Rachel Carson Center
Perspectives

How to cite:

Schwägerl, Christian. "Neurogeology: The Anthropocene's Inspirational Power" In: "Anthropocene: Exploring the Future of the Age of Humans," edited by Helmuth Trischler, *RCC Perspectives* 2013, no. 3, 29–37.

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Rachel Carson Center for Environment and Society
Leopoldstrasse 11a, 80802 Munich, GERMANY

ISSN 2190-8087

SPONSORED BY THE

Federal Ministry of Education and Research

Deutsches Museum

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

Christian Schwägerl

Neurogeology: The Anthropocene's Inspirational Power

The Anthropocene concept captures the realization that humanity is interfering, interacting, and communicating with the Earth's long-term systems with increasing intensity. What happens to Earth could be called anthropoization. This is a new phase for the planet and a new experience for us as a species. In the Pleistocene, when modern humans evolved, they were hunters and gatherers exposed mainly passively to the powers of the Earth. In the Holocene, when humans started farming, building cities, mining, and fishing, they exploited a natural treasure trove that had built up over 4.5 billion years without considering the effects of their actions. The Holocene was the stage for a human rebellion against natural limits. It was a successful rebellion.

Now, in the dawning Anthropocene, it looks as if the future Earth will be dominated by human action (unless, as Paul Crutzen has stated in his seminal article "Geology of Mankind" in *Nature* magazine, "there is a global catastrophe—a meteorite impact, a world war, or a pandemic"). In addition, the anthropogenic changes will feed back on humans and how they perceive the world.

Planet Earth is going through a "human bottleneck." Basically all of the Earth's surface, large parts of the oceans, and even considerable parts of its crust are affected by human actions. These actions change key parameters of its geological, biological, and chemical composition and character. The planet has entered a period of what should be called "neurogeology": the mental states and resulting actions of individual humans, groups of humans, and the collective mental states of all humans together are creating a new mode of planetary development that blends human infrastructure and technology with novel ecosystems, a higher chemical and geological diversity, an altered climate, and even entirely new life-forms.

Even single individuals can have immense neurogeological power, as seen in the example of Thomas Midgley, who invented CFC cooling substances that later depleted the ozone layer, the result of two billion years of photosynthesis. He had, as environmental historian John McNeill wrote in his book *Something New Under the Sun: An Environmental History of the Twentieth-Century World*, "more impact on the atmosphere than

any other single organism in Earth's history." Another example is Fritz Haber, who together with Robert Bosch developed a way to turn atmospheric nitrogen into fertilizer, increasing food production and with it the human population, as well as altering the chemical composition of soils and the oceans.

In the Anthropocene, the future fossil record and the long-term composition of the biological world will be strongly determined by human action (and inaction). Geologist Jan Zalasiewicz pointed out at the opening of "The Anthropocene Project" in Berlin in January 2013 that there are at least 100,000 domesticated cats in the world for every tiger in the wild. This leads to the perspective that in the long run, new species of wild felines could potentially evolve from today's housecats. Directed evolution, shaped by the tastes of early Anthropocene pet owners, may procreate neo-wild species of the future and their even more distant fossil remains.

An Anthropocene age with a neurogeological character still sounds like a deliberate provocation to many, as it greatly emphasizes human action and joins the most short-term, seemingly ephemeral processes in human brains with the most long-term forces of geology. This goes against both our intuition and long-held concepts of a nature-culture dualism. Scientists' reluctance to confront this new world is reflected in the fact that 75 percent of biological research stations are crammed into 25 percent of land surface, namely those few remaining areas with little human impact, as Emma Marris has pointed out in her book *Rambunctious Garden.* The man-made landscapes are taboo for many biologists because they are "disturbed" by human activity—a rather misanthropic notion. Another example is the reluctance of mineralogists to accept man-made crystals—like those in ball-point pens—as worthy of study and classification.

But once you open your scientific and personal eyes and minds for the Anthropocene challenge, the world is already full of neurogeological phenomena, as Zalasiewicz and others have made clear in their research. The Anthropocene concept creates a single continuum that stretches from stones to human thought, from the most concrete and enduring phenomena to the most abstract and fleeting, effectively dissolving the artificial dichotomy between "nature" and "culture" that has for so long hindered a more symbiotic development between civilization and the overwhelming majority of the eight million or so other species on Earth. Beyond dualism, a world of neurogeological and biocultural amalgams, hybrids, emulsions, and fusions is waiting to be discovered, described, explored, and experienced.

For those who are skeptical about the Anthropocene concept, it might be reassuring to emphasize that first and foremost, it is only one of many scientific hypotheses. The claim that humanity's collective action is forceful enough to show up in the geological record is being tested by scientists today and will be tested further over the millennia to come. A working group under the umbrella of the International Commission on Stratigraphy has been formed to carry out the necessary research. A first scientific verdict by this group is expected for 2017, but later geologists, in the year 2700 or 27,000 (or 270,000), will continue to assess mankind's geo-power and weigh it against the criteria for dividing Earth's history into distinct pieces of time. This will lead to a series of ongoing judgments and classifications.

According to this purely scientific, analytical understanding of the Anthropocene, the concept does not contain any normative, ethical, or philosophical implications. The deciding criteria is whether it is possible to distinguish a "golden spike," a distinct and measurable signal of human presence in the geological record that remains for an extremely long time span. In this view, it does not matter what particular actions we take—whether all humans become carbon-neutral vegans or whether we decide to burn the last piece of coal. One might even consider helping future geologists by bringing about particularly significant changes in the Earth system, such as runaway climate change or a huge wave of species extinctions, because that makes the task of delineating the current epoch from the Holocene much easier. Breaking up the landscape and the underground terrain with the help of "fracking" technology, as is being done in the latest energy revolution in the United States, is another example of how it has been made easier for geologists to determine the onset of the Anthropocene. But it would be rather cynical to approach the issue at hand like this. Luckily, hardly anyone views the Anthropocene concept in such a way.

Without a larger and deeper meaning, the Anthropocene idea would probably not have attracted so much attention and debate. The reason why the concept is so attractive is its usefulness as an introspective and interactive tool: by offering a name for the totality of human-Earth interactions and for a potentially long future of humans on Earth, the Anthropocene concept takes the shape of a new framework to think about ourselves as individuals and as a collective. On a phenomenological level, it reflects a progression: while humans once made regional and short-term changes to the environment, the changes are now global and long-term. On a more ontological level, it stands for the

expansion of our environmental consciousness from our immediate vicinity to the entire globe, and of our predictive scientific power from isolated laboratory experiments to the behavior of global biogeochemical systems. There is also a strong temporal aspect: the Anthropocene idea extends the traditional "short now" (ranging from single moments to the duration of an individual life) to a "long now" that includes the effects of our daily lives of today on the centuries, millennia, and actual millions of years to come.

One very strong metaphorical message that seems to come out of the Anthropocene idea is that it attributes to humans a rightful place on Earth and a deep embeddedness in Earth history. When people are first confronted with the Anthropocene idea, a typical reaction is that they think it is the sum of all environmental problems, short for everything that goes wrong and for the alienated and actually alien status of humans within a perceived "natural world." On closer examination, the Anthropocene idea does the opposite: it firmly links humans with everything that goes on around them and integrates humans into what used to be called the natural world. We start to see the link between natural phenomena and the man-made, like the work of past organisms that have created the limestone used in our cities or the contribution of bacteria billions of years ago to produce the ores that we use to build our machines and skyscrapers. We also start to see the man-made in the natural when we accept the biodiversity brought about by cultivating plants, animals, and bacteria, and when we observe how the millions of tons of man-made machines become parts of the biomaterial cycle through decomposition.

A future science of neurogeology can explore how we will meet ourselves in the nature of the future and what this does to us. Humans will shape nature in ways that have rather scary real-world consequences, like superstorms caused by anthropogenic emissions of greenhouse gases or poisoned ecosystems resulting from the accumulation of toxic waste. Human action will be embedded even in orchids deep in the rainforest because the plants grow using carbon atoms that have already gone through coal-fired power plants. At the same time, more beautiful processes become possible, like increased knowledge from long-term remote sensing and global monitoring. This could pave the way for an expansion of our global consciousness and for more introspective insight into our fateful connection with the dynamic changes in climate and biological systems.

Despite these opportunities, there is still a lot of skepticism about whether the Anthropocene idea is valid and useful. That is understandable and healthy. Accepting

the Anthropocene concept prematurely, that is, before proper scientific assessment or because it is a new and fashionable term that delivers us from the boredom of repeating "sustainability," would not be helpful for its long-term evolution. It is important that the Anthropocene idea is developed with a sound grounding in science and with contributions from many perspectives. There are a multitude of viewpoints.

Old-school geologists (or rather their stereotypical representatives) might be suspicious that the Anthropocene theory ignores the retrospective and deep-time character of the traditional stratigraphic classification system. They might even be alarmed by this strange intrusion of ephemera-producing culture on the geological record. A stereotypical biologist might feel uncomfortable with what seems to be an overemphasis on human action within the Earth's flow of matter and genetic information. A humanities scholar might see a dangerous attempt to create a naturalistic world order as an extension of technocratic concepts of Western-style progress. An ethicist could ask whether experts on stones and soils now want to study and even set human social norms instead of the disciplines and institutions that are traditionally responsible for doing this. Historians could easily see an expropriation of their home turf, as human history is suddenly absorbed into the larger picture of Earth history with its own and different mechanisms and contexts. Indigenous people might feel that their very different view of humans and nature is being forcefully taken over by a universalistic concept created by white, male natural scientists from Western cities that declares all other perspectives to be "pre-Anthropocene," that is, outdated or outright primitive. An old-school environmentalist might view the Anthropocene idea as an attempt to justify and rationalize the triumph of industrial destruction with pseudo-harmonic rhetoric. Someone who believes in a superior creator, a.k.a. God, will be upset by the hubris of the human determination to engineer Earth that emerges when the Anthropocene and anthropocentrism are seen as one. From this perspective, the Anthropocene might just be a reenactment of the Tower of Babel story. And finally, a politician might dislike the Anthropocene because it imposes a long-term temporal pattern that is hard to reconcile with the four- or five-year rhythm of Western democracies.

But conversely, for the very same mix of people, the Anthropocene concept might turn out to be a very useful and inspiring tool for reconsidering, developing, or modernizing their ingrained perceptions.

Old-school geologists (or again, their stereotypical representative) can revisit the criteria upon which their discipline is based and expand their ideas about whether Earth history has entered into a new phase with new rules that deserves new criteria. The biologist can start to research new emerging entities of biocultural nature, entities that merge the molecular and the cultural sphere, that have so far escaped deeper study and are hidden in the continuum from soil to thought. Humanities scholars might be tempted to work on extending their interpretational power into the organic-material sphere. An ethicist could look into the novelty of a world of man-made natural causes and effects and explore whether these phenomena merit the creation of new rules for living together. A historian could use the Anthropocene concept as a lens to revisit past events in terms of their relevance for the emerging world and as an empty signifier for the future of history and the history of the future alike. Indigenous people could rightly claim a place in the Anthropocene pluriverse, where their values and ideas are treated as contemporary instead of old-fashioned. An environmentalist might use the concept to escape from the paradox of shifting reference points in the past, depart from the retrograde nineteenth-century nostalgia embedded in many eco-strategies, break through the "apocalyptic wall" of doomsday forecasts, and jump out of the tragic narrative of environmentalism. All this could empower us to shape and frame the future instead of clinging to an idealized past. A Christian believer or scholar could use the Anthropocene as a metaphor for a time in which the biblical mission of "subduing" the Earth has been nearly completed, posing questions about what to do next. And finally, a politician might use the concept as a tool to argue against and perhaps overcome the "egotism of the present" that is so characteristic of many policies, from financial regulation to pension policies to environmental management.

Developing the Anthropocene idea need not be a linear or elitist process in which a body of canonical texts arises and a small elite of specialized scholars defines what this Age of Humans is about and what it is not. In contrast, the Anthropocene is a platform open to anyone to join in the debate and reflection. It is a privilege for all humanity that the Anthropocene is becoming a "process that reflects about itself" (Jürgen Renn). Therefore, rolling out the idea globally must be a very democratic and open-source undertaking that is continually revised and adapted. Inevitably, the neuro-geological future of Earth will be shaped by the sum of the mental states of all its citizens, including a wide range of desires and motivations such as existential needs, greed, egotism, common dreams,

evil intentions, beautiful aspirations, and short-sightedness, as well as prescient and attentive attitudes. However, it will be much more difficult to find a way to invite all humans into the Anthropocene arena and make them conscious members of a planetary polis. Due to rapid urbanization and the extension of the "invisible city" (the extensive infrastructure of farming, mining, and extraction of fossil fuels needed to sustain city life), this polis seems an inevitable necessity, but one that is hard to achieve.

In this context it is important to focus on the first part of the word "Anthropocene." While the concept initially gives the impression of a grand and encompassing term, it also allows us to connect individual everyday lives to global changes. Every human being can be seen and can see himself or herself as an Anthropocene protagonist. When Australian zoologist Tim Flannery describes humanity as a "mammalian super-organism" in his book *Here on Earth,* he does not equate humans with pre-programmed ants. Instead, this super-organism consists of billions of beings, each with a very high emotional, creative, and intellectual potential, given the right conditions to develop it.

This is important, as entering the Anthropocene means entering a phase in which the planet is permeated with human intentionality. Until recently, CO_2 emissions were a blind collective process; however, since the reports of the Intergovernmental Panel on Climate Change (IPCC), the story is different. Humanity continues to change the climate without a plan, but at least now we are aware of what driving cars, flying planes, and consuming energy-intensive goods will lead to. In the future, climate models will tell us with increasing clarity what the effects of our personal and collective emissions are. Very soon, then, we will no longer be able to excuse ourselves by pleading a lack of knowledge. What emerges is a new imperative to end the inadvertent side-effects and start making our interactions intentional, as Julia Pongratz, a researcher at the Max Planck Institute for Meteorology in Hamburg, noted in a talk for "The Anthropocene Project" in Berlin in 2012. We have to move from behaving like a bull in a china shop to curating the planet as a collection of priceless artworks. This is a tricky task, as a lot of the changes we perform are of such a long-term nature that it is difficult to assess the pros and cons. Climate change, for example, threatens the coming generations, but in the long run might stop the Earth from entering another ice age. Biotechnology might be monopolized by very problematic companies at the moment, but at the same time it open up new possibilities for enriching the planet with man-made biodiversity.

What is happening is a shift of intentionality and responsibility from the "short now" to a "long now." This challenges political institutions to develop forms of representation for non-human agents and for the interests of future inhabitants of the Earth. The debate about this expansion of democracy has only just begun. The same is true about most other aspects of the Anthropocene. Given the average "lifespan" of ten million years for any given species on Earth, we humans are incredibly new on Earth, as if we have just arrived. The Anthropocene is but a moment on the geological scale so far. Therefore it can be seen as a wide-open opportunity to fill the world not only with sensors, but also with sense.

The Anthropocene tells us how deeply interwoven the geosphere, the biosphere, and the emerging noosphere are becoming. Future neurogeologists will coin new terms to describe the patterns and mechanisms of this process. What is important to note is that modern life doesn't separate us humans from "nature." On the contrary: the more we interfere with resources and ecosystems, the closer we get to natural phenomena and the deeper we move "into" the new nature that arises through our actions. When we start to see past living organisms in the products that surround us as urban dwellers; when we start thinking about the 40 mountains hidden in the components of any given smartphone; when we become aware of the gargantuan effects that the past two hundred years of modern life have had upon our world: then we might start to question our current priorities, our sense of time and place, our attitude towards our co-inhabitants of Earth and our daily material communication with the billions of future human beings who will inhabit the Middle or Late Anthropocene. When we start seeing ourselves not as the masters of the planet, but as the primordial humans of the future, we might be able to escape hubris and strengthen our sense of humility. While previous epoch names played no role for our everyday lives, this is different in the Anthropocene. It is an epoch that is about everyone, concerns everyone, and belongs to everyone. That is what gives it such enormous inspirational power.

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