the crops received the optimal amount of rainfall. Under drought conditions, the entire maize-growing region would suffer yield losses, with more than 75% of areas predicted to decline by at least 20% for 1 degree Celsius of warming. One of the co-authors of the report commented that «The pronounced effect of heat on maize was surprising because we assumed maize to be among the more heat-tolerant crops.»⁷³
- *Cyclones and droughts*: Australia was facing up to AUD 800 million in crop losses after the cyclone Yasi in February 2011 devastated key banana and sugar farms – and threatened both inflation and exports.⁶⁸ This came after the epic droughts and forest fires in Australia in recent years, also climate related, which decimated crops.⁶⁹ In 2011 Texas has been experiencing its worst-ever drought with very harsh long-term effects – «a natural disaster in slow motion».⁷⁰ In 2009 a drought spelled a grim outlook for crops on the Horn of Africa. In 2011 the East African countries – Somalia, Ethiopia, Kenya, Djibouti and parts of South Sudan – were hit by the worst drought in 60 years, causing hunger in more than 12 million people and requiring emergency assistance. It has been aggravated by higher food prices globally, by livestock mortality, poor infrastructure and political conflicts.⁷¹ So once again, horror stories accompanied by the pictures of listless and dying infants have been projected on TV screens all around the world. Yet nations fall short in funding immediate aid and long term measures.⁷²
- *Desertification*: In March 2011 the well-known environmentalist Lester R. Brown wrote that China is threatened by expanding deserts: «As old deserts grow, as new ones form and as more and more irrigation wells go dry, Beijing is losing a long battle to feed its growing population on its own.» Not only are sand dunes encroaching on cropland – Chinese agriculture is also losing irrigation water to cities and factories. China's food supply is getting more strained and food prices are rising. This is also likely to have impacts in other parts of the world as well – notably the US as the world's breadbasket, but also globally because of rising food prices.
- *Rising sea levels*: Climate change resulting in rising sea levels is likely to have an impact on coastal fisheries and agriculture. For example, in a country like Bangladesh rising sea levels affects them through three separate but related processes: salinity intrusion, flooding and cyclone frequency. This will result in reduced GDP, and «will cause food shortage leading to health hazards or even famine. The ultimate result of reduced agricultural production is high poverty that will force Bangladesh to seek aid from other countries.»⁷⁴

- *Multiple ocean stresses* that threaten «globally significant» marine extinction. In June 2011 the International Programme on the State of the Ocean warned that the combination of stressors on the ocean is creating the conditions associated with every previous major extinction of species in Earth's history. The key oceanic changes are acidification, rising temperatures and falling oxygen levels, while the resilience of the ocean to climate impacts is severely compromised by overfishing, habitat destruction and pollution e.g. from run-offs of agricultural fertilizer and wastewater discharges. The magnitude of the cumulative impacts is greater than previously understood, and the pace of changes is unprecedented and appears to be accelerating. The threat of extinction is rapidly increasing while the timeline for action is shrinking and the cost of delayed action is rapidly increasing.⁷⁵ The 20th century provides several dramatic examples of overfishing. In the late 1960s the Norwegian spring spawning herring stock collapsed, in the 1970s Peruvian coastal anchovies fishing led to a collapse, while Atlantic cod was overfished in the 1970s and 1980s, leading to a dramatic collapse in 1992.⁷⁶ Similar stories could be told for whales, dolphins or more recently tuna and other types of fish in many parts of the world. Whether a species is able to recover depends on the resilience of the whole ecosystem – the depletion of one stock may lead to irreversible changes in the ecosystem composition. Clearly this has important bearing on the future supply of food.

The history of agricultural production in the last century is an amazing success story. For some of the major crops – such as wheat or corn – yield per acre quadrupled or quintupled. This was due to enormous improvements in both agricultural science and production – i.e. in seed selection, fertilizer, irrigation and farming technology. Advances that can substantially increase production are also likely in the decades ahead – e.g. in biotechnology. And modern methods of agriculture will increasingly be used globally – e.g. drip irrigation.

Yet there is the question of whether food production can keep up with the population increase and people's demands for better living conditions. Over the last decade there have been considerable rises in food prices.⁷⁷ Aside from the population increase and bad weather, storms, floods and droughts mentioned above, among the key price drivers are the following:

- Changes in the composition of what people eat towards more resource-intensive food. As incomes increase, for example in China, more meat is consumed. But then the «7 to 1 rule» kicks in: to produce 1 unit of meat calories, animals consume 7 units of feed grain.
- Modern agriculture is energy driven – whether it is used to produce fertilizer, run tractors or transport products – sometimes around the globe. The long-term trend in energy prices has been upwards.
- Increase in the production of biofuels – partly as a consequence of subsidies. It has had other adverse effects as well – e.g. promoting deforestation, which is not good for the climate.

During 2007-2008 there was a dramatic spike in food prices, creating a global crisis with food riots and unrest in the Americas, Africa and Asia. The crisis exposed glaring social inequalities. Rising food prices is considered one of the factors behind the revolts in Arab countries in the spring of 2011.

Such have been the reactions of the common man. And the outlook is dire. In May 2011 Oxfam warned that rising food prices increasingly will squeeze the poor. By 2030, the average cost of crops could increase between 120 and 180%.⁷⁸ And both the FAO and OECD foresee stubbornly high food prices at least into 2012, potentially pushing millions more into hunger.⁷⁹

But there have been governmental reactions to the immediate crisis as well. In 2007-2008 some countries slashed tariffs, lowered taxes and increased subsidies on foodstuffs in order to keep local prices down. Other countries, such as India, China and Russia, curtailed their exports.

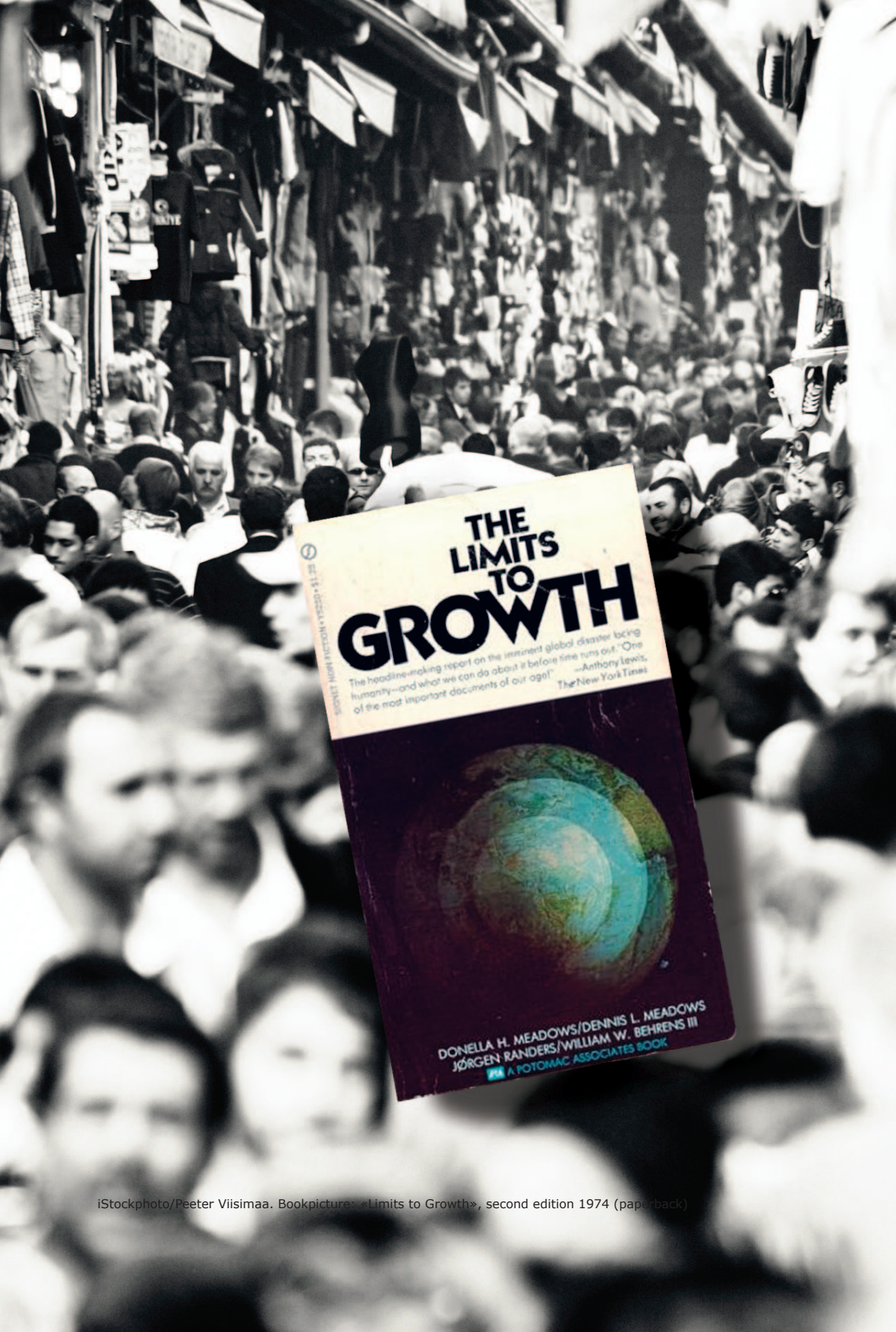
Again this has further ramifications. Increasing food prices and subsidies reduce the funds that can be spent on, say, education or health, slowing economic development. It also increases tensions between nations with a surplus and a deficit of food. It increases speculation and hoarding and social tensions within many countries. Further down the line it will shift the power equations among nations – increasing the power of countries with rich or poorly used soil, such as Russia or Ukraine.

In addition to immediate reactions to spiking food prices, there has been long term strategic positioning as well. Both corporations and governments, notably China, have started to buy farmland in Latin America, Africa and in Australia. Countries subject to such «land grabs» as well as their own food inflation have responded by taking measures to restrict foreign ownership.⁸⁰

In short: there have been dire warnings about an impending planetary crisis of food shortages that can be upon us by mid-century – resulting from factors such as water shortages, rising energy prices, global warming, desertification, overfishing and population increase.⁸¹ They can result in hunger, conflicts within and between nations, and waves of refugees. Former US President Jimmy Carter is among those who have argued that food shortages are not just a poverty issue, but also a global security risk: «There can be no peace until people have enough to eat. Hungry people are not peaceful people,» he stated in 1999.⁸² Recent books synthesizing both research and reports from many international bodies have ominous titles, such as Julian Cribb's *The Coming Famine* or Anirudeh Krishna's *One Illness Away. Why People Become Poor and How they Escape Poverty*.⁸³ And *The Global Hunger Index* shows that the world community is far from being on track to reach the top *Millennium Development* Goal of cutting in half the proportion of people who suffer from hunger by 2015. Hence in coming years we may see pictures as disconcerting as those that came from Biafra in the late 1960s.

The *take home lessons* from this story are:

- *Poverty and hunger have been part of the human condition.* During the 20th century enormous strides were made in escaping them, particularly in industrialized countries.
- In the period of decolonization, after about 1960, the focus was placed on the predicament and potential of the former colonies. Indeed, a specific term was coined to underline that the predicament was not destiny but could be altered by deliberate policies and international efforts: they were called «*developing countries*.» Clearly there have been important strides in development and welfare, yet many policies have yet some countries and regions have proved stagnant.
- In spite of the initial optimism there were *devastating setbacks* highlighted by famines and starvation – the first and most notable was the catastrophe in Biafra. But it has been followed by other catastrophes similar in nature and devastation. Indeed, the global public has, so to speak, seen «reruns» of the script from Biafra – i.e. massive hunger, human misery and widespread death – most recently in East Africa in 2011.
- Over the last few decades the threat of *hunger and famine has increasingly been tied to climate and environmental change* – not just as the slow rise in average global temperatures, but also as the flashpoint from the concomitant natural disasters, such as floods, extreme storms or heat waves with devastating impacts on food production.
- *The outlook for the coming decades is bleak.* The combination of a growing world population with higher expectations for improved welfare – foremost of which is food security – combined with shortages of water and energy may well result in more widespread hunger.
- Food shortages in turn can lead to severe domestic violence in many countries in the form of *food riots, political upheavals and unpredictable regime change*, as well as international turbulence caused by *migration pressure* from poor people and security risks for all.



5. «Limits to Growth» – Scarcity

1973 was a dramatic year for both international politics and the international economy. On October 6 of that year, Egypt and Syria attacked Israel in what came to be called the Yom Kippur War. The war began during another growing friction: the low and declining income from oil in the Arab petroleum exporting countries – organized in OAPEC, as a subset of OPEC – The Organization of the Petroleum Exporting Countries. The Soviet Union responded to the outbreak of the war by delivering weapons to Egypt and Syria. On October 12, the United States countered with an airlift of military supplies to Israel. The military conflict metastasized into an economic altercation four days later, when OPEC announced that it would raise oil prices by 70%, to USD 11 a barrel.⁸⁴ The US and other countries were embargoed, followed by production cuts in the oil producing countries. The Yom Kippur War lasted only ten days and ended on October 26, while the embargoes were only gradually lifted.

Yet the economic impact lasted longer – as did the global psychological and political impact as well. For the situation did not revert to *status quo ante*. The OPEC countries had learned the power of the «oil weapon»: that they could collaborate and operate as a cartel by managing the global price of oil. In the consumer countries the OPEC policies resulted in shortages and a spike in oil prices. This was countered by price controls, rationing, and the imposition of lower speed limits or no-drive days and weekends in order to conserve energy. The longer term response was an intensified search for energy alternatives as well as for more fuel efficient automobiles. Another long-term result was a shift in the global balance of power, though not in any linear fashion. The price of oil peaked in 1980 at 35 dollars a barrel, but then fell and resulted in what came to be called the «1980s oil glut.» Since then oil prices have again risen, with oil prices at a permanently higher level with periodic spikes, such as in the spring of 2011.

The 1973 oil crisis was interesting from another perspective: It highlighted a broader, yet controversial argument that had been widely publicized the year before in the report *Limits to Growth*,⁸⁵ coauthored by Donella H. Meadows, Dennis L. Meadows, Jørgen Randers and William W. Behrens III. Theirs was an analysis of the interactions between the Earth's limited resources and the world's growing population. *Limits to Growth* did not so much make concrete predictions as identify how exponential population increase worked itself out when faced with finite or only linearly growing reserves. The report was informed by computer modeling that mapped the interaction of world population, industrialization, food production and resource depletion, including the supply of petroleum, and was based on different assumptions about the future state of the world as well as the best data available. The key conclusion was that the only sustainable scenarios for human welfare all required a reduction in growth. The team later published 20- and 30-year follow-ups, improving the models and using fresh data – yet with the same overall conclusion. The 30-year update also concluded that if one limit could be transcended but overall growth continued, another limit would be encountered – indeed, several could be encountered at the same time.⁸⁶

In many respects *Limits to Growth* was a distant echo of Thomas Malthus' famous *Essay on the Principle of Population*, first published in 1798.⁸⁷ Malthus argued that the growth in population is limited by the means of subsistence. Simply put, he considered that population would increase as a geometric progression whereas resources increased only at an arithmetic progression – or, in modern lingo, population would increase exponentially while resources would only increase linearly. The discrepancy between population growth and resource constraints would be a spur to activity – but could also result in growing misery, indeed, result in what population theorists later came to call a «population crash,» when the sum total of the population overshoots the carrying capacity of the land.

About the same time as *Limits to Growth* was published, there were also optimistic messages coming about the potential for increased agricultural production. The catchword for this was *The Green Revolution* which had started already in the 1940s but had accelerated beginning in the late 1960s. The initiatives and measures it encompassed included developing high-yield varieties of plants and seeds, e.g. for hybrid corn or cereal grains; improving life-stock breeding; expanding irrigation and the use of synthetic fertilizer; introducing new technologies and methods for land rotation, pesticides and insect control as well as new techniques for management, transport and marketing.

In the quarter century after 1960, this resulted in the doubling of the yield of several crops, e.g. cereals, whereas the yield from other crops, like maize and rice, steadily grew. However, this meant that agriculture not only became more energy intensive but also more dependent on pesticides and herbicides – increasing dependency on fossil fuel. Hence there is now a concern that a future decline in petroleum reserves may also lead to a decline in agricultural production.

Limits to Growth was roundly criticized, e.g. by the later Nobel Laureate in Economics Robert Solow, for having too weak data, or by Allen Kneese and Ronald Riker of «Resources for the Future,» who claimed that «The authors of the report load their case by letting some things grow exponentially and others not.»⁸⁸ Nevertheless, the 1973 oil crisis provided an illustration, indeed a forewarning of scarcities to come, not just of food resulting in hunger but also of increasing shortages of resources such as drinkable water. In the *2010 Global Hunger Index*, published by the international Food Policy Research Institute, one could read that the overall number of hungry people surpassed 1 billion in 2009.⁸⁹ And the World Health Organization states that:

Almost one-fifth of the world's population (about 1.2 billion people) lives in areas where the water is physically scarce. One quarter of the global population also live in developing countries that face water shortages due to a lack of infrastructure to fetch water from rivers and aquifers.⁹⁰

Indeed, water shortages were not among the key resources addressed in *Limits to Growth*. Water scarcity problems are probably best illustrated by China, which faces not just an acute but an even more severe, long-term water crisis. China has 20% of the world's population but only 7% of its global water resources – 85% of it is used for irrigation. If present trends are not reversed, the World Bank⁹¹ estimates there

will be 30 million environmental refugees due to water stress. More than 80 million people have to walk more than a mile every day for drinking water. More than half of China's 160 cities suffer water problems and water tables are falling everywhere. Ninety percent of cities' groundwater and 75% of rivers and lakes are polluted. Hundreds of millions drink contaminated water every day. As for the causes,

Water shortages are blamed on increasing demands of new industries, an expanding population, agriculture, pollution, reckless development, and poor planning, especially in northern areas where there isn't much water. Affluence and the increasing use of toilets, showers and washing machines and increased consumption of meat and alcohol (which need more grain and thus more water) has increased demand for scarce water supplies.⁹²

In addition to publications of such reports, the *public perceptions* of the global challenges have been strongly impacted by events. The years 2007-2008 saw a food crisis affecting millions and affecting them severely – and which may be the harbinger of things to come. The price of basic foods doubled or even tripled – and the increases were most rapid from the autumn of 2007. The rising cost of corn, wheat, soy oil and meat cut down even on the family budgets in the North and had harsh effects on the living conditions of poor people in the South, where the lion's share of their income is spent on alimentation.

But there was another, political cause as well: In order to reduce greenhouse gases, there was a diversion of agricultural production towards biofuels – partly as a consequence of subsidies. This in turn has also had negative effects on the environment, e.g. due to increased deforestation. A report in *The New York Times* summarizes the recent developments in the following way – and at the same time provides a good illustration of the argument made in the *Limits to Growth: The Thirty Year Update* – that if one limit is overcome but overall growth continues, one or more other limits will be encountered:

Each year, an ever larger portion of the world's crops – cassava and corn, sugar and palm oil – is being diverted for biofuels as developed countries pass laws mandating greater use of non-fossil fuels and as emerging powerhouses like China seek new sources of energy to keep their cars and industries running. Cassava is a relatively new entrant in the biofuel stream.

But with food prices rising sharply in recent months, many experts are calling on countries to scale back their headlong rush into green fuel development, arguing that the combination of ambitious biofuel targets and mediocre harvests of some crucial crops is contributing to high prices, hunger and political instability.

This year, the United Nations Food and Agriculture Organization reported that its index of food prices was the highest in its more than 20 years of existence. Prices rose 15 percent from October to January alone, potentially «throwing an additional 44 million people in low- and middle-income countries into poverty,» the World Bank said.

Soaring food prices have caused riots or contributed to political turmoil in a host of poor countries in recent months, including Algeria, Egypt and Bangladesh, where palm oil, a common biofuel ingredient, provides crucial nutrition to a desperately poor populace. During the second half of 2010, the price of corn rose steeply – 73 percent in the United States – an increase that the United Nations World Food Programme attributed in part to the greater use of American corn for bioethanol.⁹³

On March 20 2008, the World Food Programme, whose mission it is to reduce hunger, particularly for the world's most vulnerable, issued an urgent call for added contributions. Most urgent were the emergency needs in Darfur – amounting to 3 million people alone – in addition there were 70 million people in need in about 80 nations. Between June 2007 and March 2008 WFP's food prices rose more than 50%, which led to a shortfall in its budget of about USD 500 million.

But there is more to the story. In 2008, surging food prices spread social unrest across Africa and Asia. Food riots were triggered in Niger, Senegal, Cameroon, Burkina Faso, Yemen and Morocco – and in some Asian countries, like the Philippines, people took to the streets to protest that the government is not doing enough to counteract food inflation. This is not hard to understand, as the price for a ton of rice jumped from USD 373 in January 2008 to USD 760 in the last week in March 2008.⁹⁴ Engines run on fuel while riots are energized by empty stomachs. So in March 2008, the president of the World Bank, Robert B. Zoellick, presented a report warning that some 33 countries were in imminent danger of social unrest, ranging from Haiti in the West and Mauritania to Egypt in North Africa to Bangladesh in the East. Those who had thought «it can't happen here» had to change their minds. The escalating bread crisis exposed glaring social inequalities. For example, in 2008 in Egypt alone, more than 30 million poor depended on subsidized bread. People took to the streets in this world's second largest importer of wheat. President Mubarak instructed the military to bake and distribute more bread – yet the proportion of the population living below the poverty line was increasing.⁹⁵ In the Philippines the supply of rice was affected, since the country could no longer rely on its former suppliers, such as Vietnam. The Philippine Secretary of Agriculture suggested that people reduce their normal serving of rice from one cup to one-half.⁹⁶

So during the food squeeze in 2008, not only the common man reacted – governments reacted as well. Some countries slashed tariffs on foodstuffs, lowered taxes and increased subsidies in order to keep local prices down. Big food importers cut tariffs – e.g. Saudi Arabia cut customs on wheat. Other countries, such as India and China, curtailed their exports. In Argentina, farmers organized strikes in protest against export tariffs on other products such as soy – they wanted to reap the benefits of rising world market prices, while the government wanted to keep local prices down.⁹⁷ Russia, before the presidential election in 2008, restricted exports of wheat to counteract adverse reactions to rising prices from the electorate.⁹⁸

The extent to which such countries can cash in on increasing food prices will also depend on natural catastrophes and climate change. In the summer of 2010 Russia was scorched by a punishing heat wave – the worst drought since it began to

keep records. The effects on crops were devastating – they were reduced by about a third. The drought also led to spikes in prices and shrinking world grain stocks. And Russia, the world's third largest wheat exporter, for a time stopped exports to keep domestic prices down.

In 2010 Australia was first hit by a devastating drought – «the big dry» (e.g. reducing its rice crop by 98% and agricultural output overall by 20%), and then by rain and floods which in New South Wales and South Australia reduced the wheat crop by about 60%), then cyclone Yasi which destroyed 15% of its sugar crop. Not only crops were decimated – large numbers of farmers were also put in dire straits.⁹⁹

In the spring of 2011 many Arab countries saw public uprisings that toppled regimes. There were multiple causes, but the increase in food prices added to public discontent. Globally the increasing price of oil in the spring of 2011 – which in turn affects the cost of fertilizer, cultivation and transportation – will feed back to these and other countries by further increases in food prices.¹⁰⁰

So where does this leave us? The long-term message of the first oil crisis of 1973 is becoming clearer and clearer. And it can be spelled out in terms of the broad system dynamics that was outlined in *Limits to Growth*. Even though its original models were fairly simple, the type of logic it used – to describe the unfolding interaction between the evolving world population, its changing behaviors, use of resources and technologies – has carried the day as the most appropriate general intellectual frame of reference for what is going on in the world. And it is slowly affecting the mindset of people.

Indeed, a succinct statement of this perspective was given in February 2011 by one of the world's most renowned economists, Jeffrey D. Sachs. Its tone is almost as apocalyptic as the first pages of *The Communist Manifesto* in which Marx and Engels described the dynamics of industrial capitalism. Hence it is worthwhile to quote him extensively:

The world is hitting global limits in its use of resources. We are feeling the shocks each day in catastrophic floods, droughts, and storms – and in the resulting surge in prices in the marketplace. Our fate now depends on whether we cooperate or fall victim to self-defeating greed.

The limits to the global economy are new, resulting from the unprecedented size of the world's population and the unprecedented spread of economic growth to nearly the entire world. There are now seven billion people on the planet, compared to just three billion a half-century ago. Today, average per capita income is \$10,000, with the rich world averaging around \$40,000 and the developing world around \$4,000. That means that the world economy is now producing around \$70 trillion in total annual output, compared to around \$10 trillion in 1960.

China's economy is growing at around 10% annually. India's is growing at nearly the same rate. Africa, long the world's slowest-growing region, is now averaging roughly 5% annual GDP growth. Overall, the developing countries are growing at around 7% per year, and the developed economies at around 2%, yielding a global average of around 4.5%.

This is very good news in many ways. Rapid economic growth in developing countries is helping to alleviate poverty. In China, for example, extreme poverty has been cut from well over half of the population 30 years ago to around 10% or less today.

Yet there is another side to the global growth story that we must understand clearly. With the world economy growing at 4-5% per year, it will be on a path to double in size in less than 20 years. Today's \$70 trillion world economy will be at \$140 trillion before 2030, and \$280 trillion before 2050 if we extrapolate from today's growth rate.

Our planet will not physically support this exponential economic growth if we let greed take the upper hand. Even today, the weight of the world economy is already crushing nature, rapidly depleting the supplies of fossil-fuel energy resources that nature created over millions of years, while the resulting climate change has led to massive instabilities in terms of rainfall, temperature, and extreme storms.

We see these pressures every day in the marketplace. Oil prices have surged to more than \$100 per barrel, as China, India, and other oil-importing countries join the United States in a massive scramble to buy up supplies, especially from the Middle East. Food prices, too, are at historical highs, contributing to poverty and political unrest.

On the one hand, there are more mouths to feed, and with greater purchasing power on average. On the other hand, heat waves, droughts, floods, and other disasters induced by climate change are destroying crops and reducing the supplies of grains on world markets. In recent months, massive droughts have struck the grain-producing regions of Russia and Ukraine, and enormous floods have hit Brazil and Australia; now, another drought is menacing northern China's grain belt.

There is something else hidden from view that is very dangerous. In many populous parts of the world, including the grain-growing regions of northern India, northern China, and the American Midwest, farmers are tapping into groundwater to irrigate their crops. The great aquifers that supply water for irrigation are being depleted. In some places in India, the water table has been falling by several meters annually in recent years. Some deep wells are approaching the point of exhaustion, with salinity set to rise as ocean water infiltrates the aquifer.

A calamity is inevitable unless we change. And here is where Gandhi comes in. If our societies are run according to the greed principle, with the rich doing everything to get richer, the growing resource crisis will lead to a widening divide between the rich and the poor – and quite possibly to an increasingly violent struggle for survival.

The rich will try to use their power to commandeer more land, more water, and more energy for themselves, and many will support violent means to do so, if necessary. The US has already followed a strategy of militarization in the Middle East in the naïve hope that such an approach can ensure secure energy supplies. Now competition for those supplies is intensifying, as China, India, and others bid for the same (depleting) resources.

An analogous power grab is being attempted in Africa. The rise in food prices is leading to a land grab, as powerful politicians sell foreign investors massive tracts of farmland, brushing aside the traditional land rights of poor small-holders. Foreign investors hope to use large mechanized farms to produce output for export, leaving little or nothing for the local populations.

Everywhere in the leading countries – the US, the United Kingdom, China, India, and elsewhere – the rich have enjoyed soaring incomes and growing political power. The US economy has been taken over by billionaires, the oil industry, and other key sectors. The same trends threaten the emerging economies, where wealth and corruption are on the rise.

If greed dominates, the engine of economic growth will deplete our resources, push the poor aside, and drive us into a deep social, political, and economic crisis. The alternative is a path of political and social cooperation, both within countries and internationally. There will be enough resources and prosperity to go around if we convert our economies to renewable energy sources, sustainable agricultural practices, and reasonable taxation of the rich. This is the path to shared prosperity through improved technologies, political fairness, and ethical awareness.¹⁰¹

This perspective is very different from standard economic analysis based on general equilibrium theory. It is on the one hand much broader – attempting to incorporate not just economic activities but also political behavior, not just rational action but also social sentiments, not just market relations but also institutional arrangements. And rather than describing a system which reverts to an equilibrium when disturbed, it depicts processes that when jolted might spiral out of control.

Some of the key *take home* lessons that can be drawn from the discussion above are:

- For the last two centuries – after the essay on population by Robert Malthus – there has been an extensive discussion about the relationship between population growth and available resources to not just sustain a growing global population, but to improve health, ensure longer lives and better overall welfare as well. *More people are using more resources all the time – and expectations of improved living conditions are growing as well – in all countries.*

- The publication of *Limits to Growth* in 1972 was a seminal contribution which changed the intellectual and political agenda. Critics have argued that the message is too pessimistic. But population growth has been inexorable and the demand on resources inescapable. With the world population estimated to reach 10.1 billion by the end of the century,¹⁰² with the need for more food whether from agriculture or fisheries mounting, with the depletion of fossil fuels accelerating *and* with demands for basics such as water or minerals ever mounting – *the overriding challenge is to make human life on the planet sustainable and at the same time politically tractable.*
- The global community is becoming a *small world*, and its constituent elements are ever more *tightly coupled*.
- The changes that occur are not linear and proportional, but *non-linear*. Effects are transmitted through the mesh of connections which is more *complex* and more *difficult to predict*.
- Hence *shifts in one variable may result in tipping points, ruptures and irreversible changes* – in both natural and social processes, e.g. as illustrated by desertification, overfishing, depletion of ground water or when increasing food prices result in food riots. Overshooting the biological or social carrying capacity may result in collapse – also of political regimes.

A polar bear on a tiny iceberg east of Edge island, Svalbard, 2005.
The living conditions of polar bears are at risk if the climate is getting warmer.
Photo: Arne Nævra/Scanpix



6. Long, Slow – and Irreversible? Global Warming and Climate Change

Some singular events have had an enormous impact on the public psyche by their abrupt, appalling and sometimes devastating impacts – like the atomic bomb over Hiroshima or the nuclear accident at Chernobyl. Other onsets are long and slow in coming, with effects that are gradual, sometimes hardly noticeable from year to year, but with a cumulative impact that can be disastrous and even irreversible – such as the environmental damage from DDT described with such potency by Rachel Carson in *Silent Spring*. Her book was primarily focused on the United States, though it sounded a global alarm bell.

In recent years the most portentous and ominously significant development has been global warming and climate change – a topic that could be called multi-dimensional as well as multipolitical – i.e. resulting in multiple controversies.

Global warming generally refers to the global increase in average air temperature in the last half century. *Climate change* refers to modifications in the distribution in global weather patterns with a time span that can range from recent decades all the way back to the Ice Ages or even the birth of the planet.

Generally the issues and controversies related to global warming and climate change concern seven topics:

- *The amount of change*

Here the key question is how much change – if any – has there been in average air or ocean temperature or broader weather patterns: What is the long-term trend and what are the likely future trajectories, e.g. during the next 50 or 100 years? In the 2007 Fourth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC) the increase in air temperature during the last century was estimated at 0.74 ± 0.18 centigrade ($^{\circ}\text{C}$).¹⁰³ The concomitant question is whether this is the early part of a long trend and omen of future developments.

- *The causes change*

Changes in global warming or climate can be attributed to variations in *natural phenomena* such as solar activity, orbital shifts in planet Earth, volcanic output or ocean circulation. But the causes of change can be and have increasingly been attributed to *human activities*, particularly energy use and the emission of carbon dioxide (CO_2) from the use of fossil fuel such as coal, petroleum or natural gas. Indeed, a new term has been coined for these human influences: They are called *anthropogenic* factors. Aside from CO_2 , the main greenhouse gases are water vapor, methane, nitrous oxide and ozone which may affect the emission and absorption of radiation to and from the Earth. Increasing concentrations of such gases in the atmosphere can cause rising global temperatures, known as the «*greenhouse effect*.»

The greenhouse effect was first suggested by the French mathematician and physicist Joseph Fourier in 1824, and an empirical and quantitative study was carried out by the Swedish physical chemist Svante Arrhenius in 1896.¹⁰⁴ But it is the measurements collected and the models developed during the last several decades

which have altered the general view of both the changes underway and the forces at work. The most famous of the data time series collected is the Keeling Curve, which graphs the change in concentration of carbon dioxide in the atmosphere since 1958 based on observations taken at the Mauna Loa Observatory in Hawaii. The time series with these observations was started by Charles David Keeling and provided the first reliable and notable support for a steady augmentation in CO₂ in the atmosphere.¹⁰⁵

- *The consequences*

A wide range of both actual and potential impacts of global warming and climate change have been identified. They include large-scale deforestation, desertification and degradation of land, destruction of habitat, coral bleaching and species extinction. Some of these impacts are broadly negative, e.g. in the reduction of agricultural production resulting in food shortages and malnutrition. But some impacts are potentially beneficial, such as the increased availability of resources in the polar basin when the ice frontier withdraws, allowing for the use of new transportation routes such as the North-East Passage. Melting ice from retreating glaciers and ice caps will add to the sea level, as will the thermal expansion of water due to rising temperature. Thawing permafrost can release more greenhouse gases, so there is the potential for activating more complex feedback loops. Weather patterns will change and more extreme weather conditions and events, such as floods and storms, may become more common.

It is interesting to note that warnings about the effects of global warming and climate change have come not only from the scientific establishments in the natural sciences or medicine, but from military establishments as well. A case in point is the April 5, 2011 editorial in *The British Medical Journal* on «Climate change, ill health, and conflict.»¹⁰⁶ Its point of departure is a new report by the *International Institute for Strategic Studies* (IISS)¹⁰⁷ on the effects of climate change on collective security and the global order. Among the effects of climate change is more limited access to food, safe water, power, sanitation and health services. This in turn will drive mass migration and competition for the remaining resources. Hence starvation, diarrhea and infectious diseases will become more widespread, and as a result of this and of conflicts, mortality rates will rise. Floods, droughts, heat waves and the changed distribution of disease vectors will have the same effect. This analysis is not only in line with that from other military establishments,¹⁰⁸ but also the medical journal *Lancet's* own 2009 report which argued that climate change is the biggest threat to global health in this century due to declining water and food security, poorer human shelter and settlements, and migration.¹⁰⁹

- *The distribution*

The changes due to global warming and climate have not been uniform around the globe – indeed, there are great variations. Some are more exposed and vulnerable to slow changes, e.g. those at risk from rising sea levels, such as the Maldives in the Indian Ocean whose highest land point is less than 2.5 meters, Tuvalu in the Pacific Ocean between Hawaii and Australia whose highest point is 4.6 meters, or Kiribatu

and the Marshall Islands.¹¹⁰ If sea levels rise by one meter, many coastal cities, including parts of London, Bangkok and New York, will be submerged. The economic costs of protections against tides would be prohibitive for many countries. Clearly many island nations, coastal cities or estuaries are also vulnerable to king tides and even more to extreme events such as tsunamis.

Not only are there geographical variations in impacts of global warming. There are temporal fluctuations as well – and temporal variations in their location. Examples are the 2010 floods in Pakistan, Southern China or Queensland, Australia. Similar temporal fluctuations and geographical variations are found in the areas and regions exposed to heavy downpours, hurricanes or droughts.

- *The uncertainties*

Clearly this also translates into discussions about whether the recorded trends and projected trajectories are empirically robust and firm, or tenuous and unstable – indeed, whether what is presented are doomsday scenarios rather than documented science.

In both the scientific and broader community there have been fervent discussions about whether the *observations* on global warming or climate change are solid or whether they are due to short or longer term natural fluctuations. After all, there have been considerable variations in the past, such as the Little Ice Age after the Medieval Warm Period generally set between the mid-16th to the mid-18th century.¹¹¹

Likewise there have been disputes about the soundness of the *models* constructed to mirror the natural phenomena – i.e. what variables are and should be included, how parameter values are estimated, what the logic and loops of the constructs are. Some have argued that the models are too simplistic to mirror the real world. Others have argued the opposite – that they are too complex and nonlinear so that the conclusions depend more on the tangled feedbacks in the models themselves rather than on the observational material about the interconnections in the real world. Hence projected tipping points and projected irreversibilities have also been challenged.¹¹²

- *The responses*

There are ongoing debates and controversies not only about whether global warming in fact is taking place and whether climate change is anthropogenic. There are also disputes about the appropriate measures to be taken if the changes are there.

They range from the feasibility and cost of reducing emissions of greenhouse gases to the development and use of cleaner and less polluting technologies in everything from factory production to more efficient car engines and less energy-consuming light bulbs. They range from tapping alternatives to fossil fuel, such as wind or solar power, to storing carbon dioxide below the ground. They range from imaginative – sometimes fanciful – ideas for how to reflect more of the Sun's radiation back to space to reducing energy needs by better insulation of private homes and reducing the consumption of red meat which is both extremely water-intensive as well as a major source of methane.

In sum, as was stated above: global warming and climate change are multidimensional as well as multipolitical, resulting in multiple controversies in both the scientific community and in the broader community. There are intense debates globally about what is happening, what are the causes, what can be done, what should be done, how and by whom should decisions be made, who should carry burdens and who should foot the bills. The controversies are not just about the state of the world but about the state of the art.

These debates are fed not just by slow trends but by extreme events as well. One summary statement on this issue is found in the work co-sponsored by the *International Council of Science* and the *International Social Science Council* in their program on «Integrated Research on Disaster Risk» (IRDR). It illustrates that the steady, year-to-year changes in global warming and climate not only can have a gradual and cumulative impact but also trigger dramatic events:

The impacts of natural hazards continue to increase around the world; the frequency of recorded disasters affecting communities significantly rose from about 100 per decade in the period 1900-1940 to 650 per decade in the 1960s and 2000 per decade in the 1980s, and reached almost 2,800 per decade in the 1990s.

Hundreds of thousands of people are killed and millions injured, affected or displaced each year because of disasters, and the amount of property damage has been doubling about every seven years over the past 40 years. Although earthquakes and tsunamis can have horrific impacts, most disaster losses stem from climate-related hazards such as hurricanes, cyclones, other major storms, floods, landslides, wildfires, heat waves and droughts. Current evidence demonstrates that changes in the global climate will continue to increase the frequency and severity of climate-related hazards.

Globalization, population growth, widespread poverty, particularly in hazardous areas, and a changing climate will cause the risk associated with natural hazards to be even greater in the future, with more people and communities at risk. In urban regions, the complex infrastructure systems that make life and economic activity possible, the concentration and centralization of economic and political functions, social segregation and complex spatial and functional interrelationships, all contribute to the vulnerability of populations to disruptions caused by hazards.¹¹³

The physical impacts of disasters also change how potential damage is monitored (for example, to gauge local impacts quickly), how damage can be counteracted, how catastrophe losses are managed. The insurance industry is reworking its play-book: «We are literally rewriting the economic and financial history of disasters on a global scale,» stated Robert Hartwig, Chief Economist and President of the Insurance Information Institute.¹¹⁴

With respect to policy measures to adapt to, ameliorate and recover from climate change, prominent scientists have argued that time is running short. Yet political measures are being delayed. For example, Parry, Lowe and Hansen document how at the G8 summit in 2007 a roughly 50% reduction in global emissions was assumed by 2050. Yet at the UN Climate Change Conference 2009 in Copenhagen no concrete agreement was reached on starting to reduce such emissions which are currently increasing at 3% annually. Yet even with immediate implementation, achieving peak emissions in 2015 leaves a chance of exceeding a 2°C of warming, peaking as late as 2065. Sea levels may continue to rise after land areas have begun to cool. Delay would cause higher peaks at a later date. And the longer delay, the more massive and onerous investments would be needed – and the more damage along the lines illustrated in the paragraph on «Consequences» above. As the authors conclude:

The window of opportunity for beginning effective long-term action on climate change is extraordinarily narrow. Urgent and major emissions reductions are essential to avoid the most severe effects. Yet even the most prompt and stringent action still risks overshooting a target of 2 °C, and it will require centuries to achieve a roughly stable climate with tolerably low amounts of warming. The consequent demands on adaptation will be enormous, many times those currently envisaged. We should therefore give policies of adaptation much more urgent attention.¹¹⁵

This is the same general point about time running short as has also been made by the International Programme on the State of the Ocean quoted above.

There are several *take home lessons* from the above summary. Among them are:

- There has been a *growing consensus among scientists that global warming is increasing and that the Earth is in the midst of a dramatic climate change – yet the argument is controversial. Findings are disputed and models are disputed.*
- Even if decisive measures were taken today, temperatures would continue to rise for decades – *the momentum of present processes will be manifest for many years to come.*
- The controversies arise not just from the changes in nature and on how to model them, but also from different positions on *how the costs and burdens of adaptation and amelioration are to be distributed.*
- Meanwhile the impacts of *climate change, particularly in more extreme weather, is likely to rise on all continents and in all countries*, with enormous costs in terms of resources depleted, lives lost and opportunities missed. At the same time such events have strong impacts on people's perceptions and opinions about climate change and global warming – they are generally too big and dramatic to be ignored. (The frequency and intensity of the 2010 tornadoes in the US is a case in point.)
- This illustrates that there is not one, but several crises – indeed a *confluence of crises* – climatic, environmental, social and political.

- These crises are *not likely to be effectively addressed or solved unless they are considered as a whole and tackled simultaneously*.
- When the laws of nature are triggered and mediated by human activities and their consequences are social and global, the knowledge needed cannot be obtained from one or a few disciplines – *what is needed is knowledge from many different fields, spanning from physics and biology to economics, sociology, engineering and medicine*.
- More than that, *in order to change the human condition what is needed is integrated research*: Research that in its very design brings together the natural and the social sciences in joint projects.



7. The Blue Planet: The Earth Seen From the Moon

Throughout most of human history the world was perceived as vast and boundless: There were ridges beyond ridges, oceans lost in faraway horizons – and looking up, there was the endless blue yonder and stars lost in space. Travel was slow and most people never visited another country and few places beyond their own local community. Indeed, most people were buried in the same place as they were born.

For millennia humans had gazed at the Moon and pondered its mysteries. Only some forty years ago it became possible for humans to reverse the perspective and look at the Earth from the space.

This occurred on Christmas Eve 1968, when the astronauts of the Apollo 8 spacecraft were the first humans to circumvent the moon by flying around its backside, which is not visible from the Earth. Apollo 8 also was the first spaceflight to escape the gravitational pull of the Earth and orbit another celestial body. It was during the fourth pass that the Apollo crew for the first time saw – and was able to photograph – what came to be called the obverse of Sunrise – «Earthrise»: the view of a Blue Planet above the grayish, desolate horizon of the Moon against the black backdrop of infinite space. The picture appeared in print for the first time a couple of weeks later, on January 10, 1969. It later was included among *100 Photos that Changed the World* by *Life* magazine.¹¹⁶ The photos from the Apollo journey were developed by Dick Underwood of NASA, who said about them:

Many of the pictures were stunning – the last stage of the rocket surrounded by floating debris; a huge Earth seen for the first time as a complete globe hanging in a black void; and the scarred and cratered surface of the Moon at close quarters. But one picture stood above all the rest in its unfailing ability to produce gasps. It showed the Earth from a distance of quarter of a million miles, a fragile blue and white sphere, hanging over a barren grey-brown lunar horizon.¹¹⁷

As has been written about it: «It was an image that would eventually launch a thousand environmental movements, such as its impact on public consciousness.»¹¹⁸ Our planet was lonely yet lovely, hospitable yet vulnerable, fertile yet fragile. As the American astronomer Carl Sagan later said about the view of the Earth seen from space:

Look again at that dot. That's here. That's home. That's us. On it everyone you love, everyone you know, everyone you ever heard of, every human being who ever was, lived out their lives.Our posturing, our imagined self-importance, the delusion that we have some privileged position in the universe, are challenged by this point of light. Our planet is a lonely speck in the great enveloping cosmic dark. In our obscurity, in all this vastness, there is no hint that help will come from elsewhere to save us from ourselves.¹¹⁹

Earthrise, Christmas Eve, 1968. As the astronauts in Apollo 8 emerged from behind the Moon, they were surprised and enchanted by an amazing view of Earth rising over the lunar horizon. Bill Anders quickly snapped the picture. Photo: Nasa

The iconic image of our Blue Planet revealed to everyone that what down on the Earth was experienced as enormous distances and vast expanses, was limited and bounded – and that its habitability could be endangered by heedless action, thoughtless dealings and witless pursuit of short-term gain.¹²⁰

In a striking vein, the picture of the fragile Blue Planet gave an arresting global significance to an article that had been published in the journal *Science* just two weeks before Apollo orbited the Moon. It was written by Garret Hardin and was titled «The Tragedy of the Commons.»¹²¹ The article describes a conflict between individual rationality and joint benefit – the quandary that crops up when many individuals act rationally out of self interest, and will diminish, deplete or destroy a shared limited resource even when it is in their long term interest to preserve it. Overgrazing or overfishing is a case in point: Each actor is better off harvesting what they can, but the joint result when all do so is a degradation, depletion or even devastation of what they share. The picture of the Blue Planet brought home that its limited resources that could be harmed by pollution, ruined by overtaxing or breakdown by ecosystem destruction.

As the saying goes, if a picture is worth a thousand words, the publication of the iconic image of the blue planet Earth was a watershed event – it irreversibly changed the way humans looked upon themselves and their habitat.

The take home lessons were, simply put:

- Though the Cosmos is infinite, *Earth itself is finite*.
- More than that: *The Earth is a commons* – and hence suffers the many problems caused by population growth, energy use, etc. resulting in over-harvesting or over-use.
- *Human welfare depends on how the whole Earth is managed*, not just on how we individually manage our private plots or shares in it, or our community or our country.

Summary: Event-Generated Change in Outlook and Attitudes

In the pages above, I have made a broad claim: That the last half century has seen a dramatic change in public opinion on the environment – what was dubbed the «Ecological Revolution.»

How did this change in world view come about? Clearly it has been strongly influenced by new concepts and visions in the international community of scholars. Yet the claim is that the change in mindset has not so much been the result of meticulous information dissemination, scientific discourse and everyday reasoning as driven by occurrences that in a striking way has disclosed what was not previously realized or only obscurely seen. Clearly dialogue and controversy has played a role, but rather as a consequence of and response to events that actually transpired and attempts to make sense of them after the fact.

Hence I have described seven courses of events that had a strong – sometimes immediate, sometimes a more protracted – influence on public opinion. They had strong impacts and, became turning points by changing people's attitudes and as an ensemble their outlook. Or put more bluntly: The event was the stimulus; the change of mind was the response.

So what, more generally, are the *characteristics of event driven attitude or outlook change*? The following seem to be among the most salient:

- Events that represent a sudden change in the status quo are arresting. When existing conditions are overturned, the state of affairs suddenly reset or the scene shifts; it *grabs the attention – and can capture the imagination*. The impact can be due to the magnitude of the event itself, such as the atomic bomb in Hiroshima, or the magnitude of the consequences, such as the death toll from an earthquake. When a trend is suddenly broken, the new situation cannot just be ignored – attention is generated by the event, a crisis sharpens perception.
- The event jolts the mind – is a *simultaneous blow to several preconceived notions which then become uncoupled*. What has been taken for granted is no longer tenable. What is earth shattering may be mind blowing. Sometimes it is a telling detail that is jarring because it does not fit with the rest of the mental picture. The point is that the force of circumstance, so to speak, *allows for rethinking – by unhinging preconceptions and prompting a mental rearrangement by calling for a new framework to make sense of the event*. When events shatter world views, they have to be reconstructed. Ambiguities have to be resolved; the dots have to be connected in a different way which demands out-of-the-box thinking. In a surprising or dramatic way the event provides incriminating evidence, so to speak, against set notions. So the way things are have to be reinterpreted and the bits rearranged in a new mosaic or unified whole. What the event has dissolved and uncoupled has to assume a new pattern and be re-crystallized into a new gestalt. Rachel Carson is a case in point, making the jarring observation, providing a compelling narrative and encapsulating it in a potent metaphor: *Silent Spring*.

- The event not only generates attention, disturbs preconceptions and invites reinterpretation – this *reinterpretation is a social activity*. Set notions are generally shared, as conventional notions within a group. A big event triggers discussion, is exiting to talk about, and you can learn about it from friends, from media and from scholars. *People react to it by reacting to each other*. The social nature of such changes also expresses itself in *controversies* – e.g. between adherents of the old and the new, between different schools of thought about what is the appropriate new frame of reference. The event infiltrates people's opinion networks, so to speak.
- The event can have *different impacts on different age groups*. The demographer Norman Ryder identified what he called a «*cohort-defining event*,» an occurrence experienced by a specific age group during the same time interval. Ryder's idea was that the impact of an event depends on the stage of life or social conditions of those exposed to it. Cohorts differ because they undergo the same historical changes at different ages - for example a famine, such as the one in Biafra. «History determines a cohort's destiny.»¹²²
- The event can be not just a jolt to one's mind but also scary: an *affront to one's sensibilities and an assault on one's sense of security*. The disturbance of previously held beliefs is then emotionally charged and fused with a new sense of vulnerability. This in turn increases the demand for and alertness to information bearing the situation. Even in cases where the people directly hit are living in far-away places, the event may upturn one's presumption that «it can't happen here». The Fukushima nuclear accident was taken in many countries to imply that nuclear power plants closer to home are not safe either: «Indeed, it can happen here!» Even in cases where one's homeland or hometown is unlikely to be affected by a similar event, one's sensibilities may be shaken by the fate of others – a famine in Africa may precipitate distress and a burst of empathy. And what is seen to be at stake is not just one's own exposure but the risk to society, indeed, to the world, as well.
- The impacts of events are likely not to be straight, slow and cumulative, but *non-linear, abrupt and moving by sudden blows in different directions at the same time*. Rather than change coming little by little, the event can be a tipping point or crisis where the build-up of small changes effects a big change.¹²³ Global warming can be slow at first, but then metastasize, so to speak, into rapid and irreversible change. The prospect of such a scenario can itself be distressing and alarming.
- An event can impact not just on individuals and their interactions but on whole communities or nations. *Events can juxtapose political agendas and prove game-changing when they challenge broadly held views and values and highlight the greater stakes involved*. What has seemed impossible can suddenly seem necessary – e.g. as illustrated when Chancellor Angela Merkel announced on May 30, 2011, a policy to shut all nuclear reactors by 2022, a policy rushed through after the Fukushima disaster.¹²⁴ Clearly when events catapult issues onto the political agenda, this also generates friction, resistance, opposition and controversy. Indeed, if politics is about conflicts, events are not neutral.

- Finally an event can *trigger changes in several attitudes in different yet related areas* at once, like a conversion – indeed, as a collective conversion because many can react to the same event and react to each other's reactions as well. The sudden awareness of the dangers of pollution, say after the three month long BP oil spill in the Gulf of Mexico in 2010, can highlight a broader threats to the environment and link to, say, carbon emissions and global warming. Even if changes in outlooks or attitudes are event-driven, clearly scientific studies and discourse play an important role not just in interpreting the events and enlightening the public, but also by providing arguments as well as coherence to the frameworks for making sense of the events and for integrating such frameworks. *Scientists recognize form and tell stories that give orderliness, meaning and pattern and to events that might otherwise appear unrelated, fragmented and chaotic*. Hence they may amplify and reinforce the redrawing of mental maps, resetting of mindsets and dissemination of shared accounts and explanations. Over time several such stories, which at first may be sketchy and separated, may be woven into a more comprehensive and integrated narrative.

Event driven changes at the same time raise the broader question of what processes cause cognitive and attitudinal shifts to take place, how people learn and how they organize their mindsets both cognitively and socially. To this we now turn.

[III. Seven events that changed the world. Endnotes]

- 1 There is a huge body of literature on the scientific and engineering work resulting in the first atomic bomb and about the political and military decisions that resulted in the bombings of Hiroshima and Nagasaki. An important source is Richard G. Hewlett and Oscar E. Anderson, *The New World, 1939–1946*, (University Park: Pennsylvania State University Press, 1962). See also Robert Jungk, *Brighter than a Thousand Suns: A Personal History of the Atomic Scientists* (New York: Houghton Mifflin, 1958). Wikipedia has several good articles describing the Manhattan Project, Nuclear Weapons, Nuclear Arms Race, nuclear weapons, the nuclear arms race, the Atomic Age, the Pugwash Conferences, The Bulletin of the Atomic Scientists, the anti-nuclear movement, etc., as well as biographies of key actors such as J. Robert Oppenheimer, Enrico Fermi, Edward Teller, etc. –and of course, Albert Einstein and Harry S. Truman.
- 2 See for example the articles in Wikipedia on «Balance of Terror,» (http://en.wikipedia.org/wiki/Balance_of_terror), «Deterrence Theory,» (http://en.wikipedia.org/wiki/Deterrence_theory), and «Mutually Assured Destruction,» (http://en.wikipedia.org/wiki/Mutual_assured_destruction).
- 3 The classical study of the Cuban missile crisis is Graham Allison, *Essence of Decision: Explaining the Cuban Missile Crisis* (New York: Little Brown, 1971).
- 4 <http://en.wikipedia.org/wiki/Hotline> .
- 5 For the full text, see <http://www.pugwash.org/about/manifesto.htm>
- 6 Early on, other prominent public figures had brought up the potential threat of nuclear weapons, such as Albert Schweitzer, the Nobel Peace Prize Laureate of 1952. See his 1954 speech found at http://nobelprize.org/nobel_prizes/peace/laureates/1952/schweitzer-lecture.html. In 1957 he published «A Declaration of Conscience,» an explicit public stand against the development, testing and deployment of nuclear weapons.

- 7 For an excellent and thorough treatment, see Toshihiro Higuchi, *Radioactive Fallout, The Politics of Risk, and the Making of a Global Environmental Crisis, 1954-1963*, Ph.D. Dissertation (Washington D.C.: Georgetown University, Graduate School of Arts and Sciences, 2011).
- 8 For a short overview, see http://es.wikipedia.org/wiki/Daigo_Fukury%C5%AB_Maru.
- 9 Toshihiro Higuchi, op.cit. p. 31. f.
- 10 Toshihiro Higuchi, op.cit., Chapter 1 and 2.
- 11 See for example http://en.wikipedia.org/wiki/Dirty_bomb
- 12 See http://nobelprize.org/nobel_prizes/medicine/laureates/1948/ and <http://en.wikipedia.org/wiki/DDT> and <http://en.wikipedia.org/wiki/DDT>
- 13 Ibid. For succinct overviews, see also <http://www.mnwellid.org/docs/history/biographies/carson.htm>, http://en.wikipedia.org/wiki/Rachel_Carson and http://en.wikipedia.org/wiki/Silent_Spring
- 14 Rachel Carson, *Silent Spring* (Boston: Houghton Mifflin, 1962).
- 15 For an overview, see «Global Deforestation,» <http://www.globalchange.umich.edu/globalchange2/current/lectures/deforest/deforest.html>
- 16 Some progress has been made: «Tropical forests were a big winner in the Cancún Agreements. Countries agreed to implement a set of policies known as REDD+ (Reducing Emissions from Deforestation and Forest Degradation Plus Related Pro-forest Activities) to work towards conservation of these ecosystems.» See the Union of Concerned Scientists, http://www.ucsusa.org/global_warming/solutions/forest_solutions/tropical-forest-cancun.html
- 17 For further information, see <http://www.cbd.int/history/>
- 18 See Ralph J. Cicerone et al. «Stratospheric Ozone Destruction by Man-made Chlorofluoromethanes,» *Science* Vol. 185, Sept. 27, 1974, pp. 1165-1165; and Allen I. Hammond & Thomas H. Maugh II, «Stratospheric Pollution: Multiple Threats to the Earth's Ozone,» *Science*, Vol. 186, Oct. 25, 1974, pp. 335-338.
- 19 Rachel Carson, «Essay on the Biological Sciences,» *Good Reading*, 1958.
- 20 See for example the article on «Agent Orange,» http://en.wikipedia.org/wiki/Agent_orange. Another example is the «Gulf War Syndrome» which has affected between 250,000 and 700,000 American veterans who served in the 1991 Gulf War. These veterans suffer from chronic multi-symptom illnesses, such as fatigue, loss of muscle control, headaches, dizziness, memory problems, etc. Exposure to toxic chemicals is believed to be the root cause. For an overview, see the article http://en.wikipedia.org/wiki/Gulf_War_syndrome
- 21 See for example http://wwf.panda.org/about_our_earth/blue_planet/problems/pollution/. Dumping the most toxic materials was banned by the London Dumping Convention in 1972 (amended in 1996). Regarding plastics pollution, see for example <http://eco-thinker.com/the-garbage-patch-massive-collection-of-plastic-pollution-in-the-pacific-ocean/>, where «The North Pacific Tropical Gyre» also known as the «Garbage Patch,» is described along with a YouTube film. «Seven million tons of floating plastic waste spanning an area twice the size of Texas. There is six times as much plastic in the gyre than there is plankton.»
- 22 See the August 2011 report from the United Nations Environmental Programme (UNEP) <http://www.unep.org/newscentre/default.aspx?DocumentID=2649&ArticleID=8827>, which reports that «The environmental restoration of Ogoniland could prove to be the world's most wide-ranging and long-term oil clean-up exercise ever undertaken if contaminated drinking water, land, creeks and important ecosystems such as mangroves are to be brought back to full, productive health.»
- 23 See <http://www.nytimes.com/2011/08/12/science/earth/12herbicide.html?scp=3&sq=New%20herbicide&st=cse>
- 24 See Alexis Madrigal, «7 (Crazy) Civilian Uses for Nuclear Bombs» in *Wired Science*, April 10, 2010, <http://www.wired.com/wiredscience/2009/04/yourfriendatom/>
- 25 At the UN conference on the environment in Johannesburg in 2002, nuclear power was actively promoted as a solution to the threat of climate change by both the OECD and the EU Commission, while the IAEA promoted the same message at the climate summit meeting in Montreal in 2005. See Bente Aasjord, «Kyoto and Gukushima» in *Klassekampen*, March 22, 2011.
- 26 See http://simple.wikipedia.org/wiki/Nuclear_accident
- 27 See Robert Bernero, «March Madness,» a review of J. Samuel Walker, *Three Mile Island: A Nuclear Crisis in Historical Perspective*. (Berkeley: University of California Press, 2004) in *American Scientist*, November-December 2004 (<http://www.americanscientist.org/bookshelf/pub/march-madness>)
- 28 See Informasjonskriser (Oslo: NOU 1986:19).
- 29 See Gudmund Hernes, «Information Crises» (unpublished manuscript).
- 30 In «Europe After Chernobyl – Cooler Attitudes Toward Nuclear Power,» *The New York Times*, April 27, 1987, it was reported that «Chernobyl appears to have significantly affected Western European attitudes toward nuclear power. Opposition to nuclear power has hardened in many European countries.» See <http://www.nytimes.com/1987/04/27/world/europe-after-chernobyl-cooler-attitudes-toward-nuclear-power.html>
- 31 On April 13, 2011, Reuters reported that a majority of the French people wanted to get rid of nuclear power, underscoring the impact of the Fukushima disaster on public opinion around the world. Fully 57% of respondents in a poll were generally in favor of dropping nuclear energy, with 20% strongly in favor. However, only 27% were prepared to accept a corresponding rise in electricity tariffs, however, compared to 72% against, the survey found.

«Fukushima has unquestionably had a major emotional impact on the population,» said Matthieu Courtecuisse, head of Sia Conseil, the consultancy firm which commissioned the survey along with the French weekly L'Express. The Fukushima disaster has triggered fierce debate over the safety of nuclear energy production, with calls to stop nuclear expansion projects and shut down existing plants. See <http://af.reuters.com/article/energyOilNews/idAFLDE73CoZl20110413>
- 32 See «Germany Shuts 7 Plants as Europe Plans Safety Tests,» *The New York Times*, March 15, 2011, <http://www.nytimes.com/2011/03/16/business/global/16euronuke.html?scp=1&sq=germany%20nuclear%20power&st=cse>
- 33 See «Merkel Loses Key German State on Nuclear Fears,» *The New York Times*, March 27, 2011, <http://www.nytimes.com/2011/03/28/world/europe/28germany.html?scp=3&sq=germany%20nuclear%20power&st=cse>. *Financial Times* wrote on March 29, 2011: «It is ...hard to conceive how a disastrous earthquake and tsunami in Japan can cause a political upheaval in the heart of Europe» – «the theme of nuclear safety had dominated the final days of the campaign.»
- 34 <http://www.guardian.co.uk/world/2011/may/30/germany-to-shut-nuclear-reactors>.
- 35 See <http://www.nytimes.com/2011/04/13/world/asia/13japan.html?hp=&pagewanted=print>
- 36 Neil Smith, «There's No Such Thing as a Natural Disaster,» in *Understanding Katrina* (Social Science Research Council) Published June 11, 2006), see <http://understandingkatrina.ssrc.org/Smith/> See also Gregory Squires and Chester Hartman (eds.) *There is No Such Thing as a Natural Disaster: Race, Class, and Katrina* (New York: Routledge, 2006).
- 37 Woodrow Wilson's analysis was in many respects ahead of his time and is worth quoting extensively. He wrote: «Our government has been for the past few years under the control of heads of great allied corporations with special interests. It has not controlled these interests and assigned them a proper place in the whole system of business; it has submitted itself to their control. As a result, there have grown up vicious systems and schemes of governmental favoritism (the most obvious being the extravagant tariff), far-reaching in effect upon the whole fabric of life, touching to his injury every inhabitant of the land, laying unfair and impossible handicaps upon competitors, imposing taxes in every direction, stifling everywhere the free spirit of American enterprise.

Now this has come about naturally; as we go on we shall see how very naturally. It is no use denouncing anybody, or anything, except human nature. Nevertheless, it is an intolerable thing that the government of the republic should have got so far out of the hands of the people; should have been captured by interests which are special and not general.» And Wilson goes on: «If the government is to tell big business men how to run their business, then don't you see that big business men have to get closer to the government even than they are now? Don't you see that they must capture the government, in order not to be restrained too much by it? Must capture the government? They have already captured it.» Published in *The New Freedom: A Call For the Emancipation of the Generous Energies of a People*. (New York: Doubleday, Page & Co, 1913). Online edition: http://en.wikisource.org/wiki/The_New_Freedom:_A_Call_for_the_Emanicipation_of_the_Generous_Energies_of_a_People
- 38 A classic is 100,000,000 Guinea Pigs (New York: The Vanguard Press, 1933), which describes how products, notably pharmaceuticals and food, are marketed with little knowledge or concern for how they can adversely affect the consumers. The book argues that not only may products not do what they purport to do – they may also have severe side effects, and the regulators in the US Food and Drug Administration (FDA) have fallen victim to regulatory capture.

Also in recent years the drug industry provides many examples of products that have been withdrawn from the market, such as Thalidomide which was introduced in the 1950s and withdrawn in 1961, or more recently Vioxx which was approved by the FDA in 1999 and withdrawn in 2004 because it could increase the risk of heart attack and stroke. Vioxx was «one of the most widely used drugs ever to be withdrawn from the market. In the year before withdrawal, Merck had sales revenue of USD 2.5 billion from Vioxx.» See <http://en.wikipedia.org/wiki/Rofecoxib>

39 See George Stigler, «The theory of economic regulation,» Bell J. Econ. Man. Sci., 1971: 2 pp. 3-21.

40 A good recent example is found in «Culture of Complicity Tied to Stricken Nuclear Plant,» http://www.nytimes.com/2011/04/27/world/asia/27collusion.html?_r=1&scp=1&sq=culture%20of%20complicity%20tied%20to%20stricken&st=cse. See also «It Could Happen Here,» <http://www.nytimes.com/2011/03/24/opinion/24Von-Hippel.html?ref=chernobylnuclearaccident1986>. See also the report «AP study: US nuclear regulators weaken safety rules,» http://news.yahoo.com/s/ap/20110620/ap_on_re_us/us_aging_nukes_part1

41 Professor Frank N. von Hippel wrote in The New York Times after the Fukushima accident: «... perhaps the most important thing to do in light of the Fukushima disaster is to change the industry-regulator relationship. It has become customary for administrations not to nominate, and the Senate not to confirm, commissioners whom the industry regards as ‘anti-nuclear’ — which includes anyone who has expressed any criticism whatsoever of industry practices. The commission has an excellent staff; what it needs is more aggressive political leadership.» See «It Could Happen Here,» <http://www.nytimes.com/2011/03/24/opinion/24Von-Hippel.html?ref=chernobylnuclearaccident1986>

42 The reactions Rachel Carson faced when she wrote Silent Spring described above is a case in point.

43 A case in point are the reports about the relations between the Minerals Management Service under the US Department of Interior and the oil industry:

«The Minerals Management Service is the agency charged both with regulating the oil industry and collecting royalties from it.

Numerous Congressional and internal investigations have called the oversight agency badly mismanaged and at times corrupt. It has been rocked by regular scandals, including disclosures in 2008 that agency officials took bribes and engaged in drug use and sex with oil industry officials. Its own scientists have said that senior agency officials in recent years revised staff reports to eliminate environmental concerns that might have complicated oil-company drilling applications for offshore sites in waters near Alaska.

An inspector general’s report found that agency officials allowed industry officials to fill in their own inspection reports in pencil - and then traced over them in pen before submitting them. The report also found that inspectors had accepted meals, tickets to sporting events and gifts from at least one oil company while they were overseeing the industry.

Interior Secretary Ken Salazar announced plans in May 2010 to reorganize the federal agency to improve its regulatory role by separating safety oversight from the division that collects royalties from oil and gas companies. The proposal would end a decades-old relationship between industry and government that has proved highly profitable - and some say too cozy - for both. The minerals agency, which was created in 1982, brings in an average of USD 13 billion a year.

The Obama administration has been under growing pressure to address weaknesses in federal oil regulation since the April 2010 explosion of the Deepwater Horizon drilling platform in the Gulf of Mexico. The explosion of the rig, leased by the oil company BP, killed 11 workers and resulted in thousands of barrels of oil spilling into the Gulf each day.

Reacting to reports that federal regulators allowed extensive offshore drilling without first demanding the required environmental permits, the White House and the Department of Interior said in May 2010 that there would be a review of all actions taken by the minerals agency.

The minerals service short-circuited the process when it granted hundreds of recent drilling permits, according to documents and current and former government officials. The BP well that blew in the Gulf in April was granted an exemption from the assessment process because company officials assured regulators that it carried little hazard. Officials went along with the company and granted the permit. See http://topics.nytimes.com/top/reference/timestopics/organizations/m/minerals_management_service/index.html?scp=2&sq=Gulf%20oil%20spill%20regulation%20failure&st=cse

44 «The revolving door spins several ways: government-to-industry, government-to-lobbying and industry-to-government. All of it produces a pro-business bias as colleagues with friendly connections and insider knowledge of ‘how things work’ in everything from Congressional committees to Pentagon weapons development teams provides for the special needs of corporate America.» See <http://www.dailykos.com/story/2011/06/03/981683/-Revolving-door-ensures-that-some-people-have-a-job>

45 As just one example, the career quarantine has been urged for senior managers in Irish Health Service (HSE). See <http://www.tribune.ie/article/2008/oct/12/calls-for-career-quarantine-for-top-ranking-hse-st/>

46 The New York Times wrote on the investigation after the Deepwater Horizon blow-out: «The presidential panel investigating the 2010 oil spill in the Gulf of Mexico recommended on Tuesday that Congress approve substantial new spending and sweeping new regulations for offshore oil operations at a time when the appetite for both is low. Releasing its final report, the commission found that the Deepwater Horizon explosion and subsequent oil spill arose from a preventable series of corporate and regulatory failures. It warned that unless industry practices and government regulation improved, another such accident was inevitable.» See <http://www.nytimes.com/2011/01/12/science/earth/12spill.html?scp=2&sq=Gulf%20oil%20spill%20regulation%20failure&st=cse>

47 In the US the Nuclear Regulatory Commission has on occasion followed the nuclear utilities lead and rejected or fought expensive safety improvements. «The commission’s defenders often argue that it must be cautious because increased costs from safety requirements could kill the nuclear power industry.» Ibid. One may say that the general rule in cases where there may be severe or irreversible damage done to the environment is to «err on the side of caution.»

In March 2011, The New York Times reported on the organizational changes implemented after the blow-out in the Gulf of Mexico in 2011: «A year after BP’s Macondo well blew out, killing 11 men and spewing millions of barrels of oil into the Gulf of Mexico, the much-maligned federal agency responsible for policing offshore drilling has been remade, with a tough new director, an awkward new name and a sheaf of stricter safety rules. It is also trying to put some distance between itself and the industry it regulates.

But is it fixed? The simple answer is no. Even those who run the agency formerly known as the Minerals Management Service concede that it will be years before they can establish a robust regulatory regime able to minimize the risks to workers and the environment while still allowing exploration offshore.»

«We are much safer today than we were a year ago,» said Interior Secretary Ken Salazar, who oversees the agency, «but we know we have more to do.»

«Regulation of Off-Shore Rigs is a Work In Progress,» <http://www.nytimes.com/2011/04/17/us/politics/17regulate.html?ref=mineralsmanagementservice>.

48 In «Japan Held Nuclear Data, leaving Evacuees in Peril,» one can read that «officials...did not want to take responsibility for costly evacuations if their estimates were later called into question.» <http://www.nytimes.com/2011/08/09/world/asia/09japan.html?scp=1&sq=Anger%20in%20Japan&st=cse>.

49 A recent study by the Associated Press concluded: «Federal regulators have been working closely with the nuclear power industry to keep the nation’s aging reactors operating within safety standards by repeatedly weakening those standards or simply failing to enforce them, an investigation by The Associated Press has found.

Time after time, officials at the US Nuclear Regulatory Commission have decided that original regulations were too strict, arguing that safety margins could be eased without peril, according to records and interviews.

The result? Rising fears that these accommodations by the commission are significantly undermining safety — and inching the reactors closer to an accident that could harm the public and jeopardize the future of nuclear power in the US.

Examples abound. When valves leaked, more leakage was allowed— up to 20 times the original limit. When rampant cracking caused radioactive leaks from steam generator tubing, an easier test of the tubes was devised so that plants could meet standards.

Failed cables. Busted seals. Broken nozzles, clogged screens, cracked concrete, dented containers, corroded metals and rusty underground pipes — these and thousands of other problems linked to aging were uncovered in the AP’s yearlong investigation. And all of them could escalate dangers in the event of an accident.

Yet despite the many problems linked to aging, not a single official body in government or industry has studied the overall frequency and potential impact on safety of such breakdowns in recent years. Meanwhile, the commission has extended the licenses of dozens of reactors.

... Records show a recurring pattern: Reactor parts or systems fall out of compliance with the rules. Studies are conducted by the industry and government, and all agree that standards are ‘unnecessarily conservative.’ Regulations are loosened, and the reactors are back in compliance.»

See «AP study: US nuclear regulators weaken safety rules,» http://news.yahoo.com/s/ap/20110620/ap_on_re_us/us_aging_nukes_part1

Similar types of arguments were launched against the Financial Crisis Inquiry Commission in the US which delivered its report in January 2011. It was also criticized for not providing a comprehensive review or risk analysis: «The long-awaited Financial Crisis Inquiry Commission report, finally published on Thursday, was supposed to be the economic equivalent of the 9/11 commission report. But instead of a lucid narrative explaining what happened when the economy imploded in 2008, why, and who was to blame, the report is a confusing and contradictory mess, part rehash, part mishmash, as impenetrable as the collateralized debt obligations at the core of the crisis.» See «Washington's Financial Disaster,»

<http://www.nytimes.com/2011/01/30/opinion/30partnoy.html?sq=Executives Behind Financial Crisis Face Little Risk Of Being Caught&st=Search&scp=1&pagewanted=print>.

- 50 One among many examples is Norwegian fish farming where Norway's special unit for economic crime, Økokrim, is reported to possess information that employees have been ordered to keep silent about escaping salmon, which is mandatory to report, and other legal infractions. See Dagens Næringsliv June 23, 2011.
- 51 After Fukushima it was reported that Japan's political leaders «at first did not know about the system and later played down the data, apparently fearful of having to significantly enlarge the evacuation zone – and acknowledge the accident's severity.» «Japan Held Nuclear Data, leaving Evacuees in Peril,» <http://www.nytimes.com/2011/08/09/world/asia/09japan.html?scp=1&sq=Anger%20in%20Japan&st=cse>.

- 52 Mr. Kosako and others, however, say the Speedi [radiation] maps would have been extremely useful in the hands of someone who knew how to sort through the system's reams of data. He said the Speedi readings were so complex, and some of the predictions of the spread of radiation contamination so alarming, that three separate government agencies – the Education Ministry and the two nuclear regulators, the Nuclear and Industrial Safety Agency and Nuclear Safety Commission – passed the data to one another like a hot potato, with none of them wanting to accept responsibility for its results.

In interviews, officials at the ministry and the agency each pointed fingers, saying that the other agency was responsible for Speedi. The head of the commission declined to be interviewed.

- 53 See «Japan Held Nuclear Data, leaving Evacuees in Peril,» <http://www.nytimes.com/2011/08/09/world/asia/09japan.html?scp=1&sq=Anger%20in%20Japan&st=cse>
- 54 Under the headline «Biggest Fish Face Little Risk of Being Caught,» the New York Times columnist Joe Nocera wrote about the executives heavily involved in the financial crisis: «Most of the other Wall Street bigwigs whose firms took unconscionable risks – risks that nearly brought the global financial system to its knees – aren't even on Justice's radar screen. Nor has there been a single indictment against any top executive at a subprime lender. ... Two and a half years after the world's financial system nearly collapsed, you're entitled to wonder whether any of the highly paid executives who helped kindle the disaster will ever see jail time – like Michael Milken in the 1980s, or Jeffrey Skilling after the Enron disaster. Increasingly, the answer appears to be no.»

In a different sphere – Norwegian fish farming – the journal Dagens Næringsliv reported on June 23, 2011, that the special unit for economic crime in Norway, Økokrim, is sharpening its reactions against firms responsible for eco-criminality, in this case salmon which have escaped their farm-fish cages. With an increasing number of escaped salmon, the report stated, «This development indicates that the penalties are not severe enough, or have sufficient general preventive effect.»

- 55 For a concrete example, see «Culture of Complicity Tied to Stricken Nuclear Plant,» http://www.nytimes.com/2011/04/27/world/asia/27collusion.html?_r=1&scp=1&sq=culture%20of%20complicity%20tied%20to%20stricken&st=cse
- 56 «See Hippel, «It Could Happen Here,» <http://www.nytimes.com/2011/03/24/opinion/24Von-Hippel.html?ref=chernobylnuclearaccident1986>, op.cit.
- 57 See http://www.nytimes.com/2011/06/25/world/asia/25myth.html?_r=1&hp. This article also contains the following information: «The nuclear establishment also made sure that government-mandated school textbooks underemphasized information that could cast doubt on the safety of nuclear power. In Parliament, the campaign was led by Tokio Kano, a Tepco vice president who became a lawmaker in 1998. Mr. Kano, who declined to be interviewed for this article, returned to Tepco as an adviser after retiring from Parliament last year.

In 2004, under the influence of Mr. Kano and other proponents of nuclear power, education officials ordered revisions to textbooks before endorsing them. In one junior high school social studies textbook, a reference to the growing anti-nuclear movement in Europe was deleted. In another, a reference to Chernobyl was relegated to a footnote.»

- 58 On March 26, 2011, Financial Times wrote under the headline «Safety risk was played down»: When Tokyo Electric Power's crippled nuclear power plant was plunged into crisis two weeks ago, Masataka Shimizu, the company's president, placed the blame squarely on Mother Nature: the 14-metre tsunami that knocked out its safety systems had, he said, been «bigger than our expectations.»

But Tepco's expectations are now under scrutiny amid revelations that just two years ago one of the country's senior seismologists repeatedly highlighted the possibility of a huge tsunami in the area of the Fukushima Daiichi plant, which is now spewing radioactivity into its surroundings.

At safety review meetings convened by the Nuclear and Industrial Safety Agency that were attended by Tepco officials, seismologist Yukinobu Okamura warned that research called into question the assumptions underpinning the plant's design.»

See also •Pyntet på feil og mangler. USA: Kjernekræftiere fortalte ikke sannheten,» Aftenposten March 17, 2011. When Japan on April 11 decided to raise it assessment to Chernobyl levels, The New York Times wrote «The decision to raise the alert level to 7 from 5 on the scale amounts to an admission that the accident at the nuclear facility, brought on by the March 11 earthquake and tsunami, is likely to have substantial and long-lasting consequences for health and for the environment. Some in the nuclear industry have been saying for weeks that the accident released large amounts of radiation, but Japanese officials had played down this possibility.» <http://www.nytimes.com/2011/04/13/world/asia/13japan.html?hp=&pagewanted=print>

- 59 W. J. Rorabaugh, Donald T. Critchlow, Paula C. Baker (2004). «America's promise: a concise history of the United States.» Rowman & Littlefield, p.47, ISBN 0742511898.
- 60 See New Realities for an Older America, (Stanford: Stanford Center of Longevity, 2010) <http://longevity.stanford.edu/files/New%20Realities%20of%20an%20Older%20America.pdf>. The report shows that the number of older people (age 65 and over) will double over the next 30 years, from 40 million to 80 million, and the percentage of older people in the population will increase from 13% to 20%.
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IV. Explanations of Attitude Change



A tsunami breaching an embankment and flowing into the city of Miyako in Iwate prefecture shortly after a 9.0 magnitude earthquake hit the region of northern Japan, March 11, 2011.
Photo: AFP/Jiji Press/Scanpix

IV. Explanations of Attitude Change

What do people believe about climate change? We know quite a bit about that – but less about the changes in such beliefs and what causes them – and even less about how changes in mindsets are inherently linked to changes in social relations.

In 2007-2008 Gallup polls were conducted in 137 countries about different aspects of global warming. A third of the world's population had never heard of it. The percentage knowing «something» or a «great deal» ranked from a low of 15% in Liberia to a high of 99% in Japan. Public awareness tends to be higher in highly developed countries and lower in less developed countries, with those in Africa least aware. Of those aware, the highest percentage who believes rising temperatures are the result of human activities is found in Latin America while the opposite belief is most widespread in Africa, parts of Asia, the Middle East and Russia.¹

A poll in 2007 showed that Americans are less concerned about climate change than Europeans. Professor Nick Pidgeon, a specialist on attitudes about climate change at Cardiff University, commented: «The debate in Europe is about what action needs to be taken, while many in the US still debate whether climate change is happening.» Pidgeon argues that *national attitudes reflect the discourse of politicians* (*ital. added here*) which in turn have a strong impact on policies. «The issue has been reframed in Europe over the last five years, with politicians and even some oil companies raising the issue At the same time, we still see a lot of the skepticism about climate change originating from the United States.» Pidgeon argues that the polls reflect different stages of engagement about global warming on each side of the Atlantic.² In other words: National leaders are important opinion leaders.

A 2007 study from the UK showed that the public increasingly perceived climate change as a major global issue with far-reaching consequences for future generations – 45% say it is the most serious threat facing the world today and 53% believe it will impact significantly on future generations. Fully 88%, irrespective of cause, believe the climate is changing. Yet public opinion deviates from the Intergovernmental Panel on Climate Change (IPCC): 41% believe that climate change is being caused by both human activity and natural processes, while 46% believe human activity is the main cause, as the IPCC maintains. There is recognition of environmental limits and the need for action as well as increasing optimism about the capacity to find solutions. A large proportion hold doubts and is uncertain about the science on which reports on climate change are based. A total of 63% say they *need more information* to form a firm view.³

But is attitude formation and attitude change just – or mainly – a question of getting more information?

Beliefs and Identity

The core of identity is stability: identity is what makes one recognizable to oneself – and to others. Beliefs, dispositions and attitudes are constituent parts of what you are – your mindset is the crux of your identity. Indeed, the term mindset conveys that a mind is set – that it remains fixed for some extended period of time. Identity means that you are what you were and stay the same.

So humans tend to have fairly stable outlooks – they pretty much believe, stand for and embody the same things this year as last year. They remain on the whole «true to themselves» and «true to character» – i.e. generally acting in line with what they already believe and see themselves to be, as continuous selves.

But what you believe can in fact be wrong. Your notions may be misconceived. And, equally important, your views about what is the case or therefore what needs to be done can change. Indeed, you can have a firm identity – yet an inquiring mind.

This raises the broad and important question about what makes for the stability of beliefs, outlooks and attitudes and what makes for their change – and what remains stable while other things change.

Specifically we may ask two questions: How have and how can attitudes about climate and the environment change? How can studies of people's beliefs and attitudes about climate change provide important opportunities for social science not just in this particular substantive area, but more generally to yield insights about change in world views and values? The first is about social science contributions to the discourse about the environment. The second is how the environmental issues can affect the agenda for social research.

In the previous chapters we have seen how either sudden specific events, such as the bomb over Hiroshima, the nuclear accident in Chernobyl – and slow-moving yet threatening courses of events, developments such as the Biafra famine and global warming, have jolted the public mind.

The account of such events and developments leads us straight to the topic we now will discuss in some more detail: If, as was claimed in the introduction to this book, there has been a profound change in public opinion – indeed, in several attitudes and cognitions more or less at the same time – about the global climate and indeed about where the Earth is heading, through what psychological and socio-logical processes has this change taken place? And what role does politics play?

The Empty Heads Fallacy

The opposite of identity is a mind not yet set, not yet influenced by others or the outside world, a mind still fluid and not yet formed. Indeed, one could claim that this is the human mind in its original, unstructured state – the *tabula rasa* at birth.

However, a clean slate is not the normal human state for long: The external world starts to exert its influence on the mind immediately after parturition. Hence the typical is not that everybody's mind is blank – it is furnished and even cluttered. And it is not fluid or malleable for long but increasingly fixed and firm. This is also the reason why we talk about «personality structure» and «character» – the durable features, traits and makeup of a person's mind.

To assume that people have no or few convictions or set views, either in general or in a specific area, could therefore be called the «empty heads fallacy.» Rather everybody's mind is, so to speak, filled – i.e. occupied by facts of life and assumptions about how the world works based on experiences from the outside world of persons and institutions, objects and processes. Beliefs, consisting of conceptual maps and frameworks of causal relations, are what make it possible to operate in the world and manage one's affairs. To have an open mind does imply an empty head.

The formation of the mind is of course influenced by others. Such imprinting takes time. It evolves through interactions with family and friends, in communities with colleagues and coworkers, competitors and adversaries – but also more formally through schooling and work. Some of the writing on the slate results from direct personal encounters; other parts are based on vicarious experience, e.g. from education. Mental outlooks are shaped by social processes.

Yet even when shaped, outlooks can be changed. However, it often takes extraordinary efforts and energy to refurnish a mind – to alter or modify what is already congealed – and put something else in its place. Or to use another metaphor: Changing one's mind is like a writing on a palimpsest: a parchment from which an earlier text has been partially or fully scraped or cleaned off to make room for another text. Something has to be erased to make room for the new writing.

To give but one illustration: People often have set but erroneous notions about the causes and cures of diseases. For example, many believe that HIV may be transmitted by touching, by kissing or by mosquitoes, or that its origins is due to a conspiracy,⁴ and some even think that it can be cured by sex with a virgin. A mind may be filled with its share of myths as well as facts. The point is that such *notions can be changed only by being replaced by alternative beliefs*.

And since notions held about one set of issues – such as disease – are also hooked up with other attitudes – say about gender relations – *they often cannot be changed in isolation*, as stand-alone beliefs. They are linked by logic in a web, and because of this logical entanglement the change of an attitude often implies the change of a whole outlook, indeed, sometimes a whole *Weltanschauung*.

Or put differently: *A conversion must address the previous version*. Moreover, though there may be lacunas in what people believe, the mind is a fairly crowded place if for no other reason that we all *tend to project what we already believe from one area to another* and also because some beliefs are easily generalized – e.g. from

notions about «Swedes» to notions about «foreigners.» People have «opinions about everything» – and the beliefs are interlinked.

The key question is therefore how can your notions be changed – not just a point of view, but a whole outlook, or even a vision?

Event-Generated Attitude Change

The core argument that was given in the previous chapter is that outlooks and opinions can be changed by the course of events themselves. It is difficult to argue with Mother Nature whether she speaks with steady insistence and unfailing consistency through the forces of nature, such as constantly exposing us to gravity – or when she speaks with brute force, as in the fury of a hurricane or the devastation of a drought. It is hard to believe what is contrary to all experience.

Put differently: in the previous chapter the case was made that what was called the «Ecological Revolution» – the broad if uneven and patchy changes in public attitudes and assumptions on climate change – are *event-generated*.

The key point is people try to establish a *correspondence* between the *state of the world* and their *view of the world*. But then some crucial occurrence – either sudden or dramatic such as the Hiroshima bomb, or the growing awareness of some creeping danger such as described in *Silent Spring* – may shatter the resemblance between reality and representation. A gap appears between presumptions and perceptions, a disconnect between a previously held opinion and the actual situation – or, metaphorically, a discrepancy between picture and landscape. Another term for a sudden challenge to previously held notions and a turnaround of previous actions is a «Sputnik moment,» referring to the Soviet launching of the first satellite to orbit the Earth in 1957 which blew up American beliefs of technical supremacy and led to the establishment of NASA.

As mentioned, such dissociation is sometimes brutally and undeniably brought to the fore by some disaster or emergency, which generates duress and distress. The disturbance to the previously held belief can then lead to bewilderment, perplexity or shock. Sometimes it can be characterized as a *cognitive collapse*: What was never doubted before the event is proved by the facts to be inadequate or simply wrong. A set of beliefs becomes unhinged – separated from each other as well as detached from reality. An event may prove unsettling because cognitions become disconnected. Coping with the exigency of the new situation demands a novel understanding of what is the case and about what is going on. It is, so to speak, the turn of events that requires a change of mind. The force of the circumstances forces a change in how the circumstances are seen: the shock to the senses when what you never expected in fact happens.

Such a discrepancy between presumptions and the course of events can also appear gradually, build up by cumulation, but then result in a sudden awareness, a defining moment – like when the Sun sets and the soft twilight masks the fact that nightfall might trap you in the dark. Hence the widening gap also can be perceived

to lead to a tipping point – as some do with respect to global warming.⁵ (Recognition of some diseases has this character – e.g. when it dawns on you that a cumulative set of changed behaviors is due to Alzheimer).

«Locus Classicus» of Event-Generated Attitude Change: On the Road to Damascus

«Acts of God» is the insurance term for natural events that are not caused by human action or preventable by human intervention – such as storms, floods, or lightning – and for which humans therefore cannot be held accountable.

Nevertheless, when such events occur, learning, adaptation or amelioration is possible – e.g. as when it is argued that efforts to reduce global warming by curtailing the emission of greenhouse gases also will reduce the frequency of freak weather.⁶ It is possible to learn – to change one's view of the world – even from «acts of God.»

The classical account of such an event resulting in a fundamental change in outlook is the biblical description of the conversion of Paul the Apostle. Being one of the persecutors of the early Christians, a man by the name of Saul, on his way from Jerusalem to Damascus, is struck to the ground by a blinding light and addressed directly by a divine voice, leading him to stop his hunt and convert to Christianity (and adopt the name Paul. Acts 9). Hence such a transformative encounter leading to a sudden change in attitude, outlook, perspective or belief is sometimes called a «road to Damascus experience,» a «Damascene conversion» or a «Pauline conversion.»

This narrative of a life-changing event in which one's whole outlook is fundamentally or significantly altered is instructive because it highlights a conversion as a set of analytically distinct but associated set of changes:

- Change as the *replacement* of earlier beliefs. What is experientially indubitable and intellectually compelling becomes psychologically overwhelming.
- Change in a *broader mental map* – i.e. not just a substitution of separate preconceptions but of several new convictions simultaneously – i.e. a change of the *view of the world* – in cognitions, concepts and categories – as a result of a change in the *state of the world*.
- Change as a reordering of the *importance* attached to or *saliency* of particular issues – i.e. a *shift of priorities*.
- Change not just in conceptions of *what is*, but also in *what ought to be* or in what is considered good and bad.
- Change not just in presumptions about *how the world works* but also in moral *imperatives* and precepts for action for *how the world can and must be changed*.
- Change in associates or even accomplices – i.e. by establishing links to others who share the same opinions and beliefs as well as parting company with former

consorts and dissociation from former allies. *Intellectual reorientation is associated with a social realignment*. The emergence of a new school of thought implies new controversies, new colleagues and opponents, new fronts and new alliances.

The fact that intellectual outlooks, subjective opinions, and moral orientations not only *logically interlink within individuals but also lodge in the social networks between them* could be called «*double embedding*.» Saul was struck as an individual: he adopted a new faith as well as a new name, «Paul», which signified that as a proselyte also he was linking with new confidants *and* companions. I will return to this below.

This fact – that what you think has consequences not just for *who you are* but also for *whom you associate with* – is another reason why attitude change and change of mindsets is trying and – literally – upsetting. A change in outlook is investing in a new identity and sociality. A divergence of opinion may result in the separation of former colleagues. An about-face is likely to trigger criticism and conflict. Deserting a cause for another may result in your being considered a defector, heretic or renegade – but perhaps also welcomed among the new like-minded. Hence cognitive switch sometimes results in the rupture of social networks: Changing your opinions implies that you may have to change associates. It is easier to look upon the world in a different way if your friends come to see it in the same way. Linking beliefs in a new narrative is facilitated and buttressed by sharing that narrative. It is easier to see the light if others are enlightened from the same source. New convictions make for new companions.

«Road to Damascus experiences» have been frequent in the development of beliefs and attitudes about climate change.⁷ Indeed, whether climate in fact is changing is controversial.

Sources of Opinion Change

With this backdrop, let us discuss some more of the detailed mechanisms through which opinions and outlooks can change. This can be organized around ten key questions.

1. Does Your Belief Square with the Facts?

Event-generated attitude change is a subset of a broader intellectual process. It is sometimes claimed that «facts speak louder than words.» But facts do not speak for themselves – they only speak when they speak to some theory, i.e. bear on some specific preconceptions or beliefs.

Take the conception of global warming – does it happen or not? We know that there are annual fluctuations in temperature – some winters are especially cold, some springs come unusually early. Weather is not stable – no year is exactly like another. Also there are different developments in different countries and regions – El Niño, the climate pattern across the Pacific Ocean, varies periodically with fluctuations in warming and cooling. And there have been epochs in the past when climate was both warmer and colder in specific locations than it is today.

So in order to resolve the issue of global warming, we must ask: *If* global warming takes place, what would we *expect to observe*? Among the empirical consequences we should then find in the real world are the following:

- It must be possible to identify not just fluctuations but a *bona fide trend* over time – i.e. a long-term increase in average temperature.
- The increase cannot be restricted to particular regions but should be a broad *global* phenomenon, hence observable in many different locations around the world – i.e. in a representative set of measuring points.
- The general rise in temperature should be manifest in the *more exposed areas* of the world, such as in the polar regions or in territories with high mountain glaciers.
- Meteorological models predict more *extreme weather* if global temperatures rise, hence we would expect increase in the number of extreme weather episodes.

If such implications are found to hold in the real world, the conception of global warming is supported by the facts (but of course one may want to check other implications as well).

This *modus operandi* – i.e. the general cycle

- starting out with some notion or observation about what is happening,
- specifying a model to explain it,

- drawing empirical consequences from the model and then,
- checking them against the facts.

is what is refined and systematized as *the scientific method*. But it is also *a logic that people in general use to come to grips with the world*. For example, when people try to assess whether it is going to rain by looking at the pattern of clouds, this general logic is brought to bear. Or when different symptoms are used to identify which of several possible diseases affects you.

An attitude or an opinion could be conceived of as *a provisional cognitive hypothesis*. For example, you might consider a wooden ladder solid and safe. However, if a person climbs it and one of the steps breaks, you are likely to modify that belief. Your original belief is contradicted by the events.

Event-generated attitude change is, so to speak, the brute version of the scientific method: The events experienced can be so stunning or staggering, disturbing or devastating, that previous notions no longer can be sustained. A catastrophic occurrence is, so to speak, a natural experiment with an outcome that contradicts your cherished notions. And it is not generally staged – it is an «uncontrolled experiment» which therefore all the more can have both horrifying and stupefying effects. The events settle the argument: Reality has overwhelmed your preset notions. What was believed is no longer tenable.

This is precisely the reason why the cases presented in the first part of this essay – e.g. Hiroshima or *Silent Spring* – were selected: They have been *potent in focusing attention, elucidating issues and changing minds by generating facts contrary to preconceptions or common wisdom* – and have taken us a long way towards settling issues.

2. How Does the Event Affect You?

The psychological impact of an event on your views or attitudes – its impact factor – can be taken to be a function of *how immediately and directly you are affected by it*. In event-driven opinion change, therefore,

- the magnitude of the event itself,
- whether it touches you directly and decisively or indirectly and diffusely;
- whether you can influence or control its effects
- whether it impacting on your kin, neighbor, community, country or more distant mortals

will have an effect on how the event is interpreted and the vulnerability you sense, as well as your opinions on what actions need to be taken.

The *closer* one is to the locus of the event and the more *immediate* and *direct* the personal experience, the more likely the event is to lead to a reorientation or

reconstruction of assumptions and attitudes. Likewise, the more *dramatic* or *traumatic* the effects of the event – in terms of threats to health, lives lost, persons injured or driven from their homes, or material destruction – the greater the psychological impact.

A case in point is the accidental contamination caused by the US nuclear testing of a thermonuclear weapon at the Bikini Atoll in the Mid-Pacific in 1954. As mentioned above, the Japanese tuna fishing boat, the *Fukuru Maru Drago* or *Lucky Dragon No. 5*, its crew and catch, suffered damage from the nuclear fallout. Contaminated rainwater, and radioactive» fish, rice and vegetables became an issue and «imbued the average Japanese with a sense of personal danger». These concerns invaded people's households, so to speak, with worries about what was safe to eat and what was safe to serve children. In addition to the direct health effects, there were also the economic losses due to fall in consumption and loss of markets. Later the panic metastasized into a full-blown political ban-the-bomb movement and permeated the international political agenda of the Japanese government.⁸

Another example is provided by the March 2011 Great East Japan Earthquake, the tsunami that followed and the fallout from the Fukushima Nuclear Power Plant that jolted the public around the globe. But the overall impacts were closest to home, in Japan. It was here that the highest proportion sensed the most acute personal risk, changed their views on, say, preparedness or nuclear risk and started to draw the practical consequences of their raw or reinforced sense of long-term vulnerability.

So the sensitivity to risk is not just a question of natural forces and natural phenomena, but also of the impacts in terms of human behavior and reactions that catastrophes trigger as well as the institutional arrangements and political responses that natural disasters often expose as having been massively inadequate.

With the impact of the modern visual media – e.g. from television or – more and more – from short videos on the Internet, closeness is not just a question of actual geographical or social distance. We can now talk about *virtual proximity* as everybody can use their mobile phone cameras and upload what they have experienced or witnessed, and everybody can access real and unfiltered reports in real time from hotspots all around the globe.

3. Does It Add Up?

Consistency is at the core of theories about, explanations of and strategies for human behavior.

Standard economic theory is to a large extent based on the assumption of rational actors. By definition, rational actors are assumed to have well-ordered and consistent preferences – they cannot have their cake and eat it, too. And they are assumed to have coherent ideas about the world – they cannot at the same time believe that the world is flat and that it is round. Rational choice theory based on ranked order preferences. Coherent cognitions is also a theoretical framework not just in economics but also much used in political science and in sociology.

Several psychological theories presuppose what could be called an axiom of triple harmonization:

- of beliefs and values,
- of attitudes and behavior, and
- of different attitudes or beliefs.

Implicit in all three is that *what drives change in beliefs or assumptions are inconsistencies*, i.e. «people are motivated toward consistency and will change their beliefs, attitudes, perceptions and actions to achieve it.»⁹ When inconsistencies become apparent, the discomfort or even embarrassment leads to attempts at reconciliation or realignment.

The first form of harmonization implies that beliefs and values are *hierarchically ordered or organized*. For example, a belief in God's existence logically precedes the moral authority attributed to that God. Or: His commandments carry more weight than particular tenets or precepts for behaviors or activities – hence conflicts between norms can be resolved by reference to these commandments. Another example could be taken from law: The paragraphs in the constitution of a country have authority and their primacy settles inconsistencies between specific legal rules. Or the point can be illustrated by the development of mathematics: Axioms precede theorems which in turn precede their application to solve particular problems. The test of whether an argument is valid is whether it can be carried out without contradiction or can be subsumed under the same set of more general principles. Legal systems strive to weed out inconsistencies; mathematical inferences are acceptable as long as they are logically valid.

The second form of harmonization – that of attitudes and behavior – implies that *choices of action are considered inconsistent if they are at variance with professed principles*. The normative tenet is that one should behave in accordance with one's beliefs and act according to one's principles. In real life, however, one cannot expect that behavior always follows attitudes or that people live their convictions – that they «put their money where their mouth is.»

The third form of harmonization is *the alignment of different attitudes* – horizontally, so to speak, rather than hierarchically. The logical or causal concatenation of attitudes means that they are stringed or chained together in logical ensembles, networks or maps. For example: *If* you believe that global warming is occurring *and* you believe that it is a result of human activities *and* you believe that it will have a detrimental effect on the human condition *and* you believe that effective counter-measures can be implemented, *then* one would expect that you would advocate or support such measures. Beliefs are not isolates disconnected from others; to the contrary, they are associated and entangled, interwoven with recognizable patterns. Hence the question you can be confronted with when presenting your different attitudes or viewpoints is this: Do they all add up? If they don't, then – on the basis of the axioms of harmonization – attitudes or beliefs may be changed by argument. Starting with a set of preconceptions, people can convince each other either that some of their notions or parts of their ideas should be revised because they are mu-

tually inconsistent, incompatible or irreconcilable.¹⁰ This is what is generally called the «*force of argument*.»

Sometimes such a mode of argument is called the dialectical or Socratic method. It aims at the rational detection of error precisely by identifying inconsistencies – even those that are not at first recognized by the holder of the inconsistent views. Hence the purpose of a dialogue is to eliminate opinions or attitudes that result in contradictions and affirm those that are coherent with other beliefs or more general commonly held truths.

4. How Do You Cope with Discrepancies?

Above we discussed harmonization and the consistency principle – that people will change beliefs, attitudes and perceptions in order to achieve agreement between different views or accordance with facts.

However, the *fact that cherished beliefs of ordinary people or decision-makers seem or prove to be wrong is not a sufficient cause for their being discarded*. Different actors may stick to their misconceptions even when they fly in the face of facts. In the famous quote from John Maynard Keynes:

...ideas of economists and political philosophers, both when they are right and when they are wrong, are more powerful than is commonly understood. Indeed the world is ruled by little else. Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually the slaves of some defunct economist.¹¹

So what mechanisms enable people to stick to their erroneous opinions or misconceptions, even when there is strong evidence to the contrary? Some of the key ones are:

- *Selective perception* – people tend to filter out what goes against what they already believe and let in what aligns with or support what they already think (cf. the discussion of «the empty heads fallacy» above). We perceive in line with what we already believe things to be rather than what they really are. The mechanism is what is described in idioms such as «He sees what he likes to see and hears what he likes to hear» or in expressions like «Beauty is in the eye of the beholder» or, more negatively, in «twisting the facts.» Numerous studies document this tendency.¹² Selective perception is also what scientists try to protect themselves against by using *blind experiments*, where some of those involved are excluded from certain information that might bias their reporting or interpretations and hence invalidate the results. In *double-blind experiments* neither the researcher nor the subjects know who belong to the experimental group and the control group in order to protect against subjective bias. But clearly such stringent procedures are not followed in everyday life – which makes it more comforting to maintain the beliefs you already have.

- *Selective memory* – remembering certain facts and forgetting others – is related to selective perception, as is *wishful thinking*: forming comforting beliefs, sustaining them by supportive facts and neglecting counterevidence.¹³ In all cases people are predisposed to tilt evidence towards established convictions or what one they would like to be the case. If beauty is in the eye of the beholder, so is truth.
- *Reinterpretation or rationalization*. When the evidence goes against what you believe you can choose to ignore it, explain it away or reinterpret it. The psychological theory naming this phenomenon of neglecting or even denying evidence contrary to one of your cherished opinions or pet beliefs is called «*cognitive dissonance*.» Cognitive dissonance is the distress or discomfort felt when two conflicting opinions are held simultaneously or when new information clashes with the notions you already have. The theory was first formulated by Leon Festinger in the book *When Prophecy Fails*¹⁴ where believers expected the imminent end of the world on a certain date. But when the prophecy was disconfirmed by events – doomsday did not occur – the cult did not dissolve: it grew and the adherents became more devout by a shared reinterpretation of the undeniable fact.¹⁵ A recent example is the American radio evangelist Harold Camping who predicted the «end of the world» on May 21, 2011. Two days later Camping maintained his prophecy but recalculated the date of its occurrence: The world would come to an end five months later, on October 21, 2011.¹⁶

By these three processes – selective perception, selective memory and rationalization – humans could be called «cognitive escape artists» fully able to disentangle themselves from inconsistencies and contradictions, much like escapologists can get out of handcuffs, straightjackets, boxes and other traps. Self-deception is well known: Incoherence can be glossed over, opposing evidence shrouded and counter-arguments obfuscated.

So rather than talking about separate «opinions,» it seems more appropriate to talk about a *mindset*: a set of linked beliefs or attitudes which can be considered as a conceptual map of logically connected constructs. Then attitude change cannot be seen as just altering an isolated point of view – changing an opinion has repercussions and will have consequences for other opinions held, indeed for the whole map or whole belief system. Opinions are not singletons, but ensembles. More than that: Since the attitudes or opinions are logically linked, such a map could be called a «*logical lattice*.»

This can be illustrated as in the figures below. In Figure 2 three logically compatible attitudes are depicted in a triangle (illustrated by a plus, «+», by each line) between the points. All is well. But what if it appears as in Figure 3 that one of the links is incompatible with the others (illustrated by a minus, «-», by one of the lines)? This should lead to a rethinking of the other links as well.

In Figure 4 the set of issues on which one can have opinions have been expanded to four, with one incompatible link. When such a situation occurs, it can generate cognitive dissonance from several simultaneous or co-existing inconsisten-

Figure 2.
Three attitudes that are logically compatible.

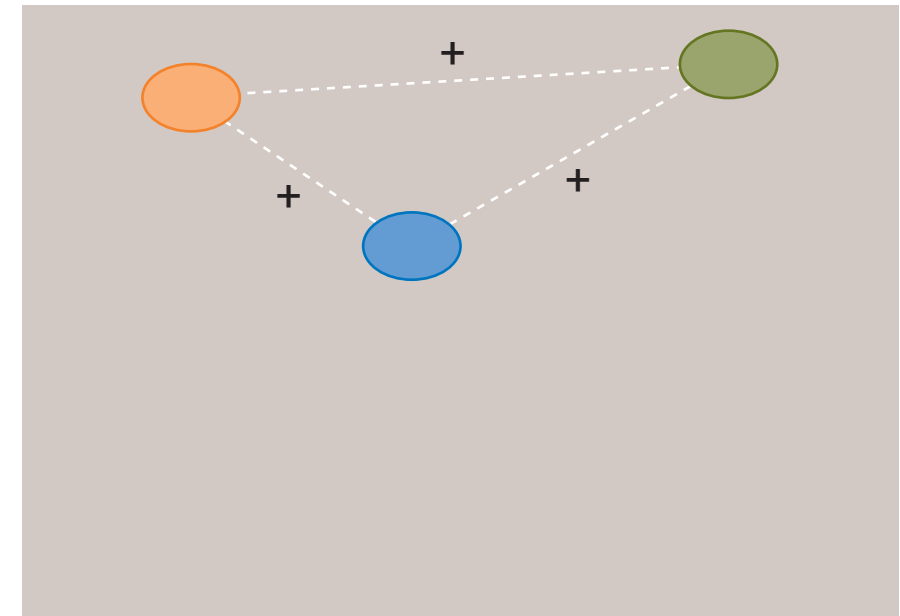


Figure 3.
Three attitudes with one logically incompatible link

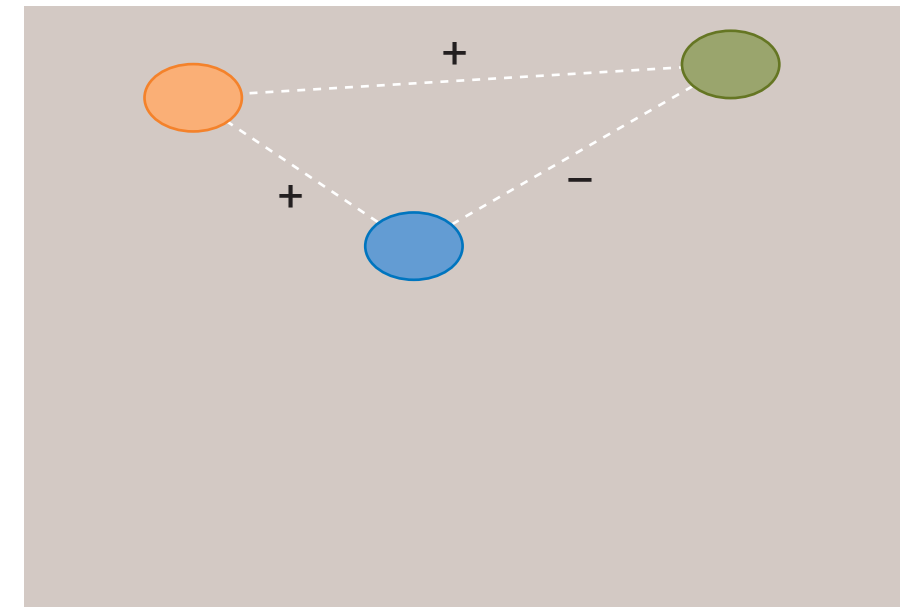
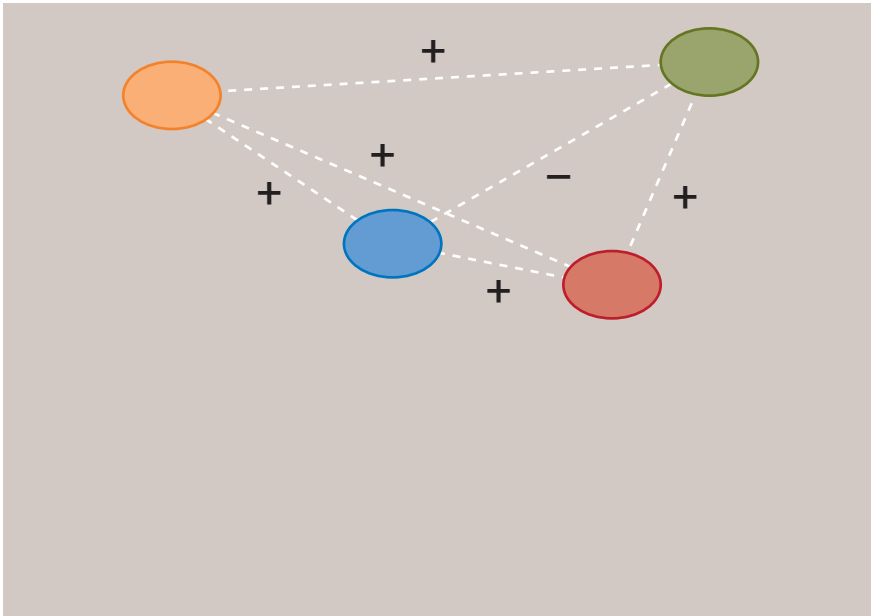


Figure 4.
The Logical Lattice: Four attitudes with one incompatible link



cies. And to resolve them, one may have to change several points of view in order to maintain consistency. But then it can be most opportune or least costly to ignore – or even misconstrue – the discordant note rather than changing many of the links to the logical lattice. Particularly since such logical lattices are an important part of identity as well as a social network, the easiest way out may be to discount, forget, overlook or even misrepresent the fact. In such a case, sharply put: Inconsistency trumps veracity.

In other words: A logical lattice, a conceptual map or a frame of mind can serve as a filter for selective perception, selective memory, rationalization and opportunistic reinterpretation of the facts. Indeed, one could imagine «maps of maps» – i.e. as conceptual maps in different areas of life that tend to become inter-linked and integrated over time – e.g. views on climate related to views on, say, pollution, environmental politics or the role of government.

In his classic work *The Structure of Scientific Revolutions* Thomas S. Kuhn used the consistency principle to explain an important source of paradigm shift in science, viz. the discovery of anomalies which cannot be logically linked to or accounted for within the prevailing paradigm:

Discovery commences with the awareness of anomaly, i.e., with the recognition that nature has somehow violated the paradigm-induced expectations that govern normal science. It then continues with a more or less extended exploration of the area of anomaly. And it closes only when the paradigm

theory has been adjusted so that the anomalous has become the expected. Assimilating a new sort of fact demands a more than additive adjustment of the theory, and until that adjustment is completed – until the scientist has learned to see nature in a different way – the new fact is not quite a scientific fact at all...

...what will ultimately be the central point – that the act of judgment that leads scientists to reject a previously accepted theory is always based upon more than a comparison of that theory with the world. The decision to reject one paradigm is always simultaneously the decision to accept another, and the judgment leading to that decision involves the comparison of both paradigms with nature *and* with each other.¹⁷

There are often discrepancies between a paradigm and observations, or counter instances of explanations. But some are tackled by *ad hoc* adjustments and, as Kuhn says, «like artists, creative scientists must occasionally be able to live in a world out of joint.» The existence of competing logical lattices also means that the the same facts, or ambiguous facts, can be interpreted in opposed ways and disputes become more antagonistic even when confronted with the «same evidence». But some anomalies become so baleful, so to speak, that their resolution becomes *the* subject matter of the discipline and a new world view or paradigm can be conceived and direct research. This line of reasoning has much in common with the arguments in this chapter. In sum: Opinions and beliefs are, so to speak, *cognitively embedded* in the logical lattice, and «attitude change» or «opinion change» is not just about changing disjointed notions or predispositions. The logical linking means that changing one key opinion may have ripple or domino effects for others – which is the reason why we can talk of not just an «attitude change» but of «conversions.»

Different maps have different potency – one may override another. But some experiences are so strong that the cognitive dissonance becomes unbearable. This is the reason why big events have been the focus in the previous chapter: Events in the outside world overwhelm the set notions and settled opinions.

5. Are Templates for Interpretation Available?

When something happens that fragments your notions or shatters your world view, a key question becomes whether there are templates available that can make sense of the altered state of the world. Are frames of reference available that can allow you to reconnect the dots?

For example, when the fishing boat *Fukuru Maru Drago* or *Lucky Dragon No. 5*, was contaminated from nuclear fallout in 1954, there was already a latent template in place in Japan: the devastations from the bombing of Hiroshima and Nagasaki was of course well known, as was both the immediate and potential long term damage from radiation. So radioactively «contaminated food translated the invisible, abstract risk of global fallout into a visible, familiar object, empowering the voice of protest against further contamination.»¹⁸ And the «threat of contamination spurred otherwise conservative workers at sea to unusual antinuclear activism.»¹⁹

Another template for interpreting these events was the Cold War framework. The US tried to sway public opinion by reference to the competition with the Soviet Union and the risks of not arming to match the threat. In Japan the course of events was framed differently:

Japan's extensive fallout monitoring, capturing radioactive dust drifting from north and south, reinforced the nation's identity as an innocent victim of the Cold War, who happened to live 'in the valley of the ash of death'²⁰

Sometimes pre-existing templates can lead to a misinterpretation of the events. For example, during the Chernobyl accident, authorities in Norway and elsewhere thought the nuclear explosion would have little immediate effect. Their models were taken from nuclear testing, which had spread radioactivity high up in the atmosphere. In the Chernobyl accident the pattern was different – here fallout was spread by low clouds and wind, and by rain showers that concentrated radioactivity unevenly in different geographical areas. One valley could be severely affected, a nearby valley hardly at all. Since the theory was wrong, the initial measurements were also deficient.

Clearly organized science is about organizing world views. So in modern societies the key supply of templates for understanding what is going on, comes from scientists. The Heliocentric model of the universe is one example; the complex models provided by the *Intergovernmental Panel of Climate Change* is another.

One more point can be added. In political science literature one finds what is called the «Almond-Lippmann consensus,» with three propositions:

- Public opinion is *volatile*, shifting erratically in response to the most recent developments.
- Public opinion is *incoherent*, without a consistent structure – and often one finds areas where the public has no set views.
- Public opinion is often *irrelevant* – ignored by political leaders.²¹

A key role of political parties is generally described as «interest aggregation» – combining a set of issues into a political platform. If the Almond-Lippmann consensus – itself not isolated opinions but a wider conception! – is taken as valid, one could argue that the key role of political parties is «interest *integration*» – the program of a party cannot mix issues any which way. Organizations strive for consistency.

This means that political parties and political organizations generally have more worked out agendas – platforms rather than miscellaneous planks – than do ordinary citizens. Indeed, when citizens do not entertain a haphazard collection of beliefs or opinions, a key reason is that political organizations organize opinions and make them more consistent for them. Supporting or joining a party or an interest organization makes people adapt to and adopt a large part of its program. So people in fact have fewer constellations of opinions than there are logical possibilities for combining them.

This point can be illustrated in a simple manner.²² Assume that there are two political issues, each of which one can be for or against – e.g. that CO₂ emissions should be taxed (for or against) and that funding for public transportation should be increased (for or against). This results in four possible combinations (for/for; for/against; against/for; against/against).

If a third such binary issue were added – say on taxing polluters – there would be eight combinations. If there were 10 issues, each which one could be for or against, there would be 1,024 possible strings or combinations.

What organizations – such as political parties, churches or interest groups – do is to *reduce the number of combinations and string them together in coherent ideological wholes*. In order to study opinions and beliefs about climate change, public opinion therefore cannot be studied in isolation, as aggregates of individuals – the link to the ideological developments in organizations must be brought in, as they not only reflect but also shape and channel public opinion. The fact that party ideologies provide more or less integrated ensembles of opinions also makes them more resistant to change.

One link is particularly interesting. This is what has been called the «law of anticipatory reactions»²³: Leaders or organizations may pre-empt or foresee how the public will react to a certain issue. An illustration could be German Chancellor Angela Merkel's decision first to shut down seven nuclear power plants in Germany in March 2011 after the Fukushima accident and later to stop all German nuclear power plants during the next decade. Clearly the *potential* reactions of public opinion to *not* taking such actions were a motive good enough to implement these decisions. Politicians and others act in advance of the anticipated reaction and thereby defuse it. Put differently: History is also about what does *not* happen.

The general point is that in opinion change – or opinion integration and organization – some of the most important actors are not individuals but organizations. They offer frames of reference for interpreting events and more or less coherent programs for action – templates that citizens can adopt to make better sense of their world. However, it must be pointed out that though organizations – or individuals – may put forward different conceptions of the world, they are not all equally valid – a self-contained alternate reality may in fact also be a faulty construct.

6. Are You Alone?

According to a classical theory, people can change their attitudes by solitary reasoning – one can, so to speak, convince oneself.

Yet more common is to enter into dialogues or arguments with others. Then opinions can change through a social process. Starting with a set of preconceptions people can try to convince each other either that their notions, some or parts of their ideas, should be revised. There are several justifications for such changes as discussed above, notably that the views one holds are internally inconsistent or that they cannot be subsumed under the same set of more general values. Or that the rank order of values themselves may change – e.g. when threats to the environment become more apparent, pressing or undeniable.

But as attitudes and beliefs are not logical isolates, persons are not eremites. In the famous words of John Donne:

No man is an island entire of itself; every man
is a piece of the continent, a part of the main.

Hence attitudes or beliefs are not only linked by more or less consistent conceptual maps *within* each person – *attitudes and beliefs are links between persons*. Friends and colleagues tend to share opinions, be of the same persuasion and like many of the same things. Common beliefs are human bonds.

So friends may support the same political party, belong to the same religion, and be of the same persuasion. However, if they like each other but have strongly opposing views on an important issue or a third person, they may be in trouble. Discord can result in their deciding not to talk about what divides them, or they can withdraw from each other because they are not on speaking terms. The triangle is not balanced. On the other hand, if they like each other they may become comrades in arms if one of them strongly dislikes a third party. Likewise, it can be easy to conclude that «the enemy of my enemy is my friend.»

The idea is that people not only will try to harmonize their own opinions but will try *adjust their opinions to those of their friends – or in contrast to those of their adversaries*. The underlying idea is that people will try to balance the relationship they have with significant others and harmonize their opinions. As the old adage puts the question: «Are you to trust me or believe your eyes?»

A good illustration of this *general logic whereby internal consistency is worked out in a social process which can at the same time create a divide between opponents and proponents, allies and adversaries* is provided by Max Weber in his discussion of the development of Calvinism:

The question is why and how the particular theological construction of Calvinism arose. Here it seems that Weber hints at a *cognitive model*, in which the working out of internal consistence is at the heart of the argument. Weber writes about the development of the doctrine of predestination:

With Calvin was just the opposite [from that of Luther]: the significance of the doctrine for him increased, perceptibly in the course of his polemical controversies with theological opponents. It is not fully

developed until the third edition of his *Institutes*, and only gained its position of central prominence after his death in the great struggles which the Synods of Dordrecht and Westminster sought to put an end to. With Calvin the *decretum horrible* (predestination) is derived not, as with Luther, from religious experience, but from the logical necessity of this thought; therefore its importance increases with every increase in logical consistency of that thought. (p. 102)

In Weber's specific argument there is a *model for change of actors* based on logical or cognitive consistency (that is, what actors can and do believe), and he connects the working out of consistency to a social process, namely intellectual conflicts or polemics.²⁴

How persons are joined or forced apart by shared or opposed views was formalized by the psychologist Fritz Heider, again from the consistency motive mentioned above. He drew triangles where one line connected two persons and the other two lines connected each of them to an object. Pluses and minuses were assigned to positive or negative attitudes. A triangle would be balanced if the product of the signs were positive (see Figure 5). Hence «the enemy of my enemy is my friend» is also balanced, because the product of signs $[(-)(-)(+)] = (+)$.²⁵ But then a triangle could be unbalanced, e.g. if two persons who like each other have opposing views on an issue (See Figure 6). An unbalanced triangle could be balanced by one of them changing his opinion – or by their ceasing to be friends.

Figure 5.

A balanced triangle between two friendly persons with the same opinion on an issue

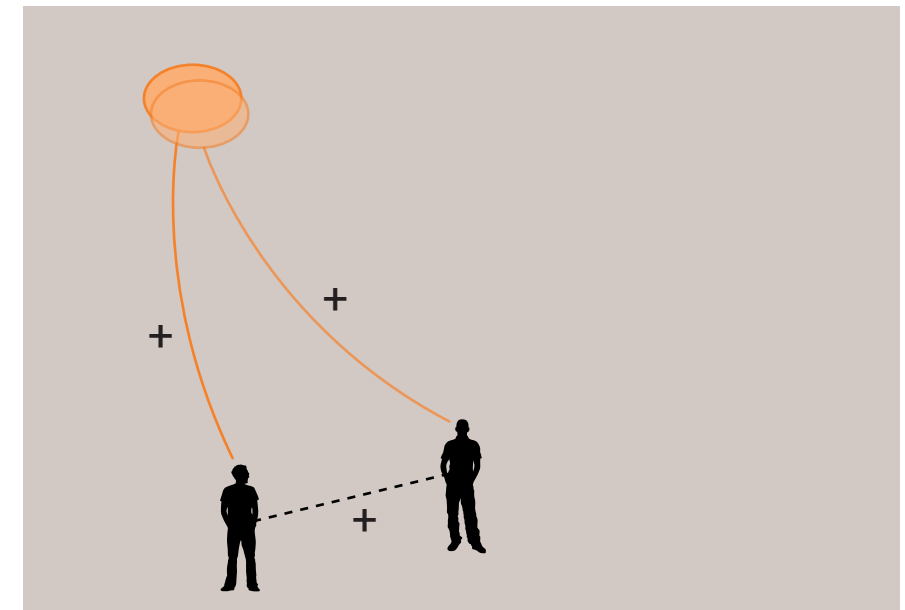


Figure 6.
An unbalanced triangle between two friendly persons with opposed opinions on an issue

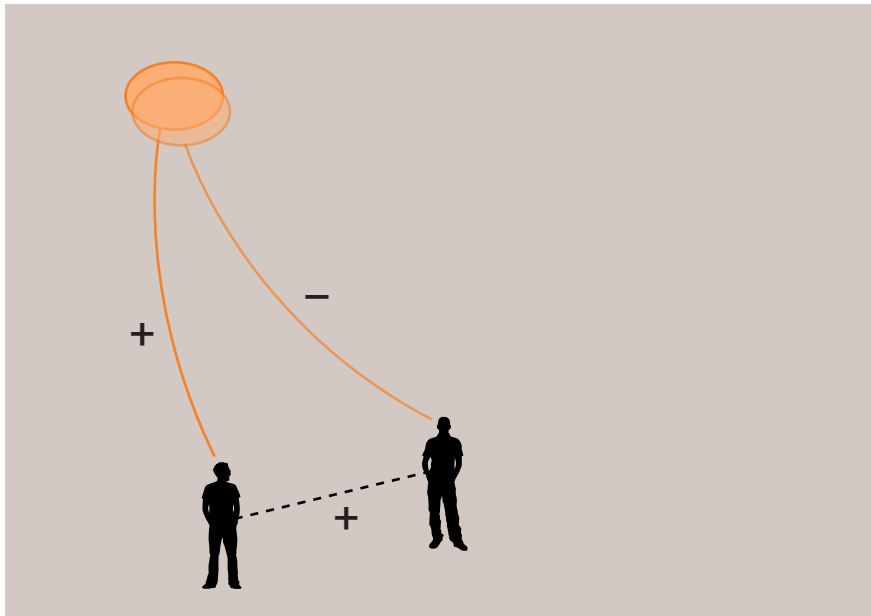
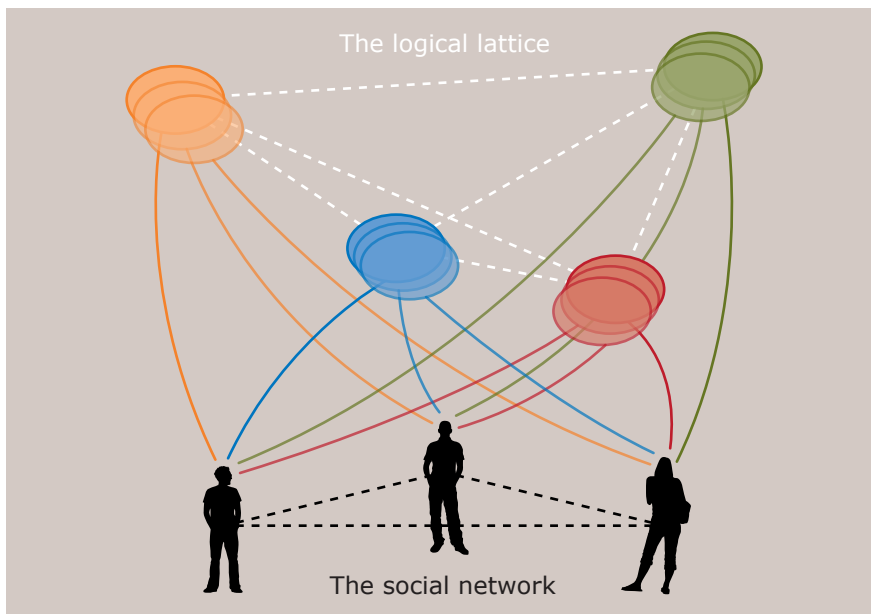


Figure 7.
Opinions are doubly embedded – in a logical lattice as well as in a social network



However, people are connected not just to one or two other people, but to each other in wider social networks. More than that: The persons in a social network have opinions on much the same set of issues. Hence we can speak of opinions or beliefs as being «*doubly embedded*»: On the one hand, different opinions and cognitions over time become more interlinked, coherent and consistent, and hence are *cognitively embedded in a logical lattice*. On the other hand, conceptual maps are at the same time *shared*, i.e. are *socially embedded in an interpersonal network*. (See Figure 7.) Here there could be plusses and minuses along the connectors indicating that neither are all links in the figure consistent nor all relations harmonious. The key is how such discords work themselves out in the system.

In the process of working out, people are driven not just by logic or appeals to fact – they are also driven by relations they want to maintain or strive to attain – or to dissociate themselves from. Logical relations can become more consistent through disputes – i.e. by proponents and opponents arguing their case. The result may be that they end up in sync, on the same wavelength – as adherents to the same set of beliefs, hence allies. Or they may split into rival camps as antagonists and adversaries. New issues may be interpreted in such a way as to cement sympathy – or new issues, due to the way they are spun, may reinforce animosity between arch enemies. Decisions about outlooks are not made by arguments, logic and evidence alone, but how they define the boundaries between social groups.²⁶

The point is that *those who share or split on conceptual maps also control each other via social networks* – issues can be used not just to flag opinions but also to define loyalties. Concepts and beliefs can, so to speak, be used as shibboleths – markers that distinguish between different sets or even kinds of persons, between insiders and outsiders. You resign from a group by rescinding its beliefs; you affiliate with another by adopting its views. Intellectual conversions entail social rearrangements and *vice versa*.

One could therefore argue that it is not you who has an opinion – rather the opinion has you. Your cognitions can move you in and out of networks – while switching loyalties by becoming a member in another group can make you change your views, and vice versa. Opinion change does not occur in isolation – just as there are fads and fashions in thinking there are realignments and reconfigurations in social relationships. Indeed, one could coin the term «copiniator» for those who interact on the basis of shared opinions (combining the French «copain» for friend and «opinion»).

From this conceptualization it also becomes apparent why mindsets lodged in social networks are resistant to change: Making a new mental map or logical lattice requires intellectual effort, making a whole group convert requires the resetting of many minds, which is strenuous. This also helps explain phenomena like selective perception and cognitive dissonance. Put bluntly: People help each other to maintain their shared misconceptions. (The famous Asch conformity experiments showing that people could be socially induced to accept something contrary to their own perceptions, provide an illustration.) Or stated differently: Opinions embedded in logical lattices as well as in social networks are resilient – they tend to return to their original form after perturbation or stress.

It is therefore interesting to study change in attitudes towards climate change as network change: i.e. to what extent and by what points of entry whole networks change – or are changed by – new ideas. Indeed, one could study such change as ripple effects through networks. This would be quite different from standard opinion surveys, which only register the attitudes and beliefs of individuals and how they are distributed – not how they are propagated through a social mesh.

A case in point is climate change becoming a wedge issue in American presidential politics. The different political camps disagree not just about what needs to be done, but also about what is going on, what are the facts and what is the validity of science. Conflicting opinions and beliefs about the same issue – *in casu* climate change – is a litmus test for the antagonists:

Four years ago in New Hampshire, campaigning for the Republican presidential nomination, John McCain said to voters, «I do agree with the majority of scientific opinion, that climate change is taking place and it's a result of human activity, which generates greenhouse gases.» He made global warming a key element of every New Hampshire stump speech.

This week in New Hampshire, the governor of Texas and newest presidential contender, Rick Perry, said scientists have manipulated data to support their «unproven» theory of human-influenced global warming. He said increasing numbers of scientists have disavowed the theory altogether.

This is not simply a case of two very different politicians saying two very different things. The political discussion about global warming has lurched dramatically in four years – even as the scientific consensus has changed little. McCain's 2007 description remains the scientific consensus: Human activity, including the burning of fossil fuels, is pumping carbon dioxide and other greenhouse gases into the atmosphere and warming the planet.

But that scientific conclusion has become a lively point of debate in the GOP presidential campaign. Joining Perry on the skeptical side, for example, is Rep. Michele Bachmann (R-Minn.), who suggested Wednesday that «manufactured science» underpins what a questioner called the «man-made climate-change myth.»

The nominal GOP front-runner, Mitt Romney, drew sharp fire from conservatives when he said in June that he accepts the scientific view that the planet is getting warmer and that humans are part of the reason. Former Utah governor Jon Huntsman Jr. (R) on Thursday tweeted: «To be clear. I believe in evolution and trust scientists on global warming. Call me crazy.»

«Climate change has become a wedge issue,» said Roger Pielke Jr., a University of Colorado professor who has written extensively on the climate debate. «It's today's flag-burning or today's partial-birth abortion issue.»²⁷

Two more points should be underlined in this connection. Neither in the logical lattice nor in the social network are all nodes of equal consequence or sway – some are

more equal than others. That is, with respect to the logical lattice – the interrelations between beliefs or opinions, one dissonance or inconsistency may be more momentous for other beliefs: Belief in the heliocentric system had repercussions for many other presumptions. With respect to the personal network, some are potent opinion leaders: When they change their mind, they prompt others to do the same. And clearly, when opinion leaders also are the leaders of organizations, their shifts may swing the whole membership.

7. Is the Issue Controversial?

From the argument above it follows that the extent to which events may change attitudes also depends on the controversy they generate. Shattering events focus the attention by jolting complacency and shattering notions. They affect a large number of people at the same time setting a common agenda. And they mobilize many who have not been active before, either in thinking about the issues or in acting on them.

Controversies force protagonists and antagonists to react not just to the course of events, but to each other. The main issue becomes more sharply defined; the stakes are heightened because they are expanded: not just confined to what has occurred, but what are its causes, who is to be blamed and what is to be done – i.e. about the distribution of power. Contention provokes consistency. As part of the debate opposing views become better articulated and more coherent – and the parties more polarized. The bone of contention becomes more precisely identified. What happens can be presented as concrete examples of more general phenomena.

In such conflicts it is also often possible to reveal and call attention to the ways in which different groups have been or will be affected – and also that the *status quo* is not tenable or sustainable. In the case of 1954 Bikini Atoll nuclear accident in 1954 first contaminating *Fukuru Maru Drago* or *Lucky Dragon No. 5*, generated several conflicts: about causes, about cover-up, about compensation, about ramifications, about responses. The danger of contaminated food quickly altered the popular perception of risk – it was transported, so to speak, from the Bikini Atoll to Japanese kitchen tables. It inspired a local petition drive to ban-the-bomb, there was a high interest «like we cannot eat fish, we cannot eat vegetables», the nationwide crisis sharpened the message and rooted it in peoples livelihoods and lives. And it spilled over into the political arena, and indeed became a conflictual issue between the US and Japan:

In September 1955, on the basis of over 20 million signatures, the Suginami campaign turned into the Japan Council against A- and H-Bombs (Gen-suibaku Kinshi Nihon Kyogikai, or Gensuikyo). This first mass-based nuclear disarmament advocacy group in Japan grew out of the citizenry's loss of confidence in the government's reassurances.²⁸

In other words: *Controversy works at both levels in the double embedding of attitudes – in logical lattices as well as in social networks*. By affecting many persons at the same time, they become both more malleable and more mobilizable: they can change their views and they can shift their loyalties.

8. Does Politics Polarize the Issues?

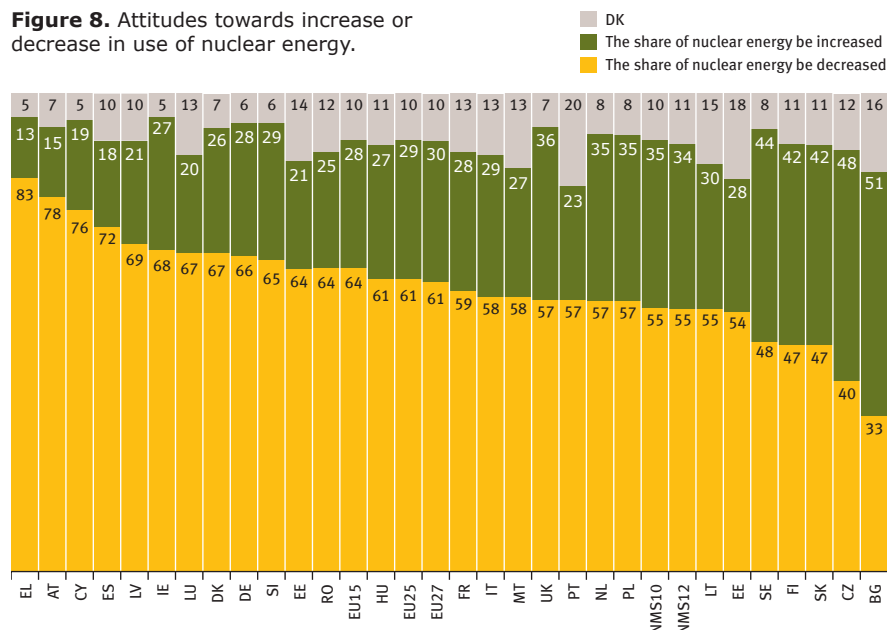
Of particular interest is to what extent controversies spill into the political arena and thence affect public attitudes. For example, it has been argued that the reason why anti-nuclear sentiments are so much stronger in Germany than in France is due to the fact that in Germany it has been a contentious issue among political parties, while in France there has been a high degree of national consensus among the political class to expand the use of nuclear power to generate electricity.

Indeed, polls find that there are wide differences in attitudes and beliefs about various aspects of climate change or environmental threats not only globally between continents, but also among neighboring European countries. A case in point is views as to whether the production of nuclear energy should be increased or decreased. (See Figure 8 below.)

To a considerable extent such differences may be due to two factors:

First, the general *political agenda in a country* (which issues are pushed to the top by politicians as opinion leaders) and *what other issues are salient* for the general public. Attitudes are not independent of *but conditioned by the political culture into which they are embedded*. Professor Nick Pidgeon argues that skepticism about climate change is seen most strongly when environmental issues compete with other topics for importance. For example, when compared with other concerns like terrorism, religious fanaticism, viruses or war and famine, half of Americans ranked terrorism as their greatest concern, with global warming coming second.²⁹

Figure 8. Attitudes towards increase or decrease in use of nuclear energy.



One third of EU electricity comes from nuclear energy. Regarding nuclear energy there are two fundamental approaches, which one do you tend to agree more? % Base: all respondents, by country. Flash Eurobarometer 206a – The Gallup Organization, Hungary. Source: http://ec.europa.eu/public_opinion/flash/fl_206_slides_en.pdf

Second, by the nature and intensity of the controversies between the political parties, i.e. by the saliency of the issues for the electorate and election outcomes, as was discussed in more general terms above.

In sum: Public attitudes on climate are influenced by the political climate in a country – i.e. by the institutional conflicts and the way they play themselves out.

9. How Do the Issues and Their Adherents Change Over Time?

In Figure 7 a static system logical as well as social relations are depicted. What is shown are both sources of tensions as well as forces of conservation.

The obvious follow-up to this question would be to look at changes over time – i.e. whether certain attitudes affect each other, whether opinions become more or less widespread, whether there are changes in the intensity of held beliefs and whether beliefs in related areas become more or less integrated both within persons and between them. These are questions of social dynamism.

How could we depict changes in attitudes over time, e.g. in the simplest case when two attitudes mutually affect each other? For example, one could assume that your view on whether global warming is taking place is related to your view on whether this change is anthropogenic. We could also envision two consistent combinations:

- 1) the view that global warming is taking place *and* that it is due to human activities, and
- 2) the view that climate is stable *and* deviations from the average are only expression of natural variation.

How this can be depicted is illustrated in Figure 9.³⁰

Figure 9. Over time mutual effects or attitudes

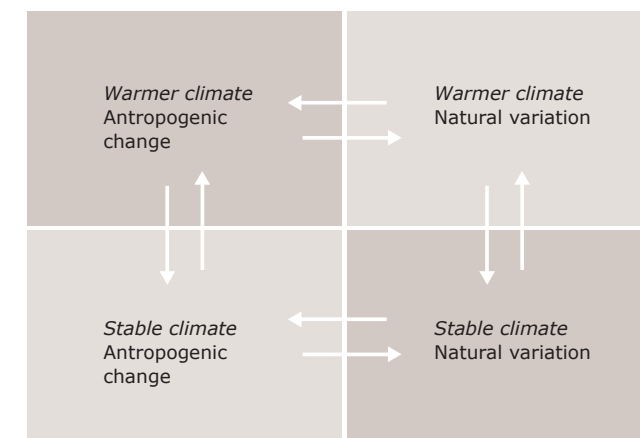


Figure 10.1 Here are four views on pollution and environmental problems. Which is closer to your own?

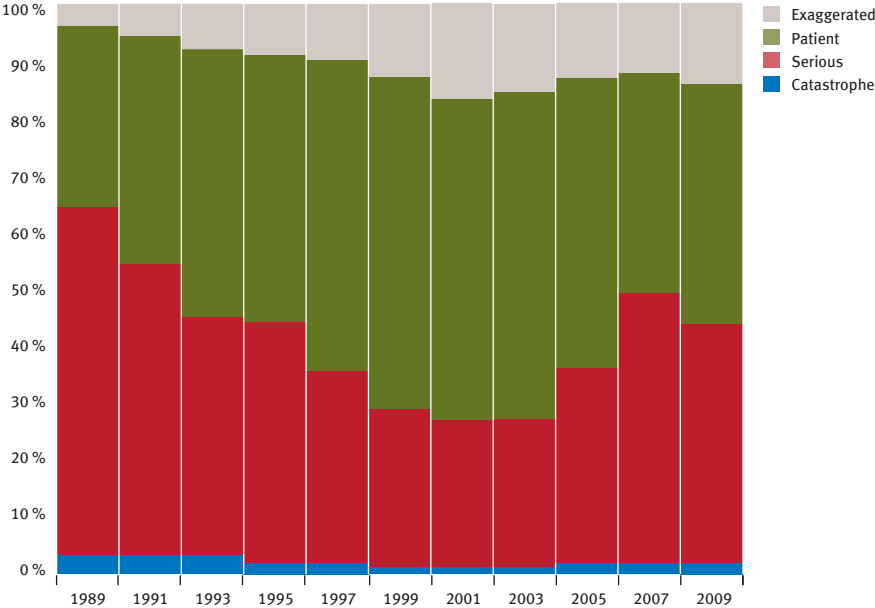


Figure 10.3 How worried are you about acid rain?

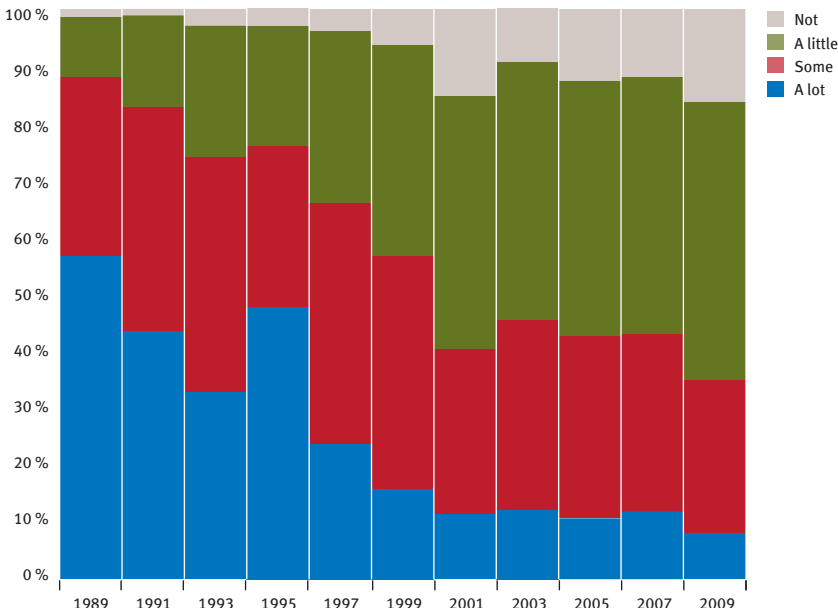


Figure 10.2 How worried are you about depletions of the ozone layer?

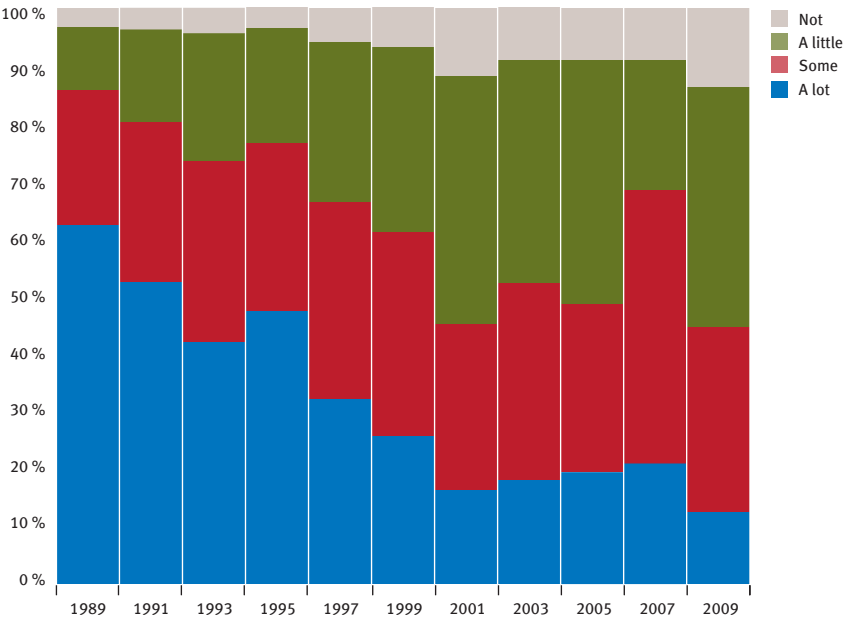
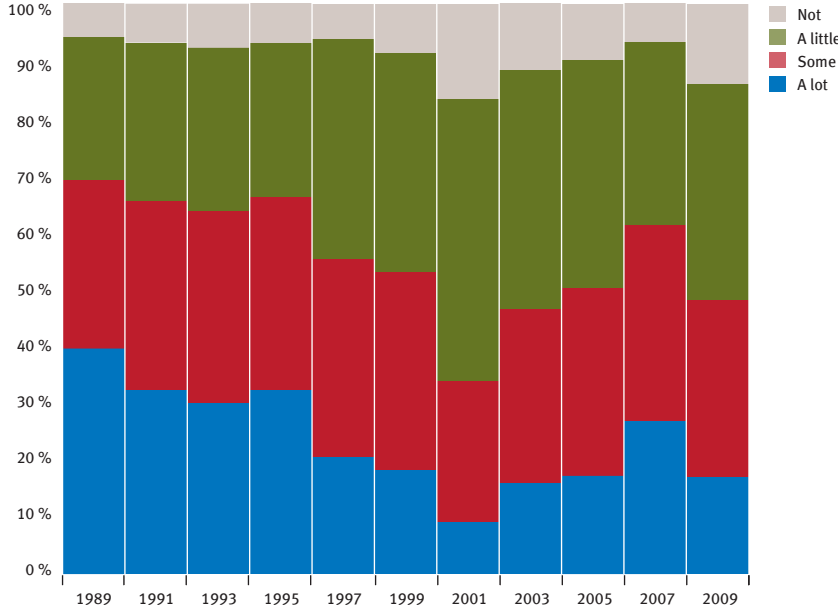


Figure 10.4 How worried are you about the greenhouse effect and climate change?



In the last couple of decades there has been a considerable swing in public opinion on climate issues – in fact in many countries the concern about climate change has declined. In Tables 10.1-10.4 showing bar diagrams, the attitudes of Norwegians are given at two-year intervals from 1989 to 2009. From these tables it can be seen that overall the percentage that thinks pollution and environmental problems are serious has declined, though there has been some increase since 2005.³¹

The declining concern is even more pronounced with respect to the depletion of the ozone layer as well as acid rain, not quite as much for climate change and the greenhouse effect. In short: There are different views on different specific climate issues.

Why have these changes taken place? Some shifts are probably due to the fact that effective measures have been introduced, for example to cut the use of Freon gases that have had such a negative impact on the ozone layer.

But there may be two other effects as well. The first is this: If important attitude changes are event-driven, then of course its saliency may become *weakened* over time.

This may be due to three analytically separate processes. As a catastrophe with a strong impact on public opinion becomes more distant, it comes to occupy a less prominent place in the public mind. This has been seen for example with respect to the use of nuclear reactors – or with respect to the concern for hunger. An issue can recede from consciousness and fade from public distress. Both the 2011 nuclear catastrophe in Fukushima and the hunger catastrophe in East Africa suggest that new similar events are required to rekindle both understanding and apprehension.

Secondly, those who have experienced a catastrophe themselves pass away. For example, over a 20-year period several hundred thousand Norwegians have died – they are out of the survey sample, so to speak. For those who experienced a dramatic event or a portent trend, its effects may attenuate and become weaker in force over time, such as those who still remember Hiroshima.

The third process is due to the cohort effect touched on above. A generational cohort has been defined as «the group of individuals (within some population definition) who experience the same event within the same time interval».³² The idea is that *the same event may have different effects for different age groups* – a war may affect grown-ups more than children. Hence also the *absence* of an event can also shape an age group. Some of the specific environmental effects, such as damage to the ozone layer, may have been especially pertinent to those who were exposed to its discussion in the mid-1970s. The dangers from the arms race or fallout from nuclear testing may have been especially worrisome for young people who experienced it at the time. The young in recent years may have heard little about it; hence it may not have become a very salient issue for them. This also implies that *new cohorts may have to make their own experiences* – there is no automatic transfer of vicarious experiences or knowledge and attitudes from one generation to the next. That is why institutional and organizational memory is so important.

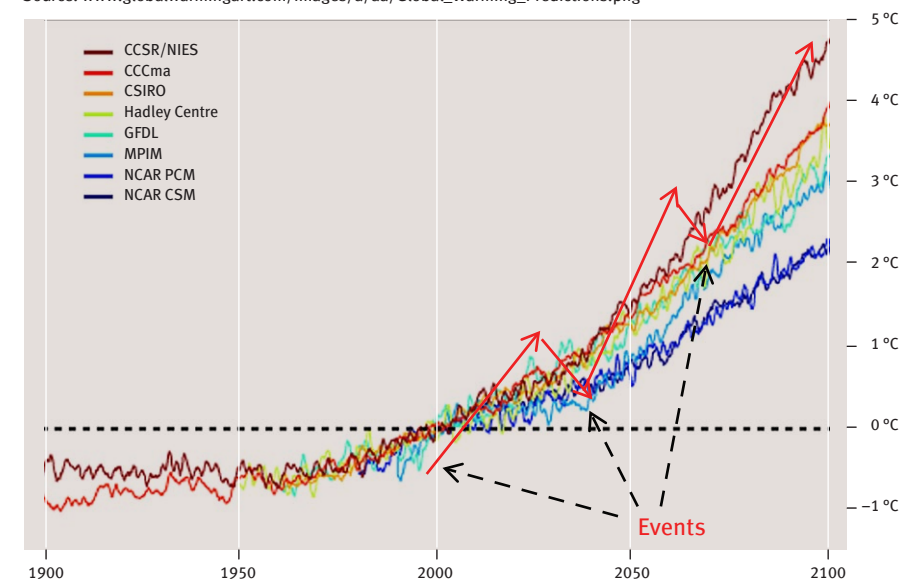
Cohort effects can also work in the opposite way – i.e. by an old guard passing away and the newcomers becoming a majority. Thomas Kuhn, in *The Structure of Scientific Revolutions*, includes the following quote: «And Max Planck, surveying his own career in his Scientific Autobiography, sadly remarked that ‘a new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up familiar with it’.»³³

But then a new dramatic event can evoke anew and strengthen previous experiences and conclusions – it serves, so to speak, as a repeat lesson. If we take as an illustration global warming projections, even though they differ between different agencies, they have the same general upwards trajectory. We can then surmise that *attitude change is not a mirror image of a regular trend*. Rather we would expect attitudes to *change in spurts after an event* – but then relapse and fall back relative to the temperature curve – to be energized anew by some new event. In other words, even global warming follows a slowly growing gradient, it may trigger dramatic weather events (e.g. such as the 2011 Texas drought or tornadoes in the US) which provide jolts to public awareness and opinion. The expected result would then look like the jagged curve superimposed on the temperature trajectories in Figure 11. It illustrates that there can be a *ratchet effect*, so to speak: i.e. that opinion is yanked upwards by events, and if there is some backslide, there is not a full fallback to the starting point.

Figure 11. Global Warming Projections and Jagged Opinion Triggered by Events

Temperature Anomaly (°C).

Source: www.globalwarmingart.com/images/a/aa/Global_Warming_Predictions.png



10. Who Has a Pecuniary Interest in the Issues?

The American author Upton Sinclair famously said, «It is difficult to get a man to understand something when his salary depends on his not understanding it.» And a claim that has been repeatedly made is that economic actors that have stood to lose from changed environmental or climate policy have been very active in challenging the scientific consensus, casting doubt for example on the anthropogenic nature of climate change and highlighting negative impacts of interventions, such as the cost of new regulations and restrictions.

A report on this issue is the book *Merchants of Doubt* authored by two US historians of science, Naomi Oreskes and Erik M. Conway. They show the likeness between the strategies used in the debate on climate change and earlier controversies on ozone layer depletion, tobacco smoking and acid rain. Casting doubt and spreading confusion, they claim, has been an integral part of the strategy of those with a direct pecuniary interest in the issue and in the political interventions to ameliorate or reverse developments. Oreskes and Conway identify parallels between the climate change debate and earlier controversies over tobacco smoking, acid rain and the hole in the ozone layer. They write that spreading doubt and confusion was the basic strategy of those opposing action in each case. They also argue that obfuscation has been integral to the strategy of the climate skeptics.³⁴

Another author who makes similar points is Chris Mooney in *The Republican War on Science*.³⁵ He argues that a coalition of skeptical scientists, and pundits and think tanks of the Right have attempted to replace scientific discourse with ideological argument – e.g. in promoting doubt about what is not scientifically controversial. Other polemical volumes are the recent book by environmental lawyer Robert F. Kennedy Jr., *Crimes Against Nature: How George W. Bush and Corporate Pals are Plundering the Country and Hijacking Our Democracy*³⁶ and Al Gore's *The Assault on Reason*.³⁷

Above it was argued that attitudes are not independent of but conditioned by the political culture into which they are embedded. Clearly the same also holds with respect to business culture and measures taken to protect and promote corporate interests.³⁸

Studies of climate change and attitude change have to address this topic.

Hot Topic – Cold Comfort

In this essay two key arguments have been made. First, that the broad change in views of the Earth, its place, condition and predicament – what was encapsulated in the catchphrase the «Ecological Revolution» – has largely been due to specific events in the period following the Second World War. Attitude change has been event-driven. Over time these separate events – reinforced by others like them – have slowly coalesced into a broader outlook about where planet Earth is heading.³⁹ It is literally a change in world view which is on par with the Copernican Revolution. Clearly this «Ecological Revolution» is not yet completed: All the lessons are not yet learned – nor have they been fully taught.

In the second part it has been argued that this broad change in outlook provides a challenge as well as an opportunity for the social sciences. In the final chapter, a set of topics for research is outlined. The key theme in this second part has been a theoretical one – about how attitudes are changed. Simply put, the argument is that attitudes are lodged simultaneously in logical lattices as well as in social networks. Taken separately, each tends to maintain and conserve a given configuration – a configuration of opinions into a broader outlook and a set of interpersonal relations constructed as a social network.

But they cannot be taken separately because they are in fact formed and fixed jointly – your mindset is not only critical to your identity, it also defines you in relation to others, whether or not others share your mindset. This double embedding – in a logical lattice as well as in a social network – results on the one hand in mutual reinforcement, continuity and stability. Opinions come in ensembles, friends come in clusters – and both come together: one at the level of cognition and logic, the other at the level of company and sentiment. Hence the question arises how change in them can come about.

The argument made in this essay is that broad attitude change can be event-driven. The reason is, simply put, that dramatic events may simultaneously provoke attention and attack beliefs as well as relations. The force of circumstance – event-generated attitude change – is potent precisely because the two structures are simultaneously impacted: one at the level of conceptualization – the logical lattice – and the other at the level of human relations – the social network. If opinions are doubly embedded, both layers are simultaneously perturbed by dramatic events. In the logical lattice events may disconnect the dots, in the social network events may disrupt the links. When the different links between both types of elements are unhinged, they can be reconfigured.⁴⁰ Metaphorically the dissociated ideas and persons then become like an undercooled liquid which a nucleus that can crystallize into a new lattice.

One could even talk about a third level of embedding that may be affected by events, for beliefs and attitudes become institutionalized in legal arrangements such as the international convention on biodiversity, lodged in administrative structures such as ministries of the environment or buttressed in the platforms of political parties or interest organizations such as the World Wildlife Fund. Attitude change is not just a question of individuals changing their views – it is also a question of organizational responses and ideological shifts. Broader narratives have to be rewritten.

When events in the outside world become perceptually and psychologically overwhelming – too poignant to be denied and to potent to be ignored – beliefs are changed and relations reconstructed, not primarily because of the force of argument but because of the force of circumstance.

Global warming and climate change has become a hot topic. Yet the fact that the various threats to the planet, even through major events, have not had a greater impact on the public mindset is sobering and slight consolation. Indeed, it is cold comfort. The events and disasters that have happened have been bad – yet they may not have been bad enough.

[IV. Explanations of Attitude Change Endnotes]

- 1 Brett W. Pelham, «Awareness, Opinions About Global Warming Vary Worldwide. Many unaware, do not necessarily blame human activities,» <http://www.gallup.com/poll/117772/Awareness-Opinions-Global-Warming-Vary-Worldwide.aspx> (Updated May 7, 2011).
- 2 See «More in Europe worry about climate than in US, poll shows,» IHT, <http://www.nytimes.com/2007/01/04/health/04iht-poll.4102536.html>
- 3 Phil Downing and Joe Ballantyne, *Tipping Point or Turning Point* (Ipsos Mori Social Research Institute, 2007) http://www.ipsos-mori.com/DownloadPublication/1174_sri_tipping_point_or_turning_point_climate_change.pdf
- 4 See for example «The Top 10 Myths and Misconceptions About HIV and AIDS,» <http://www.webmd.com/hiv-aids/top-10-myths-misconceptions-about-hiv-aids>
- 5 For a discussion, see Michael D. Lemonick «Global Warming: Beyond the Tipping Point,» *Scientific American*, October 6, 2008 (<http://www.scientificamerican.com/article.cfm?id=global-warming-beyond-the-co2>)
- 6 This also means that the origin of events which in the past have been seen as «acts of God,» i.e. natural catastrophes have been attributed to human interventions, e.g. when the weight of dams trigger an earthquake.
- 7 A recent example is provided by Richard Muller, a prominent American physicist, who «was so skeptical about data showing a gradual warming of the Earth's surface that he decided to investigate for himself. The results of his two-year inquiry — partially bankrolled by the Charles Koch Foundation, whose founder is a prominent global-warming denier — are now in. And, voilà, the Earth is indeed warming, just as most scientists have been saying for years.» See <http://www.nytimes.com/2011/11/04/opinion/dr-mullers-findings-on-global-warming.html?scp=1&sq=Richard%20Muller%20Koch&st=cse>.
- 8 For a thorough analysis, see Toshihiro Higuchi, *Radioactive Fallout, The Politics of Risk, and the Making of a Global Environmental Crisis, 1954-1963*, Ph.D. Dissertation (Washington D.C.: Georgetown University, Graduate School of Arts and Sciences, 2011). The quote is from his dissertation, p. 47, and is taken from Intelligence Estimate no. 72, February 16, 1955, in fldr: Moratorium on Nuclear Weapons Tests –1955 (1), Box 5, Office of the Special Assistant for Disarmament Records (OSADR), White House Office (WHO), Dwight D. Eisenhower Library (DDEL), Abilene, Kansas.
- 9 Robert B. Cialdini, Melanie R. Trost and Jason T. Newsom, «Preference for Consistency: The Development of a Valid Measure and the Discovery of Surprising Behavioral Implications,» *Journal of Personality and Social Psychology*, 1995 (Vol. 69), pp 318-328, quote p. 318. Psychological theories based on the «consistency motive» were first proposed by Fritz Heider in «Attitudes and Cognitive Organization,» *Journal of Psychology*, 1946 (Vol. 21), pp. 107-112, and elaborated on in *The Psychology of Interpersonal Relations* (Wiley: New York, 1958). Heider is considered the father of «Balance Theory» - in which he conceptualized the consistency motive as a drive toward psychological balance. Heider's theory has been challenged; see for example the article by Cialdini, Trost and Newsom. The authors argue that there has been a shift away from the explanatory utility of the consistency principle. They also report (p. 318) that a «surprisingly large percentage (at least half) of our participants [in their study] showed no strong inherent preference for consistency – a finding that may explain the failure to detect or replicate (a) traditional consistency effects and (b) a wide variety of other experimental phenomena.»

- 10 Max Weber made a point of this in his *The Protestant Ethic and the Spirit of Capitalism*. See Gudmund Hernes, «The Logic of the 'Protestant Ethic',» *Rationality and Society*, July 1989, vol. 1 no. 1, 123-162, cf. below.
- 11 John Maynard Keynes, *The General Theory of Employment, Interest, and Money* (Chapter 24).
- 12 For example, studies find that the stated price of a bottle of wine influenced how good tasters thought it was: The taste of a 90 dollar bottle was consistently ranked better than the 5 dollar one, and the 45 dollar bottle better than the 35 dollar one. It even influences the activity of the brain region involved assessing pleasure. And it was a blind testing in 1976 that enhanced the reputation of California wines relative to those from Bordeaux, «Wine Study Shows Price Influences Perception,» California Institute of Technology, 01/14/08. http://media.caltech.edu/press_releases/13091
- 13 See Jon Elster, *Sour Grapes: Studies in the Subversion of Rationality* (Cambridge: Cambridge University press, 1983).
- 14 Festinger, Leon, Henry W. Riecken, Stanley Schachter, *When Prophecy Fails: A Social and Psychological Study of a Modern Group that Predicted the Destruction of the World*. (Ann Arbor: University of Minnesota Press, 1956).
- 15 Dissonance can be reduced not just by denial of facts, but also by denunciation or by defending the opposite view. Jon Elster has called this «adaptive preference formation,» see his *Sour Grapes: Studies in the Subversion of Rationality*. (Cambridge: Cambridge University Press, 1983) p. 123ff. A popular expression encapsulating this insight is, «If you cannot get the one you want, you have to want the one you get.»
- 16 For an update, see The Christian Post > U.S.|Fri, Oct. 21 2011 12:30 PM EDT «Harold Camping Oct. 21 Rapture: Bible Preacher Declares 'Nothing to Report Here'» *The Christian Post*, Oct. 21 2011. <http://www.christianpost.com/news/harold-camping-oct-21-rapture-bible-preacher-declares-nothing-to-report-here-58957/>
- 17 Thomas Kuhn, *The Structure of Scientific Revolutions*, Chapters VI and VIII, (Kindle edition.)
- 18 See see Toshihiro Higuchi, *Radioactive Fallout, op.cit.* p. 49.
- 19 *Ibid.* p. 47.
- 20 *Ibid.* p. 44.
- 21 See Walter Lippmann, *Essays in the Public Philosophy*. (Boston: Little, Brown, 1955), Gabriel Almond and Sidney Verba, *The Civic Culture: Political Attitudes and Democracy in Five Nations* (Princeton: Princeton University Press, 1963) and Philip Converse «The Nature of Belief Systems in Mass Publics» in, David Apter, (ed.) *Ideology and Discontent* (New York: Free Press, 1964), pp. 206-261.
- 22 See Gudmund Hernes, «Politiske rammer og ressurser,» Gudmund Hernes and Willy Martinussen, *Demokrati og politiske ressurser* (Oslo: NOU 7, 1980), pp. 43-47.
- 23 The concept is usually attributed to the German-American political theorist Carl Joachim Friedrich.
- 24 See Gudmund Hernes, «The Logic of the 'Protestant Ethic',» *Rationality and Society*, July 1989, vol. 1 no. 1, 123-162, footnote 8, p. 160.
- 25 See Fritz Heider, *The Psychology of Interpersonal Relations* (Wiley: New York, 1958). For a delightful exposition, see Stephen Strogatz, «The Enemy of My Enemy,» <http://opinionator.blogs.nytimes.com/2010/02/14/the-enemy-of-my-enemy/>
- 26 The recent controversies between proponents of the Keynes-Hicks model of counteracting recessions and the budget-cut/austerity school provides an interesting illustration of maintaining your theoretical beliefs in spite of massive contrary evidence. See for example <http://krugman.blogs.nytimes.com/2011/08/20/fancy-theorists-of-the-world-unite/?smid=tw-NytimesKrugman&seid=auto#preview>. A similar critique has been launched against some of the presidential candidates ahead of the 2012 US election. For example, Kurt Anderson of NPR wrote: «Yet the most troubling thing about Perry (and Michele Bachmann and so many more), what's new and strange and epidemic in mainstream politics, is the degree to which people inhabit their own Manichaeian make-believe worlds. They totally believe their vivid fictions. Everyone is entitled to his or her own opinion. Perry is even entitled to his opinion that states such as Texas might want to secede, as he threatened at a Tea Party rally two years ago. But he's not entitled to his own facts.» http://www.nytimes.com/2011/08/20/opinion/anderson-our-politics-are-sick.html?_r=1&hp
- 27 See Joel Achenbach and Juliet Eilperin, «Climate-change science makes for hot politics,» *The Washington Post*, August 19, 2011, http://www.washingtonpost.com/national/health-science/climate-change-science-makes-for-hot-politics/2011/08/18/gIQA1eZJQJ_print.html. It is worthwhile to quote the rest of this article, which is enlightening both in terms of the substance of climate change and attitude change, but also enlightening for the more general issue of the double embedding of beliefs, logical lattices as well as in social relations:

«Historically, climate change has ranked near the bottom of issues that voters care about as they evaluate presidential candidates. It wasn't a factor in 2008's primary season or general election. The major parties' nominees endorsed the scientific consensus and believed that the government should curb carbon emissions.

But even as it appeared that the government might take sweeping action on climate change, the political opposition intensified. President Obama favored a nationwide system in which industries would have to cap their carbon dioxide emissions and trade pollution allowances with one another. The then-Democratic-controlled House passed this «cap-and-trade» system in June 2009, but the plan stalled in the Senate after Republicans and major industries criticized it as a «cap-and-tax» system that would escalate energy costs. The battleground shifted to the Environmental Protection Agency, which in December 2009 determined that greenhouse gases pose a threat to public health and welfare. That «endangerment finding» paved the way for regulating carbon dioxide as a pollutant under the Clean Air Act. GOP lawmakers and industry groups fought the plan, calling it a job-killing tax and an example of government overreach.

During this period, Americans — particularly conservative Republicans — became less convinced about global-warming science. Some in the Tea Party seized on the issue as a rallying cry in last year's election, which brought dozens of new members to Congress who reject a connection between human activity and climate change.

Missteps by scientists have given critics ammunition. Most notorious were «Climategate» e-mails hacked from computers at the Climate Research Unit at the University of East Anglia in Britain in 2009. The e-mails showed scientists being combative and clubby, but multiple investigations in both the United States and Britain cleared the researchers of scientific misconduct, concluding that there was no evidence they tried to cook the books, as critics had alleged.

Embarrassing errors were also found in a seminal 2007 report by the U.N. Intergovernmental Panel on Climate Change, which was supposed to establish, beyond question, the scientific consensus. One passage in the 3,000-page report, for example, stated that massive glaciers in the Himalayas would vanish by 2035 — which isn't true.

Such missteps revealed that the scientific establishment does not always function like a well-oiled machine and that climate science in the raw is a more contentious enterprise than the average academic news release might suggest. But the errors did not change the basic science behind the theory of anthropogenic, or human-caused, global warming.

That the planet has warmed is a fact hardly anyone disputes — it has been measured with instruments on land and sea and in space. That humans have contributed to the warming through industrial activities is a theory supported by multiple scientific organizations, including the National Academy of Sciences, the American Association for the Advancement of Science, the US Global Change Research Program, the National Oceanic and Atmospheric Administration, and NASA.

«Ultimately, we go back to physics. If you burn fossil fuel, you make CO₂,» said Richard B. Alley, a geophysicist at Penn State University and author of «Earth: The Operator's Manual.» «You can do this with bookkeeping. How much did we burn? How much CO₂ does that make? Where is it? There it is.»

One of the twists in the debate is that the data that show the planet warming over the past century — data that skeptics often deride as untrustworthy — also show that the rate of warming has slowed in the past decade or so. «The warming has slowed since 1998,» said Tom Peterson, chief scientist for NOAA's National Climatic Data Center.

The most recent decade is still the warmest on record — warmer than the 1990s, which were warmer than the 1980s. And NOAA and NASA rate 2010 as tied with 2005 as the warmest year ever measured.

But the flattening of the trend has inspired skeptics to declare that global warming is over or that these are natural fluctuations not driven by human activity. Scientists say that's hardly the case, noting that multiple factors are dampening the warming trend, including sunlight-blocking volcanic aerosols and soot emitted from China's proliferating coal-fired power plants. And they stress that the effects of greenhouse gases build over time.

«The full impact of the greenhouse gases that we've already added to the system today won't be felt for 20 or 30 years,» said Bill Chameides, dean of the Nicholas School of the Environment at Duke University and co-author of a recent National Academy of Sciences report, «America's Climate Choices.» When Chameides and his colleagues began their research in 2008, they assumed they'd have to rush to finish before the government took action on climate change. Instead, they watched the political landscape change as «Climategate» and other controversies incited public doubts about climate science. They delayed their report to take a fresh look at the research in its totality.

Their conclusion is stated in the report's first sentence: «Climate change is occurring, is very likely caused by human activities, and poses significant risks for a broad range of human and natural systems.»

There are dissenting scientists, but they're a small minority within the climate-science community. A 2010 study in the journal *Proceedings of the National Academy of Sciences* surveyed 1,372 climate scientists and found that 97 to 98 percent agreed that humans are contributing to global warming.

The general public is far more divided. A Pew Research Center poll published in October 2010 showed that over the previous four years, the number of respondents believing there is «solid evidence» that the Earth is warming dropped from 79 percent to 59 percent. There was a striking divide along partisan lines: Some 79 percent of Democrats believed in global warming, compared with 38 percent of Republicans.

A Washington Post-ABC News poll in November 2009 found conservative Republicans were least likely to believe global warming was occurring, with 45 percent saying it was happening. That represented a 20 percentage-point drop from the previous year.

Influential conservatives have pushed climate science to the fore of Republican politics. When Romney endorsed the consensus scientific view, talk-radio titan Rush Limbaugh immediately declared: «Bye-bye, nomination. Another one down.»

Climate change, said Marc Morano, publisher and editor of the skeptical website Climate Depot, is «a litmus test, pure and simple, for the presidential race.»

- 28 See see Toshihiro Higuchi, *Radioactive Fallout*, *op.cit.* p.52.
- 29 See «More in Europe worry about climate than in US, poll shows,» IHT, <http://www.nytimes.com/2007/01/04/health/04iht-poll.4102536.html>
- 30 For the logic of such analysis, see James S. Coleman, *Introduction to Mathematical Sociology* (Glencoe: The Free Press, 1964).
- 31 I am grateful to Ottar Hellevik of the polling organization *Synnovate* for providing me with these data.
- 32 See Norman B. Ryder, «The Cohort as a Concept in the Study of Social Change,» *American Sociological Review* (December 1965, 30 (6), pp. 843-861.
- 33 Thomas Kuhn, *op.cit.* Chapter VII.
- 34 As one example, see «US oil company donated millions to climate skeptic groups, says Greenpeace,» <http://www.guardian.co.uk/environment/2010/mar/30/us-oil-donated-millions-climate-sceptics>.
- 35 Chris Mooney, *The Republican War on Science* (Bloomsbury: Bloomsbury Press, 2010).
- 36 Robert F. Kennedy Jr., *Crimes Against Nature: How George W. Bush and Corporate Pals are Plundering the Country and Hijacking Our Democracy* (New York: Harper Collins, 2004).
- 37 Al Gore, *The Assault on Reason* (London: Penguin, 2007).
- 38 See footnote 166 above. For a useful overview, see http://en.wikipedia.org/wiki/Global_warming_controversy
- 39 A recent case in point is the report from Japan that «Atomic Bomb Survivors Join Nuclear Opposition.» «Aghast at the catastrophic failure of nuclear technology, and outraged by revelations that the government and power industry had planted nuclear proponents at recent town hall-style meetings, the elderly atomic bomb survivors, dwindling in numbers, have begun stepping forward for the first time to oppose nuclear power.
- Now, as both Hiroshima and Nagasaki observe the 66th anniversary of the American atomic attacks at the end of World War II, the survivors are hoping that they can use their unique moral standing, as the only victims of nuclear bombings, to wean both Japan and the world from what they see as mankind's tragedy-prone efforts to tap the atom.» <http://www.nytimes.com/2011/08/07/world/asia/07hiroshima.html>
- 40 Some of the classical theories of crowd psychology and collective behavior point to the fact that individuals may behave differently when they are part of a group (or negatively: a mob), that its size and anonymity may dissolve the regulating effects of institutions and become unhinged from established networks so that individuals are spontaneously swayed by the contagious effects of other bystanders. *Locus classicus* for the analysis of crowd behavior is Gustave LeBon *The Crowd: A Study* (1896). For a modern and imaginative analysis of crowd behavior, see John Spiegel, «The Nature of the Riot Process,» *Psychiatric Opinion*, June 1968, pp. 6-9.

V. Some Topics for Research



In August 2011, people were evacuated from this house with the aid of an excavator bucket in Stange, Norway. Roads and railway were closed. Photo: Jan Erik Heggelund / Scanpix

V. Some Topics for Research

Given the momentous – global and long-term – consequences of environmental change and the fact that the most important ones are anthropogenic, the research agenda of both the social sciences and the humanities must be reset to forcefully address these challenges.

Two types of questions must be addressed. First, how have the changes in the environment and climate affected public attitudes and beliefs and how have they been translated into political responses? Second, what new opportunities for conceptual development and theoretical innovation in the social sciences and humanities will the broad environmental changes provide? Hence the opportunities and challenges pertain not just to substantive environmental issues, but to general theory development as well. The first challenge is about contributions of social science to the discourse on the environment. The second is how environmental issues can affect social research itself, broadly defined.

Several topics are outlined below. The purpose is to trigger the imagination of the community of scholars – not to provide an exhaustive list.

- In the pages ahead the argument is made that changes in outlooks and attitudes have been largely event-driven.¹ Clearly the seven sets of events suggested do not comprise an exhaustive list. And clearly the suggested process needs further empirical study. Among the questions that can be asked are:
 - What are the specific sub-processes involved? How do what we have called the «logical lattices» that individuals keep in mind become unhinged and rearranged?
 - What is the role of single arguments affecting a particular link? Are tightly coupled logical lattices on the one hand more resistant to change and on the other hand more subject to tipping points because revision of a particular view has more direct implications for others?
 - The old idiom «seeing is believing» is sometimes used to describe what can be persuasive in changing preset attitudes. What is the role of a logical lattice in seeking supportive evidence, i.e. a «confirmation bias»? Or, put differently, is the more apt expression for the psychological processes going on: «believing is seeing»?
 - What role does psychological shock to a large group of people at the same time play – i.e. when many are placed in a situation of *conceptual deficit*,

so to speak, as what has transpired or is going on cannot adequately be accounted for by prevailing notions or explanations?

— Since people belong to different social networks, what characterizes those that are most susceptible to change? Those that are most integrated or social isolates?² Who are most easily swayed by catastrophes, «Sputnik moments» or drawn-out courses of events?

— What is the role of opinion leaders? Of marginal men – those who are members of different networks at the same time? What is the «strength of weak ties»?³ More generally, what is the role of what in the previous chapters was called «double embedding,» i.e. the simultaneous lodging of attitudes in a logical lattice and a social network, for both change fairly dramatically when impacted by events, shattering both cognitions and relations, both personal convictions and social connections? How does this same double embedding make syndromes of beliefs more resistant to change or modification?

- How do logical lattices coalesce over time into more comprehensive world views – e.g. how do attitudes, say, about global warming, combine, merge or integrate with attitudes towards nuclear power?⁴ How does such a process of coalescence take place? Are the broader views constructed in the same way in different political communities?

- How do events not only shape attitudes of individuals but also incite whole movements and contribute to the establishment of organizations? Empirical examples range from the *Whole Earth Catalogue* to the *Campaign for Nuclear Disarmament*.

- Do shifts in outlook mainly occur as individual transitions rather than as group conversions? Are changes in environmental attitudes best studied as individual change under normal social conditions and as network change if its members are subject to the same dramatic events at the same time? To what extent and by what points of entry are whole clusters changed by experiences that require reinterpretation? If one were to study such changes as ripple effects through networks, the methodology required would be quite different from standard opinion surveys, which only register the attitudes and beliefs of individuals and how they are distributed – not how they are propagated through a social mesh.

- The obvious follow-up to this question would be to look at changes over time – i.e. whether certain attitudes affect each other, whether opinions become more or less widespread, whether there are changes in the intensity of the beliefs held and whether beliefs in related areas become more or less integrated both within persons and between them. These are questions of social dynamism.

- Does change in one social network trigger counter-reactions in another – say, if some become convinced that climate change is threatening, does this tend to produce «climate skeptics»? Does mobilization of one group typically lead to polarization?

- What is the attenuation of attitudes held over time, i.e. a decline in attention to issues or of intensity of held opinions? Are repetitions – such as Three Mile Island, Chernobyl and Fukushima – necessary to sustain a set of attitudes over time? What is the effect of the learning that takes place, e.g. about how to make nuclear technology safer?

- What is the role of political leadership for changing public attitudes? Do the general relations between political elites and the population play a role? Will «politicization» of an issue typically disenchant those who at the outset do not entertain strong views?

- What are the scientific sources of the information that policymakers base their decisions on? Clearly one important source is research carried out at universities, another is the data and synthesizing reports provided by various international bodies. However, some have argued like Eric J. Barron that nations can lack «a deliberate approach to generating the ‘environmental intelligence’ needed to support good decisions and hence that it is critical to create a single, credible, authoritative source of climate information to support decision-makers.» What would be needed is greater investment in data collection and predictive models – not least those that address «the intersection between human decision-making and environmental stresses at a regional or local level.»⁵ However, there are also arguments in favor of a more decentralized system to ensure that diverse schools of thought will be heard. Can comparative studies be organized to assess the relative merits of different modes of organization?

- If events drive changes in attitudes and outlooks, how can new events be used for public enlightenment? The Fukushima accident clearly was not just a moment of truth, but also a political and pedagogical opportunity. Who seized the moment, with what strategies and what results?

- How do the general political agendas of different countries affect the development of public opinion? Under what conditions will new environmental policies become part of a broad national consensus and under what conditions will they become wedge issues between political parties? What is the role of interest organizations and corporate actors in such processes?

- In selecting – including, omitting, excluding and framing facts – the media shape how the public sees the issues. What is the role of the media in filtering and funneling information to the general public? What environmental issues are in fact covered? How do news media affect how people recognize, regard and respond to climate issues? What are the journalistic – and political – norms by which such selection is governed, e.g. the affinity for controversy or the norm called «false balance»?⁶ How are issues examined and explained? What connections are drawn between the dots – e.g. between global warming and extreme weather. Which issues are considered settled, and which open to doubt? How are the credibility and legitimacy of different actors depicted? Does the media's ownership structure affect the stories published? Do particular groups – e.g. corporations gain over-proportional influence due to the fact that they are a source of revenue? Under what conditions are they able to discredit groups with opposing views?⁷ What is the impact of concentration ownership of media on their content? What is the influence of public relation firms, think tanks and new types of content providers (sometimes euphemistically called «independent producers of news»)? Do the new social media play a different role than traditional mass media such as newspapers, radio and TV?

- What is the role of institutionalization – say in new regulation and laws, the establishment of ministries of the environment – and opinion change and political mobilization? What is the role of cross-national learning?

- How do constitutional arrangements influence the definition, treatment and outcome of environmental issues? This simple question in fact raises a number of others. What is the political impact of the balance between the so-called «numerical channel» in democracies (that ordinary people vote in elections) and the «corporate channel» (that different types of organizations, i.e. legal persons such as corporations and interest groups have the resources to influence legislative, budgetary and bureaucratic decisions between elections)? In the famous quote from the political sociologist Stein Rokkan: «Votes count but resources decide»⁸. How does this express itself on climate issues?

- Another set of constitutional questions pertain to how institutional arrangements can be devised to cope with the so-called «free rider problem» which often turns up in environmental policy. For example, in taking measures to reduce pollution, the benefits cannot be confined to those bearing the cost of the interventions, hence it is tempting to defect from collective action on the assumption that others will shoulder the costs. How can cooperation evolve and be enforced in the absence of a common constitution? Will the laggards determine the pace of change?

- The question could also be phrased this way: What are the effects of the lack of correspondence between the *range of environmental and climate impacts* and the *jurisdictions of institutions*? What can be done to reduce the mismatch between the two? For example, curbing the use of sulfurous fuel for merchant ships has proven difficult since much of this transport takes place in international waters with insufficient regulation and poor enforcement. Indeed, one could argue that the system of nation states is a prime example of the mismatch between the regional or even global impacts of pollution and the constitutional scope of national governments. For example, CO₂ emissions spill over to neighboring countries where those affected have no voice in the decision taken by the polluters across the border.

- Yet another constitutional issue pertains to *the power of a collective to act* relative to the *power of a collective to prevent action*.⁹ For example, as long as a law to curtail pollution is not in place, it is of course simple to establish polluting production – whereas a polluting industry may have substantial power to lobby against such legislation. How to address such constitutional questions and asymmetries is also clearly an issue for the normative theory of institutional design.

- Over the past few decades environmental legislation has been introduced in many countries – and many have joined international conventions. What is the more detailed history of this process? To what extent was there cross-national learning? Who were the initiators and who were the imitators – and for what reasons? Which conventions have been most successful and why? Have, say, protocols on pollution and emissions been less successful than, say, the United Nations Convention on the Law of the Sea? What is the role of international institutions such as the various UN or regional bodies, e.g. the EU, in policy development, agreements and conventions? There has been a large number of international conferences on the environment (e.g. the Earth Summit in Rio de Janeiro in 1992), and many international organizations have their own programs (e.g. UNESCO on water, the World Meteorological Organization on climate change, etc.). Moreover, many international conventions have been ratified, ranging from the FAO International Code of Conduct on the Distribution and Use of Pesticides (1985) to the United Nations Convention to Combat Desertification.¹⁰ Which organizations, professions and countries have been the driving forces behind such agreements? From what quarters has opposition come and for what reasons? What cross-sectoral learning has taken place, to what extent have events affected agendas? Has the temporal sequence been one of clusters and spurts of initiatives with lulls in between or has the growth in agreements and institutions been gradual and linear?

- What is the distribution of risk from climate change as well as from different natural hazards? A key role for the social sciences in assisting policymaking would be to map vulnerabilities, identify policies that can ameliorate impacts and suggest institutional designs that can enhance robustness and resilience. Specifically, they have to pose and answer questions such as these:

- How many will be at risk of, say, food shortages, water shortages, disease, coastal flooding, extreme weather?
- What is the geographical distribution of risk – where do people live, under what physical exposure (e.g. for earthquakes), under what kinds of humanly constructed infrastructure, and under which social conditions?
- Which locations are most likely to be affected, for example by floods, land slides, increasing temperatures, heat waves, disease patterns, etc.?
- Which groups are most likely to suffer the most adverse effects and what are their likely responses?
- What social processes tend to increase risk or vulnerabilities? Specifically, what are the conditions that contribute to the development of «cultures of complicity» between the regulators and the regulated?
- What can be done to prepare for and ameliorate impacts? What changes in infrastructure and institutions can reduce risk and enhance the capacity to cope?

Hence the social sciences have to map the distribution of vulnerabilities for different social groups as mediated by the social structure. Or put differently: They have to identify the origins of different types of risks, assess the social determinants of choices and repercussions and the effective countermeasures – and identify the likely outcomes when these are weighted by the power of the actors concerned.

- Along with the humanities they also have to identify and articulate ethical principles that can motivate, justify and make policy choices more coherent. What ethical principles are brought to bear in climate debates and in negotiations on protecting the environment? Among them are the «polluter pay principle,» the «precautionary principle,» the «principle of intergenerational equity,»¹¹ «sharing burdens proportional to capacity,» and the «principle of sustainable development.» Other principles advocated have been that «all forms of life are to be respected regardless of their utility to humans,» «respect for biodiversity,» «safeguarding the durability of the biosphere,» «viewing the Earth as a global commons,» «the right of every human to a safe and sound environment – and the responsibility of every human to protect it.» Environmental ethics¹² has become an important discipline in philosophy – indeed, the label «ecosophy» was introduced by

Arne Næss as early as the 1970s.¹³ Yet much fundamental work remains to be done, not least on how systems of justification are created. At the same time, interesting empirical studies can be carried out to analyze which principles in fact are brought to bear in both national decisions and international negotiations about the environment.¹⁴ Clearly the role that economic or political interests play in conditioning which principles different parties bring to bear and the extent of «principled opportunism» is also a topic for research.

- Nobel Laureate Elinor Ostrom has distilled «design principles» for managing common ecosystems in order to avoid collapse and maintain long-term sustainability. She does not advocate «one-size-fits-all,» but the key principles that can be embodied in diverse concrete institutional arrangements are:¹⁵

1. Clearly defined boundaries (effective exclusion of external un-entitled parties);
2. Rules regarding the appropriation and provision of common resources adapted to local conditions;
3. Collective-choice arrangements that allow most resource appropriators to participate in the decision-making process;
4. Effective supervision by monitors who are part of or accountable to the appropriators;
5. A scale of graduated sanctions for resource appropriators who violate community rules;
6. Mechanisms of conflict resolution that are cheap and easy to access;
7. Self-determination of the community that is recognized by higher-level authorities;
8. In the case of larger common-pool resources: organization in the form of multiple layers of nested enterprises, with small local common pool resources at the base level.

To what extent can these principles be subsumed under more general principles of political ethics? To what extent are they reflected in conventions and agreements on managing common resource pools among nations?

- What role can the social sciences play in institutional design? For example, a «cap and trade program» first sets a maximum limit on emissions – and may also specify a program of lowering the limit. Each actor covered is allowed to emit a certain fraction of the total (e.g. based on present emissions). The actors then design their own compliance strategy, including

the sale and purchase of allowances. The idea is that such trades will result in the most efficient reduction in emissions. The point here is not to assess the merits of such a program (or problems of compliance measurement). Rather the point is that this particular market-like institution has been designed by social scientists, and it has benefits as well as defects.¹⁶ What other types of institutions can social scientists help construct?

A more general perspective has to be added to the list above: *the need for integrated research*,¹⁷ i.e. research that not only mobilizes the social sciences and the humanities, but in its very design, execution, application and presentation brings together the natural and social sciences in joint projects. It can showcase to decision-makers how the urgent choices they confront can be enlightened by the results and recommendations of integrated research that addresses the complexities they face. The whole will be more than the sum of the parts. More than that: Scholars as well can learn how to work better together.

The need for integrated research has been highlighted above all by the types of events described in the first part of this essay – i.e. the impacts of natural hazards triggered by climate change such as tsunamis, earthquakes, hurricanes, heat waves, floods, epidemics, etc. – but also by disasters due to human constructions, such as nuclear accidents, the long-term effects of pesticides, emissions of greenhouse gases or hunger.

As human interventions impact more strongly on how the forces of nature manifest themselves in human societies – and the human use of the forces of nature not only produces intended effects but also unintended consequences for the global habitat – natural and social phenomena have to be addressed jointly and simultaneously. As the human and natural system becomes more and more integrated – indeed becomes one system – one cannot remain trapped in two cultures.

The importance of social science has been heightened in proportion to the effects of human actions on global conditions – notably with respect to climate change. Social science contributes to the way decisions are framed – and decision-makers, both public and private, in all countries and in all areas apply social science more and more.

At the same time, we have learned that the genie is out of the bottle – that the powers that science has given to humans can, by careless use, also pose a threat of great damage to humanity. This provides an important lesson about the link between the subject matters of science and social science.

Therefore integrated research is necessary, indeed urgent. And strange as it may seem, there is opportunity in crisis. Climate change imposes on us the reality of there being only one planet. When it is imperiled, it imposes on us a situation in which the two cultures may and must be transcended. The community of scientists and scholars can only help the world get its act together by getting its own act together.

[V. Some Topics for Research.Endnotes]

- 1 One can argue that a parallel in political science is V.O. Key's concept of «critical elections,» which create durable new groupings of voters with a sharp alteration in a pre-existing cleavage in the electorate. See Key, V.O. «A Theory of Critical Elections.» *The Journal of Politics*, 1955. 17: 3–18.
- 2 There is a longstanding debate in sociology about the diffusion of opinions and innovations in different kinds of networks starting with James S. Coleman, Elihu Katz and Herbert Menzel, *Medical innovation: A diffusion study* (Indianapolis: Bobbs-Merrill, 1966).
- 3 Granovetter, Mark S., «The Strength of Weak Ties,» *Amer. Journal of Sociology*, Vol. 78, (1973) Issue 6, May 1360–80.
- 4 A case in point is the article in *The New York Times* on August 6 (the same day as the first atomic bomb was dropped over Hiroshima) entitled «Atomic Bomb Survivors Join Nuclear Opposition» which reported the following about the survivors: «Aghast at the catastrophic failure of nuclear technology, and outraged by revelations that the government and power industry had planted nuclear proponents at recent town hall-style meetings, the elderly atomic bomb survivors, dwindling in numbers, have begun stepping forward for the first time to oppose nuclear power.» <http://www.nytimes.com/2011/08/07/world/asia/07hiroshima.html>
- 5 Eric J. Barron, «Beyond Climate Science,» Editorial in *Science* (Vol. 326), 30 October 2009, p. 643.
- 6 For a discussion, see Maxwell T. Boykoff and Jules M. Boykoff, Climate change and journalistic norms: A case-study of US mass-media coverage,» *Geoforum* (2007), <http://www.eci.ox.ac.uk/publications/downloads/boykoff-geoforum.pdf>. A controversy has arisen as to whether the media have been governed by a norm of «false balance,» i.e. presenting the climate issue as more balanced between opposing views than is actually the case, e.g. by giving «equal time» to non-representative points of view or by interviewing climate skeptics partly to generate interest from the resulting controversy. A case in point is the prominence given to Bjorn Lomborg's books, e.g. *The Skeptical Environmentalist*, (Cambridge: Cambridge University Press, 2001), *Global Crises, Global Solutions. Copenhagen Consensus*, (Cambridge: Cambridge University Press, 2004), and *Cool It: The Skeptical Environmentalist's Guide to Global Warming*, (New York: Knopf Publishing Group, 2007). For a critique and discussion see Michael Svoboda, «A Critical Review of Bjorn Lomborg's Cool It ... and of Media 'Complicity' in Climate Contrarianism,» The Yale Forum on Climate Change & the Media, May 12, 2011. <http://www.yaleclimatemediaforum.org/2011/05/a-critical-review-of-bjorn-lomborgs-cool-it/>. See also Pål Prestrud, «Tvil som klimadebatt,» *Aftenposten* (kronikk) 20 Sept. 2011. For another study, see Katherine Berrios Duarte, *En ubehagelig sannhet om norsk klimadekning. Hvilke stemmer og holdninger blir representert i norsk pressedekning om klimaendringer* (University of Bergen: master's thesis in media studies, 2010).
- 7 One example is «Climategate,» a term used to describe a controversy that followed the assertion that the Climatic Research Unit (CRU) at the University of East Anglia had committed scientific fraud by fabricating data on global warming. Global warming denialists immediately pounced on the story, claiming that much of the data supporting the existence of global warming was fabricated. «By 2011, five separate investigations by the British government and multiple independent ethics committees had been completed. None found any evidence of fraud or manipulation of data. The CRU data was also independently replicated.» See <http://rationalwiki.org/wiki/Climategate>. See also Pål Prestrud, «Tvil som klimadenbatt,» *Aftenposten* (kronikk) 20 Sept. 2011.
- 8 See Stein Rokkan, «Norway: Numerical Democracy and Corporate Pluralism,» Chapter IV in Robert A. Dahl, ed., *Political Oppositions in Western Democracies* (New Haven: Yale University Press, 1966), pp 70–115, quote p. 106.
- 9 For this distinction, see James S. Coleman, J.S. (1971): «Control of Collectives and the Power of a Collectivity to Act,» in B. Lieberman (ed.) *Social Choice* (New York: Gordon and Breach, 1971), pp. 269–298.
- 10 For a list of international environmental agreements, see http://en.wikipedia.org/wiki/List_of_international_environmental_agreements
- 11 An interesting example is a recent lawsuit in the United States: «Advocates of stringent curbs on greenhouse gas emissions sued the federal government on Wednesday, arguing that key agencies had failed in their duty to protect the earth's atmosphere as a public trust to be guarded for future generations. Similar lawsuits are to be filed against states around the country, according to the plaintiffs, a coalition of groups concerned about climate change called Our Children's Trust.» See <http://www.nytimes.com/2011/05/05/science/earth/05climate.html?scp=1&sq=Suit%20accuses%20U.S.%20Government%20of%20failing%20to%20protect%20earth&st=cse>
- 12 For a quick overview, see http://en.wikipedia.org/wiki/Environmental_ethics
- 13 Arne Næss, *Økologi, samfunn og livsstil: utkast til en økosofi* (Oslo: Universitetsforlaget, 1974).

- 14 For an illustration, see the special issue on «Contours of Climate Justice. Ideas for Shaping Climate and Energy Politics,» in *Critical Currents* No. 6 (October) (Uppsala: Dag Hammarskjöld Foundation, 2009).
- 15 Elinor Ostrom Governing the Commons: *The Evolution of Institutions for Collective Action* (Cambridge: Cambridge University Press, 1990). See also http://en.wikipedia.org/wiki/Elinor_Ostrom
- 16 See «Carbon Trading: How It Works and Why It Fails,» in *Critical Currents*, No. 7 (November) (Uppsala: Dag Hammarskjöld Foundation, 2009).
- 17 The following paragraphs are base on and partly taken from Gudmund Hernes, «One Planet – Two Cultures,» *Public Service Review: European Science and Technology* , (Issue 2, 04 March 2009), http://www.publicservice.co.uk/article.asp?publication=Science%20and%20Technology&id=375&content_name=Research%20and%20investment%20overview&article=11381 . «Two cultures» refers to the famous essay by C.P. Snow, *The two cultures and the scientific revolution*, The Rede Lecture 1959 (Cambridge: Cambridge University Press, 1959).

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Hot Topic – Cold Comfort Climate Change and Attitude Change

The last half century has seen a dramatic change in public opinion on the environment and climate, indeed on the whole Earth's condition and course. This shift in the way the world and its inhabitants are viewed, is an «Ecological revolution» on par with the Copernican revolution, and like it influenced by new concepts and tenets from the international community of scholars.

However, people are notoriously loath to alter their outlooks and opinions. Hence it is argued that the major shift in people's mindsets has been driven by events resulting from human activities. Seven such events and their aftershocks are discussed - momentous occurrences which became moments of truth as well as of decision.

Resistance to change is explained in terms of what is called the double embedding of attitudes - i.e. that they are lodged in logical lattices as well as in social networks. Both layers are perturbed by dramatic events. When the logical links are severed and social relations unhinged, they can be reconfigured, provoking a revision of conventional wisdom and set ways of behavior.



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