Beyond the Epochal Anthropocene Earth Science for a Human-Transformed Planet



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http://commons.wikimedia.org/wiki/File:Nile_River_Delta_at_Night.JPG

The Anthropocene is dead. Long live the Anthropocene

Panel rejects a proposed geologic time division reflecting human influence, but the concept is here to stay

5 MAR 2024 · 4:00 PM ET · BY PAUL VOOSEN



https://www.science.org/content/article/anthropocene-dead-long-live-anthropocene

A Formal Epoch Definition in the Geologic Time Scale **Rejected March 5, 2024** by the Subcomission on Quaternary Stratigraphy (SQS) *Proposed July 11, 2023* by the Anthropocene Working Group (AWG; 2009 - 2024)

Anthropocene Epoch & Series

The current geological epoch, beginning in the calendar year 1952 CE, defined by a marked upturn in ²³⁹⁺²⁴⁰Pu in a sedimentary sequence in Crawford Lake, Canada, marking the start of the Crawfordian Age/Stage (Global Boundary Stratotype Section and Point; GSSP), and correlated with additional stratigraphic indicators in three stratal sequences.

> International Commission on Stratigraphy Subcommission on Quaternary Stratigraphy http://quaternary.stratigraphy.org/working-groups/anthropocene/



"I feel this has been a missed opportunity to recognize and endorse a simple reality, that....

our planet left its natural functioning state in the mid-20th century"

Martin Head Brock University, Canada



https://www.france24.com/en/live-news/20240322-no-human-era-in-earth-s-geological-history-scientists-say

Definitions The Anthropocene

Original (Crutzen and Stoermer 2000)

the current time, in which... "the global effects of human activities have become clearly noticeable."

"To assign a more specific date to the onset of the "anthropocene" seems somewhat arbitrary, but we propose the latter part of the 18th century,"

Common USage (Oxford English Dictionary 2014)

"the current geological age, viewed as the period during which human activity has been the dominant influence on climate and the environment."

Anthropocene

the human era

PLANETARY CHALLENGES | OPPORTUNITIES



Anthropocene



Earth System

The Anthropocene Condition: Social change drives Earth system change



Ellis (2024)

The Anthropocene Condition: Evolving through Social-Ecological Transformations *Philosophical Transactions of the Royal Society B: Biological Sciences* 379:20220255s

Entering the Sixth Mass Extinction [?]



Ceballos et al. 2015. Accelerated modern human-induced species losses: Entering the sixth mass extinction. Science Advances 1:E1400253

Changes in Land & Sea Use "The biggest threat to Earth's biodiversity"

53%

CHANGES IN LAND AND SEA USE
 SPECIES OVEREXPLOITATION
 INVASIVE SPECIES AND DISEASE
 POLLUTION CLIMATE CHANGE

51%

In Latin America and the Caribbean, almost 13% of threats to biodiversity are related to climate change, which is more than double compared to the rest of the regions.

LATIN AMERICA AND CARIBBEAN



LIVING PLANET Report 2020

BENDING THE CURVE OF BIODIVERSITY LOSS



58%

EUROPE AND CENTRAL ASIA



WWF

https://www.weforum.org/agenda/2020/11/wwf-living-planet-report-2020-biodiversity-threat/

Anthropocene : Crisis

Amazonia

Deforestation on the Amazon Frontier, Rondonia, Brazil, May 28, 2009



Anthropocene : Archaeology

Amazonia Geoglyphs >700 years BP Near Acre, Brazil

https://www.dronestagr.am/amazon-geoglyphs/

Megafaunal Extinctions: > 15 kyr BP



Koch & Barnosky (2006) Late Quaternary Extinctions: State of the Debate. Annual Review of Ecology, Evolution, and Systematics 37:215-250.



THE DEEP ROOTS OF THE ANTHROPOCENE



Ellis et al. 2016 Nature 540:192-193

Deepening the Anthropocene International Empirical Projects



Coring, profiling, and trenching: Archaeological field strategies for investigating the Pleistocene-Holocene-Anthropocene continuum







Zooarchaeology, ZooMS, aDNA



Food Globalisation



Human Migration and Diet





C14 dating, aDNA, lsotopes



Trade Networks

LA-ICP-MS, Isotopes

The legacy of 4,500 years of polyculture agroforestry in the eastern Amazon





Maezumi et al. 2018. Nature Plants 4:540-547.

Lewis & Maslin. 2015. Defining the Anthropocene. Nature 519:171-180.

1500

2000

1750

Age (CE) 1250

500

295-

290

(mdd)

750

1000

The Great Dying **Pandemic & Colonization** in the Americas



285o^{∾ 280-} 275-Did forest regrowth during the Great Dying 270change global CO₂ levels? "Orbis Spike" 1550 1600 1650 1700 1750 Age (CE) Population collapse and site abandonment carbon uptake Mid-succession Mature forest Deforested Early succession 0 - 60 years 60 - 100 years and cultivated areas +100 years Bush et al. 2021. Widespread reforestation before European influence on Amazonia. Science 372:484-487.

Koch et al. 2019. Earth system impacts of the European arrival and Great Dying in the Americas after 1492. Quaternary Science Reviews 207:13-36.

Methane & Early Rice

Constraints on the Late Holocene Anthropogenic Contribution to the Atmospheric Methane Budget

"both anthropogenic and natural sources are needed to explain LPIH changes in methane concentration."



Mitchell et al. 2013. Science **342**:964-966

Fuller et al. 2011. The Holocene 21:743-759.



RESEARCH

ARCHAEOLOGY

Archaeological assessment reveals Earth's early transformation through land use

ArchaeoGLOBE Project*†





Intensive agriculture



Science

NAAAS

Urbanism



Stephens et al. 2019 *Science* 365:897-902

The Ruddiman Hypothesis: Early land use warmed the planet

Preindustrial Land Use: ~0.7°Global Climate Change



People have shaped most of terrestrial nature for at least 12,000 years



The First Law of the Anthropocene

Human societies reshape Earth's ecology.

This reshaping will continue.



Ellis, EC 2015. Ecology in an Anthropogenic Biosphere. *Ecological Monographs* 85(3):287–331

Anthropogenic Transformation Intensity



Ellis, EC 2015. Ecology in an Anthropogenic Biosphere. *Ecological Monographs* 85(3):287–331

Recent global trends and future trajectories of land use and population



A Great <u>Deceleration</u>?

Data: FAO, UN Science MAAAS INSIGHTS

Sharing the land between nature and people Conserving the planet's ecological heritage requires a new level of societal engagement

| By Erle C. Ellis | ogy as surely as the weather does. Yet even though human societies have never been | ture for people and for the rest of nature will depend on bringing all these bands together |
|---|--|--|
| uman societies have long reshaped, environments to sustain themselves. From bands of humer-gubteress to agartian empires to global supply chains, human societies have evolved must be biosphere. Bithosphere, attempt of form the biosphere. Bithosphere, attempt of concomiesis and publics shape Earth's cod- iconomies and publics shape Earth's cod- | though running solvenus rater never been more globally capable, interconnected, or interdependent, the social institutions, peoples and the rest of life on land remain re- markably complex and heterogeneous. From parcels to planet, the management of Earth's limited land is inchands of nearly's billion people with different nexts, wants, abilities, | topenin of imaging an image names names usgenee to shape it. Most people now live longer, healthlier, and more confortable lives than their anesstors (2). Net the opposite is true for the rest of life on Farth. Space for with names has shrunk dramatically, rapid climate warming is posing trather threads, and species are going extinct at alarming rates (3, 4). Most people aspire to the modern resource-ful lifestybe responsi- |
| 2 OD MONTH 20XX + VOL XXX ISSUE XXXX | | sciencemag org SCIENCE |

CONSERVATION AND SOCIETY

Sharing the land between nature and people

Conserving the planet's ecological heritage requires a new level of societal engagement

THE ANTHROPOGENIC PLANET

URI SHI

SHIPPING ROUTES

GLOBAL ROADS

AIR NETWORKS





The Anthropocene Event

Fig 1. Gibbard *et al.* 2022



https://earthlogs.org/tag/great-oxygenation-event

The Great Oxidation Event



Summary of the evolution of atmospheric oxygen and related geological features. Percentage scale is logarithmic with modern level = 100%. (c) Alex Glass, Duke University

The First Entanglement

Web-like pattern formed by cyanobacteria

Faluweki et al. 2023. Active Spaghetti: Collective Organization in Cyanobacteria. Physical Review Letters 131:158303.

The **Anthropocene** The **Entanglement**

Ian Hodder – Archaeologist Danny Hillis - Technologist

https://news.arizona.edu/file/422445



Anthroecology Lab anthroecology.org Human Development Report 2020

The next frontier Human development and the Anthropocene



The Next Frontier: Human Development and the Anthropocene

OCTOBER 2, 2018

The report finds that even though the global population increased from 5 billion to 7.5 billion between 1990 and 2017, the number of people in low human development fell from 3 billion to 926 million—or from 60 percent of the global population to 12 percent —and that the number of people in high and very high human development more than tripled, from 1.2 billion to 3.8 billion—or from 24 percent of the global population to 51 percent.

The report lays out a stark choice for world leaders - take bold steps to reduce the immense pressure that is being exerted on the environment and the natural world, or humanity's progress will stall.

https://hdr.undp.org/content/human-development-report-2020

Second Edition!?

ANTHROPOCENE

A Very Short Introduction

A New Addition to Oxford University Press's Very Short Introduction Series

Erle C. Ellis Anthropocene A Very Short Introduction

Available in UK March 22, 2018 USA: May 2018



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The Anthropocene Event

The aggregated effects of human activities that have transformed, and continue to transform, the Earth system and influence biodiversity, thereby producing a substantial, characteristic and unique record in sedimentary strata and in human-modified ground. (Gibbard et al. 2021)

"To assign a more specific date to the onset of the 'anthropocene' seems somewhat arbitrary, but we propose the latter part of the 18th century"

Crutzen and Stoermer (2000)



The Anthropocene Divide

Obscuring Understanding of Social-Environmental Change

"dividing geologic time based on a "step change" in the global significance of social-environmental processes contravenes the socially differentiated and diachronous character of human-environment relations."

Bauer & Ellis (2018) Current Anthropology 59:209-227