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Anthropocene, the Concept of the 21st Century – A General Introduction

What Happened to the Future?

For millennia, the prospect of the future has offered hope. Men and women have gazed, in fascinated anticipation, towards the horizon of the future. ‘What new inventions, creations and exploration will humanity achieve in years to come?’, ‘What wonders await?’ and other such questions have engaged our ancestors for centuries.

Human achievements over time have been staggering. We have discovered that the earth is not the centre of the universe. The invention of the steam engine sparked the Industrial Revolution, which changed the face of the world. Quantum physics has totally reshaped the way in which we think. The advent of antibiotics has meant that diseases which would once have been a death sentence are now curable. In the space of only a few short decades since setting foot on the moon, we have built communications networks that keep us connected wherever we are on the planet. Today, thanks to internet search engines, we have practically all human knowledge just a few clicks away. More astonishing still is that we are now able to actually edit the human genome. Dolly the sheep was cloned less than 25 years ago; yet today CRISPR-Cas9 allows us to slice and splice parts of the human genome.

Time has also brought many nasty shocks. The Industrial Revolution, encouraged by Descartes’ exhortation that we become ‘masters and possessors of nature’, was in full swing in the early 20th century, when war broke out on a scale never seen before. Economic globalisation saw that war spread across the face of the planet like a plague. Barely two decades later came a second global conflict, but where WWI had left 18 million dead, manmade technology meant 60 million lost their lives in WWII! However, despite the twists and turns and bumps along the way, the modernist era was characterised by the marriage of technical and social progress. The commitment to build a brighter future elevated vast swathes of humanity out of grinding poverty.

However, three prosperous decades later, when ‘grand narratives’ (Lyotard, 1979) collapsed and ushered in the era of postmodernism, the timelines began to

unravel. Technical and social progress no longer go hand in hand. The idea of linear progress – today is better than yesterday, and tomorrow will be better still – no longer holds true. In addition, the new geological era, the Anthropocene – meaning human activity has now inexorably altered the planet’s habitability – threatens the very survival of humanity (Bonneuil & Fressoz, 2013; Bourg & Papaux, 2015; Federau, 2017; Magny, 2019; Wallenhorst, 2019, 2020, 2021; Wallenhorst & Wulf, 2022; Kamper & Wulf, 1989, 1994; Gil & Wulf, 2015; Wulf & Zirfas, 2020; Wulf, 2022a). Our future – whether it holds shock or awe – is fading from view. Greta Thunberg’s words to her young peers put the point across in resonant fashion: ‘Why should I be studying for a future that soon may be no more?’ This is a sobering hypothesis: we may soon have no future at all.

Voices – mainly those of Californian technology giants – occasionally proclaim the opposite: we *do* have a future, and a bright one at that. The future will be *great* or *bigger than ever*, we are told by a chorus of such figures, including: Mark Zuckerberg, Facebook co-founder and CEO; Larry Page and Sergey Brin, founders of Google; Jeff Bezos, Amazon founder and CEO; and Elon Musk, whose groundbreaking businesses include SpaceX, Tesla and Neuralink (the 2016 startup aiming to interface the human brain with digital technology). The future is undoubtedly digital. Ultimately, Musk tells us, this is nothing to fear. His ambition is to establish a human colony on Mars within the foreseeable future, using Artificial Intelligence (AI). Neoliberal capitalism has destroyed our ‘shared home’, so Musk wants to build us a new one, on Mars, harnessing the power that the coming digital and technoscientific revolution promises. There are no limits – planetary, corporeal or cognitive – that cannot be overcome by human engineering. We shall soon be able to merge with machines, and so massively increase our capabilities. The future will be in the hands of digital technology. Here we have a second hypothesis: our future will be a Promethean digital endeavour. The *hubris* of *Homo oeconomicus*, maximising individual interests, will prevail. The stratospheric rise of the so-called Big 5 (or GAFAM, standing for Google, Amazon, Facebook, Apple and Microsoft) and their Chinese counterparts (BATX – Baidu, Alibaba, Tencent and Xiaomi) is indicative of this trend. These companies are shaping the future for their billions of consumers across the globe.

Clearly, we need a future and must obviously work diligently to bring it about. However, surely that future is not the preserve of those Promethean few who have access to a spacecraft capable of reaching Mars. Might we not have a different future – one which is post-Promethean, *posthubris*, postcapitalist or simply convivial? We may, even now, be seeing such a world begin to emerge. Here is a third hypothesis: the future could be marked by an ethos of coexistence. Of course, in reality, the future is unlikely to be at either extreme of a scale, but rather, somewhere in between. By examining the world today, we can extract clues as to how it will look tomorrow.

The future is not a given – far from it. Perhaps the most pressing questions we face relate to the fate of humanity. *Who will we become? How can we continue to be human in the current context, marked by climate change, ecosystem collapse, but*

also the augmented humans, profound social transformations and rampant radicalisation? Our living environment has been inexorably altered, transhumanist theories abound, and researchers are seeking to surpass human limitations through technology. In this world, it is increasingly complex – even, sometimes, impossible – to ‘form a society together’. We can no longer take our humanity for granted, but it is crucial to retain it. How do we define ourselves, and what do we want to make of ourselves? This anthropological question is addressed in this handbook, based on three conceptual and epistemic options.

Firstly, it is by becoming more earthly – more connected to the earth – that *Homo sapiens* will become progressively more human. Indeed, the anthropological viewpoint discussed herein is that humanity should immerse itself fully in the natural world. This stands in opposition to the theories, which have been dominant in Western thinking since the Age of Enlightenment (Papaux, 2015), whereby humanity is hierarchically superior to the natural world, and should therefore maintain distance from it.

Secondly, breaking with the essentialism and substantialism currently popular in Western thinking, *Homo sapiens* becomes human as a result of, through and in relationships (with others, with future generations and with non-humans). Humanity is defined not just intrinsically and in static terms, but also on the basis of what it could become and what it makes of itself within its environment. In this context, the modern boundaries between nature and culture break down, as demonstrated by Philippe Descola (2005).

Thirdly, the human race will have a great deal to gain – not least, its own assured survival – from post-Promethean practices.

One thing appears clear: the hypotheses concerning the future and how to prepare for it are shaped by this new context which we must take ownership of and to which we keep returning – the Anthropocene. It concerns what is happening to the climate, changes in the biosphere and the dynamics of our societies. It is the concept of the 21st century, the concept of which it is necessary to have an in-depth understanding in order to understand the transformations that are taking place in the Earth system, to understand the world and allow ourselves to continue the process of becoming human.

Anthropocene: Improvisation of the Term at a Conference in Mexico in 2000

In February 2000 in Mexico, during exchanges at the conference of the IGBP – *International Geosphere-Biosphere Programme* – an interdisciplinary group studying the Earth system, there was discussion of the Holocene, the preceding epoch (lasting from over 11,700 years ago more or less to the current day). Someone stood up and said, ‘Stop using the word Holocene. We’re not in the Holocene anymore. We’re in the...the...the... [searching for the right word] ...the Anthropocene!’ Later

he would say, ‘I suddenly thought this was wrong. (...) I just made up the word on the spur of the moment. Everyone was shocked. But it seems to have stuck’ (Keats, 2011, p. 19). We can say that the proposal of the term ‘Anthropocene’ by Crutzen in 2000 was pure improvisation (Zalasiewicz et al., 2017a, p. 56).

Having used the term at the IGBP conference, Paul Crutzen contacted the American biologist, Eugene Stroemer, to suggest collaborating with him on a paper for the IGBP review, because Stroemer had been using this term informally since the 1980s. Here we read how Jacques Grinevald (2007, p.243), the French philosopher who was working in Geneva, reports Stroemer’s proposal: ‘I started to use the term “Anthropocene” in the 1980s but I never formalised it before Paul [Crutzen] contacted me.’ It is clear in this one-page article that one of the characteristics of the invention of the term ‘Anthropocene’ was that it was put forward before it was accorded a scientific profile and before a precise, exhaustive definition was suggested. Later, in 2002, Crutzen picked up on these elements in a short article in the review *Nature*, where he summarises all the environmental changes brought about by humans since the industrial revolution as evidence that we are entering the ‘Anthropocene’: a tenfold increase in the world population between 1700 and 2000 along with a similar increase in cattle; depletion of fossil resources and the release of CO₂ into the atmosphere; a large increase in species extinction, by a factor of 1000.

A second feature of the concept of the Anthropocene, besides the fact that it was an improvisation, is that it refers to a geological epoch and is thus part of those time periods that are customarily defined by stratigraphers on the basis of their observations of soils. But one of the first uses of this term was proposed by Paul Crutzen, a Dutch geochemist working in Germany, independently of stratigraphic observations. Originally, the term Anthropocene was not suggested by geologists based on stratigraphic evidence but with reference to changes in processes of the Earth system brought about by human activity. Therefore, in its original form, the concept of the Anthropocene is a systemic concept which has its roots in Earth system science rather than in geology.

The third interesting point is that Crutzen was awarded the Nobel Prize for Chemistry in 1995, which gave a large amount of publicity to this new term in the media and in the scientific world. The fact that a word was coined without being precisely defined (even in 2011 Steffen, Grinevald, Crutzen and McNeil recognised that the term Anthropocene still had an informal flavour) and without the usual respect for academic rules is seen by many as a reason for the success of this term, also in the way it was taken up by a very heterogeneous mixture of disciplines before it became widely used by the stratigraphers. Thus, as Ellis (2017) recognised, we may say that the concept of the Anthropocene was created by Eugene Stroemer, then publicised by Paul Crutzen. Its establishment as a scientific concept, based on stratigraphic observations, has been the fruit of work by many different Earth system scientists, the most notable of whom are Steffen and Zalasiewicz.

To begin with, it was non-geologists (chemists, physicists, biologists) who suggested creating a new geological epoch. This audacity initially took the geologists by surprise, but in 2008 the Geological Society of London instituted an official

working group on the Anthropocene with the aim of getting recognition from the International Union of Geological Sciences (IUGS). This working group, composed of brilliant research scientists, published dozens of articles, in the field of Earth system science and in geology, from the establishing of irrefutable truth to stratigraphic foundations, from the end of the Holocene Epoch and from the beginning of the Anthropocene (Zalasiewicz et al., 2011, 2014, 2017a). Thus, the Anthropocene is a new geological epoch, characterised by a change in the habitability conditions of the Earth, impacting in particular human life in society as we know it.

The scientific debates are exciting and are structured within three disciplines which examine three concepts of the Anthropocene: Earth System science, geological stratigraphy and finally the whole field of humanities and social sciences.

The Concept of the Anthropocene Within Earth System Science

The first point is the extent of the systemic upset we have caused to Earth's systems. All publications in this field examine when we passed, or will pass, the boundaries of what the planet can cope with, and the room for manoeuvre that we humans have in which to safely take action. The functioning of the Earth is a complex system, characterised by sudden, irreversible changes when certain bio-geological processes are forced upon it. There are certain boundaries that cannot be passed if we do not wish the Earth system to transgress certain systemic thresholds. There are nine boundaries to have been identified (Rockström et al., 2009; Steffen et al., 2015; Persson, 2022; Erlandsson, 2022): climate change, rates of loss of terrestrial and marine biodiversity, the alteration of biogeochemical cycles such as nitrogen and phosphorous, the impoverishment of the stratospheric ozone layer, acidification of the oceans, the global use of fresh water, land usage, chemical pollution and the discharge of aerosols into the atmosphere. The first two have a special status. Crossing just one of these boundaries is enough to tip the entire Earth system into a way of functioning that is considerably less propitious for life. *Example:* today we find that our principal allies in our economic development over the last two centuries, soil and the plants that grow in it, which act as carbon reservoirs absorbing some of the CO₂ emissions that have been released by human activities, not only capture less CO₂ but may also be releasing more than they actually capture. The Amazonian jungle, for a long time considered to be the 'lungs of the planet', even shows a positive carbon balance (releasing more carbon than it absorbs) in years that are particularly dry (Gatti et al., 2014). Other articles followed, confirming these results (Brienen, 2015; Dougherty, 2015; Esquivel-Muelbert, 2019, 2020). We cannot consider ourselves to be outside nature. There are innumerable studies which show how deeply embedded we are in our environment. Barnosky et al. (2011) write about the sixth mass extinction; Rockström et al. (2009) and Steffen et al. (2015) stress the importance of staying within the planet's boundaries. Barnosky et al. (2012) and Steffen et al. (2018) warn that our biosphere is approaching a systemic

tipping point, and the planet is in danger of becoming a ‘hothouse Earth’, incapable of supporting human society. Im et al. (2015, 2017), Mora et al. (2017) and Bador et al. (2017) forecast heatwaves of increasing frequency and intensity in years to come, etc. This branch of the debate also includes publications on what corrective action we can take, by geoengineering, or ‘planetary stewardship’ (Crutzen, 2006; Steffen et al., 2011b). It is directly connected to normative and prospective political discussion. Often, the question ‘What can we do?’ is asked. The irreversible corruption of our planet’s ability to support life is a matter of concern. Thus, we expect this vein of Earth system science will continue to produce studies grounded in the humanities and social sciences, on how society can be reorganised to exist in the altered biosphere (Eckersley, 2017; Arnsperger & Bourg, 2017; Curnier, 2017; Federau 2017; Lesourt, 2018; Wallenhorst, 2019, 2021, 2022; Wallenhorst & Pierron, 2019; Hétier, 2021; Hétier et Wallenhorst, 2021, 2022a, b, c; Prouteau et al., 2022; Wulf 2022a).

The Concept of the Anthropocene Within the Sciences of Geology and Stratigraphy

The second main branch of debate concerns the date of entry into the Anthropocene. Innumerable articles have been published in this field, although, as they are less ‘spectacular’ and more technical, they are less well known to the general public. This debate among experts in Earth system science usually draws on the multidisciplinary practice of stratigraphy. While they may indeed be less widely known, these articles are of singular importance. It is these studies (rather than those which focus on humans’ indelible and systemic impact on the biosphere) that will perhaps determine the ‘official’ start of the new geological epoch. That official date, when it is known (and if the International Union of Geological Sciences officially ratifies this new geological epoch) will be included in school curricula and will not be edited to suit a particular political agenda. As pupils study the geological timescale early in secondary school (in different countries), the Anthropocene will become part of the curriculum once officially included in that timeline.

Geologists think of Earth’s history in terms of different slices of time, based on shifts in the planet’s overall condition, markers of which can be seen in sediment cores. They identify recognisable segments on the basis of climate, sea level and biodiversity. Stratigraphic markers are used to define chronostratigraphic units, giving geologists a common language in which to advance their knowledge of the planet’s history. In the debate on how to date the onset of the Anthropocene, Earth system researchers are leading the way, identifying features visible today which we know (or can assume with a high degree of probability) will still be visible in hundreds of thousands – or even millions – of years. We do not yet know precisely what the Anthropocene has in store for the next few hundred or few thousand years; also, the most remarkable anthropic changes made to Earth’s system have yet to manifest

themselves. However, it is important for Earth system scientists to put a date on the dawn of the new geological epoch, based on sufficiently solid stratigraphic evidence. Most boundaries are defined by identifying a specific point on Earth in a stratotype known to date from a specific geological era. The markers are known as GSSPs: Global Boundary Stratotype Sections and Points. They may be rocks, sediments or glaciers which developed during a given geological period. Stratigraphic commissions aim to locate such points, which are also known as ‘golden spikes’, because once agreed upon, the stratigraphic section is marked with a plaque, sometimes on the head of a golden spike driven into the rock face.

One of the difficulties in defining a GSSP for the Anthropocene is that the full effects of human activities on the Earth system are not immediately apparent but are spread out across decades or even centuries (Lewis & Maslin, 2015, p. 173). A GSSP places a date on a physical marker that correlates to other, secondary markers. It must be at a particular site on the planet but have proven correlation with a new global context; it must also have ‘complete continuous sedimentation with adequate thickness above and below the marker’ (Lewis & Maslin, 2015, p. 172).

Indeed, a series of indicators can help date the onset of the Anthropocene, such as deposits from human activities, shifts in the biorecord, geochemical shifts, oceanic shifts (such as changes in ocean geochemistry, ocean biodiversity and sea level) and catastrophic events (be they ‘natural’ or caused by humans). Isotopes⁴ can also contribute to the debate. Changes in isotope levels can yield data about the climate or the chemical composition of the atmosphere. For example, lead (Pb) isotopes clearly indicate the Ancient Greek civilisation, which was marked by innovation and the use of heavy metals. Human activities have altered not only the atmospheric concentrations of different gases but also isotope levels. Whilst the isotope record evidences anthropogenic changes over the past few millennia, the isotopes alone do not clearly demarcate the Anthropocene from the Holocene (Dean et al., 2014, p. 284).

Waters et al. (2014) provide evidence of a stratigraphic basis for the Anthropocene, by identifying a collection of anthropogenic sediments. In their view, there is a clear stratigraphic boundary between the Holocene and the Anthropocene: ‘Humans are altering the planet, including long-term global geological processes, at an increasing rate’ (p. 137). Stratigraphic indicators of a shift from the Holocene to the Anthropocene have recently been found in sediments from a lake in west Greenland, containing plastics, radionuclides, fly ash, pesticides, reactive nitrogen and metals (Waters et al., 2016, p. 137). They view the anthropic signatures of the new-dawned Anthropocene, distinguishing it from the Holocene, as the combination of ‘accelerated technological development, rapid human population growth and increased resource consumption’ (Waters et al., 2016, p. 139).

The stratigraphic principles involved in geological methodology are particularly rigorous and based on reason. What is astonishing is how much of human activities the Earth retains. In the scientific literature of the last 20 years, various possible dates have been suggested for the beginning of the Anthropocene: the Stone Age with the controlled use of fire (Doughty, 2013); the emergence of agriculture with

the control over ecosystems and the progressive change in the chemical composition of the atmosphere (Ruddiman, 2013; Ruddiman et al., 2014); the encounter between the ancient and the new world which transformed the ecosystems (importation of different species) and reduced the world population (genocide and pandemics) (Lewis & Maslin, 2015); the steam engine and associated capitalism, becoming increasingly hegemonic (Crutzen, 2002; Steffen et al., 2011); the explosion of atomic bombs with radionuclides spreading to all four corners of the earth (Lewis & Maslin, 2015); or when we entered an age of increased consumption with its pre-programmed obsolescence (Steffen et al., 2015). There is no shortage of hypotheses when it comes to dating our entry into this new geological epoch – and the debates surrounding this have been particularly lively (Autin & Holbrook, 2012; Finney & Edwards, 2016; Zalasiewicz et al. 2012, 2017b; Edwards, 2018). Furthermore, each one of these debates contains valuable anthropological insights: human beings are characterised by their control over ecosystems, their imperialism, their unreserved exploitation of resources to the extent of determinedly sawing off the branches which give them life, they are true economic animals seeking to maximise individual interests, they are Promethean, considering all boundaries as obstacles to be overcome, they are capable of associating techno-scientific capabilities with military power, etc.

The Concept of the Anthropocene Stemming from the Humanities and Social Sciences

Since around 2010, a number of criticisms of the concept of the Anthropocene have emerged from the humanities and social sciences. They begin by questioning the *anthropos* of the Anthropocene. Crutzen, in his 2002 article, stipulates that the Anthropocene is the work of 25% and not all of humanity; however, in most of the articles by Earth system researchers, the *anthropos* responsible for our entry into this new geological epoch appears somewhat undifferentiated, far removed from the critical contributions of history and the sciences. The narrative of the Anthropocene produced by Earth system science is constructed within the framework of species and nature. At the Earth Summit in Rio in 1992, the political declaration of the various governments refers to ‘common but differentiated responsibilities’ (CBDR). It is a question of a weighting that is not completely missing in the narrative of the Anthropocene, but which does not give sufficient consideration to this differentiation.

In the following quotation from the main authors of the concept of the Anthropocene, Zalasiewicz et al., (2010), we see their analysis of the ultimate cause of our entry into to the Anthropocene and the link between human population growth and the use of fossil fuels in the Industrial Revolution: ‘First, how have the actions of humans altered the course of Earth’s deep history? The answers boil down to the unprecedented rise in human numbers since the early nineteenth

century – from under a billion then to over six billion now, set to be nine billion or more by midcentury. This population growth is intimately linked with massive expansion in the use of fossil fuels, which powered the Industrial Revolution, and allowed the mechanization of agriculture that enabled those additional billions to be fed.’ This analysis may seem quite obvious at first glance, but it is worth examining the reasons for the progressive hegemony of fossil fuels that were at the heart of the Industrial Revolution. In an article from 2013, the Swedish historian Andreas Malm shows the way in which the choice of the steam engine rather than hydraulic energy in Great Britain during the 19th century was due to the power of capital over labour. The advantage of the steam engine is that it can be deployed close to towns and workers, and the fact that it does not matter what environment it is in and whether it is close to hydraulic plants. Although in the first few decades, the steam engine’s use of fossil fuel resulted in considerably lower energy yields, the capitalist industrialists preferred to use the steam engine because it enabled the energy of the workers to be harnessed to make better use of the workforce. Thus, fossil energy was not created by an undifferentiated *anthropos*.

The humanities and social sciences insist, therefore, on the importance of social and societal forces for the Earth system. Malm and Hornborg remind us that between 1850 and 2000, the “capitalist” (or “northern”) countries accounted for 18.8% of the world population and were responsible for 72.7% of CO₂ emissions. Just after 2000, 45% of the poorest people on the planet were responsible for 7% of CO₂ emissions; at the very same time, 7% of the richest people emitted 50%. Furthermore, the British environmentalist David Satterthwaite (who was a member of GIEC) shows in a precise study (2009) that people’s responsibility for the emission of greenhouse gases varies by a ratio of 1:1000 according to where they live across the world and the life choices they make. Hence the amount of emissions in tons of carbon per person is 10.94 in Qatar; 4.71 in the USA; 1.57 in France; 0.01 in Chad and Mali. It is this that tells Malm and Hornborg that ‘As long as there are human societies on Earth, there will be lifeboats for the rich and privileged’ (Malm & Hornborg, 2014, p. 66). They therefore ask this simple question: ‘Are these basic facts reconcilable with a view of humankind as the new geological agent?’

Following all these early critical studies concerning the concept of an undifferentiated *anthropos* being the origin of our entering the Anthropocene, Steffen *et al.* gradually introduced elements of differentiation into their analyses, but this remains fairly sketchy and does not go as far as proposing a different concept to the Anthropocene. We can see this in figure 4 (2011b). However, it is possible to see that if the curves of the graph gradually show a differentiated *anthropos*, the accompanying narrative is characterised by a relative lack of differentiation (compared to the contributions of the social sciences).

It is, therefore, not possible to consider the current changes in the Earth system, and the changes that are to come, simply as the product of human nature or of the activity of an undifferentiated or abstract humanity. It is not a question of natural inevitability but a question of social, political, economic or historical causes that can be clearly identified. Earth system science alone is not able to explain the

deep-rooted causes for our entry into the Anthropocene. *Anthropos* is not necessarily at the heart of the way the Earth system functions – or in any case would need further in depth analysis.

The changes in the biosphere are evidence of how fragile the political and social world as we know it, and for which we are educating our children, has become. There is little time left to us to ensure that the Earth system can remain within the ranges of climatic variation and the functioning of the biosphere that were those of the Holocene and thus to avoid leaving its trajectory with no possible turning back for millions of years to come. The timescale we are given shows the urgency of the situation. Moreover, the risks currently incurred by the anthropic violation of our ecosystems, our use of the soil, the climate system, the chemical composition of the atmosphere and the oceans or biogeochemical fluxes, all of these are transcendental dangers to the whole of human life in society. The Anthropocene will continue to make us very fearful (something of which we became aware during the Covid 19 pandemic). Finally, lurking in the shadows of the strictly geological threat of the Anthropocene, we can see a threat that is directly political. In fact, in circles that are aware of the real risks of climate change and the collapse of our ecosystems, it is impossible to deny the seductive nature of ‘strong’ powers, hoping that they will succeed where neo-liberal democracies have failed.

To conclude, it is now up to each disciplinary field to develop its acceptance of the Anthropocene, in other words to take ownership of all the knowledge at their disposal in order to identify the paradigmatic breaks to be constructed within each of the disciplines.

The Future of Humanity Based on the Materiality of the New Geological Context

With human beings having such a central role to play on our planet in the Anthropocene, anthropological research continues to gain in importance. In such research, the human being is rarely seen an entity that is separate from the world, a *homo clausus*. It is far more common to see the human being as entangled with nature, with other creatures and other human beings. There is an increasing awareness of the *dual historicity and culturality* of anthropology. In anthropological research, themes and objects are examined at a specific time in history within a specific cultural frame of reference. There is a focus on both the past and the present, and frequently assumptions and projections of future developments are made. Historical, cultural and philosophical anthropology has offered some important contributions to our understanding of humanity in recent decades (Kamper & Wulf, 1994; Wulf & Kamper, 2002; Wulf, 2013, 2022a; Wallenhorst & Wulf, 2022) that show the importance of anthropological knowledge for our understanding of the Anthropocene. This is also true of the research into the negative developments of the Anthropocene and the global efforts to lessen their impact. Particularly

important are the attempts to combine local and regional views with global perspectives. Many problems of the Anthropocene can only be understood and dealt with by taking into consideration the interaction of local and global dimensions. Agenda 2030, with its Sustainable Development Goals, is an example of this.

In view of the demands of the Anthropocene, anthropological research projects use *plural forms of knowledge* that are often interconnected and yet also follow their own developmental logic. They acquire their knowledge from many scientific disciplines for which they use various research methods. Anthropological knowledge is often multi-, inter- and trans-disciplinary. Because of the situation in which our planet currently finds itself, this knowledge is also often inter- or transcultural. Often different, ever-changing points of reference are at the basis of global knowledge which make these research projects more complex. It is a challenge for contemporary anthropological research to make connections between several scientific disciplines and paradigms. For example, investigations by the earth sciences are important now – these include geological, stratigraphic, Earth system science and multi-paradigmatic investigations. New knowledge that is important for our understanding of the Anthropocene is also emerging in almost all sciences.

Anthropology is an *open science*. It has no pre-determined subject area. Generally, its research projects have had to do with the actions and behaviour of human beings in the Anthropocene and contribute to a better understanding of human beings. In principle, this includes all areas of human action and behaviour in relation to the world and other people. Anthropological knowledge is multi-paradigmatic; it includes the natural sciences, and in the humanities and social sciences, it embraces both qualitative and quantitative knowledge. New forms of knowledge arise in anthropology that may also be paradoxical and self-contradictory. If we presuppose a broad understanding of science this can result in new forms of anthropogenic knowledge that change the accepted way of seeing nature, the world and human beings. Examples of this are to be found in climate research, genetics and Artificial Intelligence.

New forms of knowledge are also arising in the cultural and social sciences which are important for the idiographic understanding and the nomothetic explanation of the effects of humans on the planet. Some of these come about in relation to the Sustainable Development Goals and others because of new historical or cultural perspectives. There is also the formation of hybrid forms of knowledge in which dynamics that differ from one culture to another affect each other. This happens to the same extent both in the arts and sciences, and these forms of knowledge create complex processes or “grand narratives” that are contingent on them, and new interpretations, as mentioned above (Lyotard, 1979).

By showing how knowledge relates to human beings and how they act with regard to nature and the world, the anthropological perspective can help to make it easier to understand knowledge in the Anthropocene that is often hard to access and make sense of (Council of Science and Humanities, 2006). Anthropological research projects attempt to dissolve traditional boundaries between the sciences and the humanities through new forms of connecting and combining knowledge. They can

also clearly show the importance of anthropological processing of scientific knowledge for bringing the Sustainable Development Goals to fruition.

When faced with the complexity of the Anthropocene, there needs to be *critical reflection* on the limitations of anthropological research. The question is to what extent it is possible, in discourses on the trans-human for example, to see beyond the anthropological perspective (More & More, 2013). This gives rise to doubt. Although the anthropological perspective is often expanded in an appropriate way, the anthropological viewpoint is not, as a matter of course, transcended. Even when these discourses criticise the central role of human beings as the reference point of research, they do refer to them and can transcend neither anthropology nor human beings. For many years now, the goal of anthropological research is no longer abstract human beings, detached from their historical and cultural context. The goal is far more historical-cultural research that has as its focus the specific conditions of human life in the Anthropocene (Kamper & Wulf, 1994; Wulf, 2013, 2022a, b; Wulf et al., 2010, 2011; Wallenhorst & Wulf, 2022).

With this cultural-historical anchorage, the ambition of this *Handbook of the Anthropocene* is to look ahead and to try to identify the main lines of a prospective anthropology. This dynamic joins the structuring elements of the ‘new humanism’, as defined in 2010 by UNESCO, in a tradition marked by utopian pragmatism, which emphasises humanity’s potential creativity, in terms both of devising new projects and goals and of redefining ourselves. These articles attempt to marry new humanism with ecology-based thinking and biogeochemical materiality. Such thinking (which is not seen in new humanism) represents a breakaway from anthropocentrism. This is singularly important when thinking about humanisation – the focus is not on the essence of humanity, but on our relationship with nature (one of dependency), and on accommodation of the human race (or the ‘human adventure’) as an integral part of the Earth system.

The Anthropocene: A Critical but Potentially Constructive Challenge to Shape the World

This collective work is a step toward prospective anthropological reflection, but it is by no means intended to be exhaustive. Finally, rather than being restricted to a single scientific discipline, this compendium opens doors and encourages debate.

When we refer to the Anthropocene, this often has negative connotations. We think of the great problems of the modern age that have arisen as a consequence of industrialisation, the acceleration of life and the increasing abstraction of modern ways of life. These include, for example, climate change, the acidification of the oceans, the destruction of biodiversity, the development of nuclear energy, the depletion of non-renewable energy and destruction of the environment. Most of this destruction is the result of an increasing number of people wanting a ‘comfortable’ life, based on exponential consumption, coupled with population growth. Now,

however we realise that the ways of life involved in this have led to a high degree of violence towards nature, other people and also individual existence. This has created a situation in which many people see the future of humankind and the planet as being under threat. Given this situation, there is an increase in endeavours that rest on people's creative ability and require intensive efforts to prevent such a negative outcome. If, in the Anthropocene, humans have such a profound influence on everything that concerns the planet, they can surely also use this influence to improve the situation – and, as we have mentioned, the question of temporalities is decisive here. With the work on the 17 Sustainable Development Goals (SDGs), this would seem possible. Indeed, in these articles, education is presented as a tool to help make choices in relation to the medium- and long-term changes we face (Wallenhorst et al., 2018; Wallenhorst & Pierron, 2019; Wulf, 2022a). However, it is by no means certain that these efforts will be successful. And yet it seems reasonable and promising for the nations of the global community to want to work towards achieving these goals in as far-reaching a way as possible. Here it is clear that hopes and utopian dreams have a role to play. These SDGs require fundamental changes in politics, the economy, public awareness and education. It is clear that the education and socialisation of the future generations is important. And for this reason, one of the goals is expressly aimed at education and personal development.

The global community needs to be transformed on the basis of the SDGs. Such a development extends across the following five areas that need to be improved by means of the SDGs. These are *people* (poverty and hunger, dignity, equality, a healthy environment), *planet* (protection of the ecosystems), *peace* (inclusion, peace, justice), *prosperity* (bringing prosperity to all people by means of economic and technical development) and *partnership* (cooperation). These tasks should be fulfilled through the principles of universality, inseparability, inclusion, accountability and partnership (Wallenhorst, 2019; Wulf, 2022a; Wallenhorst & Wulf, 2022, 2023). In every area a programme is being developed, the success of which hinges on correcting the undesirable developments caused by humans. Here educational processes play an important part. They oscillate between perfection and incorrigibility (Kamper & Wulf 1994). Violence, which may be explicit or implicit, plays a central role in these processes. Considerable energy and strength is required to achieve the necessary social transformations and violence is therefore sometimes unavoidable. Paradoxical conflicts that are very difficult to resolve often arise in these processes, and education creates important methods of dealing with these conflicts in a constructive way. There is a need for all-embracing processes of education and learning and the anthropological research that will make them possible. There is still uncertainty about the extent to which these processes are possible in the long term in non-democratic societies. We need to create new images of nature, the world and humanity that are not simply based on utopian ideas but also include elements of human resistance and incorrigibility. The goal is not only to change the individual and collective imaginary but also to change actions and behaviour. There needs to be a critical but constructive change in people's dominant habits, which have at their centre, for example, consumption and utility. There also need to be new approaches

to nature and the world (Wulf, 2013, 2022a; Paragrana, 2014). Mimetic processes, i.e. processes of creative imitation of examples of successful practice, are important here. Creative mimetic processes that embrace the sensuality of the body can help to form new habits (Gebauer & Wulf, 1995, 1998). On the one hand, these are the product of embodied practical knowledge, and on the other hand, they also lead to new forms of practice and structures. Rituals and ritualisations play an important role in this (Wulf, 2010; Wulf & Zirfas, 2014). For the SDGs to produce the social transformations for which they strive, they must be performative, i.e. they must lead to the staging and performance of social behaviour, that is geared towards the critical but constructive possibilities inherent in human actions and behaviour in the Anthropocene. These processes require us to embody within us the anthropogenic actions and behaviour to which we aspire (Kraus & Wulf, 2022) and also to realise the importance of what is implicit and tacit (Kraus et al., 2021).

It should be pointed out that the concept of the Anthropocene has been the subject of so many empirical studies, research and scientific publications in almost all disciplinary fields that it has now acquired an autonomy with respect to official geological institutions. The Anthropocene, regardless of its formalisation, can now be understood as a total social fact with a proven systemic scientific basis (Mauss, 1923–24), which is why it is important to explore it in this *Handbook of the Anthropocene*.

This *Handbook* is divided into six sections which constitute six facets of the Anthropocene that it is necessary to understand if we are to consider and prepare a long-term future.

1. The planet: caught between biogeophysical knowledge and the uncertainty of our adventure
2. Moving towards new epistemological paradigms linking the sciences and humanities
3. Human beings: bridging nature and culture
4. Societies: Prometheanism and post-Prometheanism
5. Profound long-term changes: education, apprenticeships and socialisation
6. Peace and violence

The almost 280 articles that make up this *Handbook of the Anthropocene* do not by any means cover the whole spectrum of the Anthropocene and its impact on human societies in a comprehensive way. We would have liked to add many more entries. But the multidisciplinary project had to end somewhere. This end is relative and temporary: as of now this task is continuing in the preparation of an *Encyclopaedia of the Anthropocene* for Springer-Nature. This work will mobilise the authors of this handbook and many others (from all continents and all disciplinary fields) to continue to circumscribe all the novelties and ruptures of the new geological era that is now ours.

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