On the Anthropocene.
Human thoughts and actions between gloom and confidence

The origin of the game of chess is lost in time, but legend has it that is was invented by one Sissa Ben Dahir. The Indian king Shirham was so delighted with the game that he offered Sissa a reward. He could ask anything he wanted. Sissa asked for a grain of wheat to put on the first square of the chessboard he invented, for two grains on the second square, for four grains on the third, eight on the fourth, and so on, doubling the number for each succeeding square, up until the 64th square. King Shiram agreed, thinking that his servant was a very modest man who didn't ask much for his wonderful invention. However, when he had a mathematician count how much grains he had to give to Sissa, it took a week to calculate the answer. It turned out that the king owed Sissa 18,446,744,073,709,551,615 grains. This comes down to the accumulated harvest of all the grains in the world, of several hundreds of years. If we assume that a bushel of wheat contains about 5000.000 grains, the king owed Sissa 4000 billion bushels. According to one version of the story, king Shirham felt as if he was misled by Sissa, and had him beheaded. This, of course, is perfectly in line with the normal behaviour of dictators faced with otherwise unsolvable problems.
Apart from what you should and shouldn't ask dictators for, the story of Sissa's demand contains an important psychological lesson: people are really bad in dealing with exponential growth. Unlike linear growth, exponential growth corresponds to the thing itself that grows. The bigger the thing, the bigger the growth. Exponential growth can move slowly, hence it can be unnoticed for a long time. But suddenly and unsuspected, it raises its head and overflows everyone and everything, tsunami like.

A virus with shoes on

The growth of humanity has a similar pattern. It took our species two hundred thousand years to have about a billion members, some years after 1800 A.D. Only slightly over hundred years later, in 1927, there were two billion people on our planet. Forty-six years later, we had doubled that. July 1987, we reached five billion. Another billion was added in twelve years. The arrival of Earthling number seven billion was celebrated in the spring of 2012. Four years later, the time of writing, we're heading toward seven billion and a half. Each day we welcome around 353.000 babies. Clearly, from an evolutionary perspective, we are thriving. This has not always been the case. In the beginning of our existence, for a couple of times our forerunners were close to extinction. We probably were rather insignificant in the bigger scheme of nature. But somehow we slipped through the genetic bottleneck and spread ourselves all over the world. Bill Hicks had a point, when he compared us to a virus with shoes on. It is not

very likely that we will still be around, say ten million years from now, but if we are, future archaeologists and other scientists undoubtedly will see the last few hundreds of years as a remarkable transition period. We always had a, generally underestimated, influence on our planet. But since the industrial revolution, in combination with our population growth, the human impact on this planet had become immense. Indeed, the reasons to see our period as sufficiently distinct from other geological epochs and therefore call it the Anthropocene, seem to become more and more convincing. Research within the field of Environmental History has made abundantly clear how we transformed the face of the earth. Already in 1956 Thomas L. William edited two volumes called *Man's Role in Changing the Face of the Earth*. William's book deals with deforestation, loss of biodiversity, desertification, the production of trash that is not biodegradable, etc. All these aspects are still with us. Some of them can be traced back to prehistoric times. During the last face of the Pleistocene, somewhere between 300.000 and 11.000 years ago, people colonized the world, controlled fire and had sophisticated technology like bows and arrows. Suspiciously, thousands of species went extinct during that period. This could be due to climatological or other reasons external to humans, but there is growing scientific support that humans caused the disappearance of the species they hunted. It is a myth that our prehistoric ancestors where somehow in balance with nature, whatever that may mean. (Martin & Klein, 1989; Simmons, 1989)

Domestication and the point of no return

A crucial aspect of all this, possibly the most dramatic step humans ever took in their history so far, is the so called Neolithic Revolution. The domestication of several animal and plant species took place between 15.000 and 10.000 years ago, independently in a few places in the world. The reasons for this are less clear that one might think. An agricultural way of life is more difficult than being a hunter-gatherer. The diet of hunter-gatherers is more diverse and healthier than the average diet in agricultural societies and it takes less time and energy than working on the field and growing livestock. It is no wonder that the book of Genesis presents the demise of our lives as hunter gatherers as a loss of life in paradise. In the bible, growing our own food is a punishment and an rather unpleasant experience: "Thorns also and thistles shall it bring forth to thee; and thou shalt eat the herb of the field" (Genesis, 3:18) and "By the sweat of your brow you will eat your food until you return to the ground, since from it you were taken; dust you are and to dust you will return." (Genesis, 3:19) It is possible that the main reason for the Neolithic Revolution was demographic pressure. (Cohen, 1977) More people means more need for food. Only small sized communities can survive by hunting and gathering, larger groups need other ways of sustaining themselves. The main advantage of agriculture is this: on lesser acres, one can grow

more food. This started a chain reaction that is still going on. More food made it possible to have more people, who had more offspring, so more food was needed, which led to inventions to grow even more food, so larger groups could survive, and so on. The effect of all this was the creation of cities, the highly specialised division of labour that we know today, the origin of law, the military, politicians and the distinction between nature and culture. Nowadays, obviously, there's no way back. We've reached the point of no return a long time ago. This whole dynamic continues to influence our lives and behaviour dramatically: ever more people live in cities and become dependent of other people growing food outside the city. As of today, over 55% of the people live in urban areas. This number, it is estimated, will increase to 66 per cent by 2050. In 2030 already, three out of five people will live in cities. Two billion of them will live in slums. The number of so called megacities, cities with over ten million inhabitants is now 35. Like population growth itself, the rise of the amount of urban people took us by surprise. In 1800, only 3% of the world's population lived in cities. This rose to 47% in only two centuries. In 1950 there were 83 cities with over a million inhabitants. Nowadays it's about 500, cities and metropolitan areas.

Capitalism as a catalyst

Obviously, the amount of food, water, space and energy that is needed by more than seven billion people is staggering. Unlike other animals, human beings managed to enhance the pressure on the natural environment by using technology and by the multiplication of needs and desires. Of course, it seems to belong to the essence of what it means to be human: we create tools that help us, in an ever more efficient way, to extract any natural resource that can be manipulated and transformed into something that is useful, from chocolate bars and bottled water to computers and space shuttles. The development of the economic system that we call capitalism catalysed this whole dynamic to unseen heights. Never before did we need more water, oil, wood and other raw materials to keep the system going. (Yergin, 2012) The beast must constantly be fed. To give just one example to illustrate the point: every single day, the world uses 85 million barrels of oil. One barrel contains 42 gallons, this comes down to a daily consumption of three billion, five hundred and seventy million gallons of oil (3,570,000,000). If you want to know how much this is in liters, do the math. One gallon is 3.785 liter. Some artefacts that we produce have a low impact on the environment, think bicycles or skateboards, but others have a huge effect, like airplanes and hummers. All of this raises the question what the carrying capacity of our planet is. It is obvious that the combination of our growing population with the capitalist desire for more profit, based on scientific and technological fine-tuned exploitation of the planet's resources, keeps on growing and becomes a global phenomenon. If something grows and expands in an uncontrolled way, within the

boundaries of a finite system, it does not take much logic to see that, eventually, it must collapse. The carrying capacity of the earth is limited.

A bet about metals and more

It is fascinating and sometimes frustrating to see that politicians, scientists, academics and other experts disagree about how to understand all this. Although many of the facts are crystal clear, their interpretation can be radically different, depending on who's stating an opinion. Consider population growth. The estimations of future numbers may differ, but nobody really disputes that our planet has over seven billion people now and that the number will keep rising for the next couple of decades. The surprising thing is that some authors believe this to be a recipe for disaster, while others see nothing but opportunities in the growing number of human beings. To illustrate this point, consider the bet between the ecologist Paul Ehrlich and the economist Paul Simon. (Sabin, 2013) The American ecologist Paul Ehrlich became famous with the publication of his 1968 bestseller *The Population Bomb*. Because of the exponential growth of the human population, Ehrlich predicted "famines of unbelievable proportions" that would occur in the mid-seventies. Hundreds of millions of people would die of starvation. In later articles and books he warned that Americans would need water and food rationing, that worldwide marine fishing might collapse and that, due to the use of pesticides, Americans' life expectancy would drop to forty-two around 1980. However, he also wrote that we might avoid these and other disasters if we took serious measures to halt population growth and reduce consumption. Diminishing the population explosion would not happen, Ehrlich argued, by rational argumentation alone. Therefore, he proposed, among other things, to establish a "luxury tax" on cribs, diapers, baby foods etc. and to give financial rewards to people who abstained from reproduction. The American economist Paul Simon at first thought population alarmists like Ehrlich to be right. But gradually he came to dismiss all of Ehrlich's arguments. In fact, larger populations, according to Simon are actually a good thing. Shortages of food and other commodities can be avoided by economic means and the promotion of investment, of scientific discovery and technological inventions. Simon's optimism, for several years, remained virtually unnoticed, due to Ehrlich's fame and media appearances, and because of other eco-pessimistic books such as *The Limits to Growth*, published in 1972 by the Club of Rome. To gain attention, in 1980 Simon proposed a bet to Ehrlich. Simon argued that several of Ehrlich's predictions had proven to be false, without Ehrlich acknowledging his mistakes. The bet was to be on the future price of five metals of economic importance. Simon wanted Ehrlich to choose the kind of metals. If Ehrlich was right, scarcity and rising demand would lead to higher prices. If Simon was right, technological progress and market mechanisms would assure that the prices would

decrease. Ehrlich immediately accepted the bet and chose chromium, copper, nickel, tin and tungsten as the metals to be followed. Ten years later, it became clear that Ehrlich had lost the bet. During the eighties, the decade of the bet, world population had grown more than in any other decade in the history of the world. Eight hundred million people had been added to our planet. The price of each metal chosen by Ehrlich, however, had declined during that same decade by an average of fifty percent.

Between uncertainty and consensus

Does this mean that so-called environmental catastrophism is just a form of pseudoscientific alarmism, and that optimism about the Earth's and humanity's future is warranted? Not necessarily. Part of the reason why Simon won the bet, might be that because of Ehrlich's and other's warnings, we avoided bigger catastrophes. Ever since environmentalists managed to get their message across, governments, at least in democracies, took action to take measures for cleaner air, water etc. Another reason is that Simon was lucky. Recent simulation studies show that macroeconomic cycles and fluctuations, more than scarcity or abundance, were responsible for the price of the metals. It turns out that it is hard to come to decisive conclusions about environmental issues based on Ehrlich's and Simon's bet. Nevertheless, their dispute became a symbol of the uncertainty we face in dealing with complex matters such as population growth, human behaviour, our economy and the environment. Ehrlich as well as Simon still have followers. What is agreed upon however, is the fact that humans do influence the environment in more ways than we used to think, or could even imagine. Animals, plants, earth, water, air and our climate are heavily affected by what we do. For several years, scientists couldn't agree on the question whether climate change was manmade, or just a statistical fluke effect. In fact, it took some time before consensus was reached that our planet got hotter in the first place. More and more governments, also on higher than national or even continental levels, take action to curb global warming. It might be one of the most important decisions ever made in the history of mankind, and in fact in the history of all life on earth. (Gardiner, 2011)

Into the Anthropocene in the blink of an eye

Ironically, what this shows us is that Paul Simon's optimism is rational, but not as he imagined it to be. More than likely, if we have ethical concerns about future generations, it is justified to worry about the environment, about the production of food, about the scarcity of water, the loss of species, global warming and so on. But it is also reasonable to believe that we are capable of confronting, avoiding or overcoming most, if not all of these problems. Many of our troubles are manmade, but so can be the solutions. Scientists, engineers and other experts are developing tools to

tackle all kinds of problems in ways that seem to surpass science fiction. From genetic engineering to robotics, from nanotechnology to artificial organs, human creativity, nourished and guided by scientific information and methodology, can achieve much, much more than Jules Verne or anyone else could imagine, until some decades ago. The technology to deal with energy or food shortage, with pollution, safety, diseases and so on, is developing right now. Many examples are truly breathtaking. Take the American Jesse Sullivan, who lost both of his arms in an accident. Scientists in Chicago created two bionic arms for him, which he can use solely by thinking. His thoughts create nerve signals that are picked up by microcomputers, which in turn give electrical signals that make the arms do what Sullivan wants them to do. (Harari, 2015) Of course, not all examples are unambiguously positive. Apart from all the great things we can do with them, the development of drones for instance, and their rapid commercialisation, raises serious questions. The same is true for certain aspects of biotechnology, brain science, pharmacy, virology and so on. On the most fundamental level, the question is not whether we can invent and develop certain kinds of technology, but whether we should. It is hard to disinvent something, once it's out in the open. Our brains, our capacity to cooperate and our knack for technology took us in a geological blink of an eye from the stone age to the twenty-first century. It remains to be seen whether we are smart and wise enough to create and use technology that will only be instrumental for the happiness, welfare and integrity of people, animals and the environment, and for nothing else. After all, we are the result of a haphazard, blind, a-moral and non-teleological evolutionary process. We are brilliant in many ways, but quite often simply stupid in dealing with global problems and in taking long term consequences into account. It is true what evolutionary psychology tells us: We are stone agers in the fast lane. However, we're still here and progress in several areas is undeniable (Pinker, 2012; Shermer, 2016). It would be an illusion, even a dangerous one, to think that what is manmade is perfect and always controllable. But that shouldn't keep us from being creative, as long as we keep an eye on the values we cherish and share as a species.

With respect to the use of the term Anthropocene, it will be difficult to come to an agreement on the beginning of this epoch. The Anthropocene, by definition, begins when humans start to have an global impact on the natural environment that changes the course of natural evolution and of geological, atmospheric and climatological factors. But even before anatomically modern humans were around, *Homo erectus* used fire and colonized large parts of the world. It is quite reasonable to argue that this fits already within the definition of the Anthropocene. And as we have seen, early *Homo sapiens* drove many species to extinction and changed the natural landscape. The Neolithic revolution added substantially to this transformation, as did the development of the capitalist economy, the industrial revolution, the burning of wood and oil, and the chemical revolution. Probably, the digital revolution leaves its marks

as well. Perhaps the growth of our species can somehow indicate an objective transition? But when? When we reached a million people? Five hundred million? A billion? Five billion? There is an lively debate on these issues going on in the most influential scientific journals, such as *Science* and *Nature*. At this moment, no consensus has been reached yet about the question whether we should recognize the Anthropocene as a truly new epoch, but many scientists in relevant disciplines and some scientific organisations, such as the Geological Society of America, are already using the word as if it is clear for everyone what is meant by it. Around the time of the publication of this book, the so-called Anthropocene Working Group will try to make a decision on the question whether the Anthropocene is a real new geological epoch. If they propose to accept the term, it still needs scientific legitimation by the International Commission on Stratigraphy and a ratification by the International Union of Geological Sciences. Only then can the Anthropocene be adopted as an official new member of the geologic time scale. But even if the term is not officialised, we cannot doubt that the world we live in becomes ever more moulded, twisted and shaped by human actions, for better or for worse.

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