Transforming Our World

Transforming Our World:

Necessary, Urgent, and Still Possible

Edited by

Ivo Šlaus

Cambridge Scholars Publishing

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This book first published 2020

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN (10): 1-5275-4736-1
ISBN (13): 978-1-5275-4736-0

Dedicated to our teachers

Harlan Cleveland, Carl-Goran Hedén, Alexander King,
Harold Lasswell, Aurelio Peccei, Joseph Rotblat, Abdus Salam,
M. S. Swaminathan and C. F. von Weizsäcker,
and to the forthcoming generations

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ACKNOWLEDGMENTS

To enrich this book, I asked several of my friends to write a few sections: Yehezkel Dror, Neven Duić, Momir Đurović, Jüri Engelbrecht, Garry Jacobs, Ş. Kilkiş, Winston Nagan, Rajendra Pachauri and Paul Stubbs, all of whom are world-renowned specialists in their fields. Contributions have also been made by Goran Bandov, Nikolina Herceg Kolman, Samantha Manausa and Mirjana Matešić.

From graduating until now in my current post as an emeritus, I have worked at the Ruđer Bošković Institute (RBI). All my activities, particularly all my achievements, are derived from my work at the RBI where I have had various responsibilities from an assistant through to a professorship and many responsibilities from laboratory head to Chair of the Board of Trustees. I thank the RBI, its employees and particularly my collaborators for a wonderful, productive and creative 65 years.

I am a member of several academies: The Croatian Academy of Sciences and Arts, Academia Europaea and the World Academy of Art and Science (WAAS), as well as the Montenegrin and Macedonian academies, and of many international organizations and associations of organizations: the European Physical Society, American and British physical societies, the Club of Rome, the European Leadership Network, the Balkan Political Club, and several others, and I have benefited from these memberships. My work in all these organizations has helped me to write this book, and I thank them all. Special thanks belong to the Croatian Academy and to the World Academy of Art and Science.

Work on this book was made much easier since I have had the honor of interacting with several outstanding persons whose ideas and actions, talks and books have inspired me: W. T. Anderson, J. S. Avery, B. Berg, G. Bernardini, R. Blinc, Baron D. Browne of Ladyton, F. Calogero, H. Cleveland, P. Cotta-Ramusino, L. Christophorou, Y. Dror, N. Duić, M. Đurović, H. Gurgulino de Souza, B. Heap, G. Jacobs, Ş. Kilkiş, A. King, R. van Lieshout, A. Likhotal, B. Lončar, S. Mesić, W. Nagan, B. M. K. Nefkens, N. Nešković, R. Peccei, J. Polanyi, J. Rotblat, H. Schopper, P. Stubbs, I. Supek, M. S. Swaminathan, B. Vlahović, R. L. Walters, E. U. von Weizsäcker, A. Wijkman and A. Zucconi. To all of them, my sincere thanks. My work at many universities, e.g. UCLA, Georgetown University, Kyoto University, Université Catholique Louvain, Duke University and North

Carolina Central University, and institutes, e.g. the Naval Research Laboratory, Los Alamos National Laboratory and TRIUMF, has enhanced my understanding.

Special thanks to my friend Paul Stubbs, economist and sociologist, who read the whole manuscript, gave several suggestions and translated "broken" English into proper English.

My thanks go to all of those who contributed to this book. Thanks to my students and assistants. Particular thanks to the participants of conferences where some thoughts expressed here were presented. Their comments, criticisms and questions were essential.

PREFACE

On 25 September 2015, the UN General Assembly unanimously adopted one of the most important international documents ever proposed, entitled *Transforming Our World, The UN Agenda 2030: Sustainable Development Goals (SDGs)*. It addresses nothing less than the survival of our habitat. And clearly, as we do not have another habitat available to us if our present habitat is destroyed, it also addresses the survival of our civilization. This book is brutally honest. This is not a book for futurists, as unless we transform our world, there will be no future. This is a book focused on transforming our world, emphasizing why it has to be transformed and how urgently it should be transformed. We are the major actors. Transforming our world is a huge task involving scientific disciplines and transdisciplinary activities: economy, health and politics, our values, our mindset. It includes individuals, countries, regions and the entire world. We are creatures molded throughout our history in this universe. It may appear that a lot is written about our history, but this represents what we are. It is vital that we understand our capacities and that we have already transformed the world, albeit locally and to a much smaller degree. This book demands all these dimensions and a large team would be required to write it adequately. My knowledge is reduced to some history and culture of the West, while Africa, Asia, Latin America and Oceania—their history, cultures and religions—are barely known to me. I am an expert only in a narrow field within physics. This has led me to use ample quotations and many data, though I have tried to emphasize that many data are not always reliable. I decided to present some aspects of my biography so that readers can assess to what extent I can write about various subjects.

It is important to prove the necessity and urgency of transformation, and that it is still possible. The emphasis here is on *still*, but unfortunately, we have a very short interval of time at our disposal. This is neither a book of future scenarios nor prescriptions for what the transformation should be or how it can be achieved. In a rapidly changing world, that would be preposterous. We limit ourselves to the essential minimum: all our activities have to be human-centered and humanity-centered. Throughout this book, we will attempt to outline what human-centered means.

In Chapters 1 and 2, the book emphasizes that change characterizes our existence and our universe. Humans long for and desire change, yet are afraid of and horrified by it. Our world is the best ever, but as Chapters 3

and 4 demonstrate, it is not sustainable, and it is self-destructive. The global threats and challenges we are faced with can be grouped into three categories: war and violence, which *can destroy* our world in less than a day, the destruction of natural and human capital, which can *and will destroy* our civilization in a decade, and unexpected new technologies, which could be beneficial but could also have disruptive and destructive impacts. We have no future if we continue as we are and even if we do nothing. What kind of change is needed: small, incremental, revolutionary or paradigmatic? In Chapter 5, we outline the SDGs that are listed in their full form in the final Appendix. Our world is rapidly changing; it is global, interdependent and complex. In Chapter 6, we outline the basic features of complexity and paradigm change and demonstrate well-known and simple examples of paradigm change and complexity from physics. Our strength: values, law, science and tolerance—some actors and attempts are presented in Chapters 9-11 and in some sub-chapters of Chapter 6. We argue in Chapters 8-16 that the new human-centered and humanity-centered paradigm has to stress demography, economy and politics. We conclude that we are responsible for today and for our future.

This book is a call to action: Transform our world! The main character of this story is us. We all are responsible for ensuring the survival of humankind. For the first time in our history, error, terror or the sheer stupidity of just a few individuals could destroy our world in less than 24 hours. It is even worse—the human destruction of biodiversity, climate change and pollution, the destruction of natural habitat and the worst: the destruction of human capital, all prove that our world is exceptionally vulnerable and self-destructive, and this necessitates transformation. This transformation is not something that can be achieved by decrees. Governments of superpowers could not do it, nor could a global government. It is not a brilliant solution that several geniuses can formulate. What it requires is that each individual country outlines a program and specific achievable goals that can be accomplished within a few decades, hopefully in less than a decade. It demands the activity of each of us. The future is always full of surprises.

> The future of humanity lies in the hands of those who are strong enough to provide coming generations with reasons for living and hoping. Do not fear to take risks. The future is not a threat to be feared.
>
> Synod 2018 on Young People, 3 October 2018

Many of us, indeed almost all of us, are not even aware that the SDGs exist and much less what we can do to achieve them. It is necessary to inform all people about the SDGs, through specific methods tailored to address individual feelings and needs.

It may sound too pessimistic. After all, we lived for 74 years with nuclear bombs, and after Hiroshima and Nagasaki, nuclear weapons were never used again. Some could say: we became used to them and we know how to tame nuclear bombs. That is utterly wrong. More states than ever before have nuclear weapons, and their leaders have changed. There is a difference between Stalin, Brezhnev, Gorbachev and Putin, as there is between Truman, Reagan, Clinton and Trump, and Kim Jong-un. Proxy, economic and cyber wars may seem to be on a rather low scale, but they can escalate to total world war that would use all weapons of mass destruction (WMD). Nobody spoke about terrorism in the fifties or sixties and hybrids among WMD, cyber warfare and terrorism would be a deadly combination. The Nuclear Threat Initiative Organization Report claims:

> The world's most lethal weapons (WMD) are vulnerable to stealthy attacks from stealthy enemies—attacks that could have catastrophic consequences. Cyber threats are expanding and evolving at a breathtaking rate, and governments are not keeping pace [...] terrorists or other hackers could sabotage civilian nuclear facilities, resulting in a release of radiation; hold a nuclear facility hostage to their demands; or use a cyber breach to facilitate the theft of nuclear bomb-making materials.
>
> Des Browne, Nuclear Weapons in the New Cyber Age, document released on 26 September 2018

A good start would be if the nine nuclear weapons states would totally, or at least to a large extent, eliminate their nuclear weapons. Though numerous world leaders have proposed and argued for the elimination of nuclear weapons, most of them after their terms of office terminated, it is naïve. Nobody will deliberately give up a military advantage. The only sensible conclusion: **no more wars** may appear even more naïve, but wars are immoral, we can make them illegal, and, importantly, they are useless. What does *useless* mean? I had the privilege of discussing this issue with General Colin Powell in Istanbul in 2009 at an international conference co-organized by WAAS. We agreed that, with the exception of the First Gulf War, all other wars had not achieved the goals that those starting them planned and wanted. The war to get natural resources ends in destroying these resources. Eliminating "enemies" creates more enemies, and peace agreements frequently generate hatred, vengeance and conflicts. Does anybody benefit from wars? Yes, weapons' manufacturers by selling weapons, some companies, e.g. oil companies, by eliminating competitors, those stealing precious objects from museums and collectors and those getting special materials, e.g. rare earth materials. While robbing any of them, large quantities are destroyed, sometimes lost forever. Very few people enjoy destruction and harming others. Wars destroy the natural and

human capitals of all engaged in the war. Humanity-centered values demand the elimination of all wars since they are destructive and useless to humankind.

In addition to weapons of mass destruction (WMD), we have weather of mass destruction (another WMD), enormous pollution, scarcity of water and the destruction of natural and human capital. While we can delude ourselves that wars can be avoided, all human beings' efforts are needed to achieve the reduction of pollution, climate change and the protection of natural and human capital. The Intergovernmental Panel on Climate Change (IPCC) involving numerous scientists and government officials released, on 8 October 2018, its Report *Global Warming of 1.5°C: an IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas (GHG) emission pathways*. We can already see the consequences of 1°C of global warming through more extreme weather, rising sea levels and diminishing Arctic sea ice. The report warns that **humankind has only limited time (less than 10 years!!**) to get climate change under control. *To limit the temperature increase to 1.5°C rather than the much more dangerous 2°C* ***is still achievable****,* but it requires a significant change. *Changing our social, economic and political paradigms is imperative!*

What can each of us individually do? We eat more meat than vegetables and the steak we eat for dinner needs about 5,000 liters of water compared to 1kg of wheat needing about 500-1,000 liters. Half of the food that we produce is wasted, sometimes because it is below standard. Reducing meat consumption and decreasing air travel could decrease CO_2 emissions. In the early 1980s, the average increase of CO_2 in the atmosphere was 0.6±0.1 ppm/y (ppm per year: number of carbon dioxide molecules per million molecules of dry air. The data is from the Mauna Loa Observatory on Hawaii of National Oceanic and Atmospheric Administration). Over the last 10 years, it increased to 2.3±0.6 ppm/y, while the average increase between 2015 and 2016 is the highest on record. Ice core data (EPICA) over a historic period dating from 800,000 years ago, over several glacial periods, shows that CO_2 was never higher than 300 ppm, typically 250 ppm, while it is 410 ppm today. We can and should plant more trees and stop deforestation.

Neither individually nor on an international level can much be done to make the world less global, less rapidly changing and less interdependent. Globalization is inevitable and it does bring us numerous positive effects. However, there are also some negative effects, e.g. the rapid spread of pathogens. The Gates Foundation estimated that if an influenza pandemic such as Spanish flu in 1918 erupted today, 33 million people would die within the first six months.

Our scientific and technological progress is substantial but it often results in unintended consequences. For example, improving car driving by adding lead to petrol and improving refrigerators with Freon caused the ozone hole. It implies we have to know considerably more than what we intend to and much more than we know now. We are using 1.7 Earths to satisfy our needs, in other words, as of 2 August 2017, we have used more from Nature than our planet can renew in the whole year. This new reality upends the knowledge we had 70 or even 20 years ago. There is no technological fix. Wars using WMD, ecological collapse and/or technological disruption—each one of them or any combination destroys our world. To survive we have to change the world and more importantly our mindset.

The World Academy of Art and Science (WAAS) has been addressing all issues concerning the SDGs since 2010 and the authors of this book are participating in these efforts. At its 50th anniversary in 2010, WAAS started publishing two journals, Cadmus and Eruditio, devoted to issues related to the SDGs. WAAS organized many conferences in collaboration with various international organizations: in September 2011, *From Crisis to Opportunity* with the international organization, Sustainable Development, Energy, Water and Environmental Systems (SDEWES). In collaboration with Pugwash and the European Leadership Network (ELN), WAAS organized two conferences: *Nuclear Threats and Security* and *Global Security*, the first in Dubrovnik in September 2012 and the second in Zagreb in May 2013. The Montenegrin Academy of Sciences and Arts organized many conferences and WAAS was the co-organizer of most. Education has been one of WAAS' main activities. In 2013 WAAS organized an international conference on education in Berkeley, and in February 2014, Charter members formally founded the World University Consortium (WUC) in Alexandria. In November 2017, WAAS and WUC co-organized an international conference on *The Future of Education* in Rome and, in 2018, in Rio de Janeiro. We had already realized in 2010 that sustainable development requires a paradigm change in economy and governance. WAAS organized several conferences, first in Geneva: *Opportunities and Challenges for the 21st Century—Search for a New Paradigm* in collaboration with the UN Office Geneva (2013), then in collaboration with the Nizami Ganjavi International Center and the Club of Rome in Baku: *New Paradigm for Human Development* (2014) and in collaboration with the Al-Farabi Kazakh National University, Almaty, and numerous NGO organizations focused on sustainable development: *New Paradigm for Sustainable Human Development*. The first issue of the journal Cadmus began with an article by Orio Giarini et al.: *Introductory Paper for the Programme on the Wealth of Nations Revisited*, emphasizing the need for

new economic thinking. WAAS is conducting biannual courses at the Inter University Center Dubrovnik (IUC) covering aspects relevant to the SDGs.

In 2020, WAAS is celebrating its 60th anniversary. In the first half of 2020, Croatia takes over the presidency of the Council of the EU for the first time. Each country either has organized or is planning to organize self-evaluations of the status of and plans for the SDGs. Current WAAS activities include all 17 SDGs. I have tried to present a mixture of UN documents, scholarly material, history and art, literature, poetry and current political issues.

In the fall semesters of 2016 and 2017, I gave lectures on the SDGs at the Dag Hammarskjöld University College, Zagreb. In 1994, I lectured at Duke University on the course, *Preparing for the 21st Century, the Role of Science and Technology* stimulated by Paul Kennedy's book, and between 1998 and 2015 I taught *Sustainable Development* at the Jozef Stefan University in Ljubljana, Slovenia. Students loved these courses and achieved remarkable grades. The IUC courses are organized and led by Garry Jacobs and Goran Bandov.

The present time is often referred to as the age of uncertainty, as discussed in Eric Hobsbawm's book *The Age of Extremes* and in J. K. Galbraith's *The Age of Uncertainty*. On the 40th anniversary of Galbraith's book in 2017, Barry Eichengreen wrote an article in The Guardian: *This is a True Age of Uncertainty*. For the first time in history, humans can destroy our civilization. *Therefore, transforming our world is necessary and urgent!* The SDGs best represent the necessary and urgent actions to be taken. The first time in our history all human beings regardless of culture, race, religion, nationality, and regardless of where they live have a common goal: our common survival and sustainable development. Transforming our world opens up a multitude of options. Many of them are inadequate, others simply wrong. We are not certain what road we should take and how we should act.

Each chapter, even each sub-chapter, of this book can be read independently, and because of that, some ideas and concepts are repeated. *The essential point is that human creativity, curiosity, freedom and compassion are required to ensure our survival!* Though I will attempt to make this book readable, attractive and stimulating, I am aware that certain sections may be too technical and, in addition, that readers may not have enough time to read the entire book. Following Brahms' statement, "the problem is to remove redundant notes," I have tried to delete redundant sentences and words. Chapter 2: "Our world" contains a lot of physics and biology. If you want to, just skip it. Though in many conversations, particularly with people I met for the first time, the discussion almost immediately turned to physics. I recall when seven years ago I was in Duke

Hospital and a chief cardiologist visiting me immediately asked: "What do you think about multi-verses?" And then we went on to black holes, dark matter and string theory. Many good MDs initiate such conversations to relax their patients. But here are the hard data: Steven Hawking's *Brief History of Time* was for many weeks at the top of the bestsellers list and Carlo Rovelli's *Seven Brief Lectures on Physics* has been translated into 41 languages and over a million copies have already been sold.

Some chapters are introduced by bullet points. The chapter that follows provides evidence for statements expressed in these bullet points. Since this book is primarily a call to action, for those who want to get just the main message and do not have time to read the entire book, we recommend reading these bullet points.

We initiated a sequence of international conferences on SDEWES in Dubrovnik, starting in 2002. By 2012, these conferences had spread throughout the world: Rio de Janeiro, Palermo, Lisbon, Ohrid, Piran, Novi Sad, Buenos Aires, Gold Coast, Sarajevo and Cologne, and were organized every year. Chosen from about 300-500 contributions to each conference, the best papers were published in top international scientific journals; nearly 1800 papers have been published up to now. In 2013, we launched our scientific journal, JSDEWES, and now volume 7 is out. We decided to publish books related to SDEWES and this is the first one in this sequence. Many aspects such as health, pollution and energy are just briefly mentioned in this book and we are looking forward to the series of books.

The purpose of this book is to stimulate those who will read it to become aware that they *can and should contribute* toward achieving the SDGs. The aim of this book is to attract readers and to excite them to action. The SDGs are an action plan for each one of us, for humankind. However, it is necessary to explain the context—the driving forces and consequences—in which our world became the best ever, and why simultaneously, humankind is destroying itself.

Zagreb, January 2020
Ivo Šlaus

CHAPTER ONE

CHANGE IS PERMANENT

IVO ŠLAUS

Bullet point 1

Our world is the best ever, but it is self-destructing. What should we do? Necessary actions are best expressed by the Sustainable Development Goals (SDGs). Our survival requires a change in our mindset—a paradigm change. It involves everybody. For the first time in our history, all human beings regardless of culture, religion and nationality have a common goal: our survival. Achieving the SDGs is necessary, urgent and it is still possible.

1.1. It was the best of times; it was the worst of times

> It is time to turn our backs on the unilateral search for security, in which we seek to shelter behind walls. Instead, we must persist in the quest for united action to counter both global warming and a weaponized world. …To survive in this world, we must learn to think in a new way. As never before, the future of each depends on the good of all.
>
> Statement by 110 Nobel laureates in Oslo, 7 July 2001 [No01]

Society develops through choice and chance, necessity and freedom. J. Monod published, in 1970, *Chance and Necessity* to explain biological evolution. Human society requires human consciousness involving freedom. "The world is either the effect of cause or of chance. If the latter, it is a regular and beautiful structure" (Marcus Aurelius) [Ma04]. The contemporary world is the best ever [Kr17], but it is not sustainable—it is extremely vulnerable and self-destructive. The Bulletin of Atomic Scientists (BAS) decided on 25 January 2018 to put the Doomsday Clock at two minutes to midnight [Bu18], [Ku16], and [Ku18]. It remained at two minutes to midnight for 2019, as bad as it was in 1953 when both the USA and the USSR tested their hydrogen bombs. On 23 January 2020, the

Doomsday Clock was put to 100 seconds to midnight, closer to midnight than ever [Bu20]. Here is an excerpt from the BAS announcement on 26 January 2019 [Bu19]:

> To: Leaders and citizens of the world
> Re: A new abnormal: It is ***still*** two minutes to midnight
>
> Humanity now faces two simultaneous existential threats, either of which would be cause for extreme concern and immediate attention. These major threats—nuclear weapons and climate change—were exacerbated this past year by the increased use of information warfare to undermine democracy around the world, amplifying risk from these and other threats and putting the future of civilization in extraordinary danger. In the nuclear realm, the USA abandoned the Iran nuclear deal and announced it would withdraw from the Intermediate-range Nuclear Forces Treaty. [...] Meanwhile, the world's nuclear nations proceeded with programs of nuclear modernization. On the climate change front, global carbon dioxide emissions resumed an upward climb in 2017 and 2018. To halt the worst effects of climate change, the countries of the world must cut net worldwide carbon dioxide emissions to zero. [...] Nationalist leaders lied shamelessly, insisting that their lies were truth. These intentional attempts to distort reality exaggerate social divisions, undermine trust in science, and diminish confidence in elections and democratic institutions. [...] Dire as the present may seem, there is nothing hopeless or predestined about the future. The *Bulletin* resolutely believes that human beings can manage the dangers posed by the technology that humans create.

In 1947, the BAS put the Doomsday Clock at seven minutes to midnight and at the end of the Cold War, the clock was at 17 minutes to midnight. However, on 14 January 2014, it was put at 5 minutes, and in January 2017 it was moved to 2.5 minutes. In 1997 we established *The Croatian Movement for Democracy and Social Justice,* which used as its logo a local Doomsday Clock put at five minutes to midnight. At that time, the Doomsday Clock on the front page of the BAS was at 14 minutes to midnight indicating that local and global doomsdays do differ and both have to be considered, since problems even in a small system can trigger major problems. *One can envisage a number of "hybrid" scenarios of Russia-NATO conflict where operations which started in the cyber, economic or criminal domains, below the threshold of conflict, trigger a military response [Ku18].* Now the dangers and threats are multiple: in addition to military conflicts, we are threatening our only home, Earth, not only by climate change but also through the sixth mass extinction (the first and so far the only mass extinction caused by humans) together with enormous pollution and overconsumption where each year we Earth's resources 1.7 times faster than they naturally regenerate. The concept of

the ecological footprint was introduced in 1992 by William Rees and his Ph.D. student, Mathis Wackernagel [Re92] and [Wa93]. The wealthiest countries produce an ecological footprint 200 times larger than the poorest ones.

In 2017, around 42% of workers (or 1.4 billion) worldwide were estimated to be in vulnerable forms of employment. This percentage is expected to remain high in developing and emerging countries, over 76% and 46% respectively. Extreme poverty remains widespread: more than 300 million workers in emerging and developing countries have a per capita household income and consumption of less than US$1.90 PPP (purchasing power parity) per day [IL18].

Our world is the best ever with the highest quality of life, highest level of education, most developed economic, political and social systems, and we are healthier, live longer and have more knowledge than ever. In the so-called "good old times," not even kings lived as well. Out of the 12 children that the Russian Czar Peter the Great had with his wife Catherine, only two survived past the age of 10. Similarly, in the 13th century, England's King Edward I and his wife Eleanor had 16 children and only six lived longer than ten years. The German weekly, Der Spiegel, published a series of articles under the title *In the Old Days Everything Was Worse*. Figures published on 16 October 2016 show a significant reduction in global poverty from 1820 when over 90% of the population lived in poverty. In 1970, the percentage was reduced to 60% and in 2015 to less than 10%. In absolute numbers: it was 1.022 billion in 1820, 2.218 billion in 1970 and 706 million persons living in poverty in 2015. N. Kristof wrote in a New York Times Op-ed *Why 2017 May Be the Best Year Ever* [Kr17] that on any given day worldwide, 250,000 people will no longer live in extreme poverty, that 18,000 children's lives will be saved and that about 300,000 people will gain electricity. Some diseases will be eradicated in most of the countries, e.g. elephantiasis, Guinea worm, river blindness and blinding trachoma.

However, the contemporary world is not sustainable and it is self-destructive: destroying human, social and natural capitals. Some problems we thought were solved have reappeared. An Argentinean peasant told Archbishop J. M. Bergoglio, "God forgives always, humans sometimes and Nature never." Figure 1-1 [Ro09] shows domains where humans have overshot the natural boundaries. The destruction of biodiversity is particularly dangerous. A Vatican Workshop on biological extinction, 27 February-1 March 2017, was attended by several fellows of the World Academy, including Calestous Juma and Sir Brian Heap. The green shaded polygon represents the safe operating space.

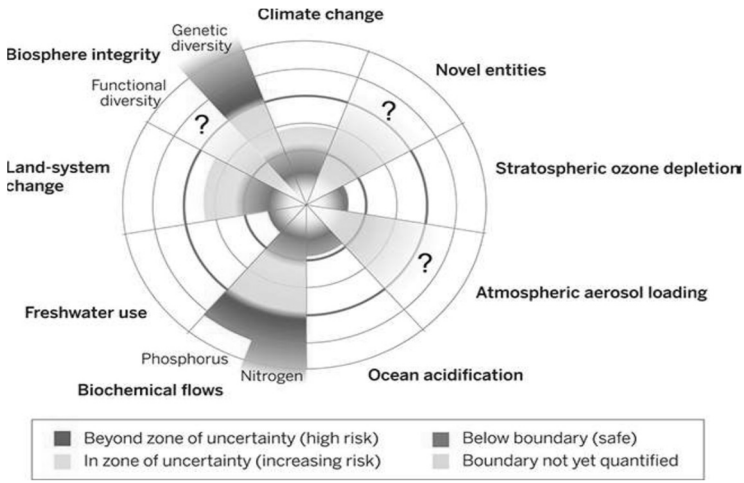

Figure 1-1: Domains where humans have overshot natural boundaries. This figure is frequently displayed not only in [Ro09] but in many subsequent papers. See centrefold for this image in colour.

A major global catastrophe such as one caused by celestial collision (which our technology can predict but now cannot prevent) or by warfare involving the use of WMD which we and our technology can cause could lead to the end of our civilization; it could even lead to the end of life on Earth. In spite of many of us thinking that 2017 was bad, it was the best year ever, but what about 2018, 2019 etc.? [Br18].

Our planet can accommodate 10 billion people, possibly even 15 billion, but certainly not a few hundred billion. But even 10 billion could be too much if greed and profit become our dominant values. Gandhi correctly stated, "There is enough for everybody's need but not for everybody's greed." Similarly, if we continue to live as we recently did and continue to consume as we do, then environmental science reliably predicts the overconsumption of water, the destruction of our habitat and destructive climate change. It is clear that the scenario *business-as-usual* or of freezing our behavior at the current level is not sustainable. As you read this chapter, several thousand children worldwide will die from hunger. From 1991 to 2013, a huge number, 423 million persons, died of hunger [Po14]—more than the number of persons killed by their own governments in the 20th century, about 200-300 million [Ru99], or persons killed during WWII, about 60 million. Of course, an estimate of the number of persons that have died of hunger in an equal time interval, say 1961 to 1983, is even larger than 430 million. Roughly one third of all

deaths, about 18 million annually, are due to poverty easily preventable through better nutrition, safe drinking water, and mosquito nets [Po07]. Children under five account for nearly 10.6 million or 60% of annual deaths from poverty related causes [UN05]. Today 50 million people live in slavery, which is 30% more than a year ago. Is that a result of an inappropriate economy? “This economy kills!” wrote Pope Francis:

> 53. Just as the commandment *Thou shalt not kill* sets a clear limit in order to safeguard the value of human life, today we also have to say *thou shalt not* to an economy of exclusion and inequality. Such an economy kills; [...] masses of people find themselves excluded and marginalized: without work, without possibilities, without any means of escape. Human beings are themselves considered consumer goods to be used and then discarded. We have created a “throwaway” culture.
>
> Pope Francis in his *Evangelii Gaudium,* 24 Nov 2013

And yet, as Table 1 shows, for most countries, human capital is appreciably larger than manufactured capital.

Table 1-1: *The balance sheet of wealth* from The Economist and also in the summary work of Das Gupta and collaborators [Da10]

We used the opening words of Charles Dickens' novel *The Tale of Two Cities* (somewhat altered) as the title of this sub-chapter introduction. Dickens described the French Revolution, "It was the best of times, it was the worst of times, it was the age of wisdom and it was the age of foolishness. …. It was the spring of hope; it was the winter of despair…." Our time can be described by these same words [Ri10].

1.2. "Can anything that is useful be accomplished without change?" —Marcus Aurelius

S. J. Gould emphasized that the history of life is a sequence of stable states marked by great, rare and sudden events which form the next stable state.

> A new species can arise when a small segment of the ancestral population is isolated at the periphery of the ancestral range. Large, stable central populations exert a strong homogenizing influence. New and favorable mutations are diluted by the sheer bulk of the population through which they must spread.
>
> S. J. Gould, 1980 [Go80]

Why does one of the most important UN documents call for transformation? The political elite in power (and the UN General Assembly is in power) hardly ever calls for a transformation. Does the document *Transforming Our World*, mirroring the words of a young aristocrat during the 19th century turmoil in Italy, justify why he endorses change? "Grandfather, everything has to be changed, to preserve it as it was" [To58]. And Alice asks the queen why everybody runs around in her kingdom, and nothing changes? Does the UN want to transform our world? Spencer Johnson's book: *Who moved my cheese?* [Sp98] was, for a long time, at the top of the bestseller list. It has four characters: two mice, Scurry and Sniff, and two little people, Haw and Hem, all four running through a maze looking for cheese to nourish them. When there was no more cheese because "somebody" moved it, or they simply ate it, Scurry scurries into action without fully understanding where and how to find the cheese, while Sniff sniffs it out and runs toward the place where the smell is coming from. Hem denies and resists change, fearing that something worse will happen and Haw decides to search for the new cheese. As Haw goes through the maze, he writes messages on the wall hoping his friend Hem will see them and will follow him: "If you do not change, you may become extinct," "Change happens, adapt to change, change and enjoy change," "When you move beyond your fear, you become free!" We know changes are not permanent, but change is.

Notwithstanding the truism, *He who does not move with the times will be removed over time* and Churchill's famous words: *To improve is to change, to be perfect is to change often*, Mary Shelley wrote in her book *Frankenstein*: "Nothing is so painful to the human mind, as a great and sudden change." Evolutionary development embedded in our nature depends on the need for stability and certainty, and simultaneously on curiosity, risk taking and a propensity to change. These opposite strivings can coalesce *in an end of history* syndrome: all changes and risks are finally realized in a stable new order, the fulfillment of our aspirations. The defeat of communism in the USSR led F. Fukuyama to write *The End of History* [Fu89]. The end of history had already been prophesied by Hegel after Napoleon's victory at Jena in 1806, and by K. Marx and A. Kojeve. The response of 29,000 persons aged from 28 to 68 years on whether they had changed was definitively "quite a lot," but to the question of whether they expected to change in the future their answer was "very little" [Qu13]. Many very different "*end of"* books were written in late 20th century [Ho96], [Ha04], [Ca12], and [Gr16]. What does *the end* mean? Does the word "end" imply that the goal has been achieved? Did we ever achieve our goal, e.g. do we adequately and fully understand physical phenomena? The title of Steven Hawking's inaugural speech when he followed Dirac as Lucasian professor in 1980 is: *Is there an End in Sight for Theoretical Physics?* Eighty years earlier, on Friday 27 April 1900, Lord Kelvin, in his talk *Nineteenth-Century Clouds over the Dynamical Theory of Heat and Light*, claimed that there are only two minor clouds dimming the bright sky of physics. The two clouds were the inability to detect luminous ether, specifically the failure to explain the results of the Michelson-Morley experiment, and the inability to explain the black body radiation effect known as the ultra-violet catastrophe. Kelvin could not have been more wrong. The two clouds represented fundamental limits to a classical approach of understanding nature. The two clouds resulted in quantum physics and in the theory of relativity. Some believe that quantum physics and the theory of relativity sum it all up: the end of science [Ha04]. Possibly, all physical phenomena can be understood by quantum physics and the theory of relativity, but that would not be the end of physics, much less of science. In the last few decades, it turned out that the Standard Cosmological Model and the Standard Model of Particle Physics account for only 4.9% of our universe, while 26.8% is dark matter and 68.3% is dark energy [Pl15]. Moreover, we do not understand either dark matter or dark energy. Though the Higgs boson has recently been discovered, we still need to understand why the electron has the mass it has. The mass of a proton is even more complicated: it is not

just the sum of the masses of three quarks, there is binding energy among them adding hundreds of times more mass. Our inadequate understanding is much greater as one turns from simple issues such as our universe (which is determined just by six numbers! And physical laws did not change for 13.8 billion years) to complex problems: consciousness, economy and politics. Contemplating this marvelous progress, we can ponder upon Rig Veda X: 129:

> Who knows for certain? Who shall here declare it?
> Whence was it born, whence came creation?
> No one knows when creation arose,
> Or whether He has or He has not made it. He who surveys it from the lofty skies
> Only He knows—or perhaps He knows not.

It is very important to distinguish between great ancient books that may and often do contain vision and wisdom and our tradition which merges and mixes the behavior of our ancestors thousands of years ago from the point of view of our present interests and myths. Why do we so frequently turn to mythology? "Humans think in stories rather than in facts, numbers or equations, and the simpler the story the better. Every person and culture has its own tales and myths" [Ha18].

Lord Kelvin emphasized the importance of measurement and stressed that unless we can measure (and define), discussion is pointless [Ca01]. Comparison with physical sciences is useful: pyramids were built and Newtonian laws formulated before meters, kilograms and seconds were precisely defined. We have to address important issues with whatever we have at our disposal, but we have to do so with a grain of salt. Many essential observables cannot be measured and expressed in numbers. Mozart's symphonies cannot be measured and compared with Shostakovich's, nor Leonardo's paintings with those of Picasso. Let us not allow the measurements so strongly urged by Lord Kelvin to be reduced to "the fallacy of misplaced concreteness," as A. N. Whitehead warned. Measurements result in data. Various instruments and sensors provide a multitude of data generating a new concept: *Big Data*. The advent of powerful computers allows the use of *Big Data*. *Big Data* are presently generated in scientific research, but much more in business, health and security. Notwithstanding powerful computers and advances in ICT (information and communication technologies), by far the best approach to *Big Data* is a good theory or at least a guiding principle. We develop models, particularly mathematical models. The exactness of mathematics can lead us into trouble, since if the model does not adequately represent

the situation, if it is plagued by our prejudices, then it will give us *garbage in, garbage out*. The amount of data doubles each year! This is not necessarily a blessing if we do not know how to treat and properly analyze, interpret and use these data.

The process of describing and understanding assumes rationality and logic. But humans are not rational beings. Humankind cannot live by rational thoughts alone [Ed07]. The history of science shows that science does not proceed rationally. The conversation between Niels Bohr and his friend is instructive. Bohr told his friend: "No, you do not think, you are just being logical!" [Fr79]. Clearly, no end is reached, and it is an open question whether it can and will be reached. Does it contradict Plato's triad: truth, good and beauty? The Philosophy Bible [Co16] lists three basic questions: 1) what is truth? 2) what ought I to do: what is right and what is wrong? and 3) what is beauty? It is prudent to remember Niels Bohr's words "The opposite of a fact is falsehood, but the opposite of one profound truth may very well be another profound truth." Quantum physics shows that no one perspective exhausts reality. Two ways of regarding the same thing are complementary when each is valid and coherent on its own, but they cannot be used at the same time since they exclude one another (e.g. an electron described as a particle and as a wave). This brings to mind yin and yang symbols and indeed N. Bohr designed his coat of arms with yin and yang and the inscription, *Contraria sunt complementa*. Concepts of modern science show surprising parallels to those of Vedas, Sutras, the Milesian School, the I Ching, and even to the teachings of Yaqui sorcerer Don Juan [Sl84]. Oppenheimer's words: "If we ask whether the position of an electron remains the same, we must say no, if we ask whether its position changes with time, we have to say no," seem to echo the Upanishads:

> It moves. It moves not.
> It is within all this
> And it is outside all this.

Compare Oppenheimer with Sri Aurobindo: "The material object becomes something different from what we now see, not a separate object in the background but an indivisible part and even in a subtle way an expression of the unity of all that we see" [Au58]. "Natural science does not simply describe Nature. It is a part of the interplay between Nature and us." Modern science has not just simply returned to ancient wisdom. Through modern science, old wisdom has obtained a new, deeper meaning. Gödel's theorem proves that there are truths beyond proof. The root of Gödel's theorem [Da99] is in the paradox of the Cretan philosopher Epimenides who said, "All Cretans are liars." This mirrors the same strange loops

which one finds in Bach's music, Escher's paintings and Lewis Carroll's works [Ho79].

Beauty certainly plays an essential role in human life. Let us not overlook the fact that the first metal to be discovered and used 11,000 years ago was gold and was used only for decoration, for beauty. Beautiful cave paintings were made more than 40,000 years ago! Frank Wilczek wrote a book *A Beautiful Question* [Wi15] and he asked: "Does the world embody beautiful ideas?" Wilczek cites Galileo, Newton, Maxwell and Einstein to prove that it does. Galileo Galilei made the beauty of the physical world central to his deep faith: "The greatness and the glory of God shine marvelously in His work and it is to be read above all in the open book of heavens" [Wi15]. In this sentence, Galileo connects all three questions—truth, beauty and action—in the right way.

The present is characterized by the values of numerous socioeconomic indicators and their trends. All these indicators change and at a different rate. It is impossible to keep both their values and their trends unchanged. Maintaining the values of indicators implies a profound change in the current trends. Maintaining the present trend implies that the values of all indicators will change. The question is whether incremental changes are appropriate: do we need revolutionary changes, such as the Copernican revolution, or the American, French and October revolutions, or do we need a paradigmatic change, such as the change that physics underwent at the turn of the 20th century, and a series of industrial revolutions? Most changes are incremental changes. Science proceeds by many incremental changes and only rarely is there a major revolution (e.g. Copernican) and even more infrequent is a paradigmatic change (e.g. quantum physics and the theory of relativity). I am making a clear distinction between "revolutions" and "paradigmatic changes." I argue that "paradigmatic change" is a change of our mindset and of our worldview. In his play *Too Good to Be True,* G. B. Shaw wrote, "The Universe of Isaac Newton which has been an impregnable citadel of civilization for 300 years has crumbled like the wall of Jericho before the criticism of Einstein. Newton's universe was a stronghold of rational determinism. […] Here I found my dogma of infallibility. And now, all is left to caprice." Indeed: time, space, determinism—all is gone, and complementarity is in. Old classical physics has preserved its validity within a narrow domain. Nobody claims that there is no *new physics* and physicists constantly search for a more all-embracing theory. Whether that unification would require another paradigm change remains to be seen.

While natural laws are given independently of us, social laws are the interplay of our environment, of general characteristics of structures but