



Presents

ANTHROPOCENE

THE HUMAN EPOCH



**A feature documentary + multidisciplinary project
exploring human impact on the Earth**

by

**JENNIFER BAICHWAL
NICHOLAS de PENCIER
EDWARD BURTYNSKY**

Narrated by ALICIA VIKANDER

(87 mins, Canada, 2018)

Languages: English, Russian, Italian, German, Mandarin, and Cantonese with English Subtitles

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PROJECT OVERVIEW

We have reached an unprecedented moment in planetary history. Humans now affect the Earth and its processes more than all other natural forces combined. *The Anthropocene Project* is a multidisciplinary body of work combining a feature documentary, fine art photography, film, virtual reality, augmented reality, and scientific research to investigate human influence on the state, dynamic, and future of the Earth.

The Holocene Epoch started 11,700 years ago as the glaciers of the last ice age receded. Geologists and other scientists from the [Anthropocene Working Group](#) believe that we have left the Holocene and entered a new epoch: the Anthropocene. Their argument is that humans have become the single most defining force on the planet and that the evidence for this is overwhelming. Terraforming of the earth through mining, urbanization, industrialization and agriculture; the proliferation of dams and diverting of waterways; CO² and acidification of oceans due to climate change; the pervasive presence around the globe of plastics, concrete, and other technofossils; unprecedented rates of deforestation and extinction: these human incursions, they argue, are so massive in scope that they have already entered, and will endure in, geological time.

Another collaboration from Nicholas de Pencier, Edward Burtynsky, and Jennifer Baichwal, *The Anthropocene Project* is a multimedia exploration of the complex and indelible human signature on the Earth. Originally conceived as a photographic essay and the third in a trilogy of films including *Manufactured Landscapes* (2006) and *Watermark* (2013), the project quickly evolved to include film installations, large-scale Burtynsky High-Resolution Murals enhanced by film extensions, 360° VR short films, and augmented reality installations. Embracing and developing innovative techniques, the trio embarked on an epic journey around the world (to every continent save Antarctica) to capture the most spectacular evidence of human influence, while taking time to reflect on the deeper meaning of what these profound transformations signify. The result is a collection of experiences that will immerse viewers in the new world of the Anthropocene Epoch, delivering a sense of scale, gravity, and impact that both encompasses and moves beyond the scope of conventional screens and prints.

The project, set for release in Fall 2018, includes:

- ❖ a **feature documentary film**;
- ❖ two major **museum exhibitions** that will **premiere simultaneously** at both the **Art Gallery of Ontario (AGO)** and **National Gallery of Canada (NGC)** before travelling to Manifattura di Arti, Sperimentazione e Tecnologia (MAST) in Bologna in Spring 2019;
- ❖ a new release of **Edward Burtynsky photographs**;
- ❖ a series of **film installations** from Baichwal and de Pencier;
- ❖ immersive **interactive experiences** in **augmented** and **virtual reality**;

- ❖ an **art book** published by Steidl and an **exhibition catalogue** published by the AGO;
- ❖ a comprehensive **educational program**.

FILM SYNOPSIS

A cinematic meditation on humanity's massive reengineering of the planet, *Anthropocene* is a four years in the making feature documentary film from the multiple-award winning team of Jennifer Baichwal, Nicholas de Pencier, and Edward Burtynsky.

Third in a trilogy that includes *Manufactured Landscapes* (2006) and *Watermark* (2013), the film follows the research of an international body of scientists, the [Anthropocene Working Group](#) who, after nearly 10 years of research, are arguing that the evidence shows the Holocene Epoch gave way to the Anthropocene Epoch in the mid-twentieth century, as a result of profound and lasting human changes to the Earth.

From concrete seawalls in China that now cover 60% of the mainland coast, to the biggest terrestrial machines ever built in Germany, to psychedelic potash mines in Russia's Ural Mountains, to metal festivals in the closed city of Norilsk, to the devastated Great Barrier Reef in Australia and massive marble quarries in Carrara, the filmmakers have traversed the globe using high-end production values and state of the art camera techniques to document the evidence and experience of human planetary domination.

At the intersection of art and science, *Anthropocene* witnesses, in an experiential and non-didactic sense, a critical moment in geological history — bringing a provocative and unforgettable experience of our species' breadth and impact.

DIRECTOR'S NOTES

It feels like our films keep getting bigger in scope. I am not sure if this is because getting older naturally brings a more global perspective, or if the urgency around problems we face at a global level demands it. For *Anthropocene* we were on six of seven continents in 20 countries and 43 different locations (n.b.: the film and project has been carbon offset). But these “big picture” subjects, I have learned, fall apart without an appropriate balance of scale and detail. Sometimes you need to go up in the sky to convey place, but if you stay up there all the time, you float away from what is meaningful. I think that humans are not meant to remain at an omniscient level, though we like to contemplate from there and technology (helicopters, drones, satellite imagery) allows us to do so. It is in the relationship between scale and detail where our work and Edward Burtynsky's comes together.

Anthropocene is third in a trilogy of films that started in 2005. *Manufactured Landscapes* (which I directed, Peter Mettler shot and Nicholas de Pencier produced) was the first, and followed Burtynsky's photographic essay of the industrial revolution in China. I was not interested there in making a portrait of the artist (as we did in *Let it Come Down: the Life of Paul Bowles*), nor a film that used the work as an arena to explore a philosophical or political problem (as we did in *The True Meaning of Pictures*). Rather, Burtynsky's photographs and the extraordinary places they conveyed, as well as the non-didactic way they conveyed them, were the starting point. The film tried to intelligently translate one medium into another —which meant in most instances trying to convey scale in time. Hence the eight minute long, single take opening sequence. But without intimacy, scale in film (and this was our last documentary actually shot on film — super 16mm) was not interesting. The vast Eupa factory floor would not have meant as much without the glances up from workers as the dolly passed them, or the person sleeping at his post after everyone left for lunch; the massive resettling of people and cities for the Three Gorges Dam would not have resonated without the woman sewing at the construction site.

In *Watermark* (which Burtynsky and I co-directed and Nicholas shot and produced), we tried to take the idea of human interaction with water and explore every facet of our use: survival and daily needs, industrial, recreational, religious. Here our biggest lesson was illumination through juxtaposition. The film did not have a lot of information about context; if you needed more than a few words to describe where you were, it wasn't going to work. So instead we put one place against another to sharpen the focus of both: the Buriganga river next to a pristine Lake Ealue in British Columbia; people taking a sacred bath in the Ganges at the Kumbh Mela next to girls cartwheeling on the beach in California. But here again it was the combination of big picture and particular focus that brought an experiential understanding of context. We could have interviewed a water expert in the Colorado River Delta. But it was the testimony of Inocencia Gonzales from the Cucupá Nation, whose fishing community was decimated as a result of the dry delta, that made viewers understand that place.

Anthropocene steps one place back from the other two films in its premise, taken from the research of the Anthropocene Working Group: that humans change the Earth and its systems more than all natural processes combined. The film required a global perspective to drive home the fact that we humans, who have really only been up and running in modern civilization for about 10 thousand years, now completely dominate a planet that has been around for 4.5 billion.

How do you convey that domination? Here again it was tempting to stay in the realm of the big; the omniscient. The aerial perspective — through helicopter and cineflix or drones — is woven all through the film, and sometimes the only way you experience a place: the phosphate mines in Florida, for example, or the oil refineries in Houston, Texas. But when everything is big or far away and diagrammatic, scale becomes incomprehensible. So the carrot farmer, Nicole Thelen, whose farm is about to be displaced, illuminates the Bagger, the largest terrestrial excavating machine on the planet, chewing up the earth in the largest open-pit coal mine in Germany. A timelapse of one small piece of bleaching coral tells the story of anthropogenic ocean acidification, and the tusks of seven thousand elephants, each one carefully weighed and recorded, becomes the way we understand human-directed extinction.

I think the balance of scale and detail is also where we have learned from each other over 13 years of collaboration. This film certainly deploys the big picture, and endeavors sometimes to convey a place in one wide frame. We have sought the highest resolution and production values possible, even in challenging environments, and have pursued the most innovative technology available to our budgets, to the point where we are launching new AR forms in the museum exhibitions of *Anthropocene*. But the film also seeks moments of intimacy — the detail needed to reveal, understand or encourage empathy within context. This is where the ethics of engagement are critical, and I would go further to say that ethics are the most important dimension of our filmmaking practice. When you go all over the world for your project, it is crucial to try and do so with humility, and an openness to what the context wants to tell you about itself, especially its overlooked margins or ignored corners.

Below are some stats on the film's production:

- ❖ Filmed over 3 years, 2 months and 22 days
- ❖ 50.77 TB of raw footage
- ❖ 202 hours and 57 minutes of material
- ❖ 43 locations, 20 countries, 6 of 7 continents
- ❖ 6 wrappers, 10 codecs, 29 cameras
- ❖ 10 months of editing
- ❖ Made without a traditional script

- Jennifer Baichwal, also on behalf of co-directors Nicholas de Pencier and Edward Burtynsky

BILLING BLOCK

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ADDITIONAL CAMERA MIKE REID SOUND DESIGN DAVID ROSE
ORIGINAL MUSIC ROSE BOLTON NORAH LORWAY RE-RECORDING MIXER LOU SOLAKOFSKI
WRITTEN BY JENNIFER BAICHWAL ASSOCIATE PRODUCER NADIA TAVAZZANI
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AT A GLANCE...

Production on *The Anthropocene Project* began in 2015, and over the course of 3 years the film team visited 43 locations in 20 countries on every continent, save Antarctica, including:

Australia	Germany	Kenya	South Africa
Canada	Ghana	Malaysia	Spain
Chile	India	Nigeria	Switzerland
China	Indonesia	Norway	United Kingdom
France	Italy	Russia	United States

The team gathered 202 hours and 57 minutes, or 50.77 TB, of raw footage.

29 different cameras were used over the course of production, some of which were sent up in the air in helicopters and on drones, into the ocean, strapped to the front of a train and into a purpose-built protective casing to film the felling of an old growth tree in British

The Anthropocene Project marks the first ever concurrent exhibition/collaboration between the Art Gallery of Ontario and the National Gallery of Canada.

Both Canadian museum shows will open to the public on September 28, 2018, and run until early 2019.

The AGO is touring the exhibit globally after its run in Ottawa and Toronto. The first international show will open in the Spring of 2019 at Manifattura di Arti, Sperimentazione e Tecnologia (MAST), in Bologna, Italy.

The film is distributed by Mongrel Media in Canada and will open in theatres in select cities on October 5, 2018. Seville International is managing sales for the rest of the world.

Carbon emissions generated as a result of the travel and energy required in production and post-production for the Project have been offset by [Less Emissions](#).

EXHIBITIONS

On September 28, 2018, the Art Gallery of Ontario (AGO) in Toronto and the National Gallery of Canada (NGC) in Ottawa will present simultaneous, complementary exhibitions of *Anthropocene*, in conjunction with Fondazione MAST, in Bologna, where the show will travel to in the spring of 2019 for its European premiere. A four-year collaboration between Edward Burtynsky, Jennifer Baichwal, and Nicholas de Pencier, the exhibitions use both new and traditional lens-based art to create an innovative and dynamic expression of humanity's incursions on the planet. Each exhibition will be comprised of Burtynsky's traditional photographic prints and High-Resolution Murals augmented by film extensions by Baichwal and de Pencier, film installations by Baichwal and de Pencier, and Augmented Reality (AR) installations. *Anthropocene* also marks the first time ever that the AGO and NGC are presenting parallel exhibitions at the same time. While some pieces will be common to both galleries, most of the installations will be unique to either Ottawa or Toronto, allowing visitors who wish to travel to both cities a wider experience. In conjunction with the openings, the documentary will begin its theatrical release across Canada on October 5, 2018.

EXHIBITION ELEMENTS:

Photographs

The museum exhibitions will be anchored by approximately 30 Edward Burtynsky archival pigment prints in each location on themes of the human signature on the planet, including extraction, the effects of climate change, and terraforming of the earth. These large-scale (48" x 64" and 60" x 80") photographs are from locations as diverse as Nigeria, Indonesia, China, Chile, and Germany.

High-Resolution Murals (HRMs)

The exhibitions will present 3-4 HRMs by Edward Burtynsky in each location. These prints will be massive in scale (up to 14' x 30') and extremely high in resolution, affording viewers a powerful witnessing of, for example, extreme population density in Lagos, Nigeria.

Film Extensions

The HRMs will be augmented by short AR-triggered film extensions by Jennifer Baichwal and Nicholas de Pencier, that will deepen contextual understanding by exploring detail in the wide views. The extensions reference the relationship between scale and detail in de Pencier, Baichwal and Burtynsky's larger collaborative work.

Film Installations

Each gallery will feature 5-10 film installations by Baichwal and de Pencier. These are meditations on the Anthropocene from around the world that best convey scale or impact in a time-based medium. *Gotthard Base Tunnel, Gotthard, Switzerland*, for

example, is a 4K projection of the world's longest railway tunnel (57 km), running through the Swiss Alps.

Augmented Reality (AR) Installations

Photogrammetry is a process wherein thousands of high-resolution photographs of a single object or a physical space are taken from every angle. These images are then stitched together in a digital environment, creating a life-sized, photo-realistic 3D model that can be explored in virtual or augmented reality.

These AR installations can only be viewed with a smartphone or tablet. For the AGO and NGC shows, visitors will be able to use the *Anthropocene* app on phones or tablets to trigger designated markers placed throughout the gallery spaces.

ANTHROPOCENE INTERACTIVE

A dynamic marriage of lens-based media and cutting-edge technology, *Anthropocene Interactive* combines documentary storytelling with responsive **gigapixel essays**, **360° film**, and **3D modelling** to fully immerse audiences in these photographic worlds, revealing what they signify for both the history and future of human civilization, and its accumulated effect on the planet.

Anthropocene Interactive, which will be made available through *The Anthropocene Project* website and *Anthropocene* app, allows audiences to journey to some of the most imposing, stunning, and remote locations in the world; places they will learn they are connected to, or often accountable for, but would never normally experience.

INTERACTIVE ELEMENTS:

Gigapixel Essays

Gigapixel images are created by taking hundreds of incremental photos of a single scene, which are then stitched together to create one super high-resolution composite photograph. In a physical sense, this means that the images can be printed to a size of about 14' high x 30' wide. Digitally, it means you can zoom deeply into the photograph to explore its smallest details.

The Essays are each based on a single high-resolution Burtynsky photograph. Accessible in digital format via the project's website, the gigapixel images have been enhanced with hidden "hot spots". As viewers pan and zoom through the photo, icons appear which, when clicked, will reveal either traditional video, 360° video, or audio clips. For instance, in a gigapixel image of a Carrara marble quarry in the Apuan Alps, one hot spot will reveal 360° drone footage from the top of the mountain; zoom in closer and another will reveal a slow motion shot of a slab of marble being carved off the mountainside. Yet another hot spot will open an audio clip from an Anthropocene Working Group scientist describing the process of terraforming (the human transmogrification of the Earth's surface). These hot spots will encourage exploration of the entire image, give context connecting the photo to the tenets of the Anthropocene, and offer gratifying "scavenger hunt" moments of discovery.

360° Films

Designed to open up a unique and complementary exploration of locations, ideas, and themes, 360° video and cinematic VR bring the borderless frame to cinema, offering viewers a completely different relationship to the photographic image, where the spatial relationships between objects and people in the images remain intact. The aim is to create experiences that literally take viewers into the realities of the Anthropocene: hard-to-reach, out-of-bounds locations that few people ever get to visit in their lifetime. Subjects such as the Carrara marble quarries, a historic ivory burn in Nairobi,

and the Dandora Landfill site in Kenya are explored collaboratively with viewers in compelling and, at times, heartbreaking detail. Flatscreen versions of the 360° films will be available online for free via theanthropocene.org, or for download to a variety of platforms including iOS, Android, GearVR and Oculus Rift.

Release of *Anthropocene Interactive* and subsequent project updates will be announced on *The Anthropocene Project* website and social media accounts.

BOOK

Accompanying the film and museum shows is a large coffee table-style hardcover book published by Steidl. Primarily consisting of colour photographs by Edward Burtynsky, the *Anthropocene* book also features essays by Edward Burtynsky, Jennifer Baichwal, and Nicholas de Pencier, as well as an overview from Anthropocene Working Group scientists Jan Zalasiewicz and Colin Waters. *Anthropocene* also includes new work from celebrated Canadian author and poet Margaret Atwood.

Similar to the museum shows, the *Anthropocene* book will also incorporate augmented reality (AR) enhancements, which can be activated using the official project app (available on both iOS and Android). Each trigger will summon complementary visual assets, such as the tusk pile in miniature.

Anthropocene, the book, will be available in both standard and special editions, and will be available for purchase through the museum gift shops and Indigo, in-store and online.

The Art Gallery of Ontario will publish a secondary *Anthropocene* book that will serve primarily as the exhibition catalogue. It will be for sale at the National Gallery of Canada Boutique, as well as the AGO gift shop.

EDUCATIONAL PROGRAM

The Anthropocene Project has partnered with The Royal Canadian Geographical Society (RCGS), Canada's largest bilingual education organization, to develop a comprehensive and engaging educational program for students of all ages, using innovative learning resources that will include virtual reality (VR) and augmented reality (AR) applications. This project will reach more than 20,000 classroom teachers from across Canada through the RCGS's educational committee, Canadian Geographic (Can Geo) Education.

More will be announced about *The Anthropocene Project* and RCGS partnership over the coming year.

CREATIVE TEAM

JENNIFER BAICHWAL has been directing and producing documentaries for over 20 years. Her films have played all over the world and won multiple awards nationally and internationally, including an International Emmy, three Gemini Awards and Best Cultural and Best Independent Canadian Documentary at Hot Docs, for features such as *Let It Come Down: The Life of Paul Bowles*, *The Holier It Gets*, *Act of God*, and *Payback*. *Manufactured Landscapes* won, among others, a Genie, TIFF's Best Canadian Film and Al Gore's Reel Current Award. It played theatrically in over 15 territories worldwide, and was named as one of "150 Essential Works In Canadian Cinema History" by TIFF in 2016. The feature documentary *Watermark* premiered at TIFF 2013, and won the Toronto Film Critics Association prize for Best Canadian Film. It has since been released in eleven countries. In recent years, de Pencier and Baichwal have expanded into film installation work, and have exhibited at the Art Gallery of Ontario, the Art Gallery of Hamilton and Nuit Blanche. Baichwal and de Pencier were also co-directors of *Long Time Running*, a feature documentary on the Tragically Hip's poignant final tour. The documentary premiered as a Gala at TIFF 2017, and was released by Elevation Pictures, and broadcast by Bell and Netflix. Baichwal sits on the board of Swim Drink Fish Canada, and is a member of the Ryerson University School of Image Arts Advisory Council. She has been a Director of the Board of the Toronto International Film Festival since 2016, and is a passionate ambassador of their *Share Her Journey* campaign, a five-year commitment to increasing participation, skills, and opportunities for women behind and in front of the camera.

www.mercuryfilms.ca

NICHOLAS de PENCIER is a documentary Director, Producer, and Director of Photography. Selected credits include *Let It Come Down: The Life of Paul Bowles* (International Emmy), *The Holier It Gets*, (Best Canadian Doc, Hot Docs), *The True Meaning of Pictures* (Gemini, Best Arts), *Hockey Nomad* (Gemini, Best Sports), *Manufactured Landscapes*, (TIFF Best Canadian Feature; Genie, Best Doc), and *Act of God* (Gala Opening Night, Hot Docs). He was the Producer and Director of Photography of *Watermark*, (Special Presentation, TIFF & Berlin, Toronto Film Critics Award, Best Canadian Film, CSA Best Documentary), and *Black Code* (TIFF 2016), which he also wrote and directed. De Pencier's video art installations with Jennifer Baichwal include *Watermark Cubed* at Nuit Blanche 2014, *Music Inspired by the Group of Seven*, 2015, with the Rheostatics in Walker Court at the Art Gallery of Ontario, and *Ice Forms*, an installation room as part of the Lawren Harris Exhibition at the AGO in the summer of 2016. Most recently, de Pencier and Baichwal were co-directors (and de Pencier DOP) of *Long Time Running*, a feature documentary on the Tragically Hip's iconic 2016 summer tour. Produced by Banger Films, the film was a Gala presentation at TIFF 2017, then subsequently released by Elevation Pictures and broadcast by Bell and Netflix. de Pencier is on the board of directors of Hot Docs, DOC Toronto and The West End Phoenix.

www.mercuryfilms.ca

EDWARD BURTYNSKY is known as one of the world's most respected photographers. His remarkable photographic depictions of global industrial landscapes are included in the collections of over sixty major museums around the world, including the National Gallery of Canada, the Tate Modern in London, the Museum of Modern Art, the Whitney Museum and the Guggenheim Museum in New York, the Reina Sofia Museum in Madrid, and the Los Angeles County Museum of Art in California. His imagery explores the collective impact we as a species are having on the surface of the planet; an inspection of the human systems we've imposed onto natural landscapes.

Burtynsky's distinctions include the TED Prize, The Outreach award at the Rencontres d'Arles, the Roloff Beny Book award, and the Rogers Best Canadian Film Award. He sits on the board of directors for CONTACT: Toronto's International Photography Festival, and The Ryerson Gallery and Research Center. In 2006 he was awarded the title of Officer of the Order of Canada; in 2016 he received the Governor General's Award in Visual and Media Arts. Most recently Burtynsky was named Photo London's 2018 Master of Photography and the Mosaic Institute's 2018 Peace Patron. He currently holds eight honorary doctorate degrees.

www.edwardburtynsky.com

ROLAND SCHLIMME has been collaborating in the edit room with leading independent filmmakers for the past twenty years, with a focus on unscripted, non-fiction features. His formal sensibility and intuitive touch can be recognized in the works of Peter Mettler (Gambling, Gods, and LSD, The End of Time), Alison Murray, Liz Marshall, Laura Taler, and Phillip Barker. His collaborations with Jennifer Baichwal, Nicholas de Pencier, and Edward Burtynsky span two decades and include Manufactured Landscapes and Watermark. In addition to editing, his credits include sound design, music composition, animation, and production.

ROSE BOLTON is one of Canada's most innovative and multi-faceted composers. She has been creating full-length film scores for broadcasters such as CBC, TVO, Arte and Super Channel for over a decade. She also has a thriving compositional practice creating electronic and instrumental music for innovative multimedia projects, as well as for concert performers. These concert compositions include major works such as Song of Extinction, a 45 minute work for Toronto's Luminato festival and created in collaboration with filmmaker Marc de Guerre and Griffin Award winning poet Don McKay. Other recent concert and electronic works include a piece for the Kitchener Waterloo Symphony with ambient electronics, and a sound and video installation at the Canadian Music Centre for Toronto's Nuit Blanche. Her concert music has been performed across Canada by Canada's leading ensembles, including the Vancouver Symphony, the Esprit Orchestra, L'ensemble contemporain de Montréal, the Aradia Ensemble and Ensemble Paramirabo. Rose Bolton has a Masters degree in composition from McGill University. www.rosebolton.com

NORAH LORWAY is a composer, researcher, programmer, and data artist. She works mainly in Human Computer Interaction and sound, creating wearable tech for a variety of purposes. Norah also live codes techno (and other music) at algoraves around the world and constructs 3D printed sensor based wearables for use with sound performance. She also creates atmospheric games for mobiles and personal computers.

Currently, Norah is a lecturer in Creative Music Technology at Falmouth University in Cornwall, United Kingdom. Previous to Falmouth, Norah did a PhD at University of Birmingham and a Postdoctoral Research Fellowship at University of British Columbia in Vancouver, Canada. She currently runs HexDB, a software consulting company, and Xylem Records, an electronic music net label. www.norahlorway.com

ANTHROPOCENE: AN OVERVIEW

Short Definition

“Anthropocene” is our current geological epoch, proposed by members of the Anthropocene Working Group and beginning mid-twentieth century, in which humans are the primary cause of permanent planetary change.

Long Definition

The Anthropocene (from anthro, for “human,” and cene, for “recent”) is a term widely used since its coining by Paul J. Crutzen and Eugene Stoermer in 2000 to denote the proposed current geological epoch, in which humans are the primary cause of permanent planetary change. A collective of geologists and other scientists, the Anthropocene Working Group (or AWG), was tasked in 2009 by the Subcommittee on Quaternary Stratigraphy to gather evidence to determine whether or not the Anthropocene epoch is, in fact, stratigraphically real. Their research charts the progression of human influence on the Earth’s system through a variety of markers: the terraforming of land for agriculture, industrialization and urbanization; the extraction of resources and the phenomenon of anthroturbation (human tunneling); sediment displacement, the proliferation of dams and groundwater depletion; the technosphere, consisting of all human-systems and technologies (technofossils), which now weighs upwards of 30 trillion tons; and human-influenced peak levels of carbon, nitrogen and phosphorus. The AWG’s evidence points overwhelmingly to the conclusion that humans now change the Earth’s system more than all other natural processes combined.

At time of writing, the Anthropocene is not a formally defined geological unit within the Geological Time Scale; it must be formally debated and ratified or rejected by the International Commission on Stratigraphy, a process that can take decades. Our current period of geological time is widely accepted to be the Holocene epoch, which began some 12,000 years ago as the glaciers of the last ice age receded.

The AWG’s proposed start date for the Anthropocene is now widely accepted to be mid-20th century, at the beginning of “The Great Acceleration” towards globalization, which was also when radioactive elements were dispersed across the planet by nuclear bomb tests. If the epoch is ratified, as Elizabeth Kolbert writes in *The Sixth Extinction*, every geology textbook in the world will suddenly become obsolete.

Key Research

After growing at a gradual pace for most of human history, the Earth's population has more than doubled in the last 50 years. According to a [2017 United Nations report](#), the current world population of 7.6 billion is expected to reach 8.6 billion in 2030, 9.8 billion in 2050 and 11.2 billion in 2100.

Since the Industrial Revolution, over [390 billion tonnes](#) of anthropogenic carbon emissions have been released into the air through cement production and the burning of fossil fuels. Concentrations of CO² in the atmosphere have increased by approximately [120 parts per million](#) since 1850, including a rise of ~2 ppm year over the past 50 years.

In the past century alone, the [level of nitrogen and phosphorus in our soil has doubled](#) — the largest impact on the nitrogen cycle in 2.5 billion years.

Humans have made enough concrete (a technofossil) to coat the Earth in a 2mm-thick layer. From 1995-2015, rapid urbanization and population growth saw the production of [more than half of the planet's total volume of concrete](#).

In 1950, less than [2 million tonnes of plastics](#) were manufactured globally per year. By the early twenty-first century, it had risen to 300 million tonnes per year. The total cumulative volume of plastics up until 2015 was calculated to be 5 billion tons, enough to cover the Earth in plastic wrap.

In 2015, it was [reported](#) that there would be more plastic than fish in the sea by 2050 (by weight).

A tenth of the world's global wilderness (defined as an area “mostly free of human disturbance”) has been [lost in just two decades](#).

The [2016 World Wildlife Fund](#) report found that a staggering half of all animal species monitored had seen a significant decline in population since 1970, with freshwater species most severely impacted.

There are now approximately [352,000 elephants left in Africa](#); that number dropped by 30% in the years between 2007-2014 alone.

Each year, we lose approximately [18.7 million acres](#) of forest annually to deforestation globally — equivalent to 27 soccer fields every minute.

Agriculture alone occupies approximately [35%](#) of Earth's terrestrial surface. [Estimates](#) state that food production will have to rise by 70% by 2050 in order to feed our growing population.

[In 2016](#), renewable power generating capacity saw its largest ever annual increase, with an estimated 161 gigawatts (GW) of capacity added. Solar represented about 47% of newly installed renewable power capacity, with wind and hydropower accounting for 34% and 15.5% respectively.

GLOSSARY

Anthropocene

The proposed current geological epoch, at present informal, in which humans are the primary cause of permanent planetary change.

Anthropocene Working Group (AWG)

A research group of geologists and other experts specializing in climate and polar science, oceanography, ecology, archaeology, human history and international law, convened by the Subcommittee on Quaternary Stratigraphy to gather evidence to determine the merit of the Anthropocene as a potential new unit of the Geological Time Scale.

Anthroturbation

Bioturbation, or disturbance of sedimentary deposits or solid rock, by humans (hence, *anthroturbation*), ranging from surface landscaping and ocean trawling to boreholes and tunnels that penetrate deep into the crust of the earth.

Epoch

Longer than an age and shorter than a period, an epoch is a subdivision of geologic (geochronologic) time characterized by particular conditions of the Earth. The current Quaternary Period is currently divided into two epochs, the Pleistocene and the Holocene. The Anthropocene has been suggested as a potential formal epoch, which if formalized would result in the termination of the Holocene. The equivalent chronostratigraphic ('time-rock') term is Series.

Mass Extinction Event

An interval in Earth's history characterized by a rapid decline in biodiversity, most notably species loss (ex. the K-Pg extinction event including the loss of the dinosaurs). Such extinctions are caused by a variety of factors, from climate change, to reconfiguration of continental landmasses or to asteroid impact, and are visible in the geologic record through marked, abrupt declines in fossil species numbers.

Geological Time Scale

The measurement of time as it relates to geological phenomena, encompassing the entirety of Earth's history since its formation. The Geological Time Scale is made up of defined divisions in the following 'dual hierarchy' of geological time (of geochronology) and 'time-rock' (of chronostratigraphy): eons/eonothems, eras/erathems, periods/systems, epochs/series and ages/stages.

Great Acceleration

The post-1950 period of accelerated industrial development, extraction of natural resources, population growth and globalization, bringing unprecedented increases in forms of human-caused pollution.

Global Boundary Stratotype Sections and Points (GSSP)

An internationally recognized demarcation of geologic time. In order to be recognized by the International Commission on Stratigraphy, a GSSP reference point must provide a continuous section of strata that includes the lower boundary of a formal geologic interval, indicated by some primary marker (such as a fossil species or chemical property), while also exhibiting secondary markers; the section should also be easily accessible and conservable. Colloquially known as the *Golden Spike*.

Holocene

Our current geologic epoch, which extends to approximately 11.7 thousands years before the twenty-first century, and is the second of two current Quaternary epochs.

Interglacial

An interval of warmer climate conditions between two sequential glacial intervals.

Technofossil

Human-made technological objects or artifacts such as plastics, concrete and aluminium which may serve as trace fossils through which the proposed Anthropocene epoch can be dated and characterized. Rapidly 'evolving' and largely resistant to decay, they are among the physical components of the *Technosphere*

Technosphere

The aggregate of all human systems and technologies (industrial, agricultural etc), including human-generated objects (plastics, concrete, etc.) that is regarded by some as a new 'sphere' on Earth originating from (and currently largely parasitic on) the biosphere. The technosphere is estimated to weigh upwards of 30 trillion tons.

Terraform

The act of transmogrifying the Earth's surface to meet human ends.

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