



**2022 CER Lunchtime Lectures  
Humboldt, Science, and The Geography of Nature**





## 2022 CER Lunchtime Lectures - Humboldt, Science, and The Geography of Nature

### Western Culture and the Study of Nature

January – Natural Philosophy and the Study of Nature

February – Natural History and the Taxonomy of Nature

March – Ecological Imperialism and the Geography of Nature

April – Physical Geography and the Science of Nature

### Humboldt and the Science of Nature

May – The Science of Nature: Humboldt and the Empirical Earth

June – The Romance of Nature: Science, Imagination, and the Poets of Nature

July – The Invention of Modern Nature: The Earth as a “Natural Whole”

August – The Evolution of Nature: Humboldt, Darwin, and Biogeography

September – The Economy of Nature: Ecology, Culture, and Cosmos

### Humboldt and the Geography of Nature

October – The Great Disruptors: Physical Geography as Modified by Human Action

November – The Earth Managers: New Sciences of Environmental Change

December – The Anthropocene: Gaia and the Science of Nature





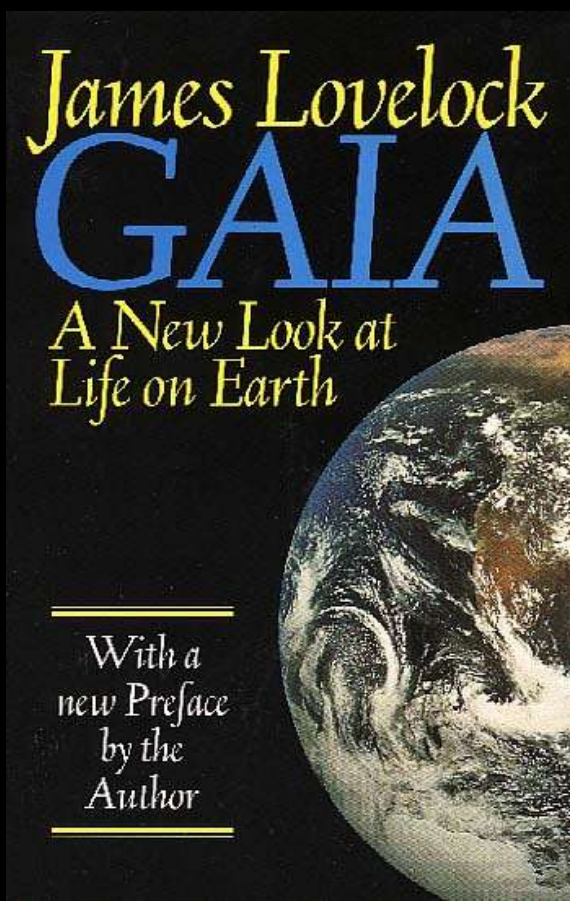
**Center for  
Environmental  
Research** at Hornsby Bend



## The Anthropocene: Gaia and the Science of Nature

Kevin M. Anderson Ph.D.

Austin Water Center for Environmental Research





# Alexander von Humboldt 1769-1859





How does Nature work?

“I shall try to find out how the forces of nature interact upon one another and how the geographic environment influences plant and animal life. In other words, I must find out about the unity of nature.”

# How does Nature work?

## A New Vision of Nature – Unity in Variety

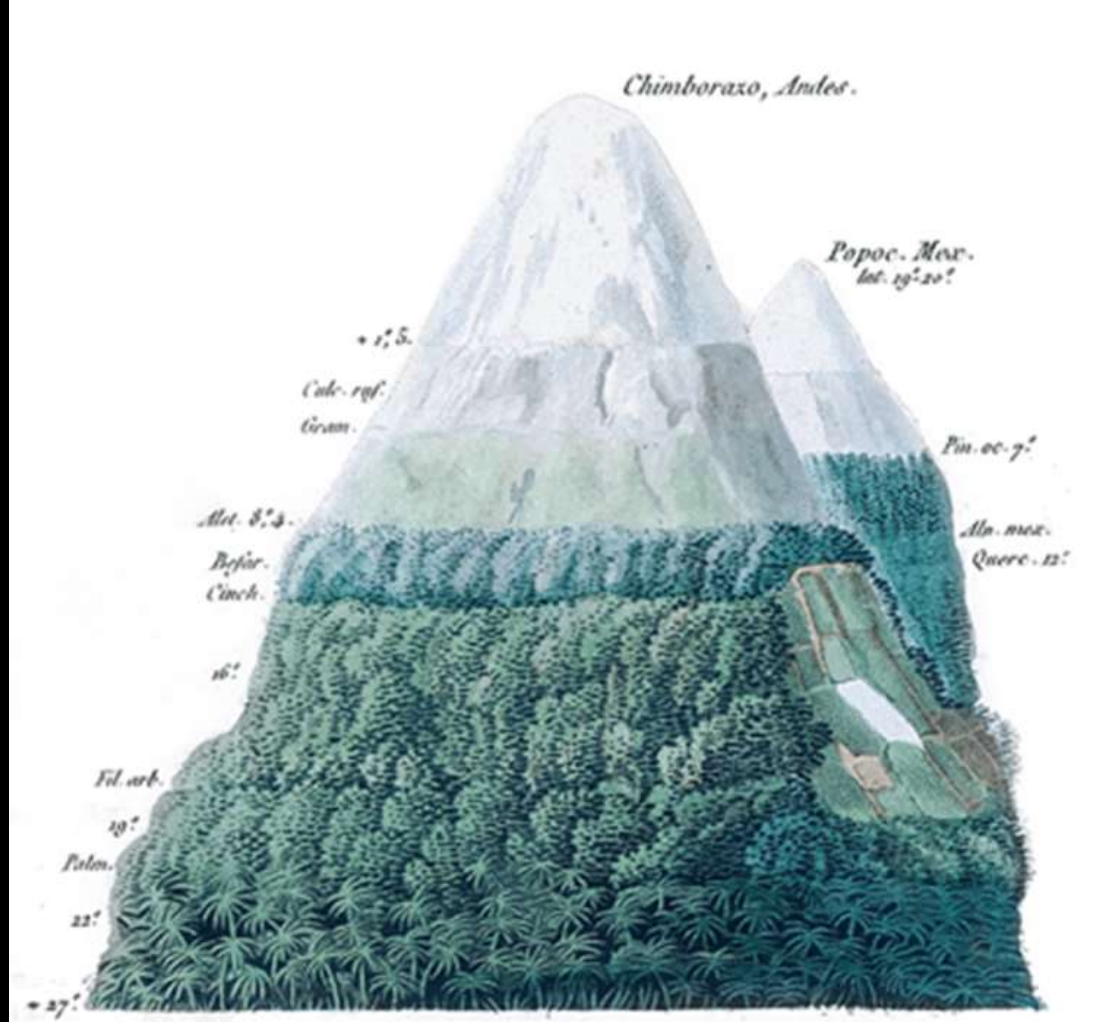
Nature is a system in which everything was connected



*Geographie der Pflanzen in den Tropen-Ländern;  
ein Naturgemälde der Anden.*

*gegründet auf Beobachtungen und Messungen, welche vom 10<sup>ten</sup> Grade nördlicher bis zum 10<sup>ten</sup> Grade südlicher Breite angestellt worden sind, in den Jahren 1799 bis 1803.*

*VON ALEXANDER VON HUMBOLDT und A. G. BONPLAND.*



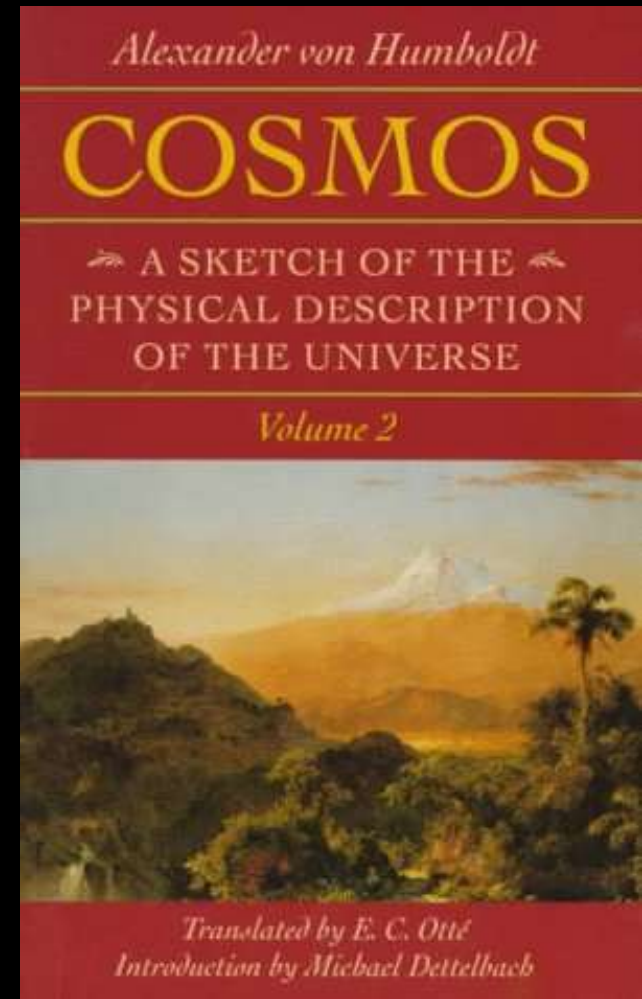
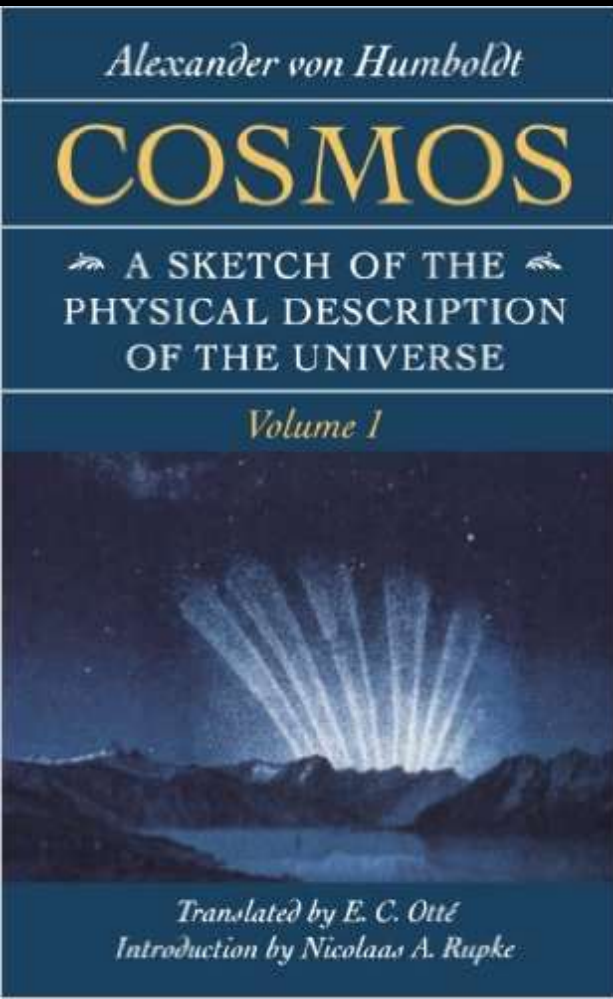
## Humboldtian Science

“the accurate measured study of widespread but interconnected real phenomena in order to find a definite law and a dynamic cause”

# Harmony and Order

## *Cosmos: A Sketch of the Physical Description of the Universe*

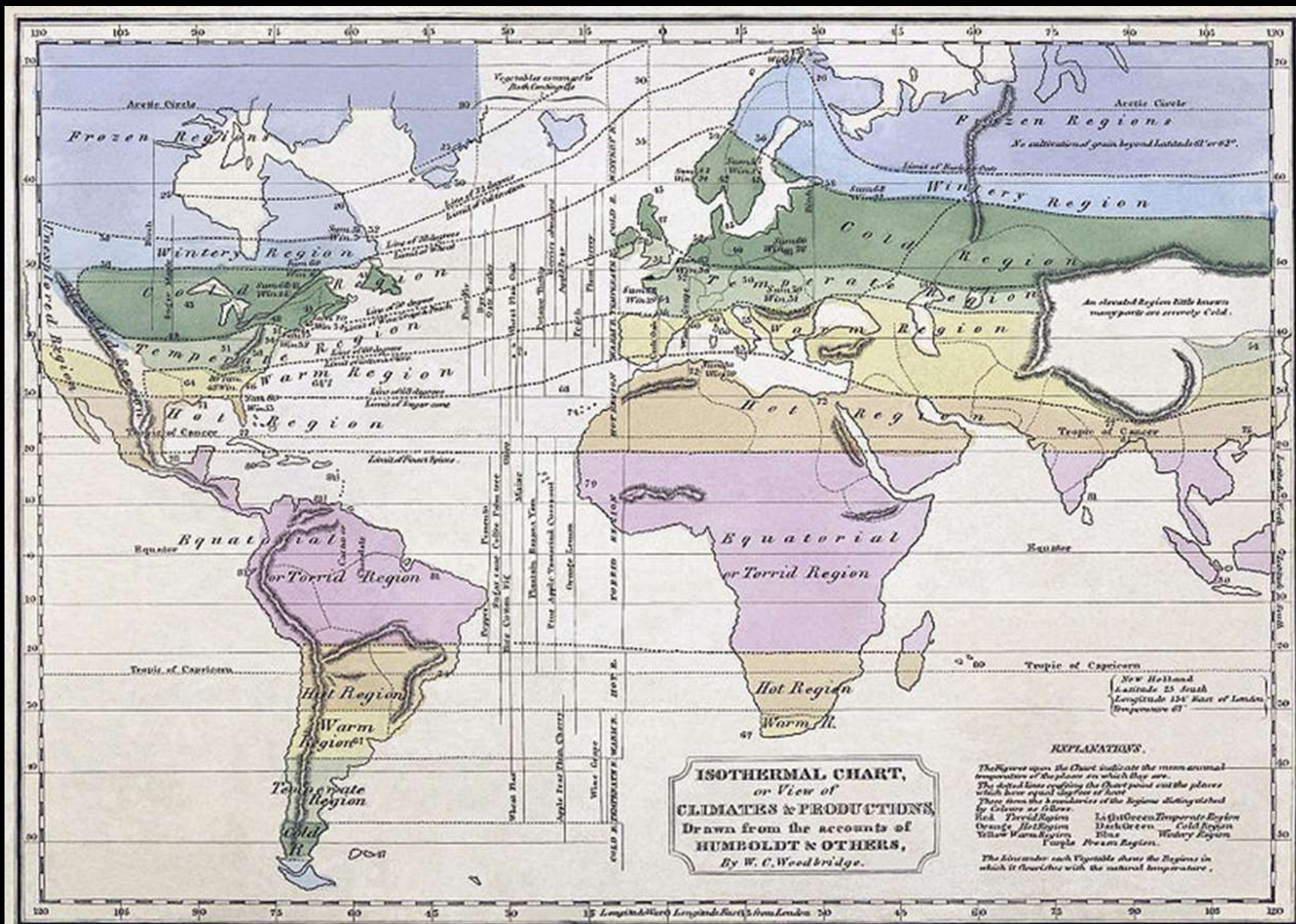
“The aspect of external nature, as it presents itself in its generality to thoughtful contemplation, is that of unity in diversity, and of connection, resemblance, and order, among created things most dissimilar in their form — one fair harmonious whole.”





# Earth Systems Science

## Unity in Diversity, Connection, Resemblance, and Order

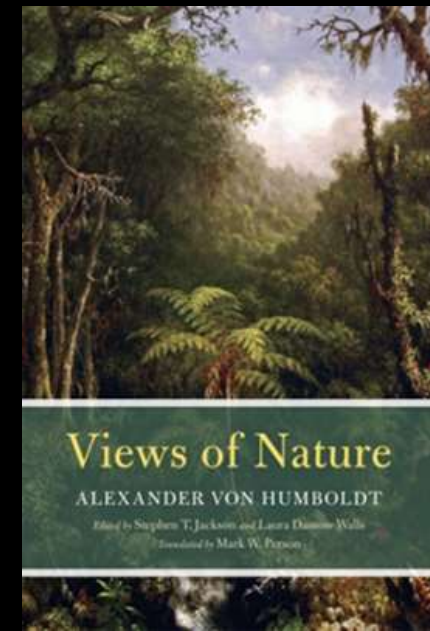
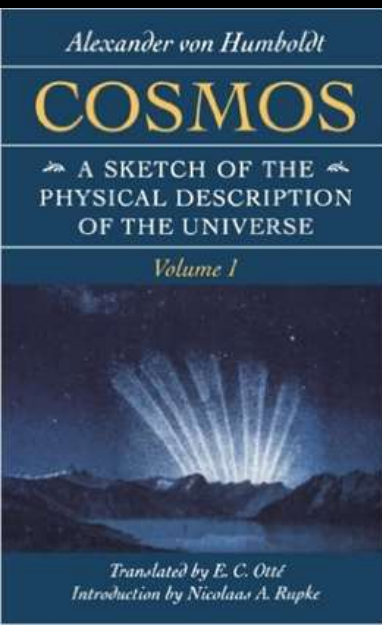


# How does Nature work? Harmony, Equilibrium, Homeostasis, Resilience

- Harmony - one concept that is central to Humboldtian science is that of a general equilibrium of forces amidst change – (Homeostasis)
- Equilibrium - “The general equilibrium, which reigns amongst disturbances and apparent turmoil, is the result of infinite number of mechanical forces and chemical attractions balancing each other out.” (Homeostasis)

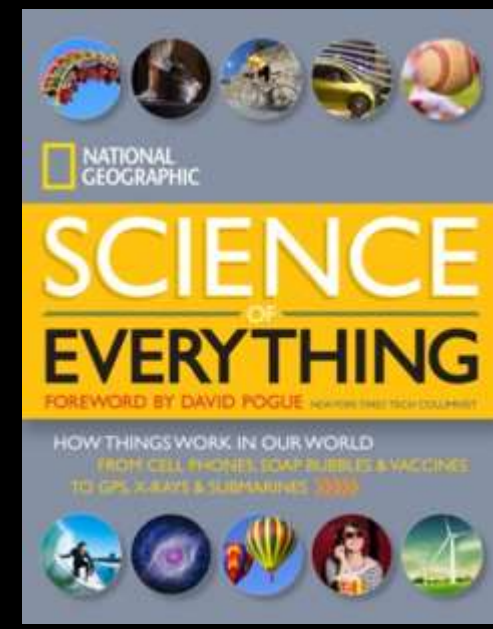
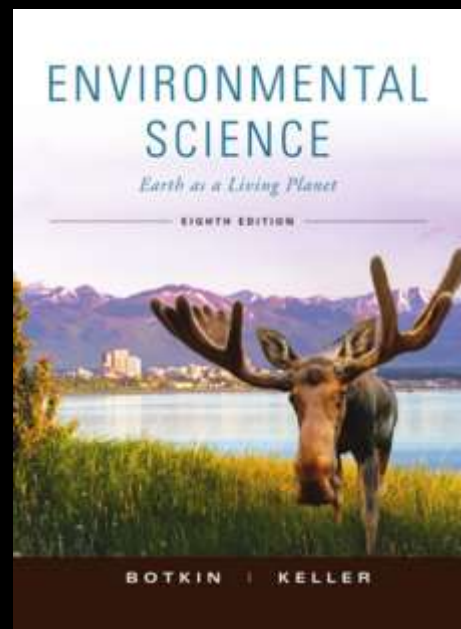
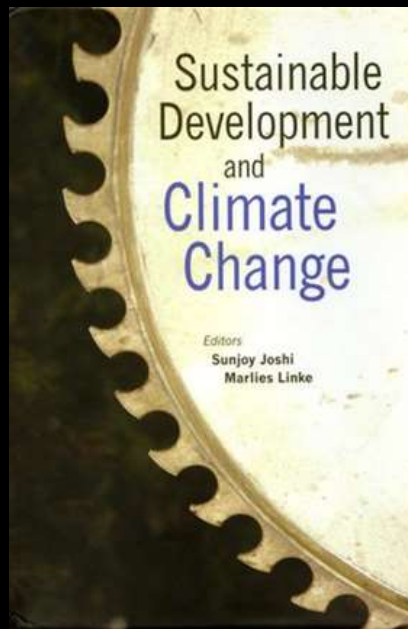
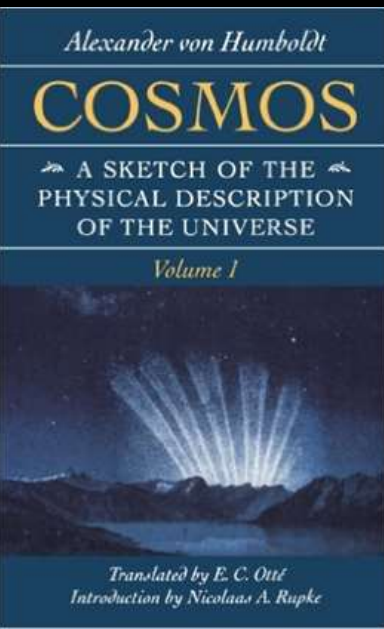
## Explain the Constancy amidst Change (Resilience)

- Change and Resilience - “to recognize unity in the vast diversity of phenomena, and by the exercise of thought and the combination of observations, to discern the constancy of phenomena in the midst of apparent changes.”



# Humboldtian Science – The Science of a Systematic Universe

- The Systematic Universe – Everything is part of the same system
- Nature is an inseparable organic whole, all parts of which were mutually interdependent, including humans.
- Everything is connected - “In this great chain of cause and effects, no single fact can be considered in isolation”
- Study the interconnections not just particulars - though he began first with particulars and moved towards generalizations, his objective was never simply to measure one kind of phenomenon in nature.

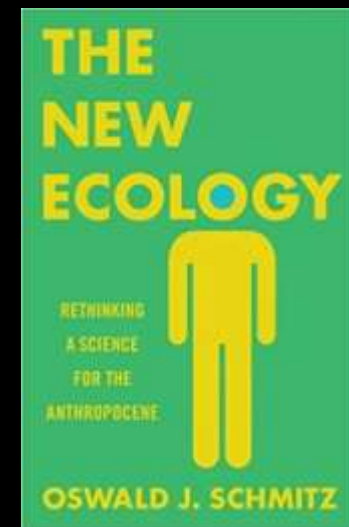
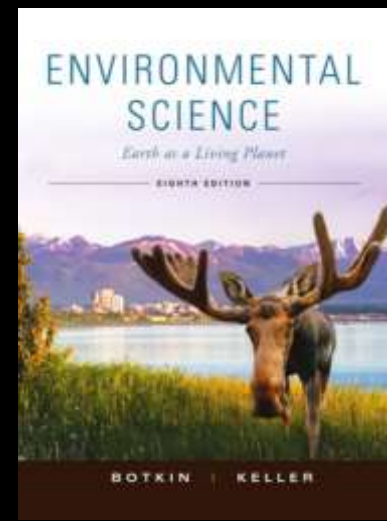
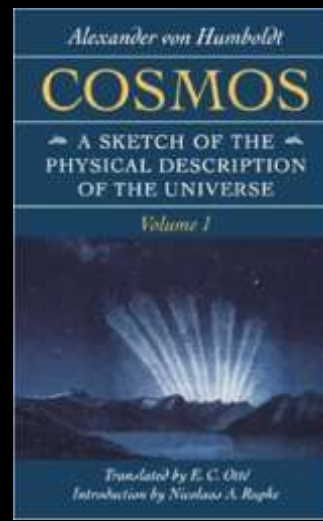


# Humboldtian Science – How does the Cosmos work?

- Natural History – Description and Classification of organisms (Descriptive)
- Natural Philosophy – How does Natura/Physis work? (Explanatory)
- Geography – Descriptive or Explanatory?

## New Sciences of the 19<sup>th</sup> and 20<sup>th</sup> Centuries

- Geology – the history of the Earth – How does the Abiotic World work?
- Biology – the study of Life – biotic world – How does Life work?
- Ecology – the study of the biotic and abiotic worlds – How does Nature work?
- Environmental Science - the multidisciplinary study of the environment and the solution of environmental problems - How does the Environment work?



# EARTH SPHERES

Lithosphere

*solid Earth*

Hydrosphere

*all water found on,  
under, and over the  
surface of Earth*



Atmosphere

*the gases that  
surround the  
Earth (its air)*

Biosphere

*all life on Earth*

Earth System Science

*Interaction of the lithosphere, atmosphere, biosphere, and  
hydrosphere*

Education Home

AHS Home

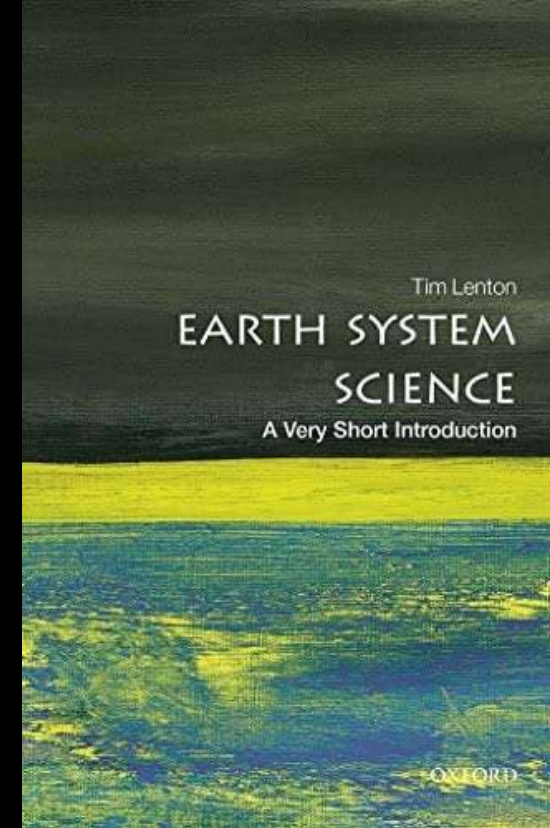
Photo Gallery

Tim Lenton  
EARTH SYSTEM  
SCIENCE  
A Very Short Introduction

OXFORD

## New Science of the 21<sup>st</sup> Century How does the Earth System work?

Earth system science assumes a holistic view of the dynamic interaction between the Earth's spheres and their many constituent subsystems fluxes and processes, the resulting spatial organization and time evolution of these systems, and their variability, stability and instability.



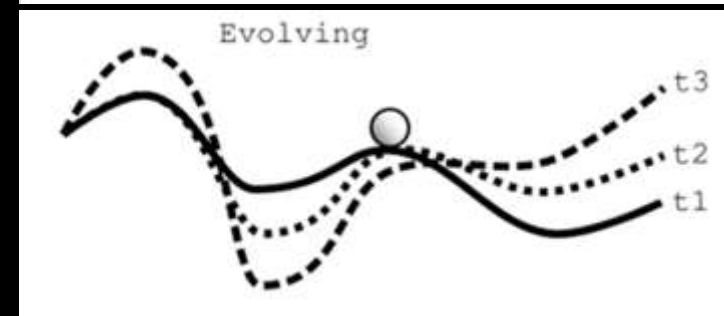
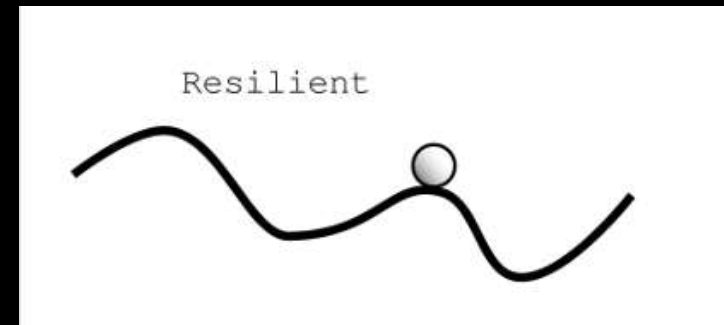
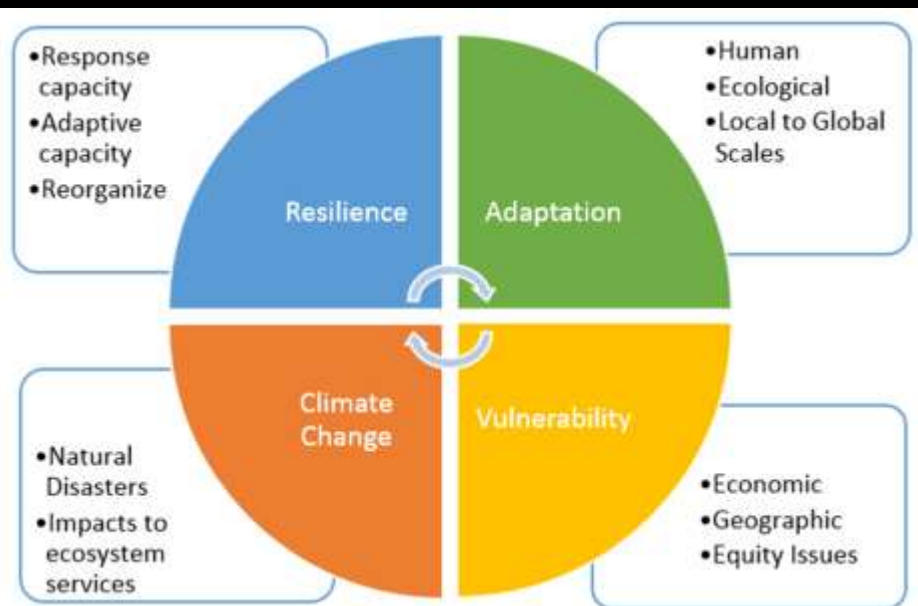
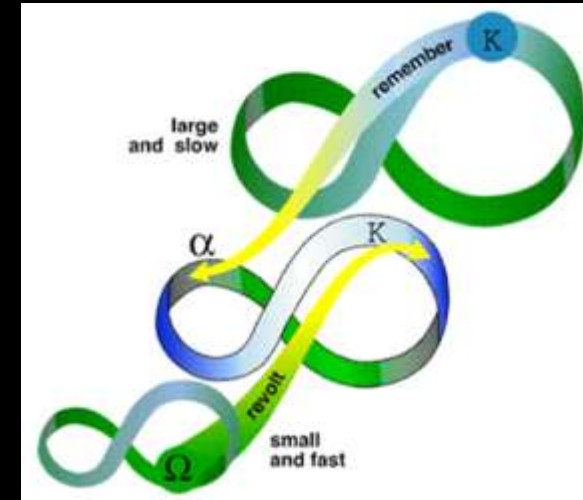
## Earth System Science and Humboldtian Science

“the accurate measured study of widespread but interconnected real phenomena in order to find a definite law and a dynamic cause”

Equilibrium/Homeostasis - “The general equilibrium, which reigns amongst disturbances and apparent turmoil, is the result of infinite number of mechanical forces and chemical attractions balancing each other out.”

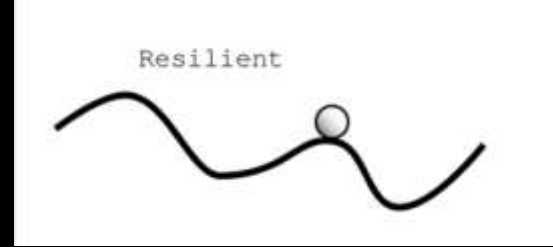
# New Sciences of Environmental Change – the Dynamic Earth

Homeostasis - Self-regulating process by which biological systems tend to maintain stability while adjusting to conditions that are optimal for survival.



# The New Ecology of Change - Ecological Resilience

Balance vs. Disequilibrium  
Permanence vs. Change

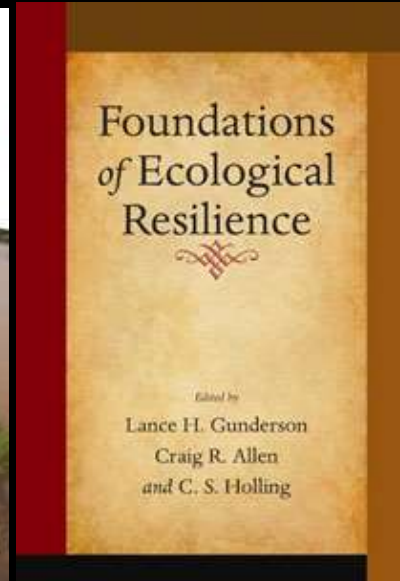
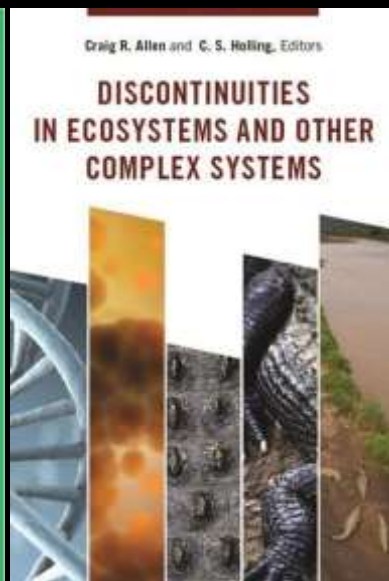


Humboldt - “to discern the constancy of phenomena in the midst of apparent changes.”

- The concept of resilience - the persistence of natural systems in the face of changes in ecosystem variables due to natural or anthropogenic causes.
- The general meaning of resilience, derived from its Latin roots 'to jump or leap back', is the ability to recover from or adjust easily to misfortune or change.

Holling, C.S. (1973). "Resilience and stability of ecological systems"

Buzz Holling 1930-2019





# How does Nature work?

## The Adaptive Cycle

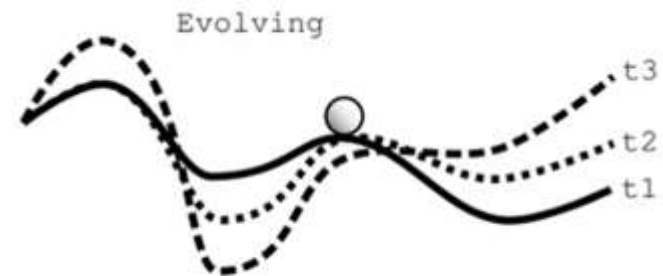
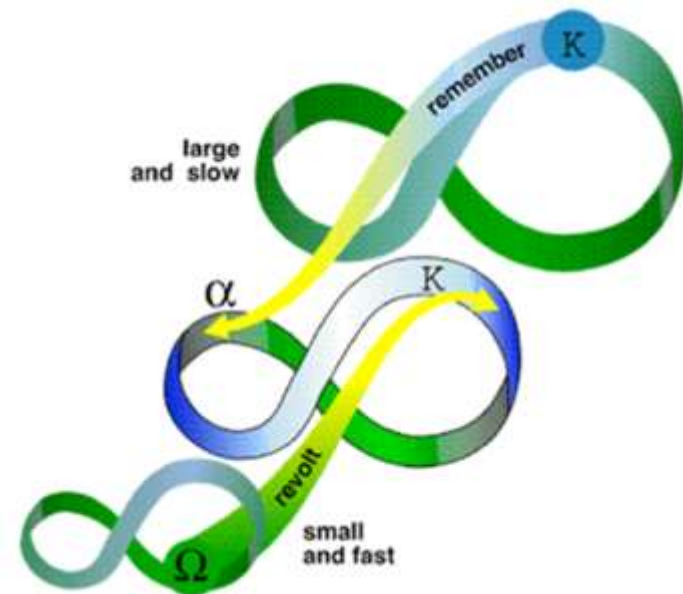
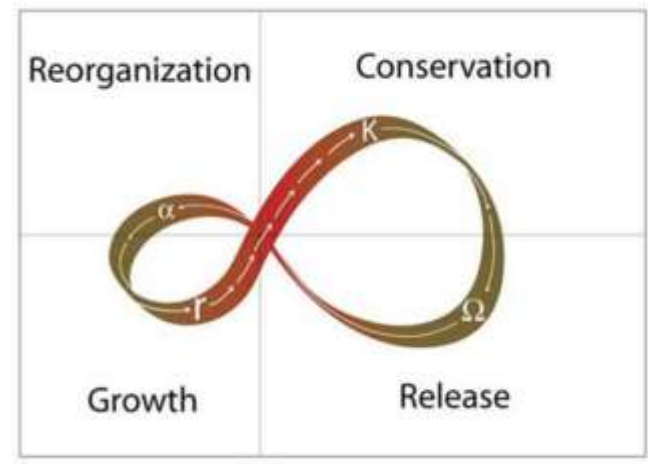
Growth - where species and systems grow and diversify to exploit new opportunities and develop entirely new ecological ways of being.

Conservation - where systems stabilize into mature, often hierarchically nested systems, where there is little or no room for innovation or growth.

Release (the “backside” of the mobius strip) - where mature systems destabilize and collapse, and become increasingly discontinuous and chaotic which opens the field for...

Reorganization – where systems return in completely new ways, which creates a new field of conditions and possibilities for the next growth phase

Humboldt – Turmoil - “The general equilibrium, which reigns amongst disturbances and apparent turmoil”

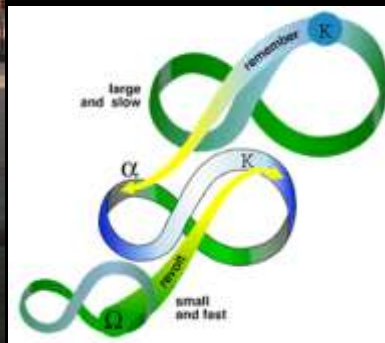
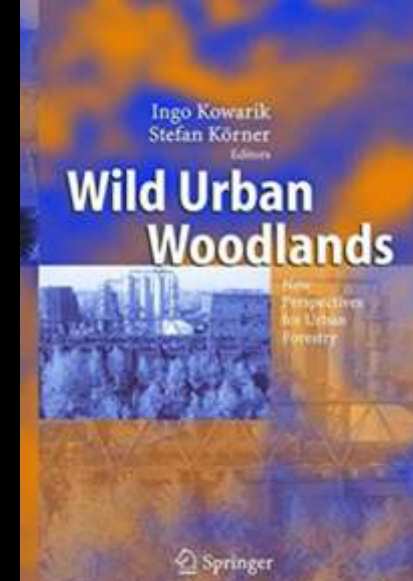


# The New Ecology – How does Nature work?

## Permanence and Change = Process

“the reference point is not an original condition of a natural landscape, but rather a condition defined based on the current site potential and the greatest possible degree of self-regulation.

From this perspective, therefore, the natural capacity for process is the central point, not a particular, retrospectively determined and often idealized, picture of nature.”



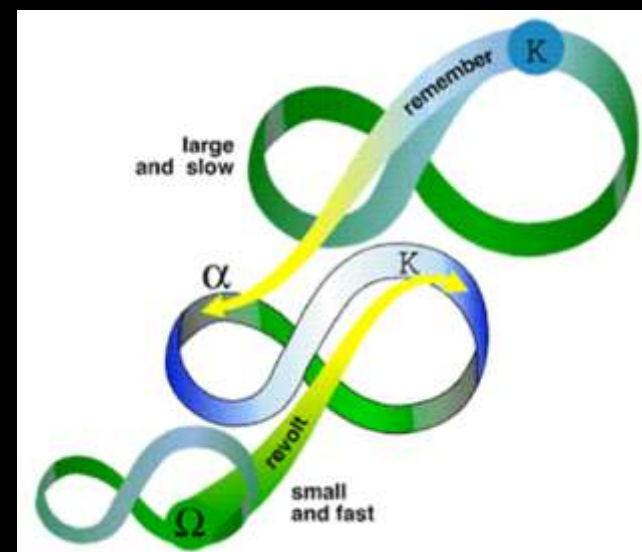
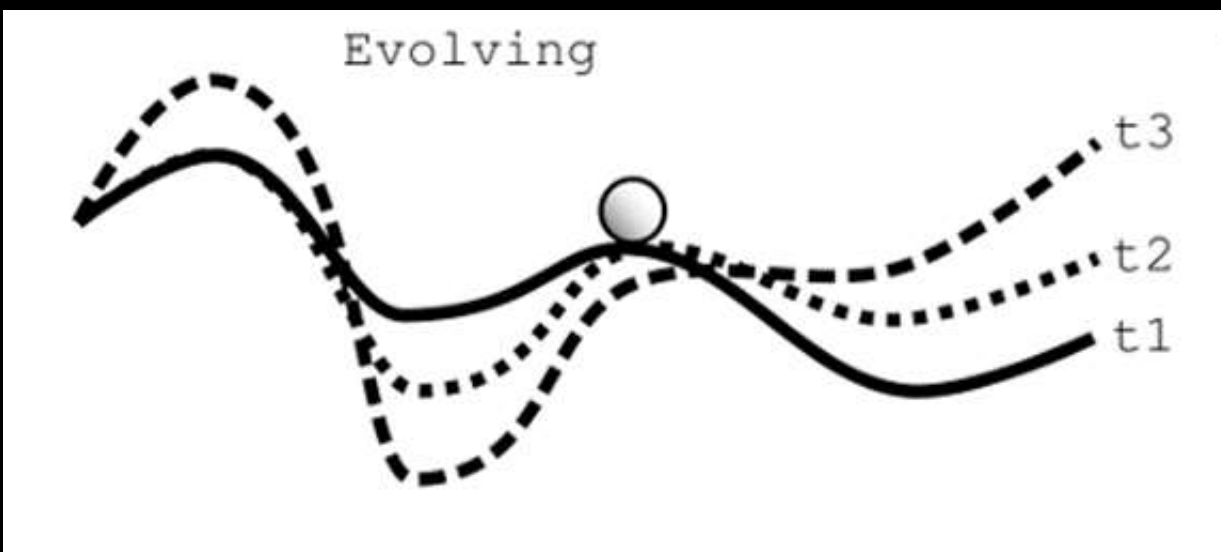
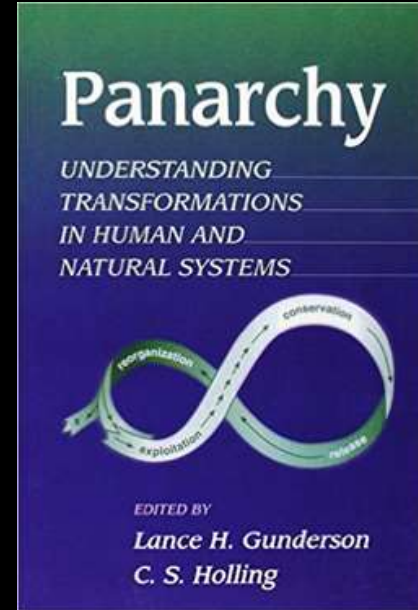
# How does Nature work? A New Narrative of Nature

## Transformation - Evolving Nature and Panarchy

### A Story of Resilience and Change

- Panarchy is a new narrative or myth of evolving nature, hinted at by the name of the Greek god of nature - Pan - whose persona also evokes an image of unpredictable change.
- Change is not always for the good - Pan has a destabilizing role that is captured in the word panic, directly derived from one facet of his paradoxical personality.

Humboldt – Turmoil - “The general equilibrium, which reigns amongst disturbances and apparent turmoil”



# Humans and Nature

# nature

THE INTERNATIONAL WEEKLY JOURNAL OF SCIENCE

## THE HUMAN EPOCH

Defining the Anthropocene PAGES 144 & 171

CONFLICT RESOLUTION

### BUILDING BRIDGES

Long-standing disputes can be fixed — in theory

PAGE 148

LINGUISTICS

### SCIENTIFICALLY SPEAKING

How English became the academic lingua franca

PAGE 154

RISK MANAGEMENT

### TAKING IT PERSONALLY

Model the growing interconnectivity of risk

PAGE 151

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17 March 2015 £10

Vol 519, No. 7542



# Global Change

International Geosphere-Biosphere Programme

Issue 78 ■ March 2012

## ANTHROPOCENE

The geology of humanity

Urban expansion  
No signs of slowing

Natural catastrophes  
2011 breaks records

GLOBAL  
IGBP  
CHANGE

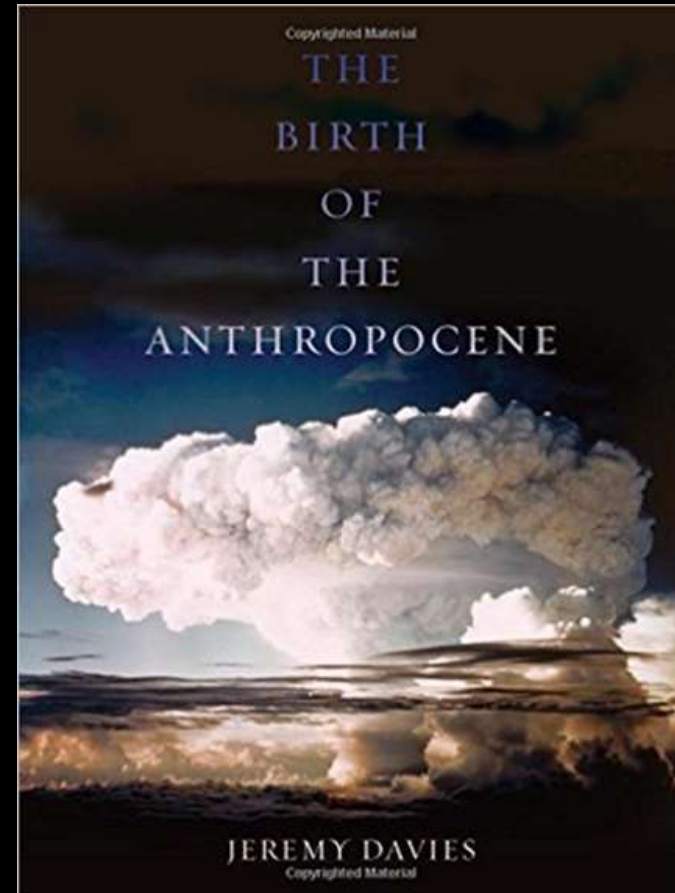
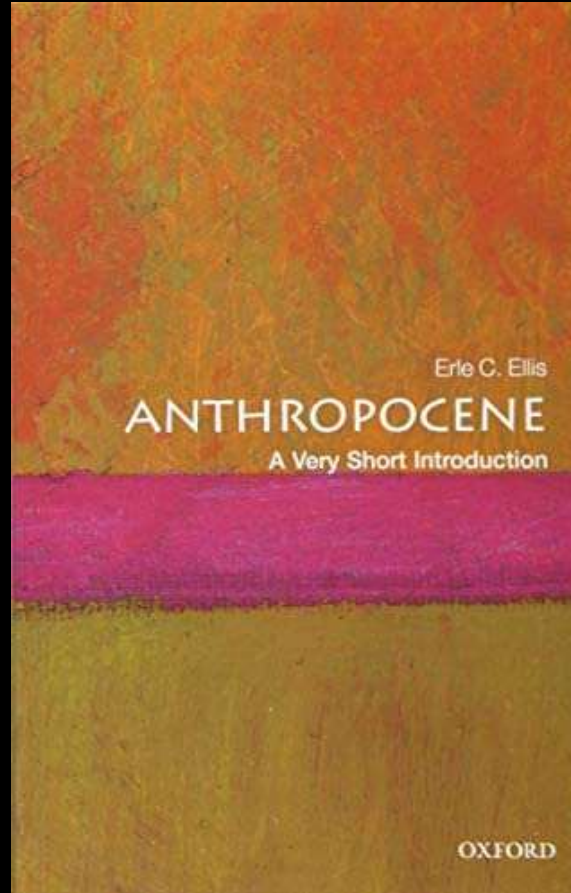
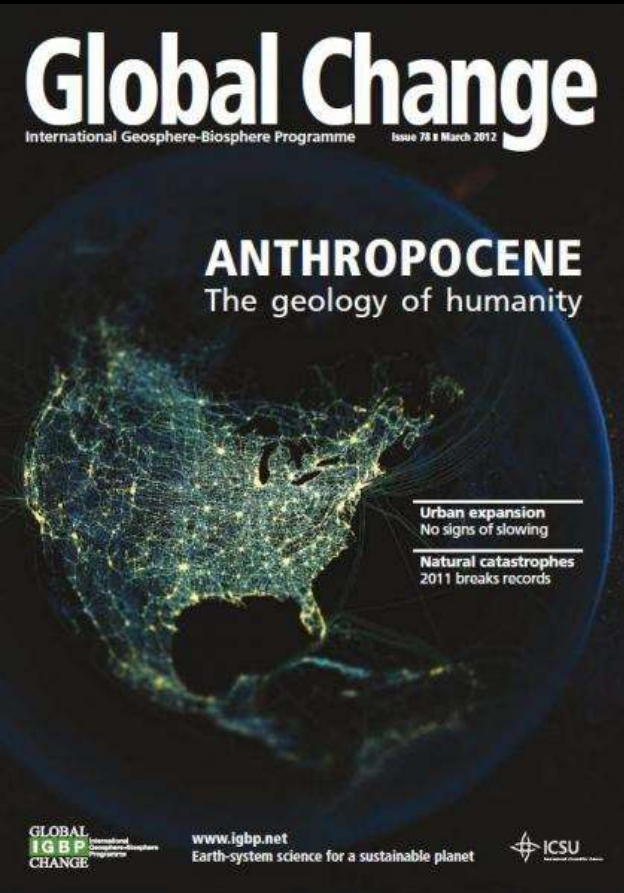
www.igbp.net

Earth-system science for a sustainable planet

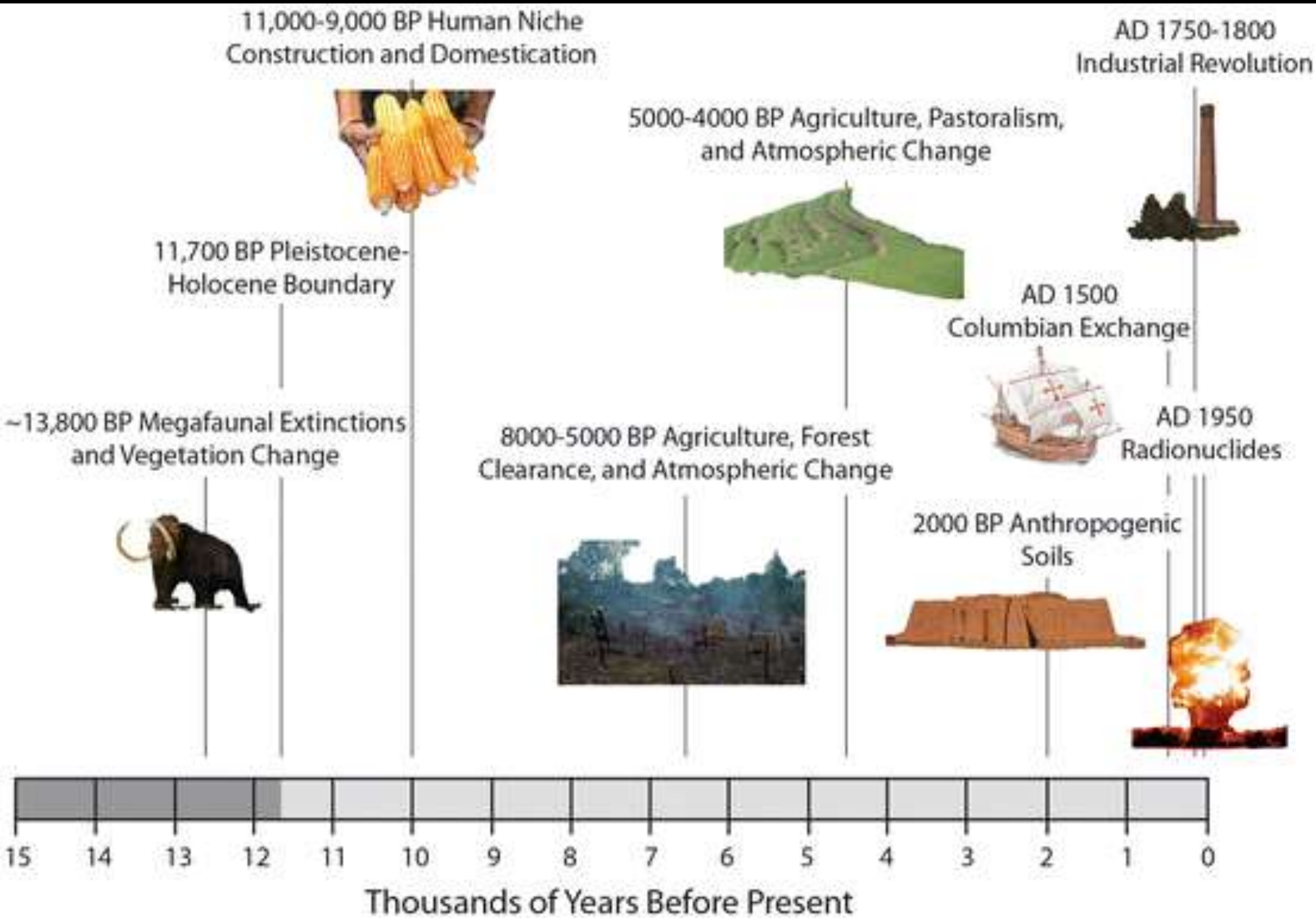


# Anthropocene – The Age of Humans

The Anthropocene is an unofficial unit of geologic time, used to describe the most recent period in Earth's history when human activity started to have a significant impact on the planet's climate and ecosystems.

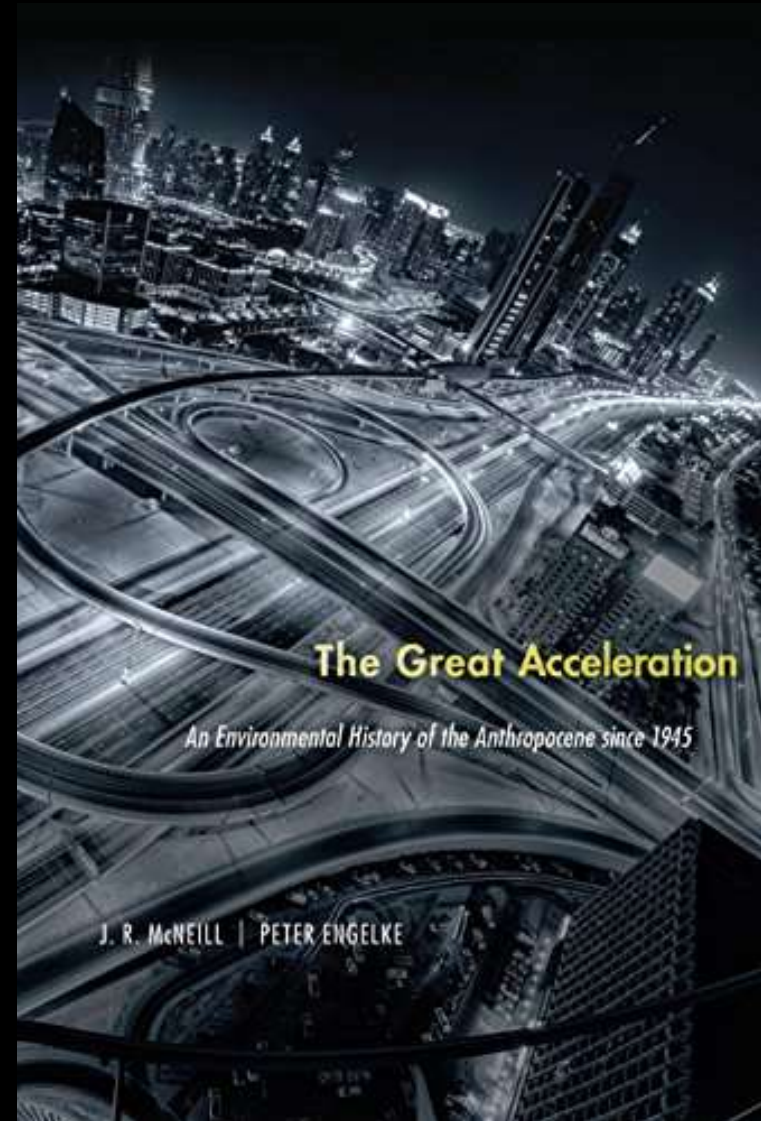
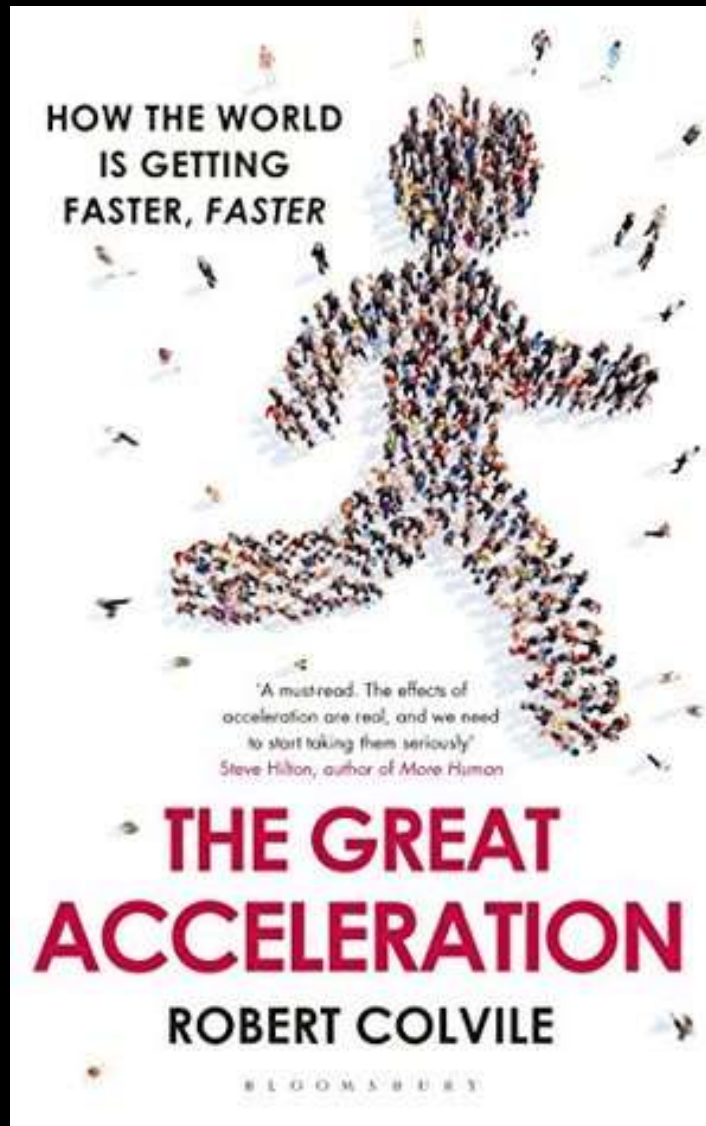


# When did the Anthropocene Begin?



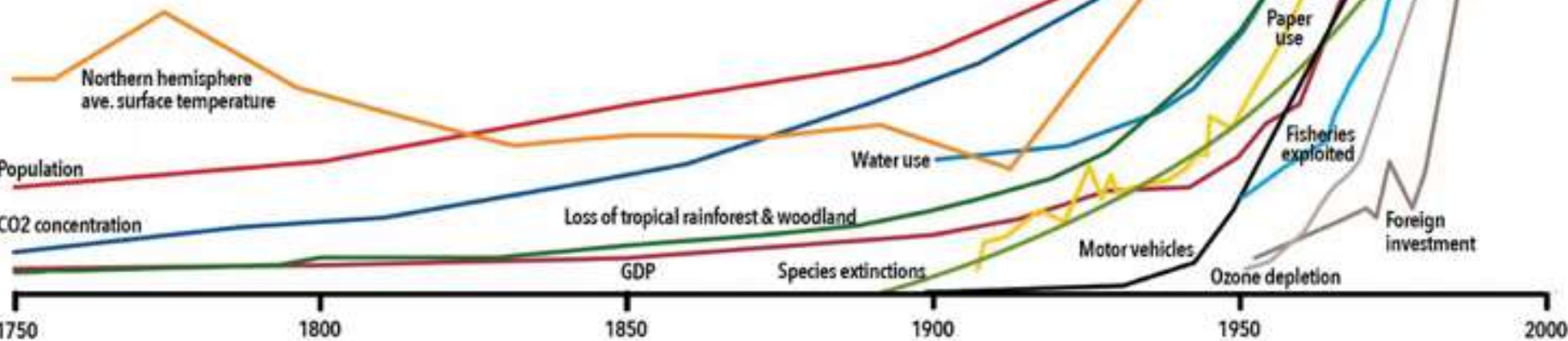
# The Great Acceleration

The dramatic, continuous and roughly simultaneous surge in growth rate across a large range of measures of human activity, first recorded in the mid-20th century and continuing to this day.



# Great Acceleration

- Population
- Real GDP
- Foreign direct investment
- Water use
- Paper production
- Fertilizer consumption
- Motor vehicles
- Primary energy use
- Telephones
- Tourism
- River dams
- McDonald's restaurants
- Atmosphere: CO2
- Atmosphere: N2O
- Atmosphere: CH4
- Atmosphere: ozone depletion
- N hemisphere surface temperature
- Loss of tropical rainforest & woodland
- Domesticated land
- Great floods
- Fisheries fully exploited
- Flood frequency
- Coastal nitrogen
- Species extinction





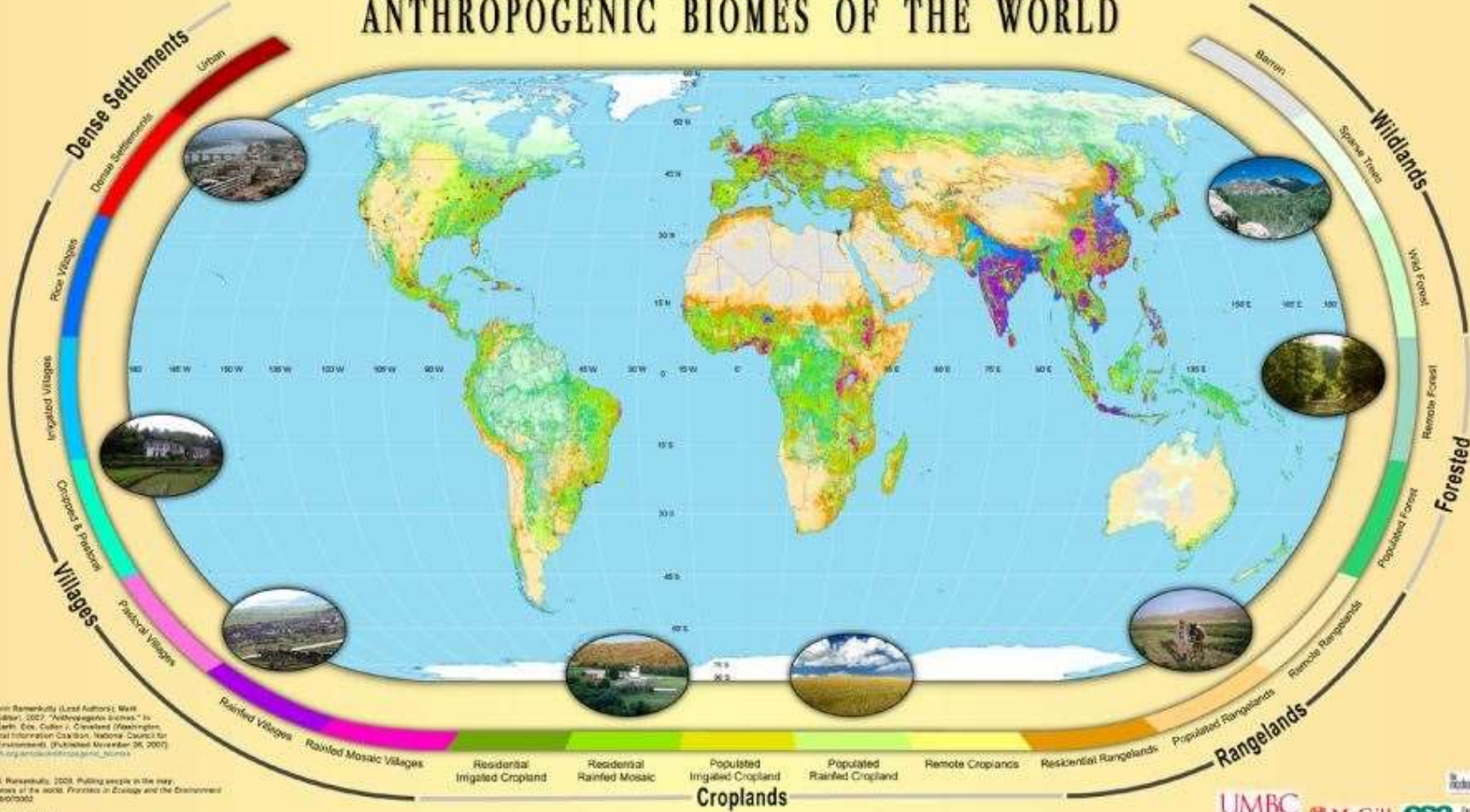
# Anthropogenic Landscapes, or "Human Landscapes"

Erle Ellis

Anthropogenic Biomes ("Anthromes"), describe the globally-significant types of anthropogenic landscapes.



## ANTHROPOGENIC BIOMES OF THE WORLD



**Citation:**  
Ellis, E. and Erin Ramanathan (Lead Authors), with  
McGill, S. (Eds.), 2007. "Anthropogenic biomes." In:  
Encyclopedia of Earth. Eds. Cullen, J., Cleveland (Washington,  
D.C.: Environmental Information Coalition, National Council for  
Science and the Environment). [Published November 26, 2007].  
[http://www.encyclopediaofearth.org/article/anthropogenic\\_biomes](http://www.encyclopediaofearth.org/article/anthropogenic_biomes)

**Map Date:**  
Ellis, E. C., and R. Ramanathan, 2008. Putting people in the map:  
anthropogenic biomes of the world. *Frontiers in Ecology and the Environment*  
vol. 6, no. 10, 589-592

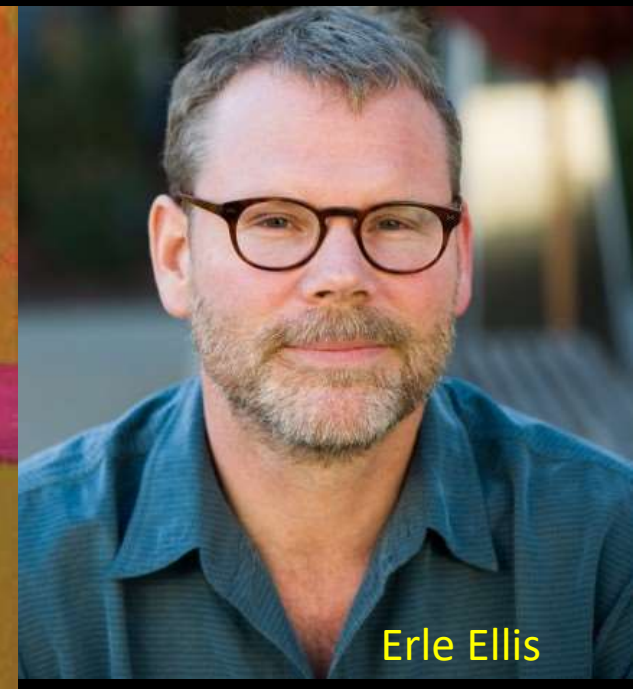
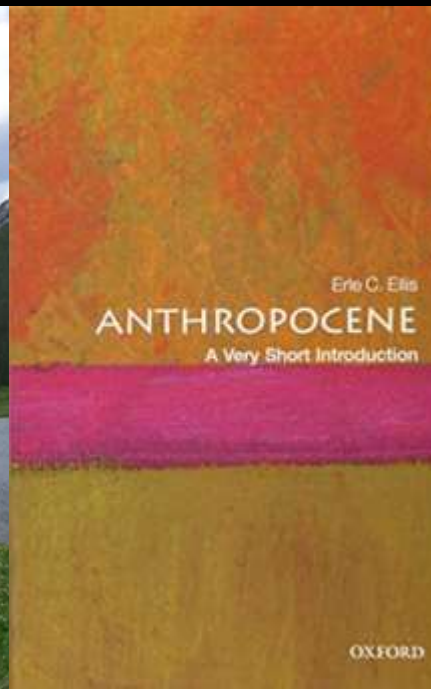
**Cartographer:** Tom Robinson  
UMBC Department of Geography & Environmental Systems

**Map Projection:** Eckert IV - equal area

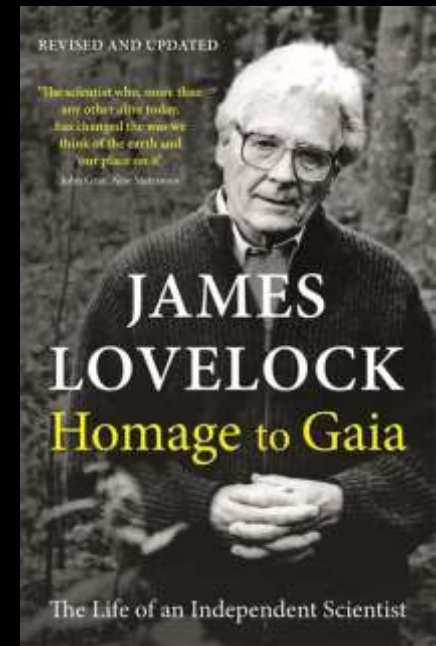
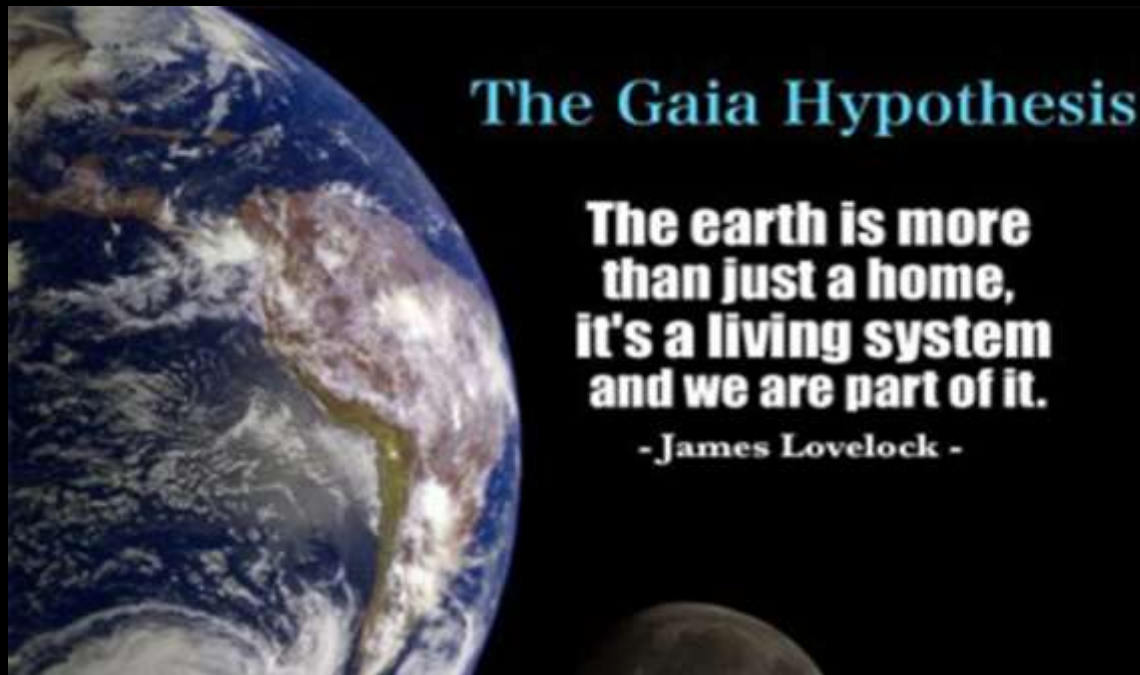
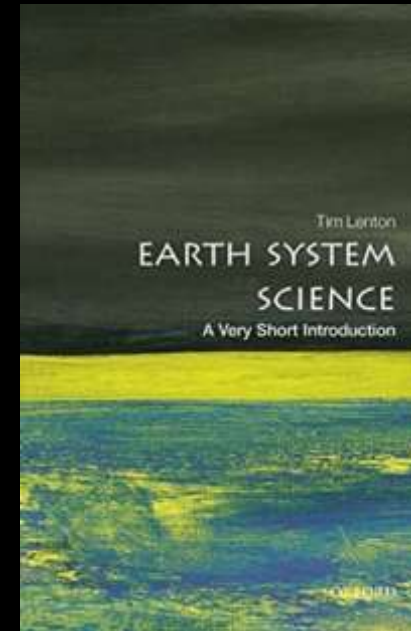
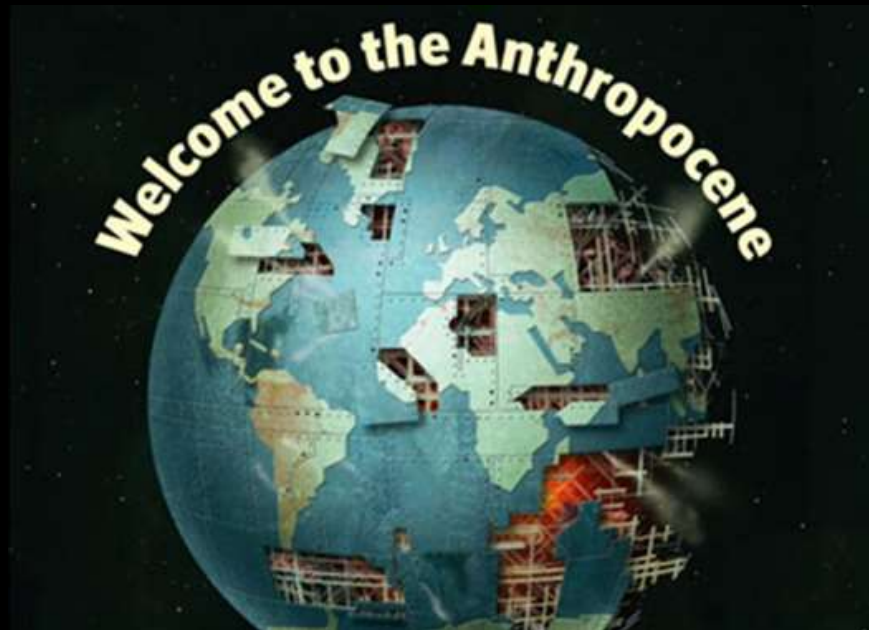
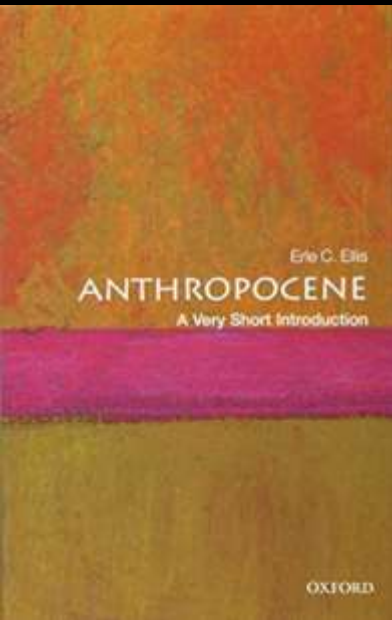
# Anthropogenic Biomes – A New Story of Nature

“Anthropogenic biomes point to a necessary turnaround in ecological science and education, especially for North Americans. Beginning with the first mention of ecology in school, the biosphere has long been depicted as being composed of natural biomes, perpetuating an outdated view of the world as ‘natural ecosystems with humans disturbing them’.”

Anthropogenic biomes tell a completely different story, one of ‘human systems, with natural ecosystems embedded within them’. This is no minor change in the story we tell our children and each other. Yet it is necessary for sustainable management of the biosphere in the 21st century.”



# How does the Earth work? – A Theory for Earth Science

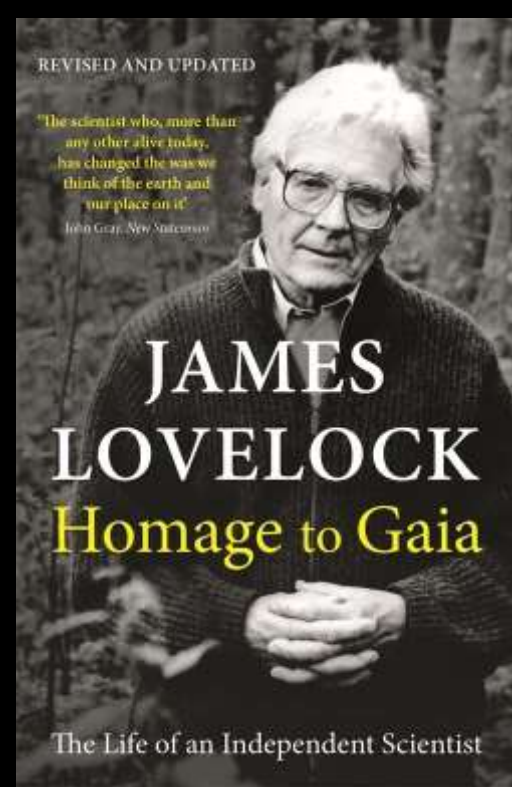


# The Independent Scientist - James Lovelock (26 July 1919 – 26 July 2022)

English Independent Scientist and Inventor

He invented the electron capture detector (ECD) in 1957 - a device for detecting atoms and molecules in a gas through the attachment of electrons via electron capture ionization and is used in gas chromatography to detect trace amounts of chemical compounds in a sample.

The detector measured tiny amounts of chlorine-based chemicals in the air, leading to the discovery of toxic chemicals in food, water and soil.



# Rachel Carson and the Electron Capture Detector




**DDT... FOR CONTROL OF HOUSEHOLD PESTS**

Prepared by the  
Bureau of Entomology and Plant Quarantine  
Agricultural Research Administration  
United States Department of Agriculture, and  
the United States Public Health Service  
Federal Security Agency  
Washington, D. C. • Issued March 1947




# SILENT SPRING

WITH AN INTRODUCTION BY  
VICE PRESIDENT *Al Gore*



# RACHEL CARSON

*"DDT is good for me-e-e!"*



The great expectations held for DDT have been realized. During 1946, exhaustive scientific tests have shown that, when properly used, DDT kills a host of destructive insect pests, and is a benefactor of all humanity.

Pennsalt produces DDT and its products in all standard forms and in quantities of the country's largest producers of this amazing insecticide. Today, everyone can enjoy added comfort, health and safety through the remarkable powers of Pennsalt DDT products... and DDT is only one of Pennsalt's many chemical products which benefit industry, farms and homes.

**GOOD FOR STEPS**—Eradicate insects immediately... but it is a general fact that... compared to untreated steps, treated steps give up to 20 percent extra when processed with DDT and many other pests with DDT insecticide.

**GOOD FOR THE HOME**—Helps you to make healthier, more comfortable homes... protect your food from dangerous insect pests. Use Pennsalt DDT Fleas and Spiders as directed... also catch the bugs "like the dust".

**GOOD FOR FRUITS**—Eradicate apple, pear and other fruit tree pests from orchards, nurseries, etc. All insecticide-spraying from DDT dunes and sprays.

**GOOD FOR SUN CROPS**—Kill more harmful of parasites per acre... DDT dunes and sprays help these farmers from their pests along to eat.

**GOOD FOR HOUSES**—Food and personal hygiene, home care, fly cleaning, plants, books... (control of insect pests effective long control, insecticide-spraying from DDT dunes and sprays with Pennsalt DDT products).

**PENN SALT CHEMICALS**  
47 Years' Service to Industry • Farm • Home

**PENNSYLVANIA SALT MANUFACTURING COMPANY**  
HUBBARD BUILDING, PHILADELPHIA 7, PA.

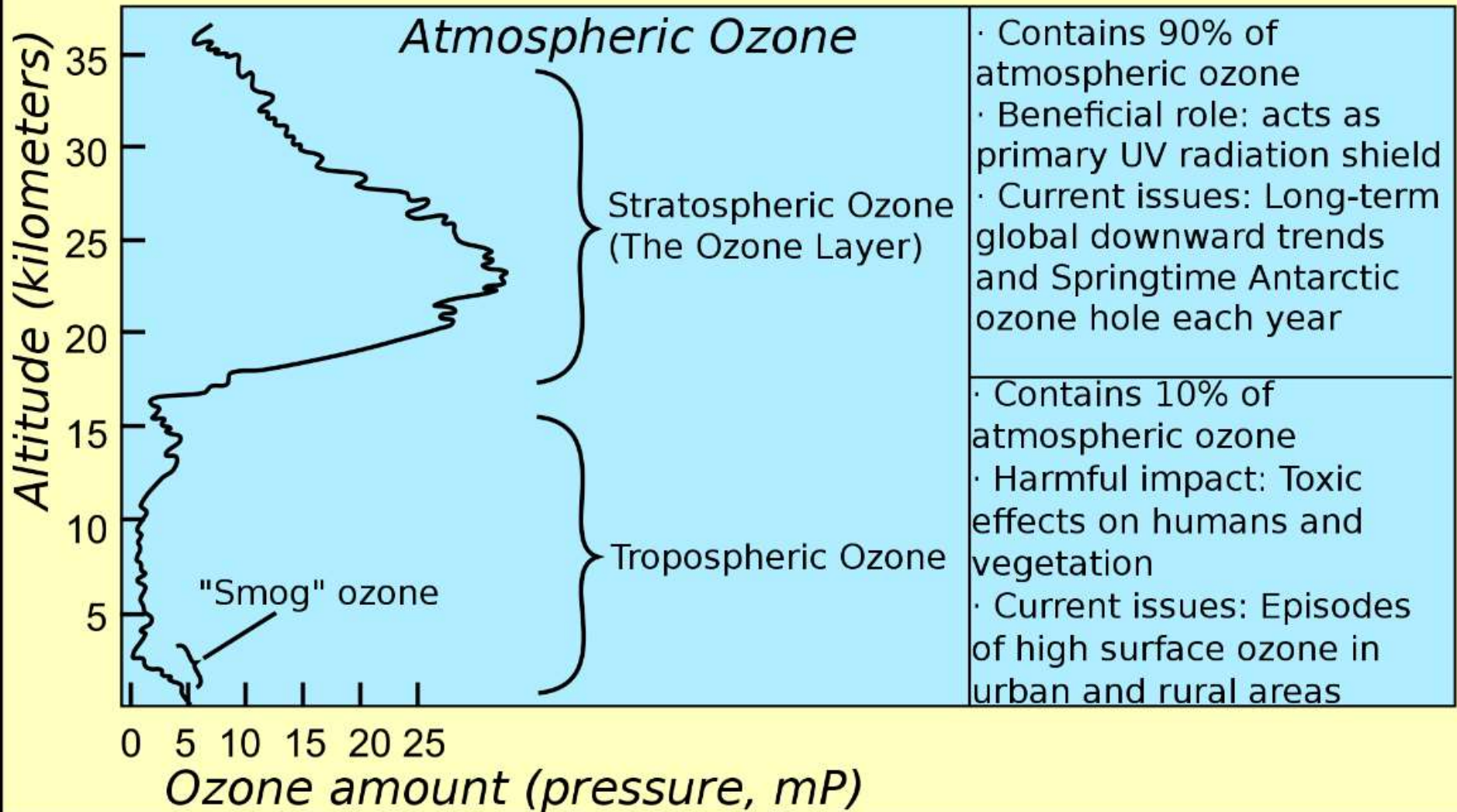
Everything is connected.

"In nature nothing exists alone."  
*Silent Spring* 1962



# Lovelock, CFCs, and the Ozone Hole

Using the ECD, Lovelock was the first to detect the widespread presence of CFCs - chlorofluorocarbons in the atmosphere and their role in stratospheric ozone depletion



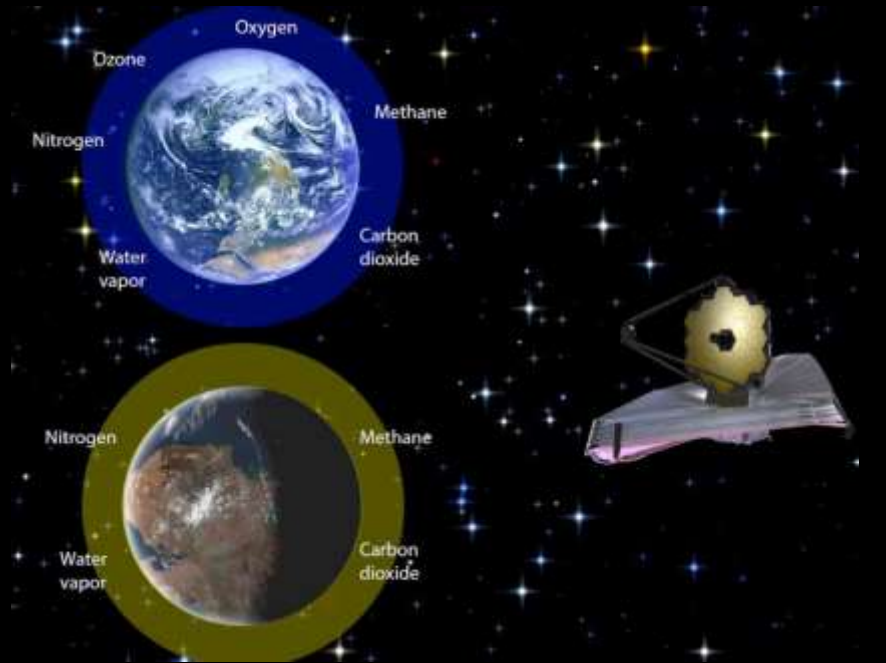
# Extraterrestrial Atmospheres and Life

In early 1961, Lovelock was hired by NASA to develop sensitive instruments for the analysis of extraterrestrial atmospheres and planetary surfaces.

Lovelock became interested in the composition of the Martian atmosphere, reasoning that many life forms on Mars would be obliged to make use of it (and, thus, alter it). However, the atmosphere was found to be in a stable condition close to its chemical equilibrium, with very little oxygen, methane, or hydrogen, but with an overwhelming abundance of carbon dioxide.

To Lovelock, the stark contrast between the Martian atmosphere and chemically dynamic mixture of the Earth's biosphere was strongly indicative of the absence of life on Mars.

Lovelock asked himself,  
“Why didn’t the Earth’s  
atmosphere end up  
like Mars’ atmosphere?”



# The Gaia Hypothesis – A New Look at Life on Earth

- The hypothesis was formulated by Lovelock and co-developed by the microbiologist Lynn Margulis in the 1970s.
- Hypothesis - Earth is a self-regulating system maintained by communities of living organisms. These communities adjust oxygen and carbon dioxide levels in the atmosphere, salinity in the ocean and even the planet's temperature to keep them within the acceptable bounds for life to thrive.
- Lovelock named the idea after Gaia, the primordial goddess who personified the Earth in Greek mythology.
- The suggestion that the theory should be called "the Gaia hypothesis" came from Lovelock's neighbor, the English writer William Golding (Noble Prize 1983, *Lord of the Flies*).
- "Gaia is the planetary life system that includes everything influenced by and influencing the biota. The Gaia system share with all living organisms the capacity for homeostasis – the regulation of the physical and chemical environment at a level that is favorable to life."



James Lovelock  
**GAIA**  
A New Look at  
Life on Earth

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With a  
new Preface  
by the  
Author

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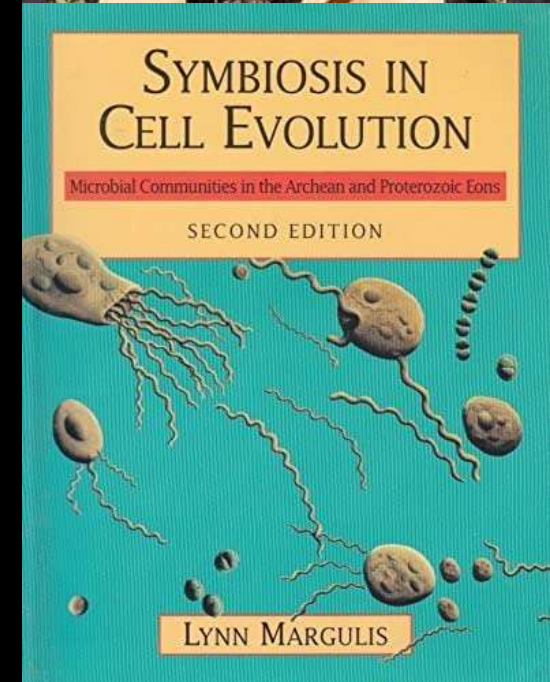
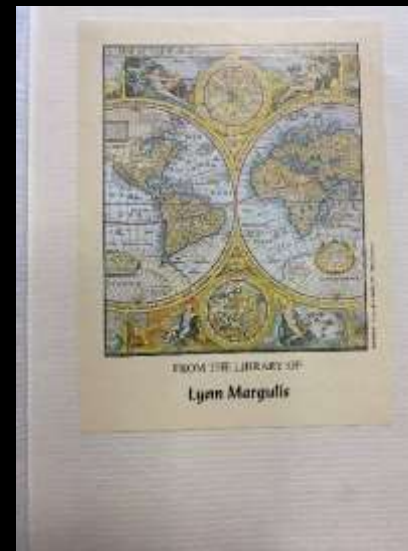
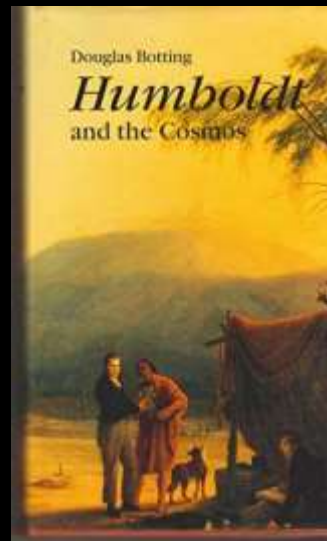




# How Nature Works – Lynn Margulis and Symbiosis

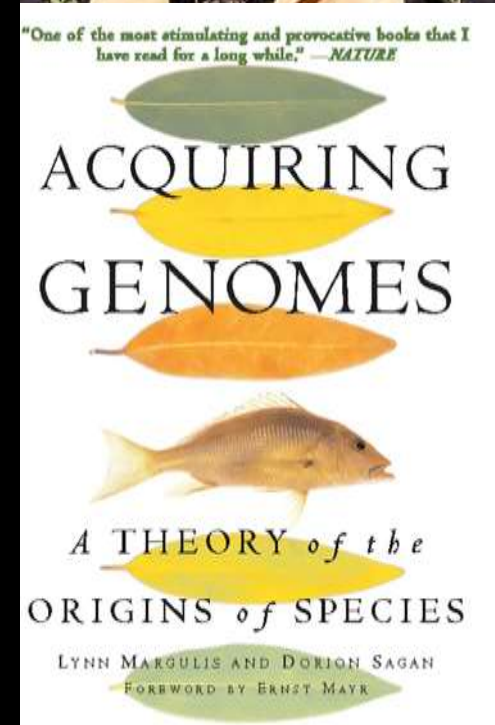
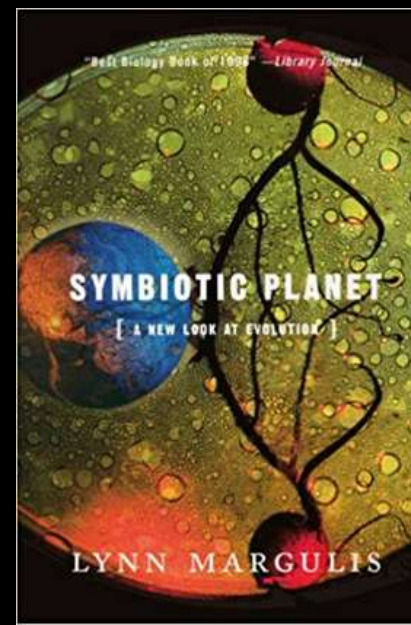
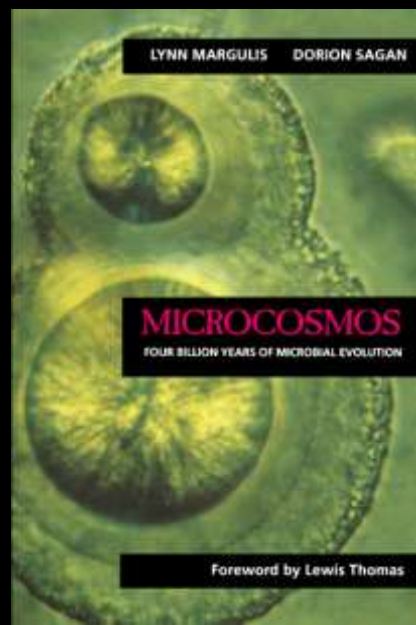
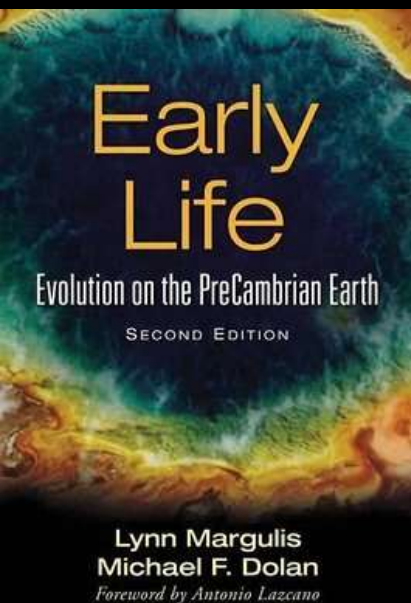
Lynn Margulis (1938 – 2011) was an American evolutionary biologist, and was the primary modern proponent for the significance of symbiosis in evolution.

- Margulis transformed and fundamentally framed current understanding of the evolution of cells with nuclei by proposing it to have been the result of symbiotic mergers of bacteria.
- Her formative paper, "On the Origin of Mitosing Cells", appeared in 1967 after being rejected by about fifteen journals. It was finally accepted by *Journal of Theoretical Biology* and is considered today a landmark in modern endosymbiotic theory.



# How Nature Works – Lynn Margulis and Symbiosis

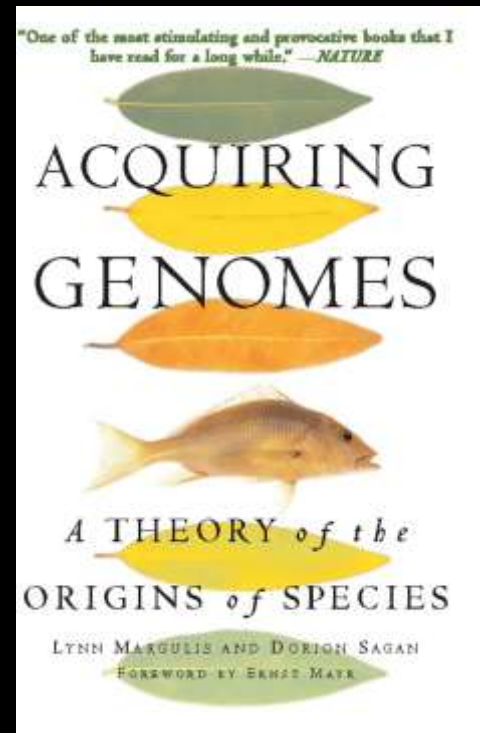
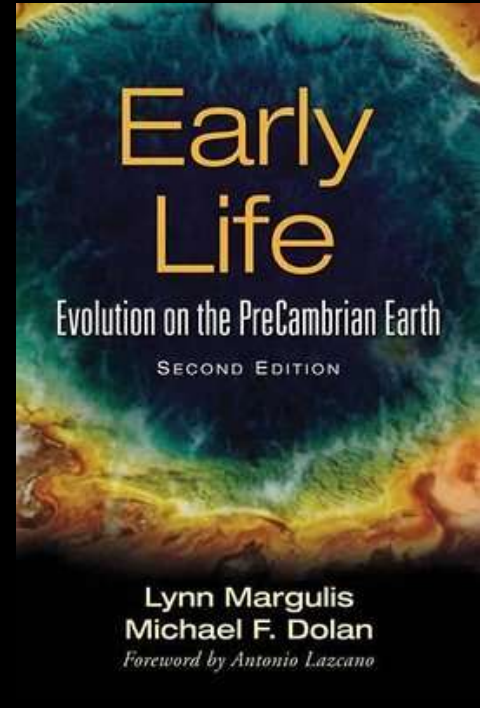
- Her theory that cell organelles such as mitochondria and chloroplasts were once independent bacteria was largely ignored for another decade, becoming widely accepted only after it was powerfully substantiated through genetic evidence.
- "Darwin's grand vision was not wrong, only incomplete. In accentuating the direct competition between individuals for resources as the primary selection mechanism, Darwin (and especially his followers) created the impression that the environment was simply a static arena".



# How Nature Works - Symbiosis as evolutionary force

## Life is a verb – The Agency of Nature

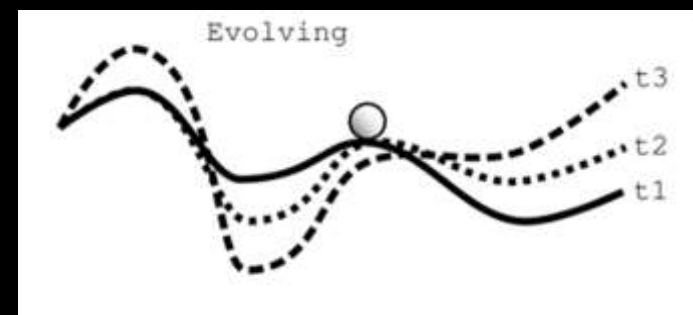
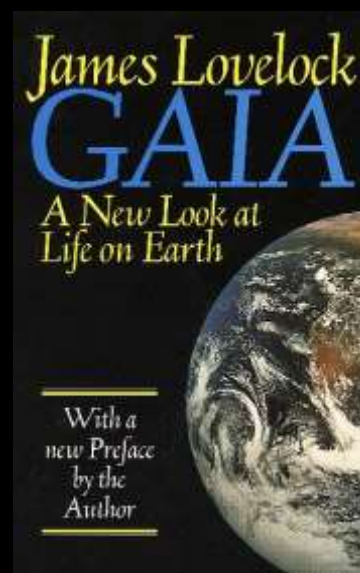
- The Agency of Nature - "Life on earth is more like a verb. It repairs, maintains, re-creates, and outdoes itself."
- Margulis opposed competition-oriented views of evolution, stressing the importance of symbiotic or cooperative relationships between species
- She later formulated a theory that proposed symbiotic relationships between organisms of different phyla, or kingdoms, as the driving force of evolution.



# How the Earth Works - Gaia and Homeostasis

## James Lovelock and Lynn Margulis

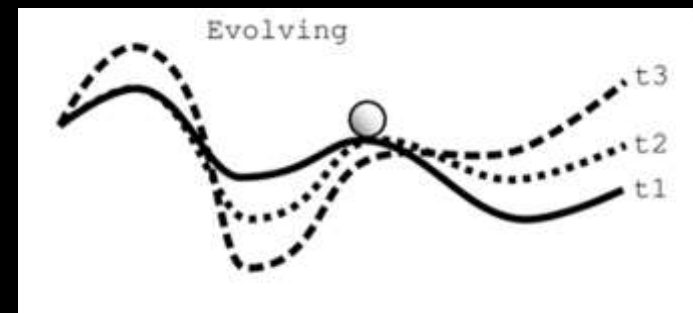
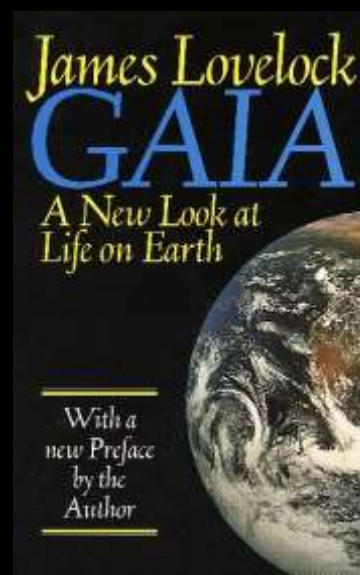
- The Earth is a self-regulating complex system involving the biosphere, the atmosphere, the hydrospheres and the pedosphere, tightly coupled as an evolving system.
- Many processes in the Earth's surface, essential for the conditions of life, depend on the interaction of living forms, especially microorganisms, with inorganic elements.
- These processes establish a global control system that regulates Earth's surface temperature, atmosphere composition and ocean salinity, powered by the global thermodynamic disequilibrium state of the Earth system.



# How the Earth Works?

## Gaia and the Agency of Nature

- The system as a whole, called Gaia, seeks a physical and chemical environment optimal for contemporary life.
- Gaia evolves through a cybernetic feedback system operated unconsciously by the biota, leading to broad stabilization of the conditions of habitability in a full homeostasis.
- Teleology – Purpose in Nature is Unscientific!



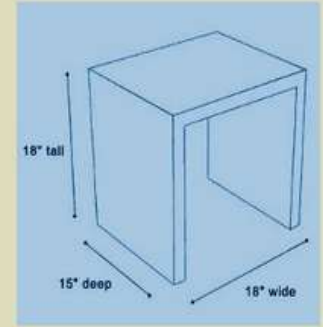
# Aristotle's Four Causes



## The Material Cause

The material out of which the thing exists

e.g. - A table's material cause is **wood**.



## The Formal Cause

The form in which the thing is arranged

e.g. - A table's formal cause is the idea of **an elevated flat surface**.



## The Efficient Cause

The 'mover' that causes the thing to be or happen

e.g. - A table's efficient cause is **the carpenter** that made it.



## The Final Cause

The purpose for which the thing exists

e.g. - A table's final cause is **to be used to place food or other things on**.

worldhistorycharts.com

# Natural Philosophy

## How does Nature work?

### Motion and Change – 4 Causes

- Material cause - An object's motion will behave in different ways depending on the [substance/essence] from which it is made. (Compare clay, steel, etc.)
- Formal cause - An object's motion will behave in different ways depending on its material arrangement. (Compare a clay sphere, clay block, etc.)

### Purpose in Nature

- Efficient cause - That which caused the object to come into being; an "agent of change" or an "agent of movement".
- Final cause - The reason that caused the object to be brought into existence.

Teleology – all things have a purpose

# Gaia and the Agency of Nature

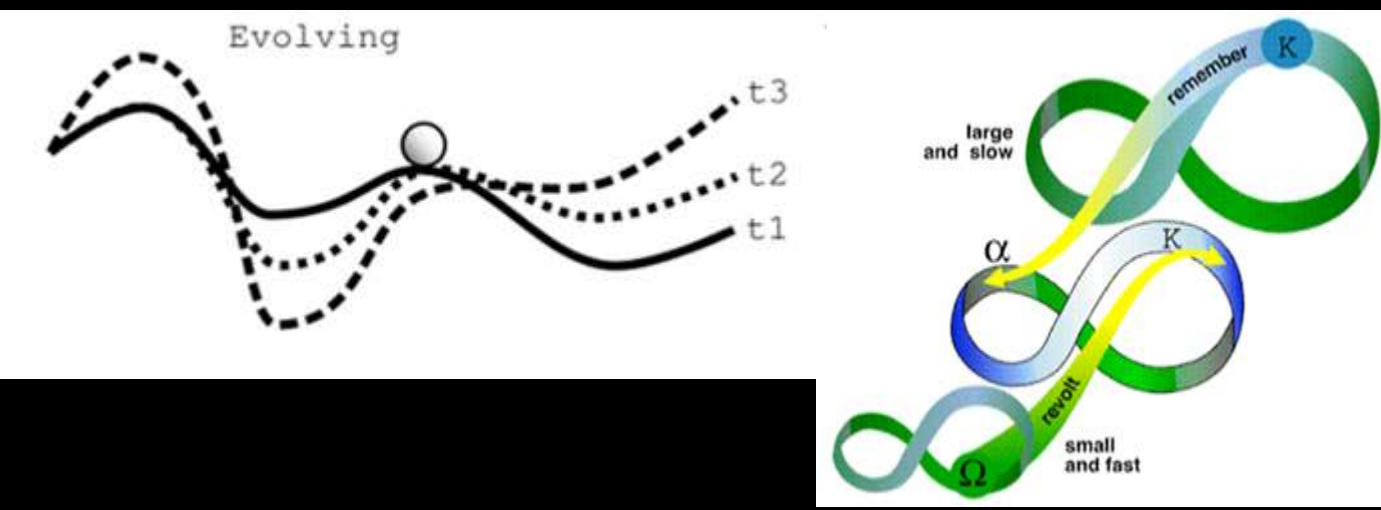
## James Lovelock

- “When I talk of Gaia as a super organism, I do not for a moment have in mind a goddess or some sentient being. I am expressing my intuition that the Earth behaves as a self regulating system, and that the proper science for its study is physiology.”
- The originality of the Gaia hypothesis relies on the assessment that such homeostatic balance is actively pursued to keep the optimal conditions for life on Earth, even when terrestrial or external events menace them – like a chemical reaction or cybernetic system (thermostat).



James Lovelock  
**GAIA**  
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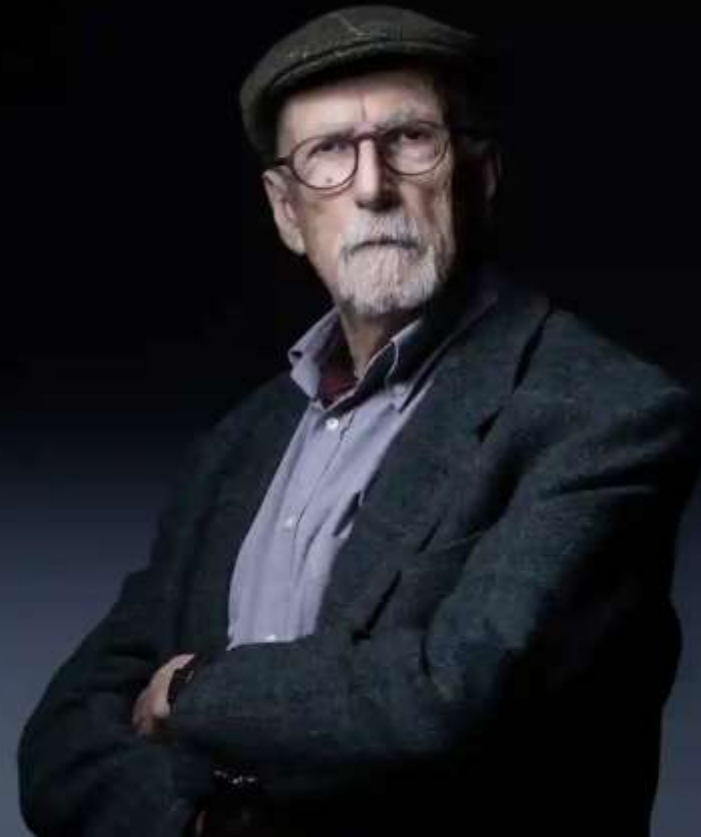
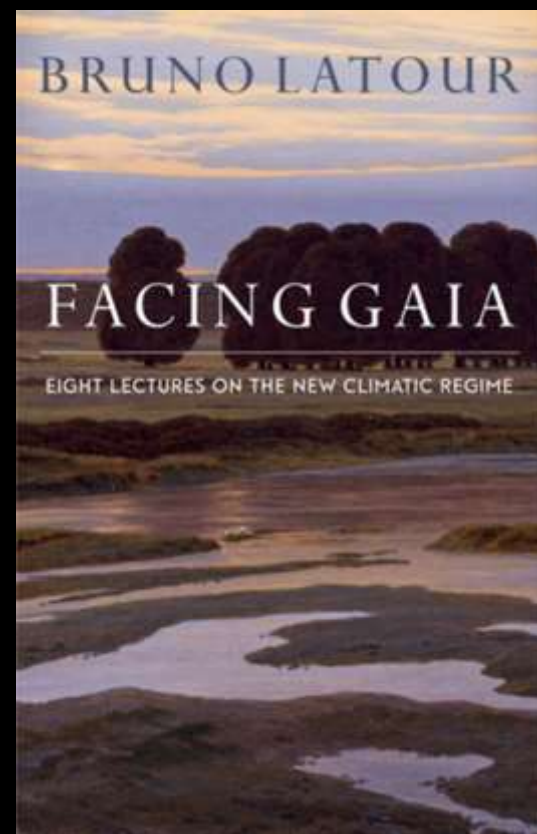


# Nature as a verb – The Agency of Nature and 21<sup>st</sup> Century Philosophy

Bruno Latour (1947-2022)

“Contrary to the old nature, Gaia does not play either the role of inert object that could be appropriated or the role of a higher arbiter on which, in the end, one could rely.

It was old Nature that could serve as a general framework for our actions even as She remained *indifferent* to our fate... Gaia is no longer *indifferent* to our actions...Gaia can treat us as enemies. We can respond in kind.”



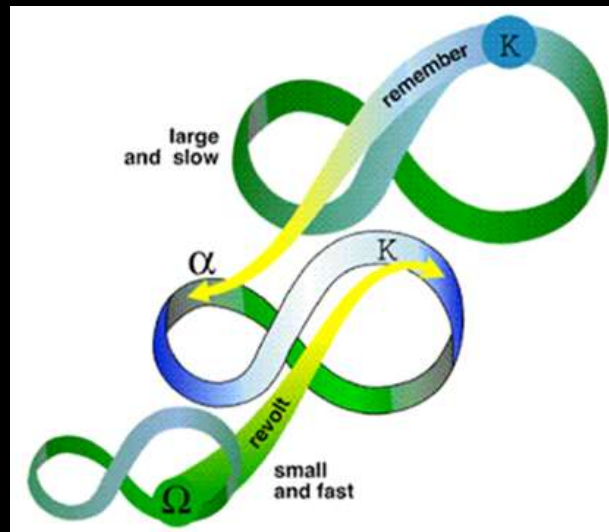
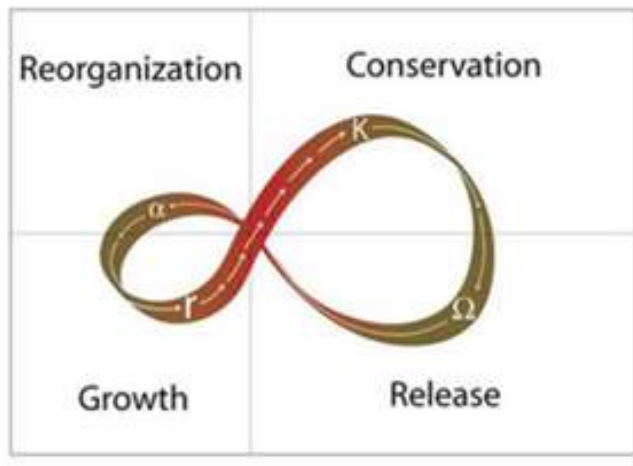
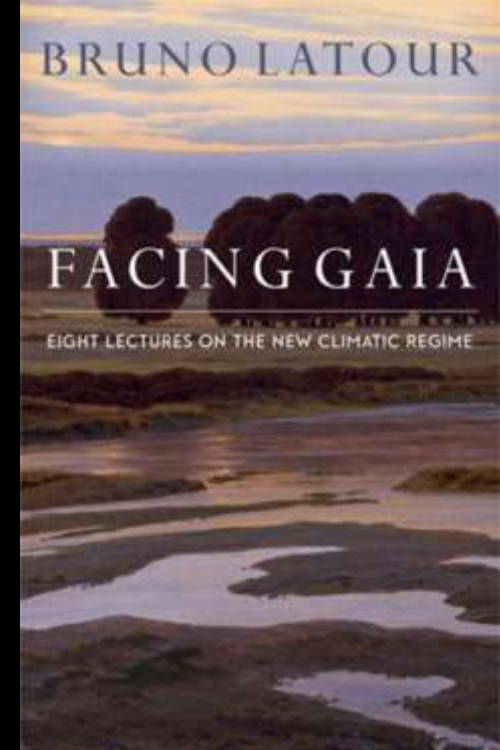


# The Anthropocene and Being “of the Earth”

Bruno Latour (1947-2022)

“That’s what the Anthropocene is all about... we have to weave ourselves, to cocoon ourselves within a great many loops so that progressively, thread after thread, the knowledge of where we reside and on what we depend for our atmospheric condition can gain greater relevance and feel more urgent.

This slow operation of being wrapped in successive looping strips is what it means to be ‘of this Earth’ and it has nothing to do with being human-in-nature or human-on-a-globe.”

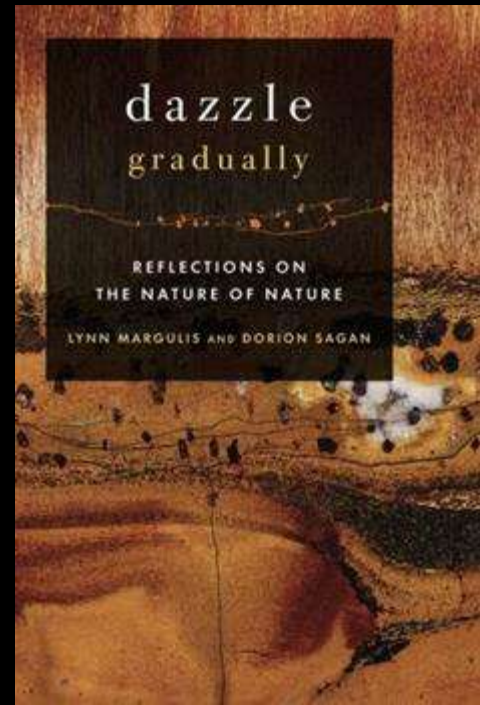


# Inhabiting the Earth – Rhetoric of the Powerless

## Lynn Margulis

- “Life is a planetary level phenomenon and the Earth has been alive for at least 3000 million years. To me the human move to take responsibility for the living Earth is laughable - the rhetoric of the powerless.
- The planet takes care of us, not we of it.
- Our self inflated moral imperative to guide a wayward Earth or heal a sick planet is evidence of our immense capacity for self-delusion.
- Rather, we need to protect us from ourselves.”

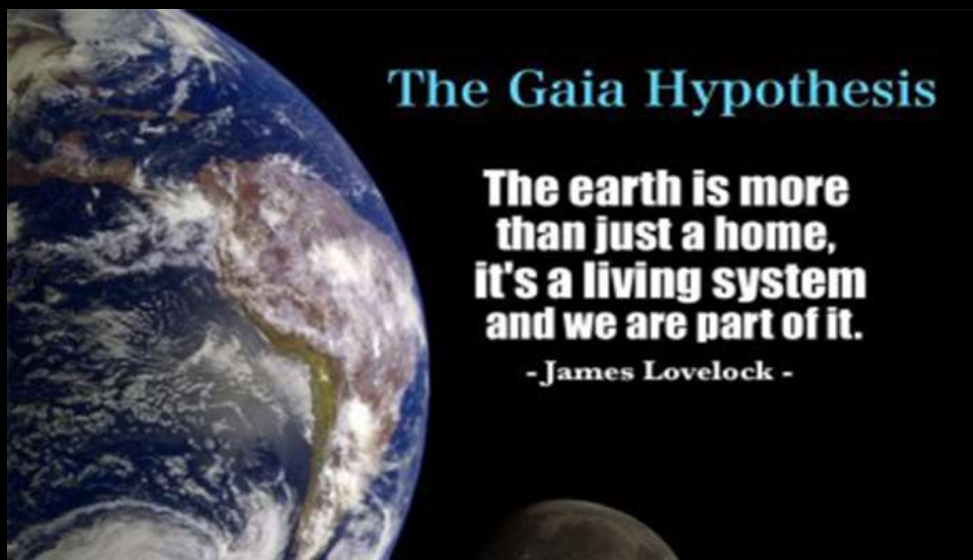
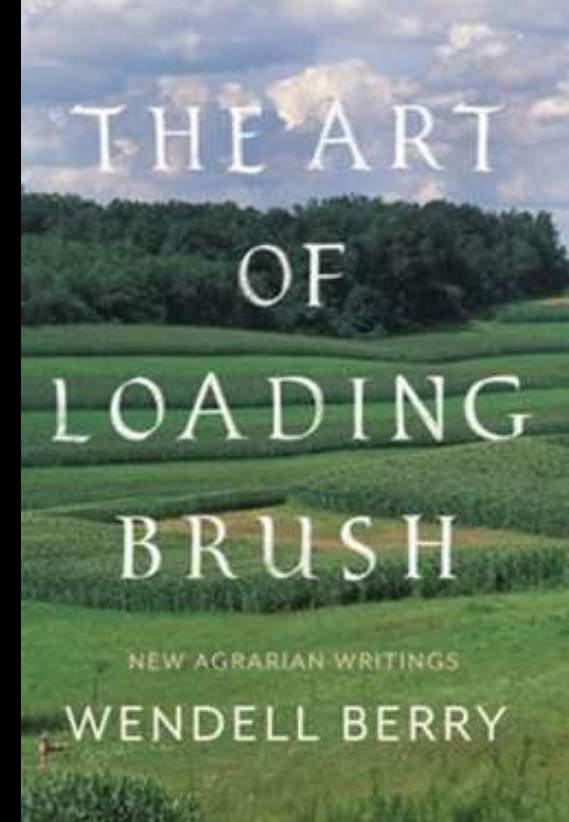
The Agency of Nature - “Life on earth is more like a verb. It repairs, maintains, re-creates, and outdoes itself.”



# Nature – Nonetheless Our Mother

## Wendell Berry and Gaia

“As many hunters, farmers, ecologists, and poets have understood, Nature (and here we capitalize her name) is the impartial mother of all creatures, unpredictable, never entirely revealed, not my mother or your mother, but nonetheless our mother. If we are observant and respectful of her, she gives good instruction. ...If we ignore or offend her, she enforces her will with punishment. She is always trying to tell us that we are not so superior or independent or alone or autonomous as we may think.”



# Living with Gaia

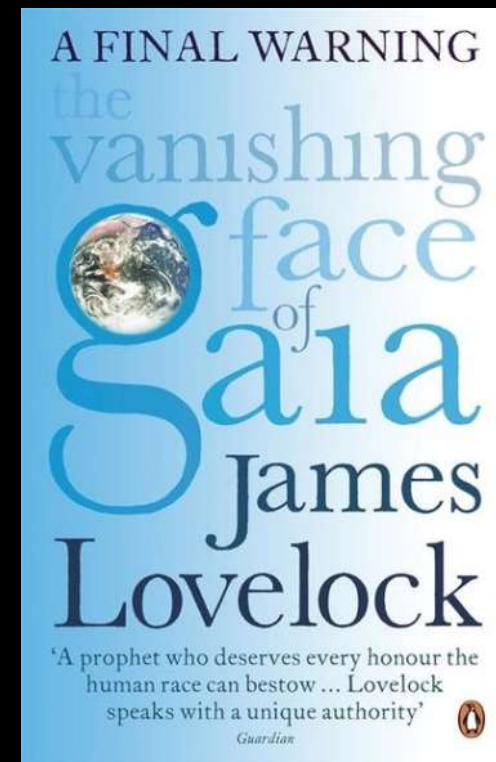
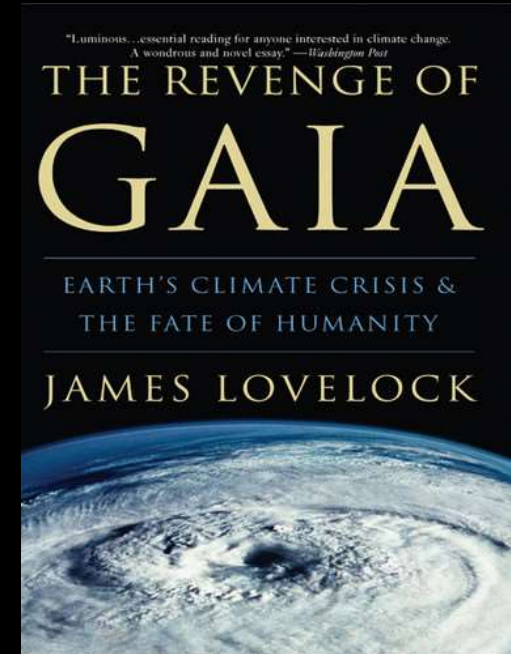
## Lovelock - Sustainable Retreat

Lovelock thinks the time is past for sustainable development, and that we have come to a time when development is no longer sustainable. Therefore, we need to retreat.

“We should be strengthening our defenses and making a sustainable retreat rather than trying to ‘save the planet’. We are not clever nor determined enough to serve in this way, but we could still be the progenitors of those that can.”

“Retreat means it's time to start talking ...

- about changing where we live and how we get our food;
- about making plans for the migration of millions of people from low-lying regions like Bangladesh into Europe;
- about admitting that New Orleans is a goner and moving the people to cities better positioned for the future.
- Most of all, it's about everybody ‘absolutely doing their utmost to sustain civilization, so that it doesn't degenerate into Dark Ages, with warlords running things, which is a real danger. We could lose everything that way.”

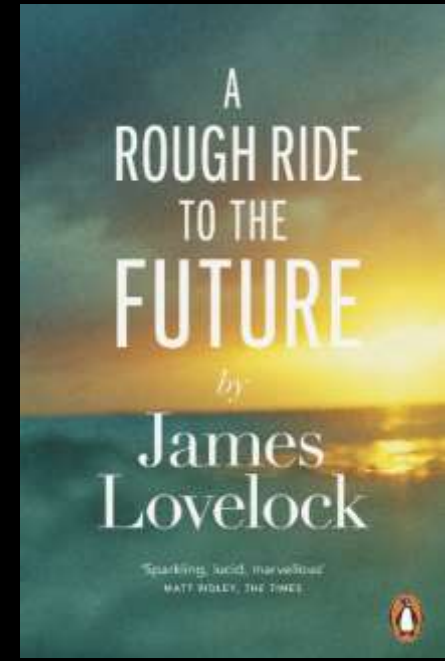
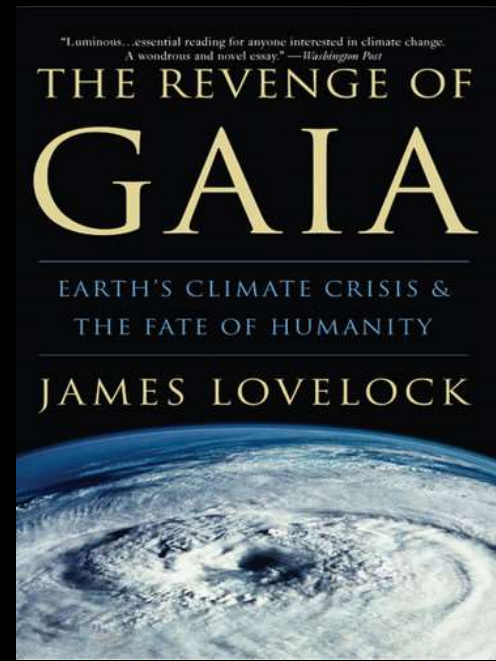
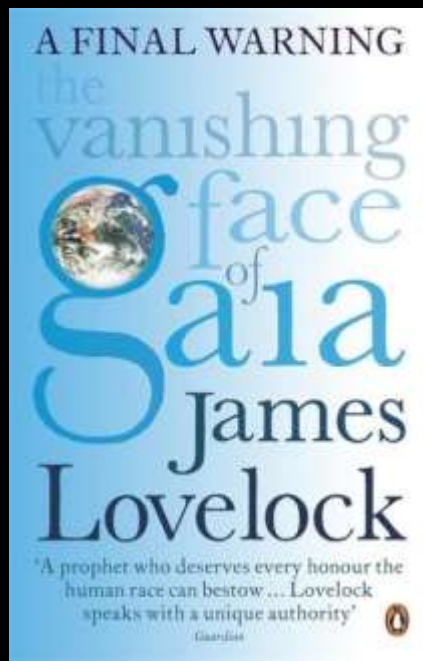
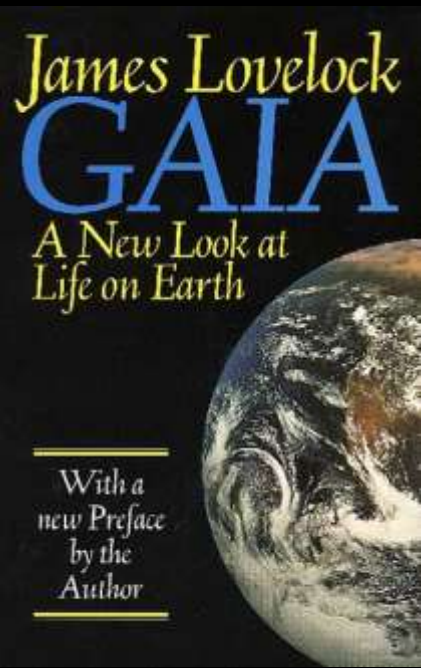


# Lovelock – Mind and Nature Invention, Intuition, and Rationality

“If you think as I do that we are an organic part of the Earth, then perhaps our intelligence is a property of the Earth. This is why it is so important that we survive.”

“Rational thinking is not necessarily our greatest property, and, although we prize it, it may be a handicap.

We have to recognize that in addition to conscious rational thinking our minds are capable of other more powerful mental processes that lead us by intuition to grasp a tiny sparkling fragment of reality.”



# The Enlightenment and Romanticism

## *The Sciences and The Humanities*

### Imaginative Understanding

“Two radically different approaches to the world are represented by the tradition of the sciences and that of the humanities.

The first takes as its model the basic pattern of inquiry of the natural sciences, which it regards as applicable to all disciplines and areas of experience.

The second is concerned with the values that are central to culture and history, an area in which there is no cumulative growth of knowledge but only growth of insight and understanding won by ‘informed imagination’ and intuition.”

### Vico – The New Science (1725)

“Imaginative Understanding”

“the capacity for conceiving more than one way of categorizing reality”

Isaiah  
Berlin

THE PROPER STUDY  
OF MANKIND



AN ANTHOLOGY OF ESSAYS

“He has made more sense of the intellectual chaos of the modern world  
no one has done more rationally and courageously than he.”  
—ARND BRUNING, JR., THE WASHINGTON POST BOOK WORLD

giambattista

VICO

the new  
SCIENCE



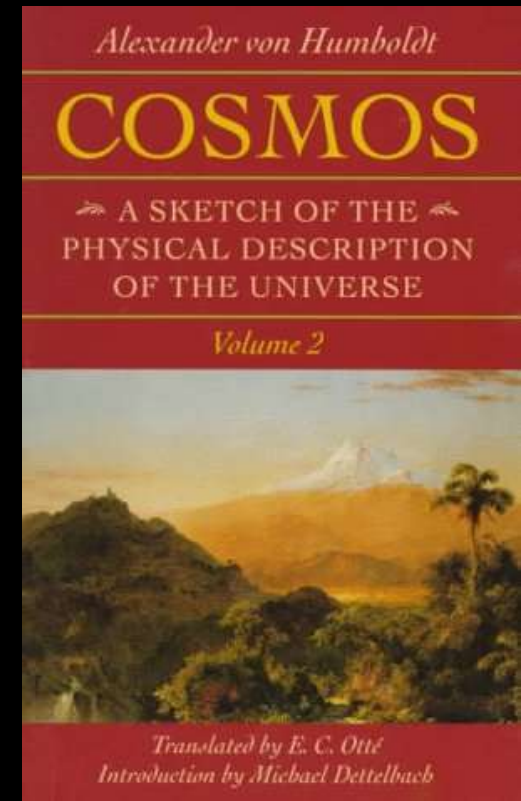
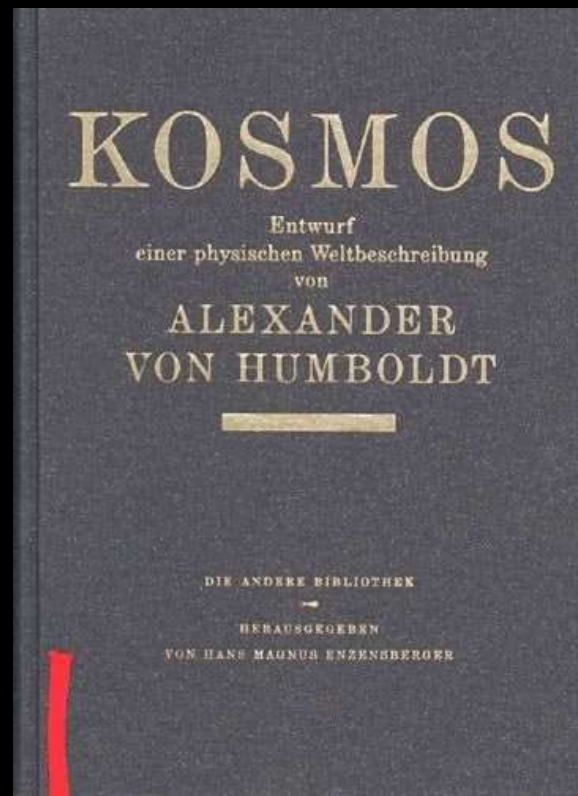
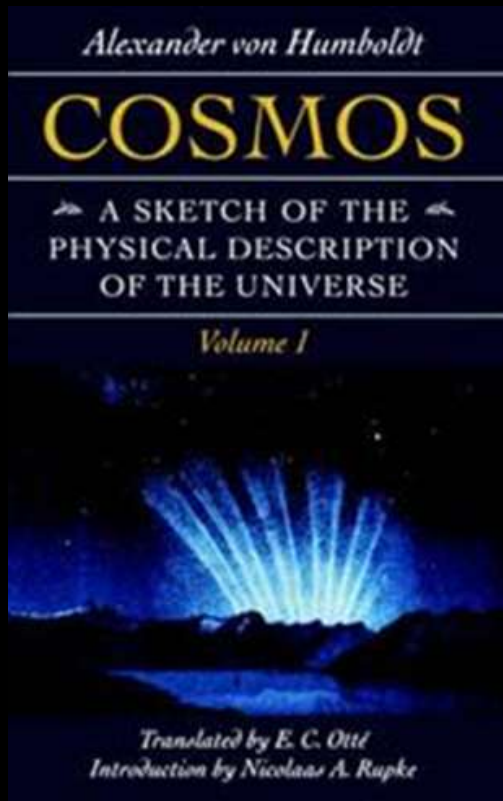
Translated and Edited by Jason Taylor and Robert Miner

With an Introduction by Giuseppe Mazzotta

# Imaginative Understanding and Science

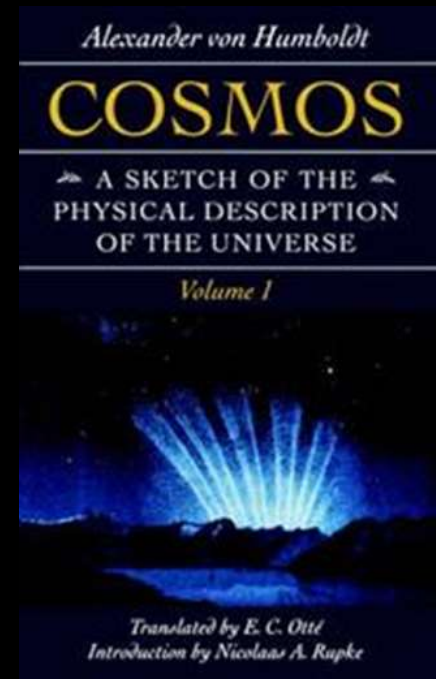
## Humboldt's Cosmos "Order and Adornment"

- For Humboldt "cosmos" signifies both the "order of the world, and adornment of this universal order."
- Order refers to the observed fact that the physical universe, independently of humans, demonstrates regularities and patterns that we can define as laws.
- Adornment refers to human imaginative perception of beauty and wonder, which is also part of the universe.



# Humboldtian Cosmos - Mind directed toward Nature

- The Cosmos is both ordered and beautiful.
- Nature and the human mind are a unity.
- “Science begins where the mind takes hold of matter and attempts to subject the mass of experiences to a rational understanding; it is mind directed toward nature.” One simply cannot take mind out of the scientific equation.
- We must not “separate the sphere of nature from that of mind, since such a separation would reduce the physical sciences of the world to a mere aggregation of empirical specialties.”
- Humans and Nature - To know nature better is thus to know ourselves better, for knowledge is a deeply human project combining understanding and imagination.
- A dynamic picture of the universe that would continually grow and change as human conceptions of nature and the depth of human feeling about nature enlarge and deepen.



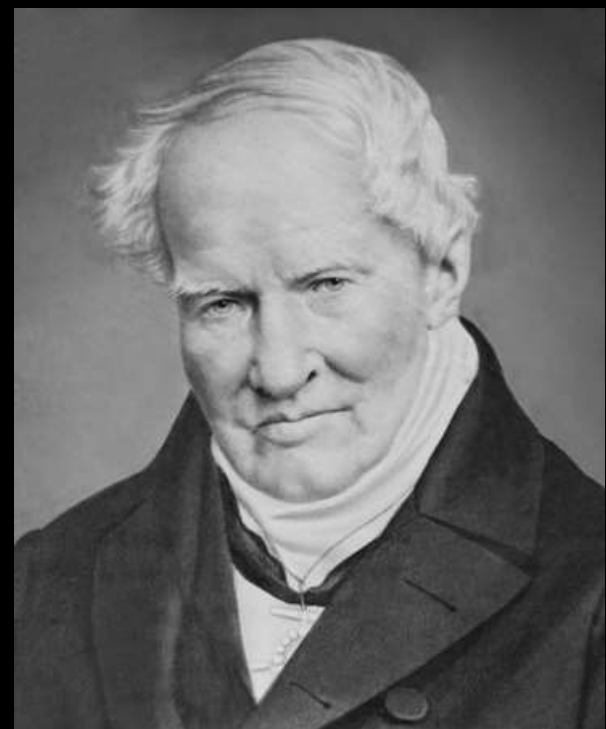
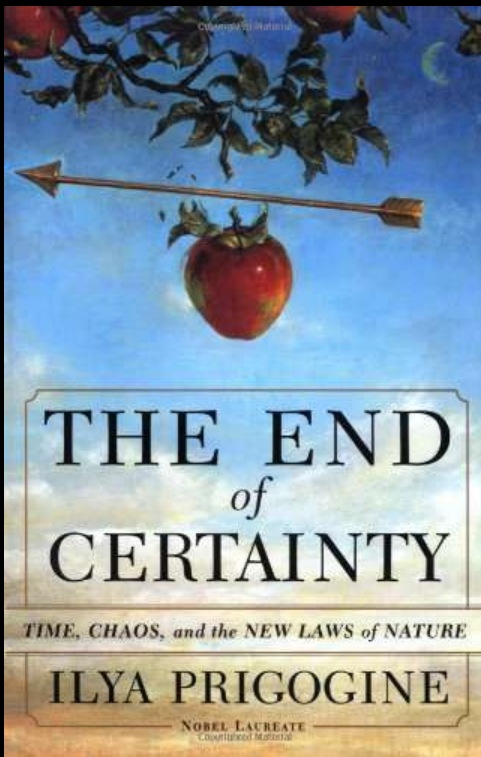
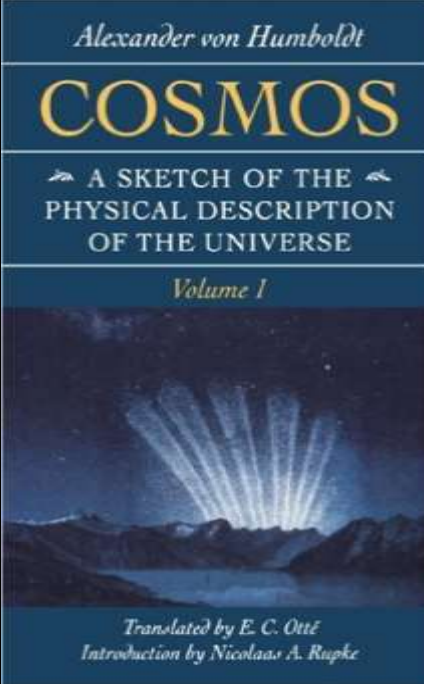


# Humanity's Limitations in Comprehending The Cosmos

“The attempt perfectly to represent unity in diversity must ...necessarily prove unsuccessful...If nature be illimitable in extent and contents, it likewise presents itself to the human intellect as a problem which cannot be grasped, and whose solution is impossible.”

The Universe is wider than our views of it.

- Henry David Thoreau





# Alexander von Humboldt 1769-1859



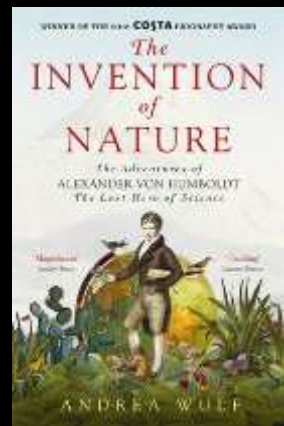
# Nature is the Domain of Liberty – Humanity and the Cosmos

“I am sad to say that at the age of eighty I am reduced to the banal hope that the noble and ardent desire for free institutions is maintained in the people and that, though from time to time it may appear to sleep, it is as eternal as the electromagnetic storm which sparkles in the sun.”



“Nature is the domain of liberty,” Humboldt said, because nature’s balance was created by diversity which might in turn be taken as a blueprint for political and moral truth. Everything, from the most unassuming moss or insect to elephants or towering oak trees, had its role, and together they made the whole. Humankind was just one small part. Nature itself was a republic of freedom.”

*Wulf Invention of Nature*



# The Consolation of Nature

The earnest and solemn thoughts awakened by a communion with Nature intuitively arise from a presentiment of the order and harmony pervading the whole universe, and from the contrast we draw between the narrow limits of our own existence and the image of infinity revealed on every side, whether we look upward to the starry vault of heaven, scan the far-stretching plain before us, or seek to trace the dim horizon across the vast expanse of ocean.

Cosmos 1:3

