

Energy as Master Resource

Eric Zencey



Fourth Annual Biophysical Economics Conference
October 26, 2012



Sadi Carnot

1796-1832



Sadi CARNOT

RÉFLEXIONS
SUR LA
PUISSANCE MOTRICE
DU FEU



ÉDITIONS
JACQUES GABAY



“It is impossible to take heat from a hot reservoir and convert it completely into work by a cyclic process without transferring a part of it to a cold reservoir.”



“To take away from England today her steam-engines would be to take away at the same time her iron and coal. It would be to dry up all her sources of wealth, to ruin all on which her prosperity depends....

“... in short, [it would be] to annihilate that colossal power.”





L. Richter del.

Th. Schreyer sculp.

Wilhelm Ostwald

1853 - 1932

Nobel Laureate
Chemistry
1909



Physics, too, needed to undergo a “radical reorientation”

“From now on, the whole of physics had to be represented as a theory of energies.”

His idea was met with “ridicule and abuse”

“...so absurd they refused to take it seriously at all”



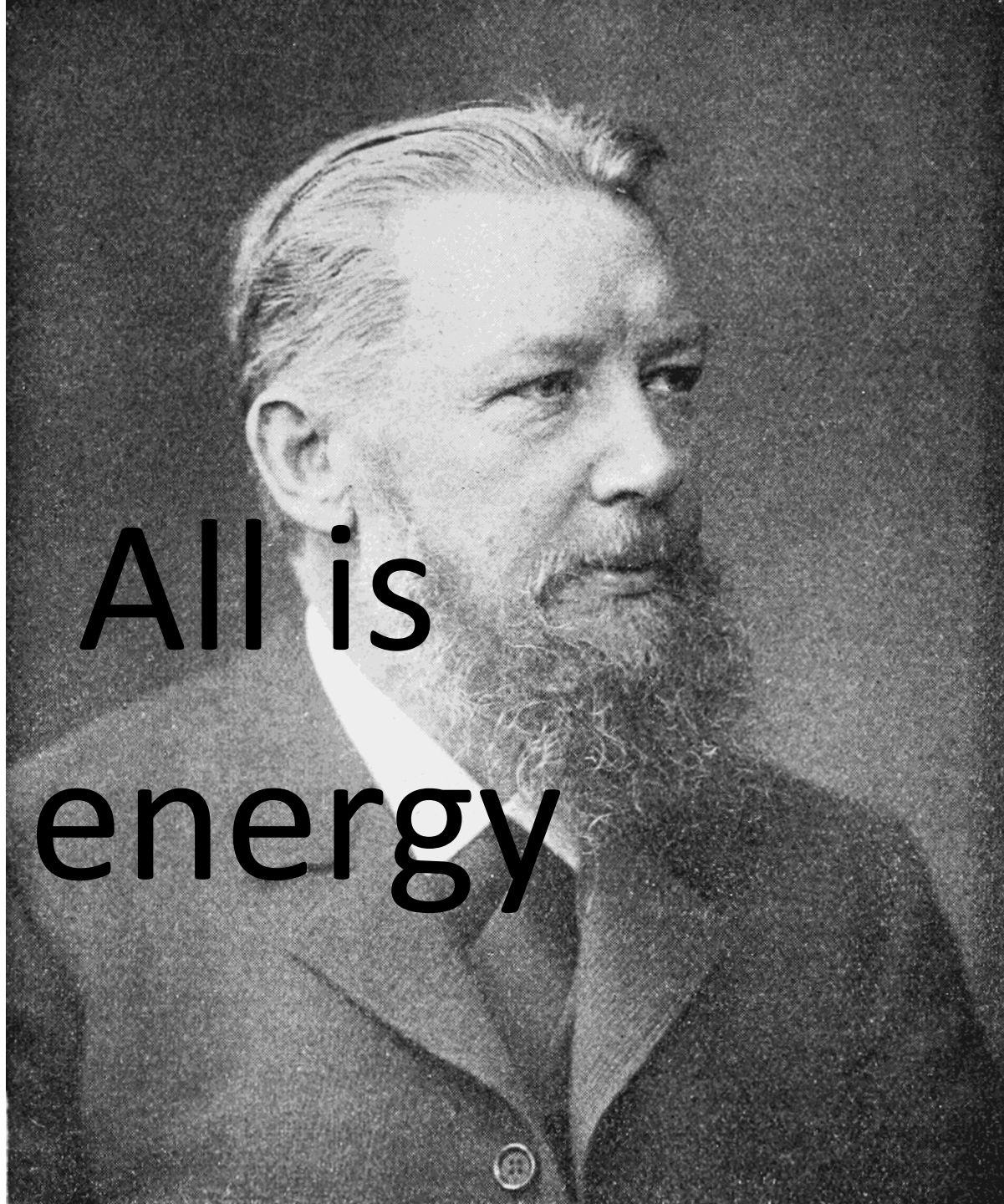




All is
energy

A photograph of a path lined with cherry blossom trees in full bloom. The trees have dark brown trunks and branches, with dense clusters of pink and red flowers. The path is covered in fallen petals, and the ground is green grass. The text "All is energy" is overlaid in the center in a large, black, sans-serif font.

All is
energy



All is
energy

- Unify
chemistry,
physics,
biology



- Unify chemistry, physics, biology
- Revolutionize other fields:



- Unify chemistry, physics, biology
- Revolutionize other fields:
 - History



- Unify chemistry, physics, biology
- Revolutionize other fields:
 - History
 - Metaphysics



- Unify chemistry, physics, biology
- Revolutionize other fields:
 - History
 - Metaphysics
 - morals



**“ACT ONLY IN ACCORDANCE
TO THAT MAXIM WHEREBY
YOU CAN, AT THE SAME TIME,
WILL THAT IT SHOULD
BECOME A UNIVERSAL LAW.”**

--Immanuel Kant

Grounding for the Metaphysics of Morals, 1785, translated by James W. Ellington 1993.

- Unify chemistry, physics, biology
- Revolutionize other fields:
 - History
 - Metaphysics
 - morals

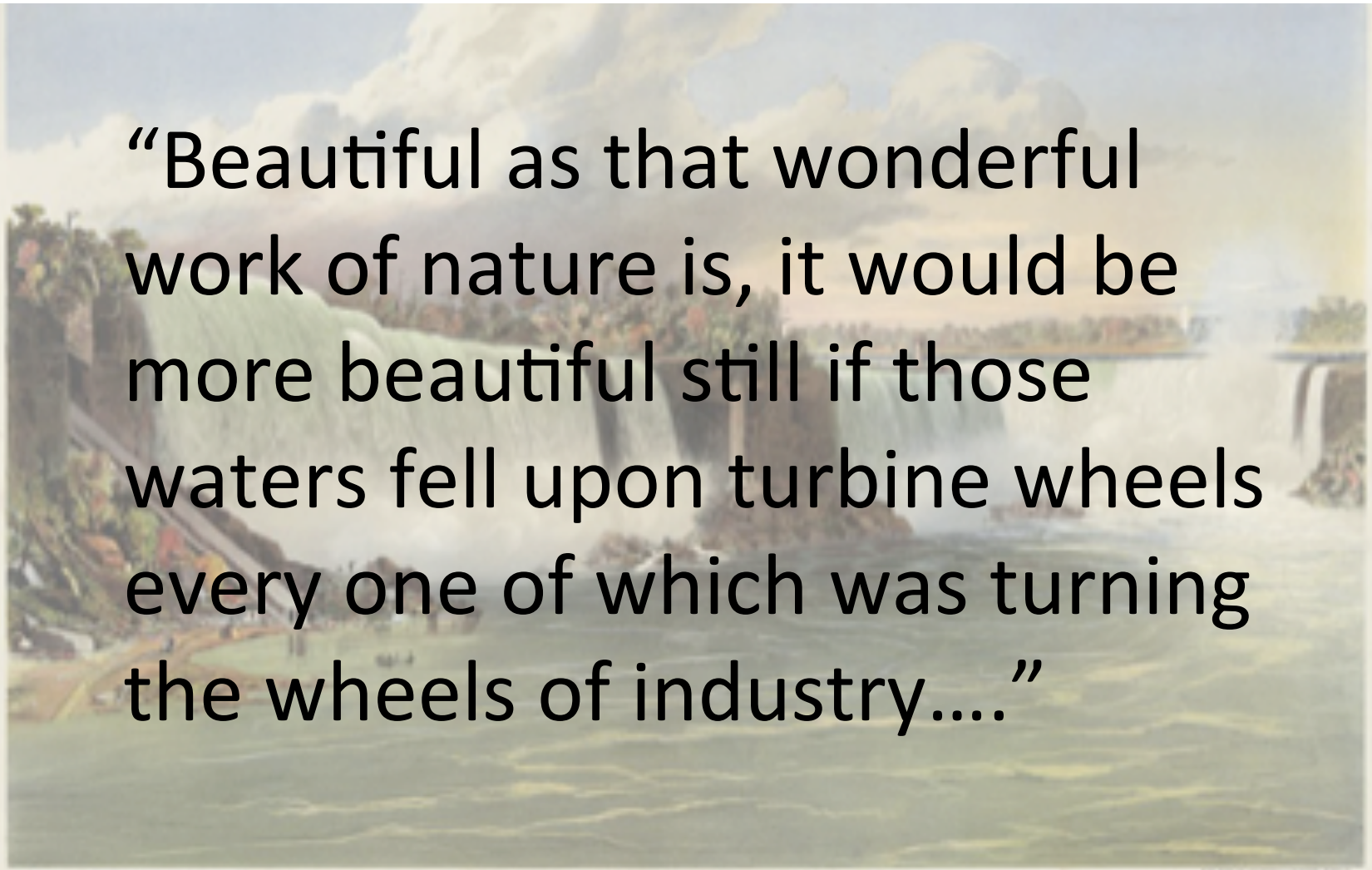


A new categorical imperative:

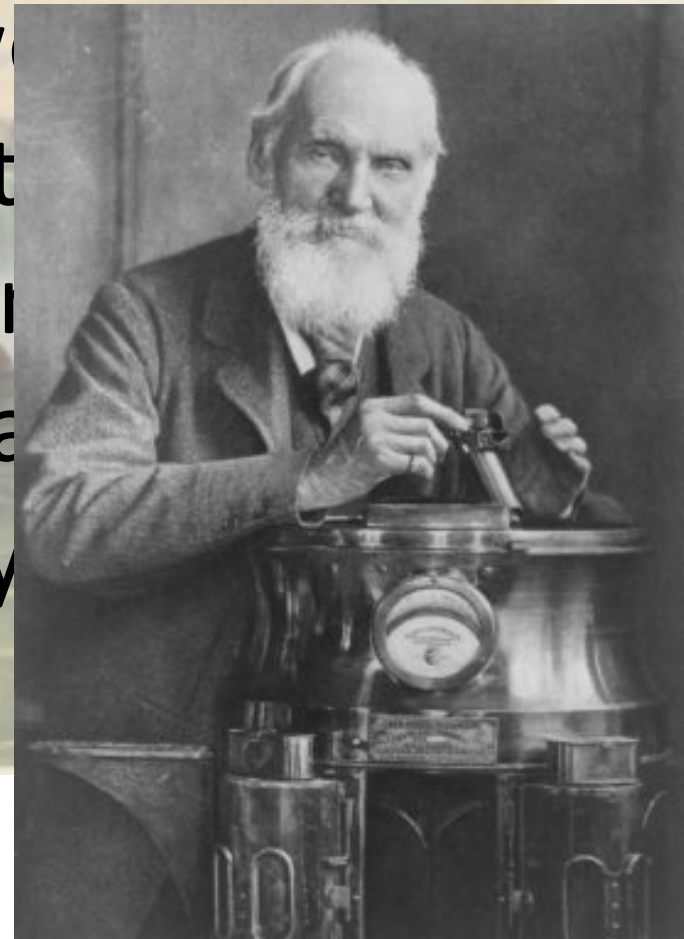
WASTE NO ENERGY!



“Beautiful as that wonderful work of nature is, it would be more beautiful still if those waters fell upon turbine wheels every one of which was turning the wheels of industry....”



“Beautiful as that wonderful work of nature is, it was more beautiful still if the waters fell upon turbines every one of which was the wheels of industry



Ostwald's energism:

- International language



Ostwald's energism:

- International language
- eugenics

Some people are born to be a burden on the rest.

This light flashes every 16 seconds

Every 16 seconds
a person is born in the
United States.



BRISTOL, MASS. 1904
MAY 10 - JUNE 10
EASTERN STATES EXPOSITION
BOSTON, MASS.

This light flashes every 7½ minutes

Every 7½ minutes a high grade person
is born in the United States, will
have ability to do creative work &
be fit for leadership. About 4% of
all Americans come within this class

EUGENICS

A black and white illustration of a large, gnarled tree. The trunk is thick and textured. At the top, a banner wraps around the crown of the tree with the word 'EUGENICS' in large, bold, serif capital letters. The tree's branches spread out horizontally, forming a wide canopy. The interior of the canopy is divided into two main sections by the central trunk. The left section contains the text 'EUGENICS IS THE SELF DIRECTION' and the right section contains 'OF HUMAN EVOLUTION'. The base of the tree, where the trunk meets the ground, is a complex, branching structure. Numerous scientific and social disciplines are labeled along these branches, including Anatomy, Physiology, Biology, Genetics, Psychology, Mental Testing, Anthropometry, History, Geology, Archaeology, Anthropology, Ethnology, Geography, Law, Statistics, Politics, Economics, Biogeography, Genealogy, Sociology, Education, Religion, Psychiatry, Surgery, and Medicine. The entire illustration is framed by a decorative border of leaves and small flowers.

EUGENICS IS THE
SELF DIRECTION

OF HUMAN EVOLUTION

ANATOMY
PHYSIOLOGY
BIOLOGY

GENETICS

PSYCHOLOGY

MENTAL TESTING

ANTHROPOMETRY

HISTORY

GEOLOGY

ARCHAEOLOGY

ANTHROPOLOGY

ETHNOLOGY

GEOGRAPHY

STATISTICS

LAW

POLITICS

GENEALOGY

BIOGEOGRAPHY

ECONOMICS

SOCIOLOGY

EDUCATION

RELIGION

MEDICINE

SURGERY

PSYCHIATRY

Ostwald's energism:

- International language
- Eugenics
- technocracy

Ostwald's “energism”

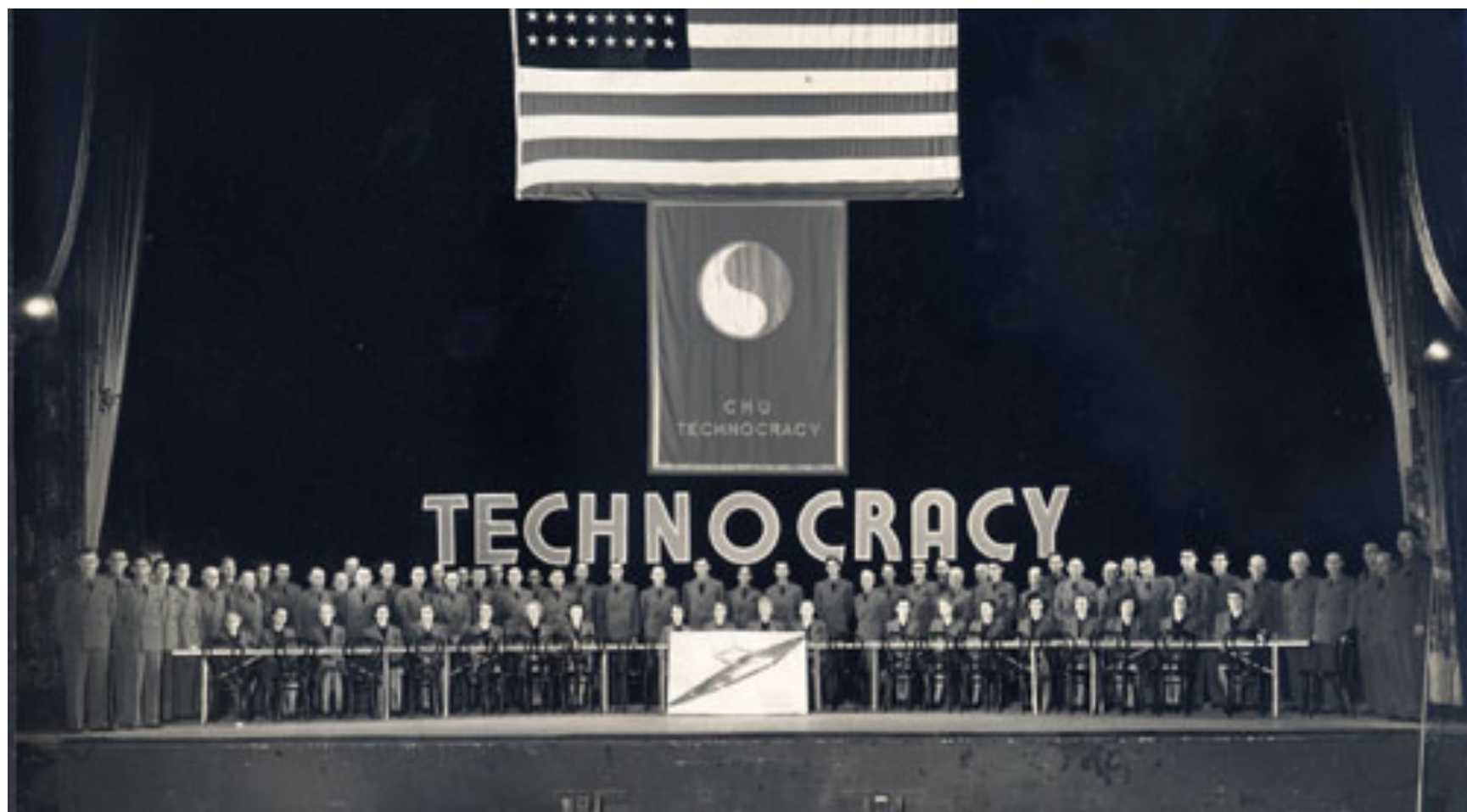
- International language
- Eugenics
- Technocracy

To manage our scarce calories to produce

– the greatest good for

– the greatest number

– over the greatest amount of time.....



The reconstructive impulse of thermodynamics

1. Physics



1905: papers on

- Brownian Motion
- Photoelectric Effect
- Special Relativity
- Mass/Energy Equivalence



1905: papers on

- Brownian Motion
- Photoelectric Effect
- Special Relativity
- Mass/Energy Equivalence



$$E = mc^2$$

The reconstructive impulse of thermodynamics

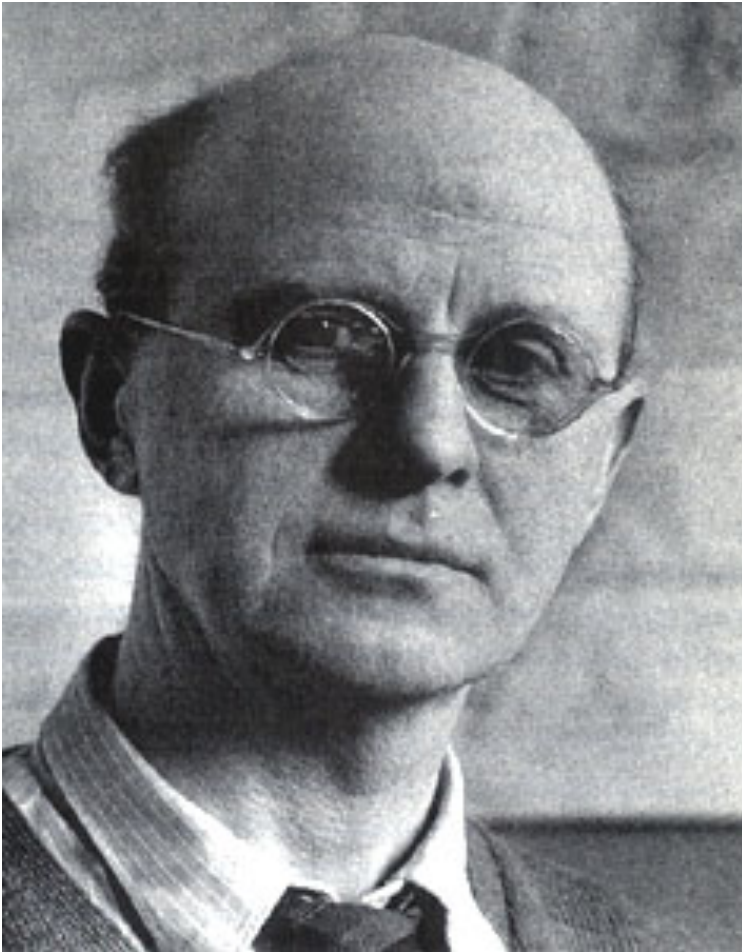
2. Biology

Edgar Transeau



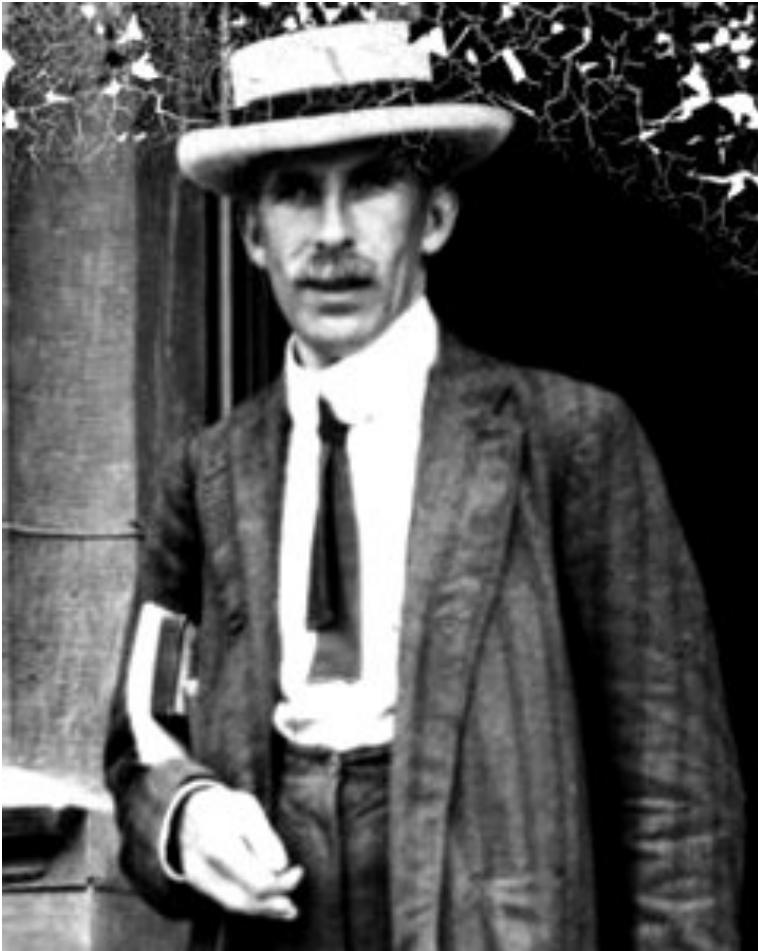
Calculated
the
energy
capture of
an Illinois
cornfield,
1926

Charles Elton



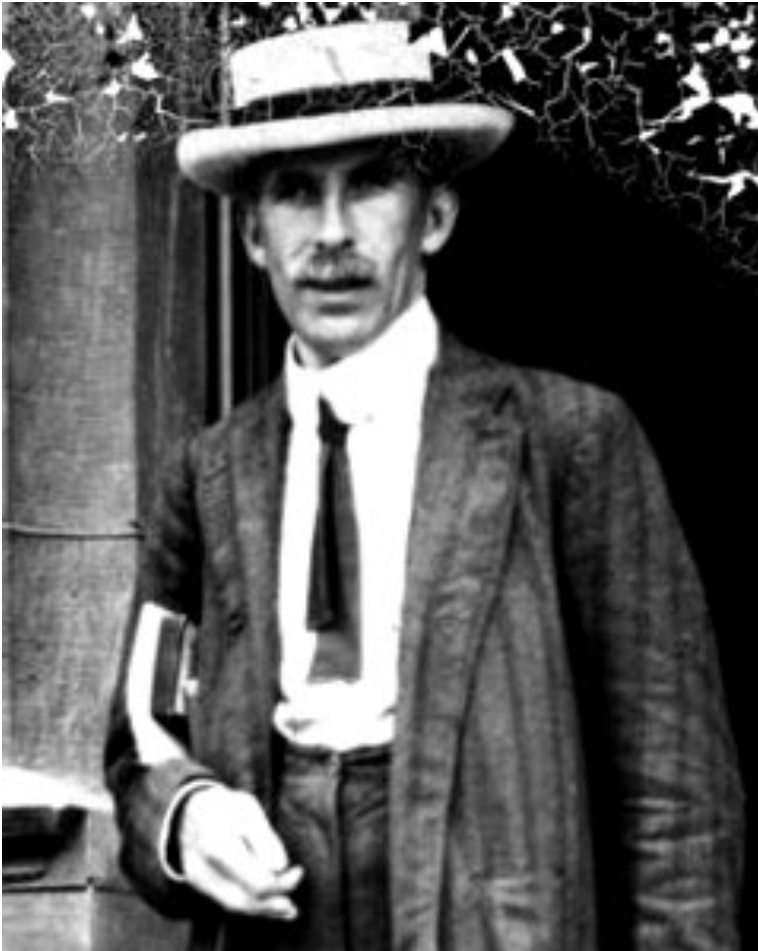
Gave us
the
concepts
of food
chains and
food webs,
1927

Arthur George Tansley



1935: coined the term
“ecosystem,” studied
them as matter-and-
energy complexes
subject to physio-
chemical law, including
the laws of energy

Arthur George Tansley



“Though the [individual] organisms may claim our prime interest, when we are trying to think fundamentally, we cannot separate them from their special environments, with which they form one physical system....”

**Tertiary
Consumers**
1 kcal



**Secondary
Consumers**
10 kcal



**Primary
Consumer**
100 kcal



Producers
1,000 kcal



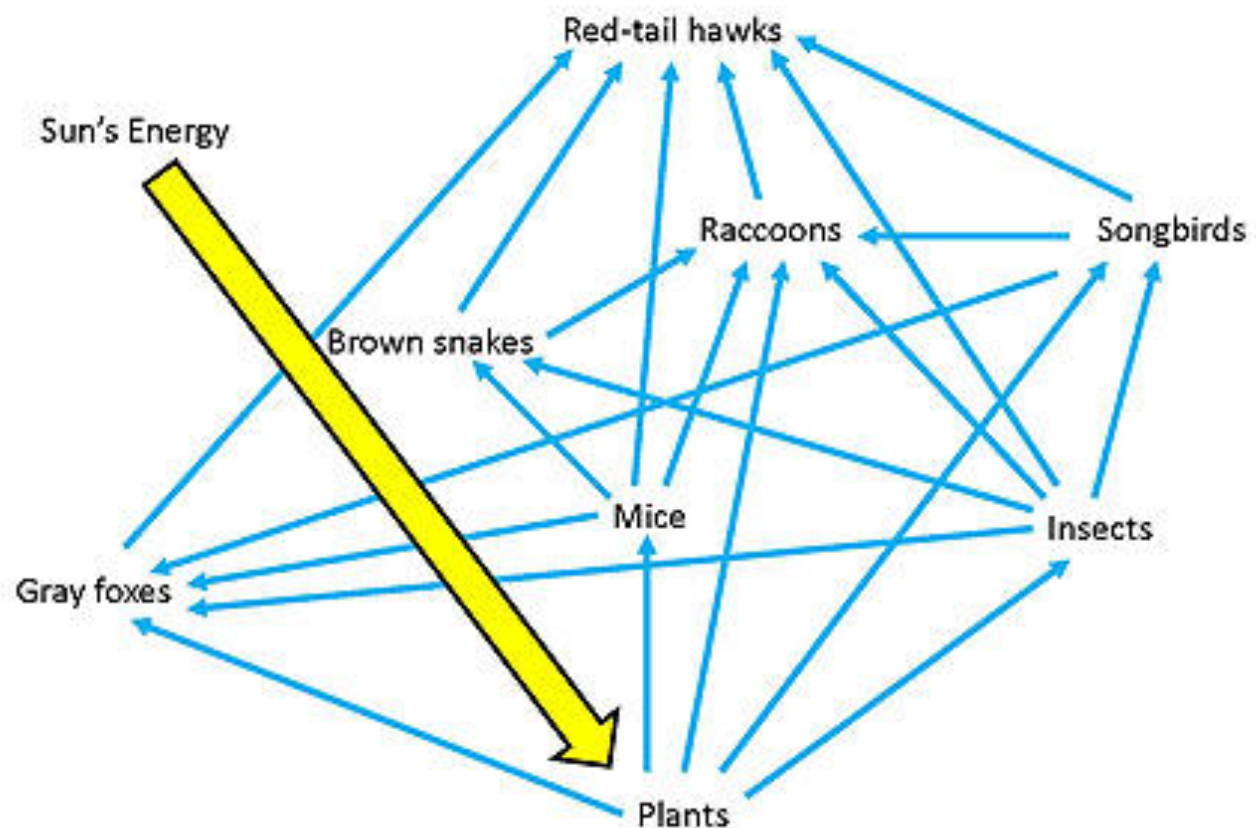
**Tertiary
Consumer**
1 kcal

**Second
Consumer**
10 kcal

**Primary
Consumer**
100 kcal

Producers
1,000 kcal

Food Web Sample

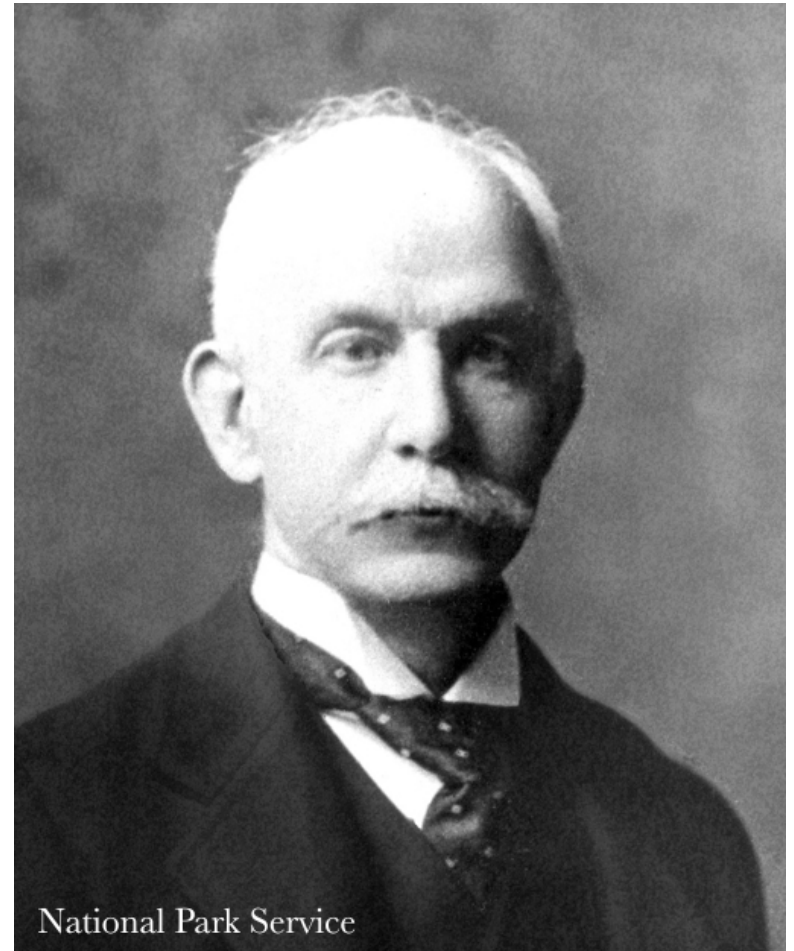


The reconstructive impulse of thermodynamics

3. History

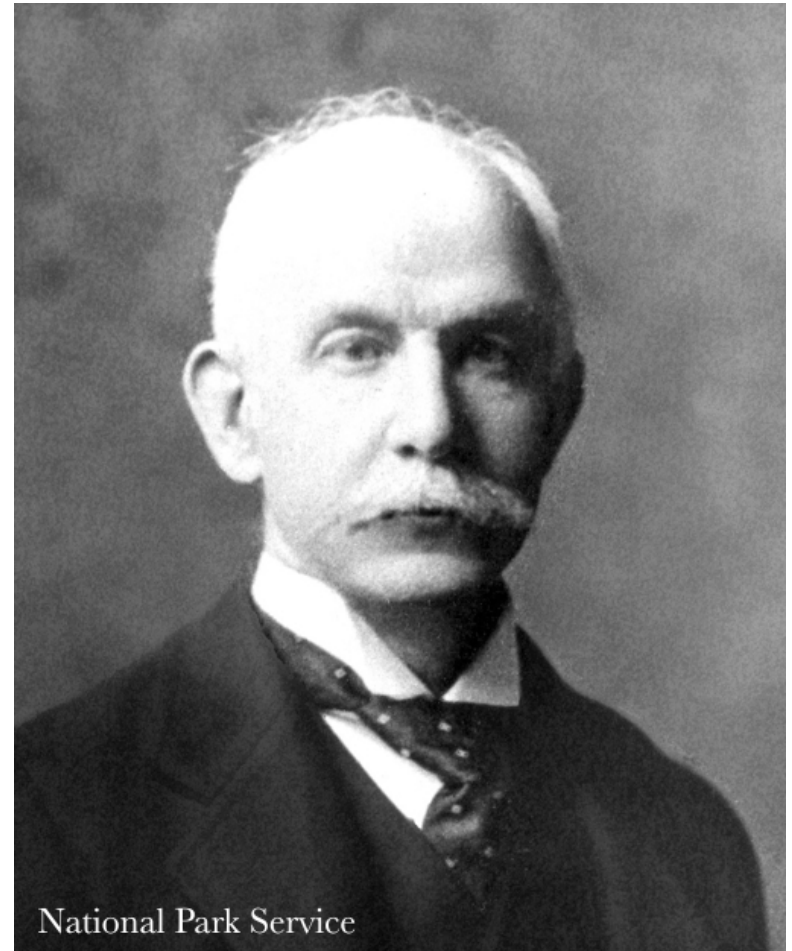
Brooks Adams

*The Law of
Civilization and
Decay, 1893*



Brooks Adams

“Animal life is one of the outlets through which solar energy is dissipated....As human societies are forms of animal life, they must differ among themselves in energy, in proportion as nature has endowed them more or less abundantly with energetic material.”



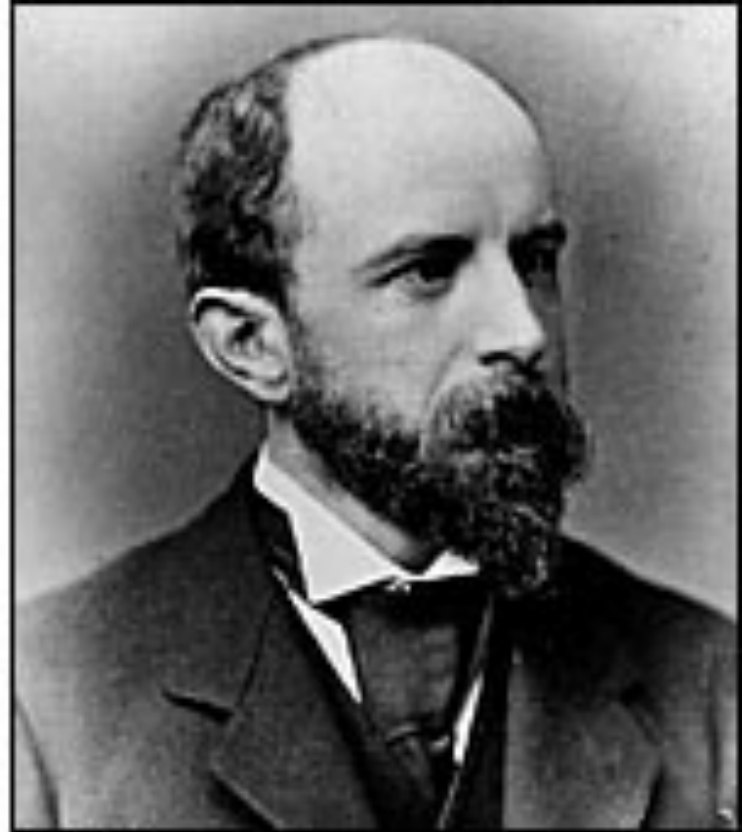
Henry Adams

“The Rule of Phase Applied to History,”

The Education of Henry Adams, 1918

- “The Virgin and The Dynamo,”
- “A Law of Acceleration”

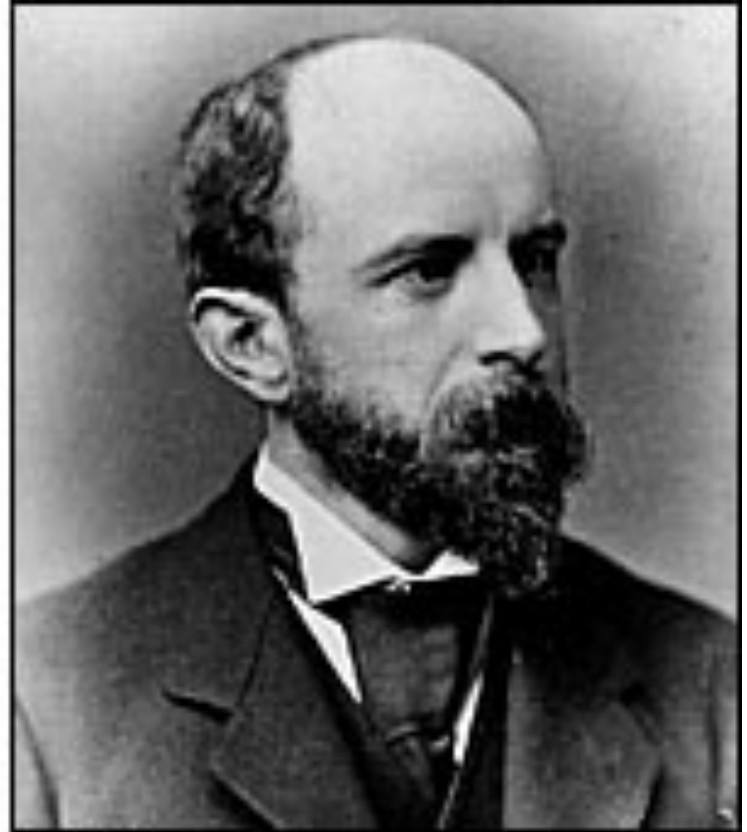
“Letter to Teachers of American History”



CORBIS

Henry Adams

“The new American,—the child of incalculable coal-power, chemical power, electric power, and radiating energy, as well as of new forces yet undetermined,—must be a sort of God compared with any former creation of nature. At the rate of progress since 1800, every American who lived into the year 2000 would know how to control unlimited power...[and] would deal with problems altogether beyond the range of earlier society.” -1918



CORBIS

The first book of its kind to cover the vast panorama of human history from a strictly ecological point of view

EDWARD HYAMS

Soil & Civilization

HARPER & BROTHERS, NEW YORK, N.Y. 10017

1952

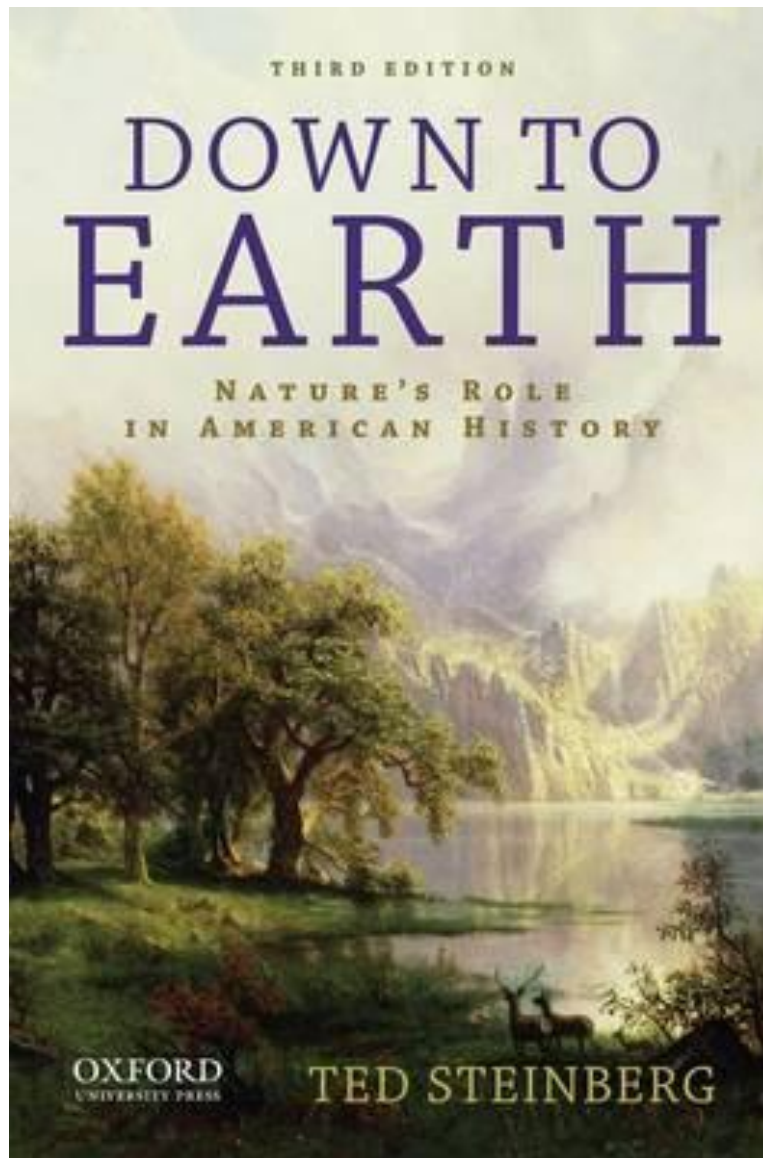
The Pentagon of Power

The Myth of the Machine
Volume Two

**LEWIS
MUMFORD**

A Harvest/HBJ Book

1970



2002

THIRD EDITION

DOWN TO EARTH

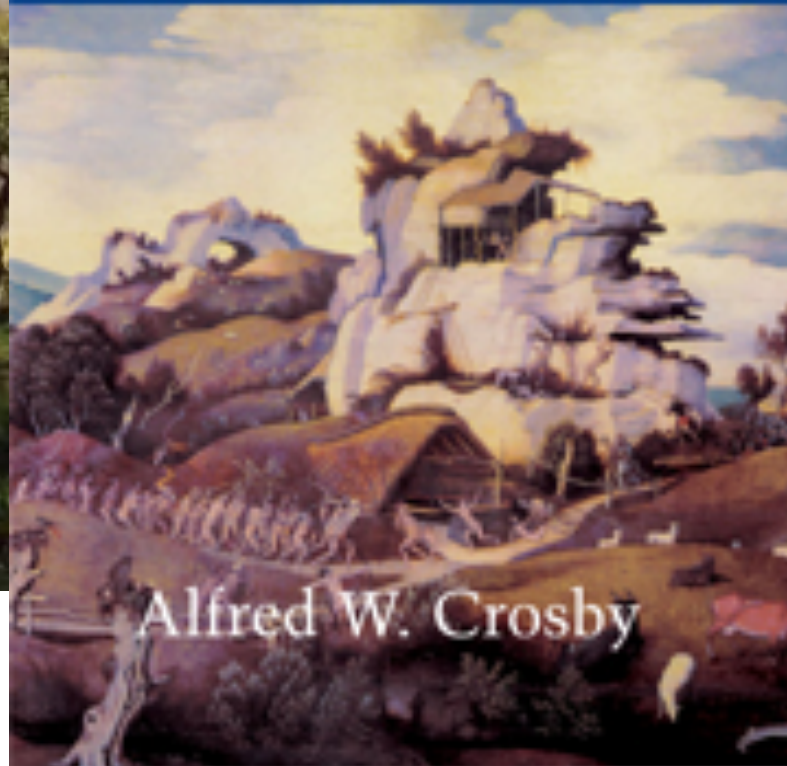
NAT
IN AMER

OXFORD
UNIVERSITY PRESS

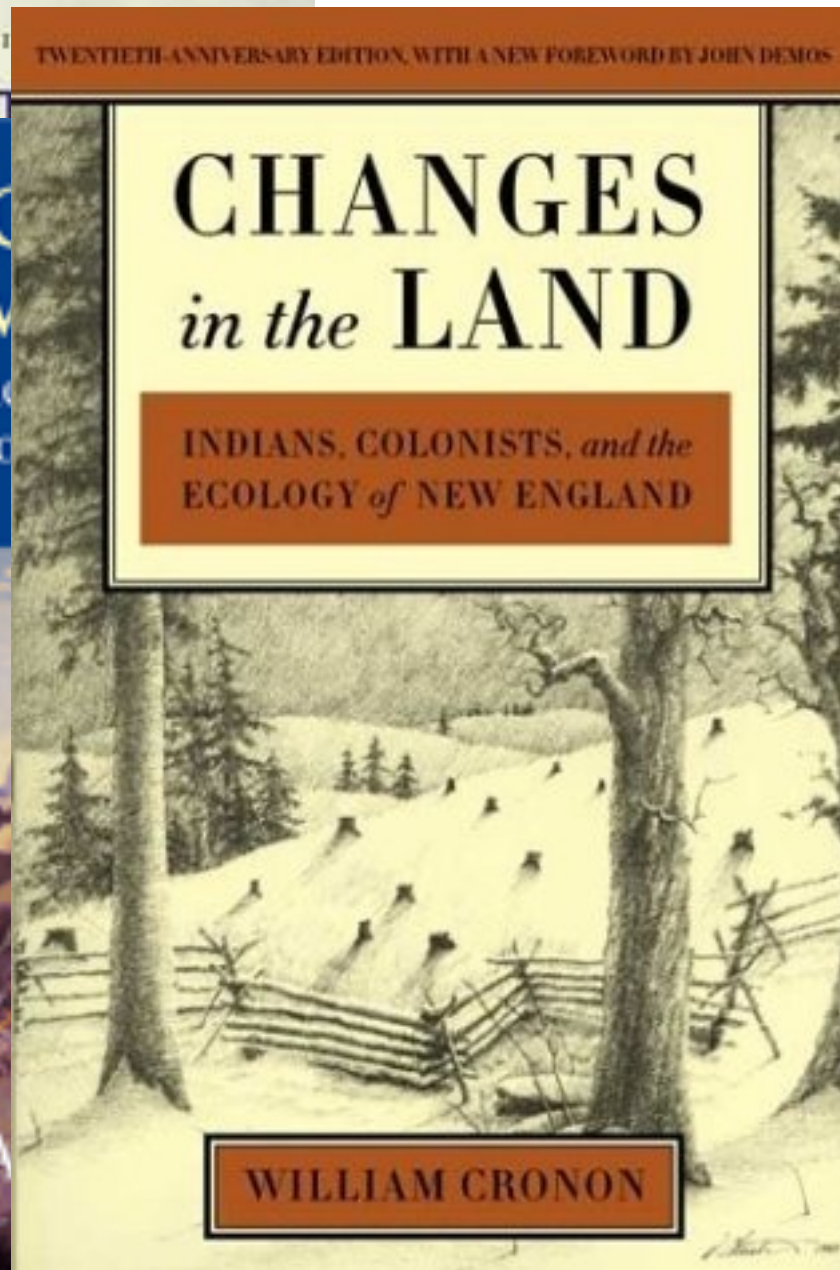
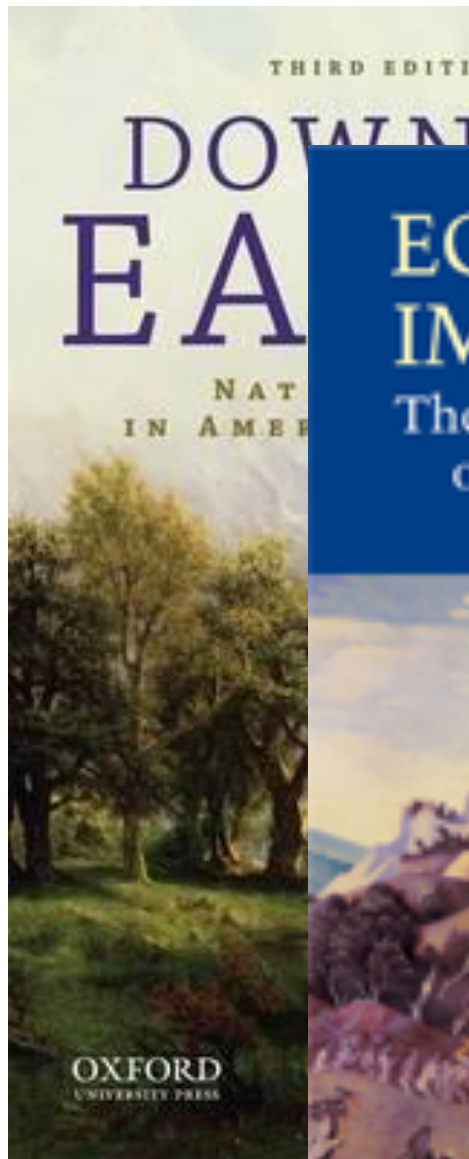
ECOLOGICAL IMPERIALISM

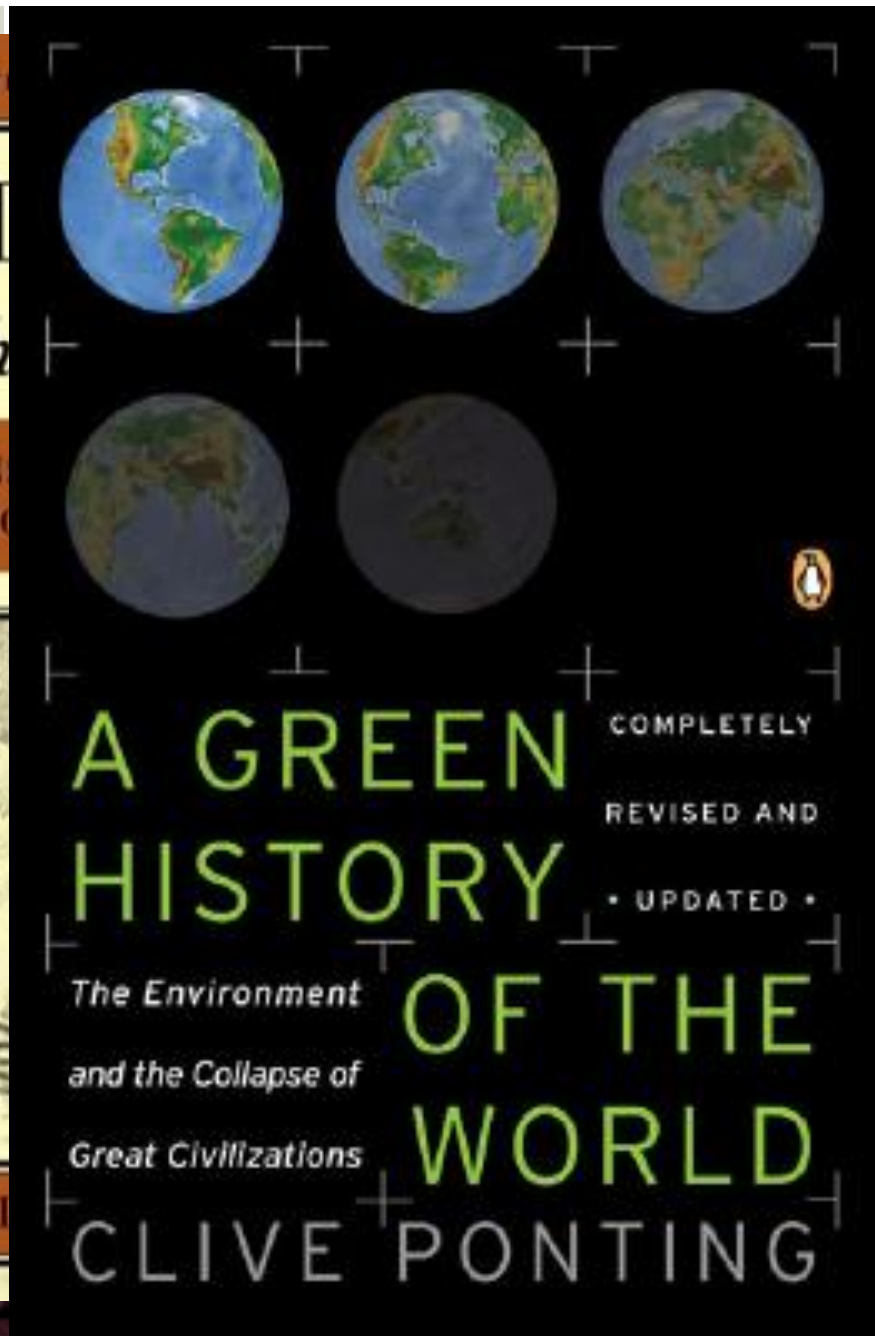
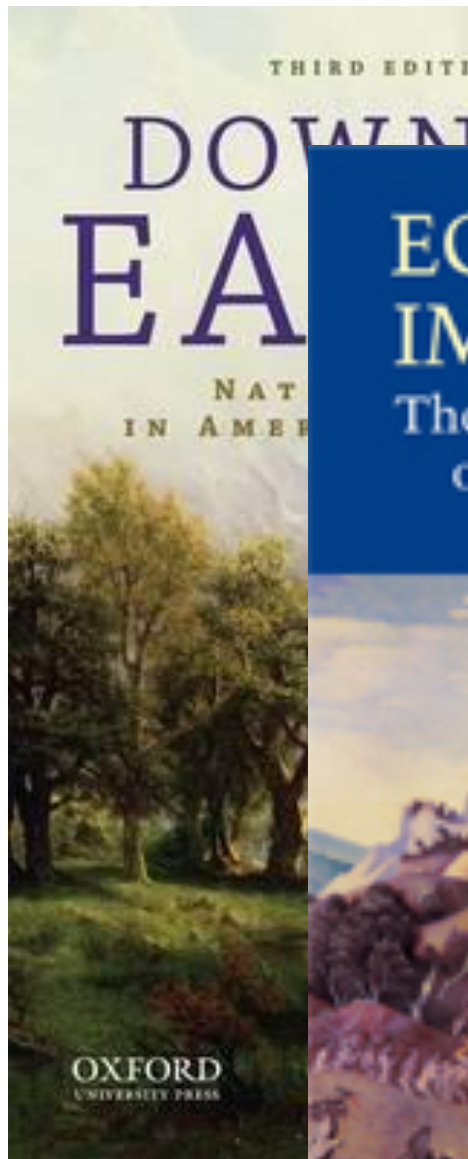
The Biological Expansion
of Europe, 900–1900

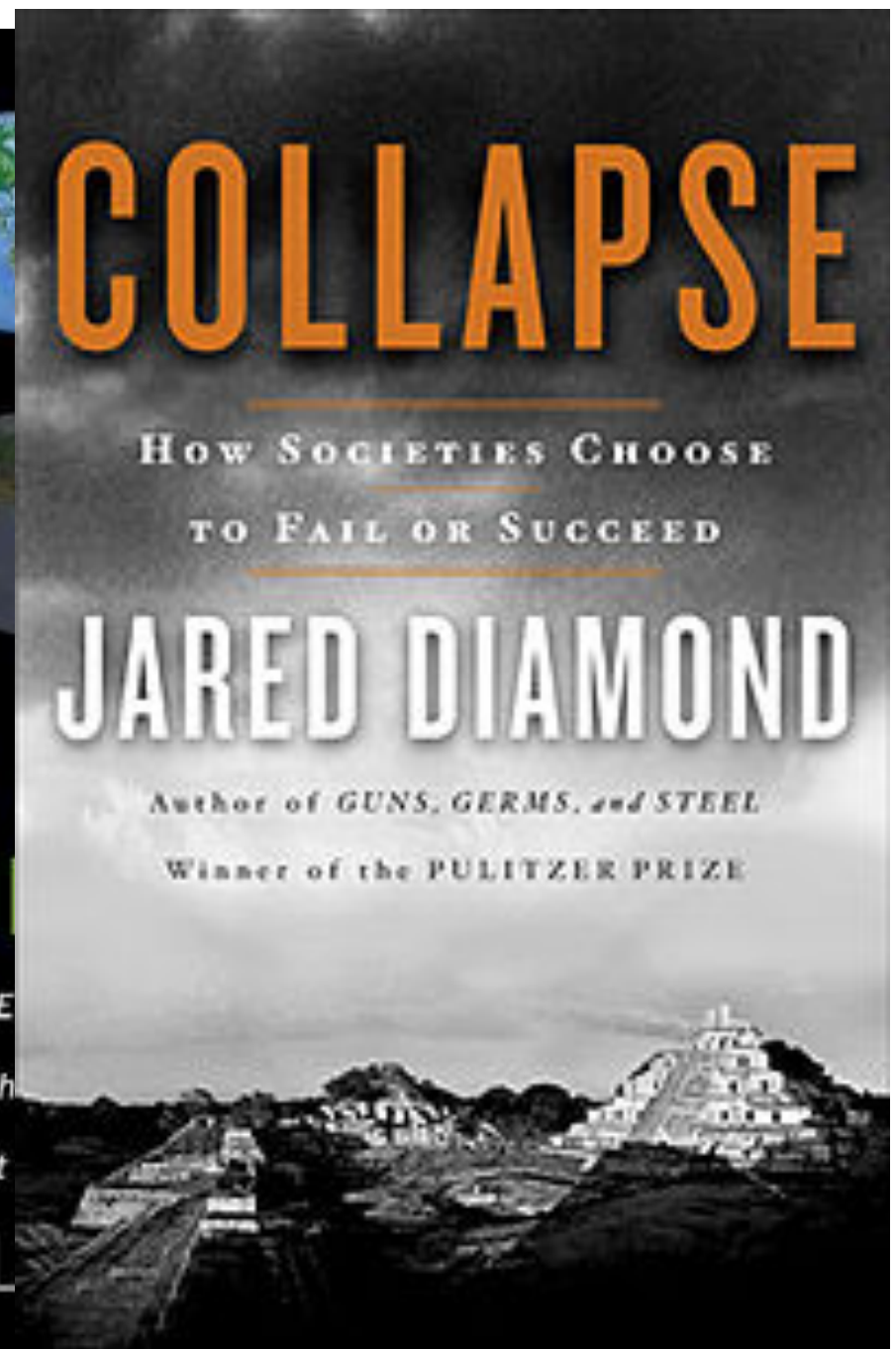
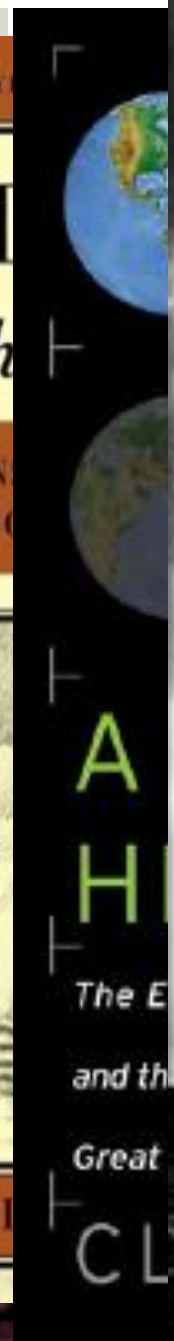
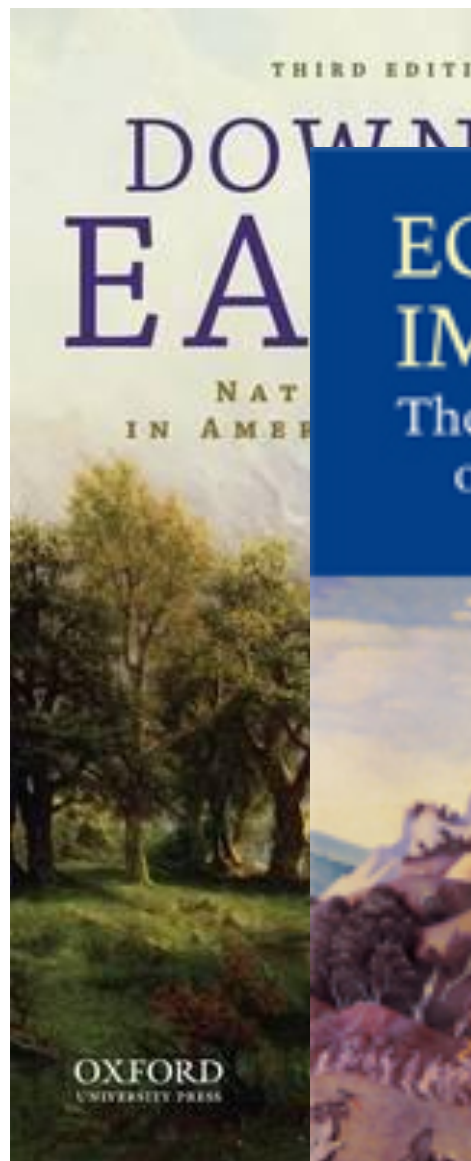
NEW EDITION

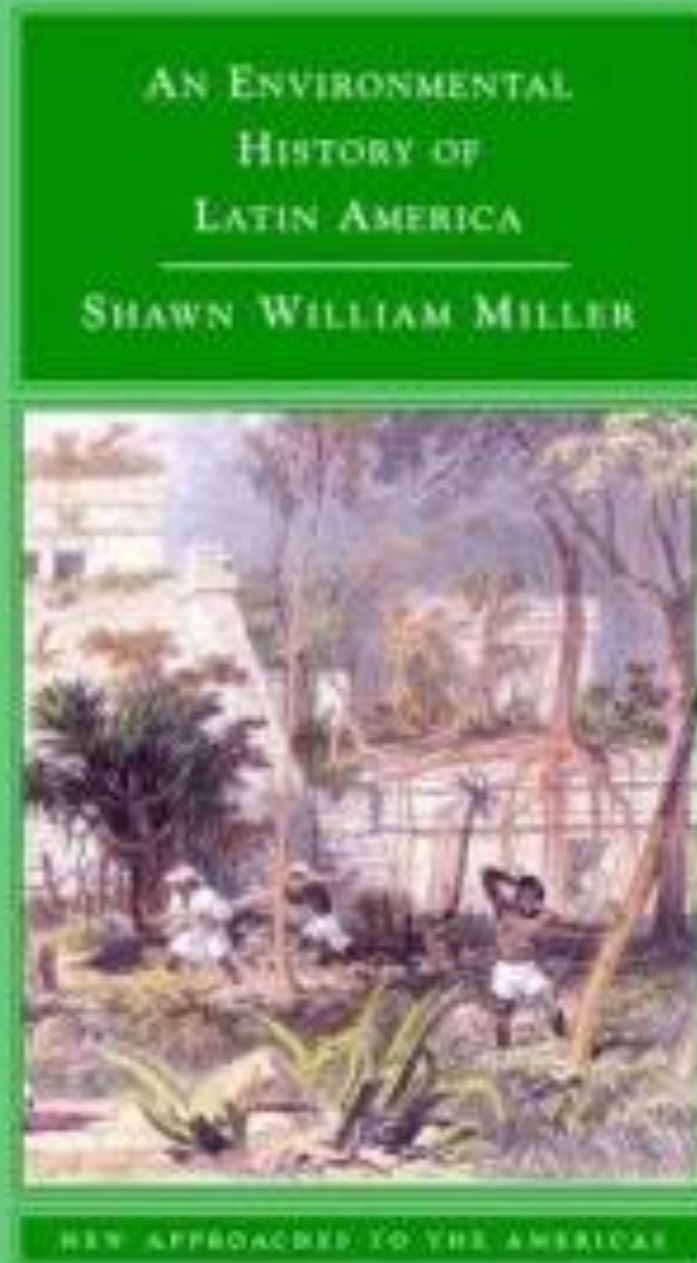


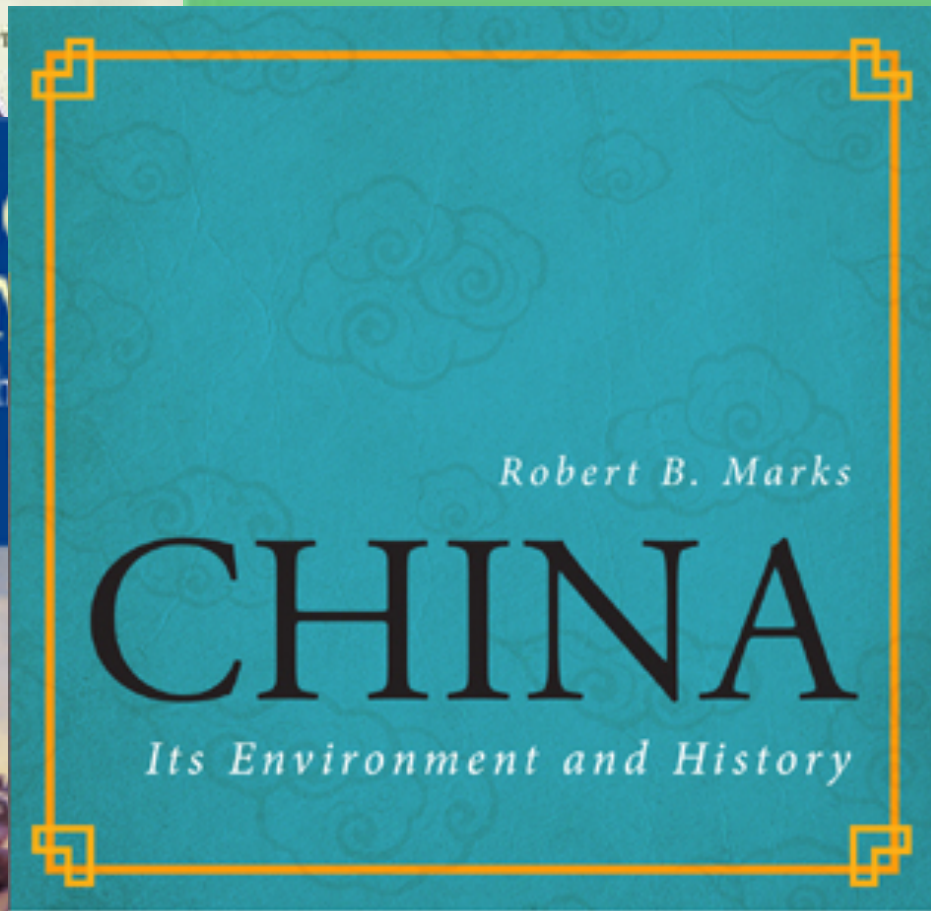
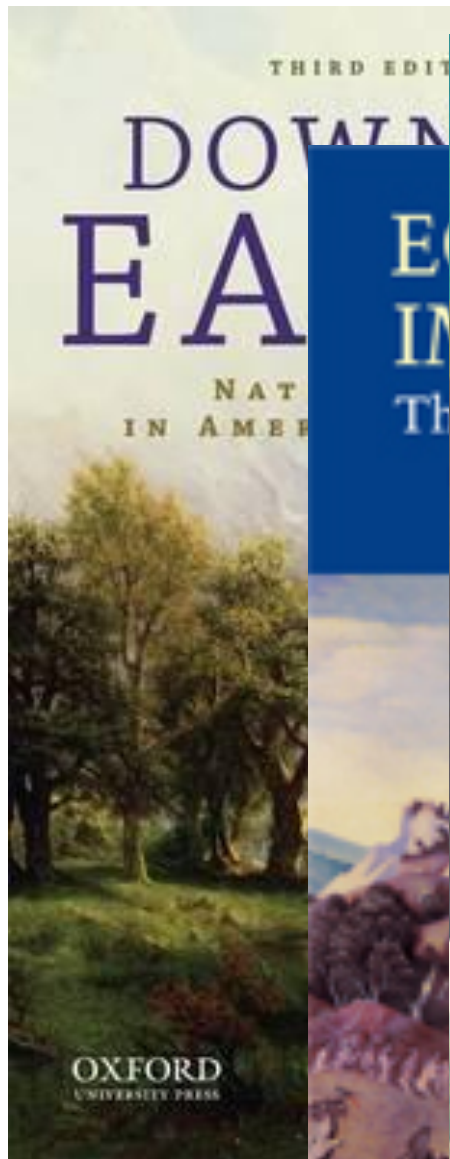
Alfred W. Crosby











Environmental History of Water



Edited by Petri S. Juntti,
Tapio S. Katko and
Heikki S. Vuorinen

IWA
Publishing

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A
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SE

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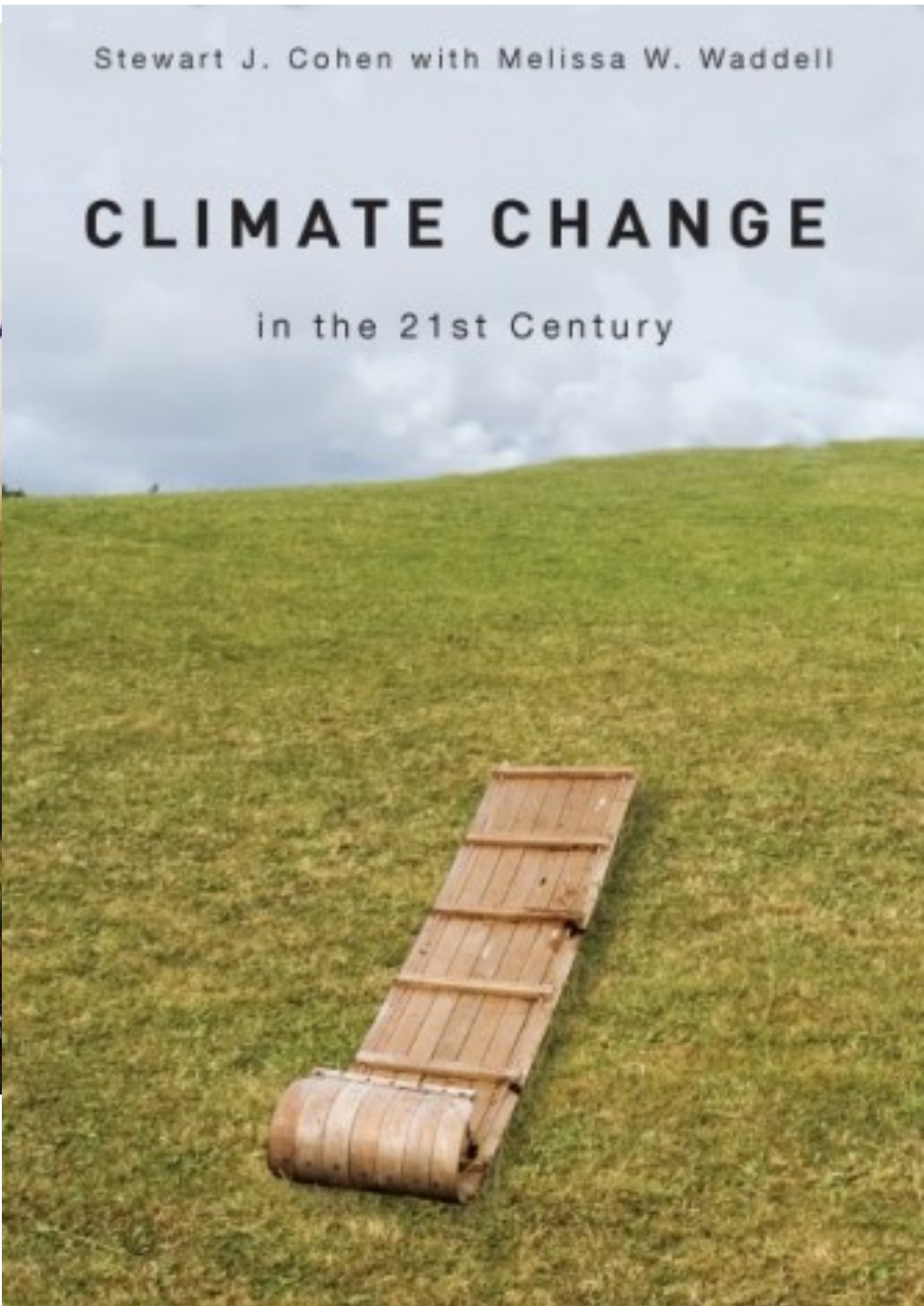
ED

OND

STEEL

PRIZE





CHILDREN OF THE SUN

A HISTORY OF HUMANITY'S
UNAPPEASABLE APPETITE FOR ENERGY



ALFRED W. CROSBY



**CATASTROPHE,
CREATIVITY,
AND THE RENEWAL OF
CIVILIZATION**

THE UPSIDE OF DOWN

THOMAS HOMER-DIXON



**CATASTROPHE,
CREATIVITY,
AND THE RENEWAL OF
CIVILIZATION**

THE UPSIDE OF DOWN

THOMAS HOMER-DIXON

Includes an
EROI analysis
of the fall of
the Roman
Empire

The book cover features a grayscale photograph of a large, domed classical building, likely a government capitol, with a dark, smoky or cloudy sky above it. The title 'THE UPSIDE OF DOWN' is prominently displayed in the center, with 'THE UPSIDE' in black and 'OF DOWN' in white. Above the title, the subtitle 'CATASTROPHE, CREATIVITY, AND THE RENEWAL OF CIVILIZATION' is written in red. At the bottom, the author's name 'THOMAS HOMER-DIXON' is enclosed in a red rectangular box.

**CATASTROPHE,
CREATIVITY,
AND THE RENEWAL OF
CIVILIZATION**

THE UPSIDE OF DOWN

THOMAS HOMER-DIXON

Demonstrates a
fundamental
cultural/
ecological truth:
energy
throughput
organizes
complex systems.

The book cover features a grayscale photograph of a large, domed building, likely a government capitol, with smoke or clouds rising from the base, suggesting a scene of destruction or crisis. The title 'THE UPSIDE OF DOWN' is prominently displayed in the center, with 'THE UPSIDE' in black and 'OF DOWN' in white. Above the title, the subtitle 'CATASTROPHE, CREATIVITY, AND THE RENEWAL OF CIVILIZATION' is written in red. At the bottom, the author's name 'THOMAS HOMER-DIXON' is enclosed in a red rectangular box.

**CATASTROPHE,
CREATIVITY,
AND THE RENEWAL OF
CIVILIZATION**

THE UPSIDE OF DOWN

THOMAS HOMER-DIXON

Demonstrates a
fundamental
cultural/
ecological truth:
energy
throughput
organizes
complex systems.
Diminish energy
and the system
simplifies.

The reconstructive impulse of thermodynamics

4. Economics?

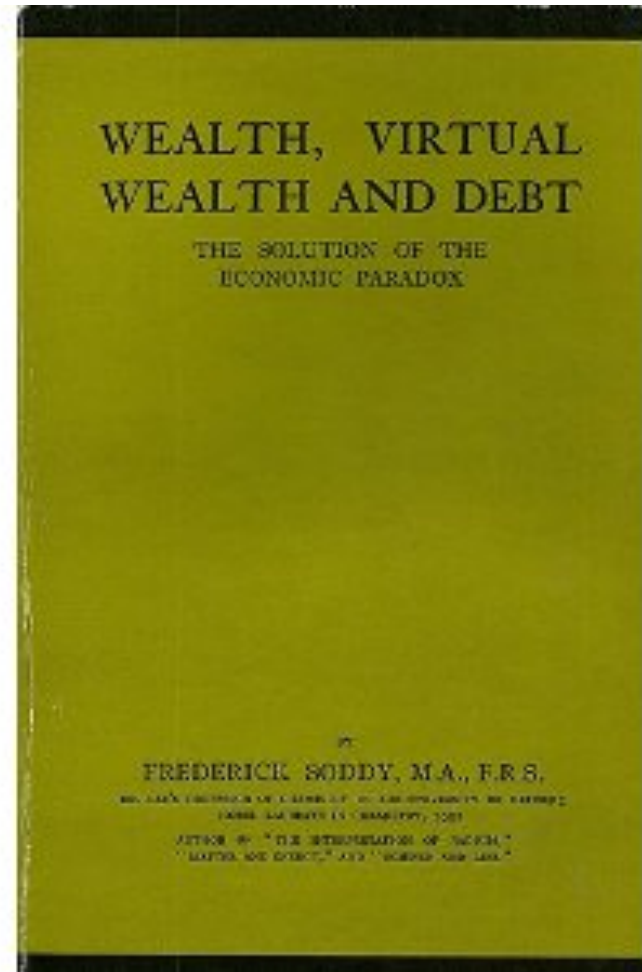
First try: 1930s



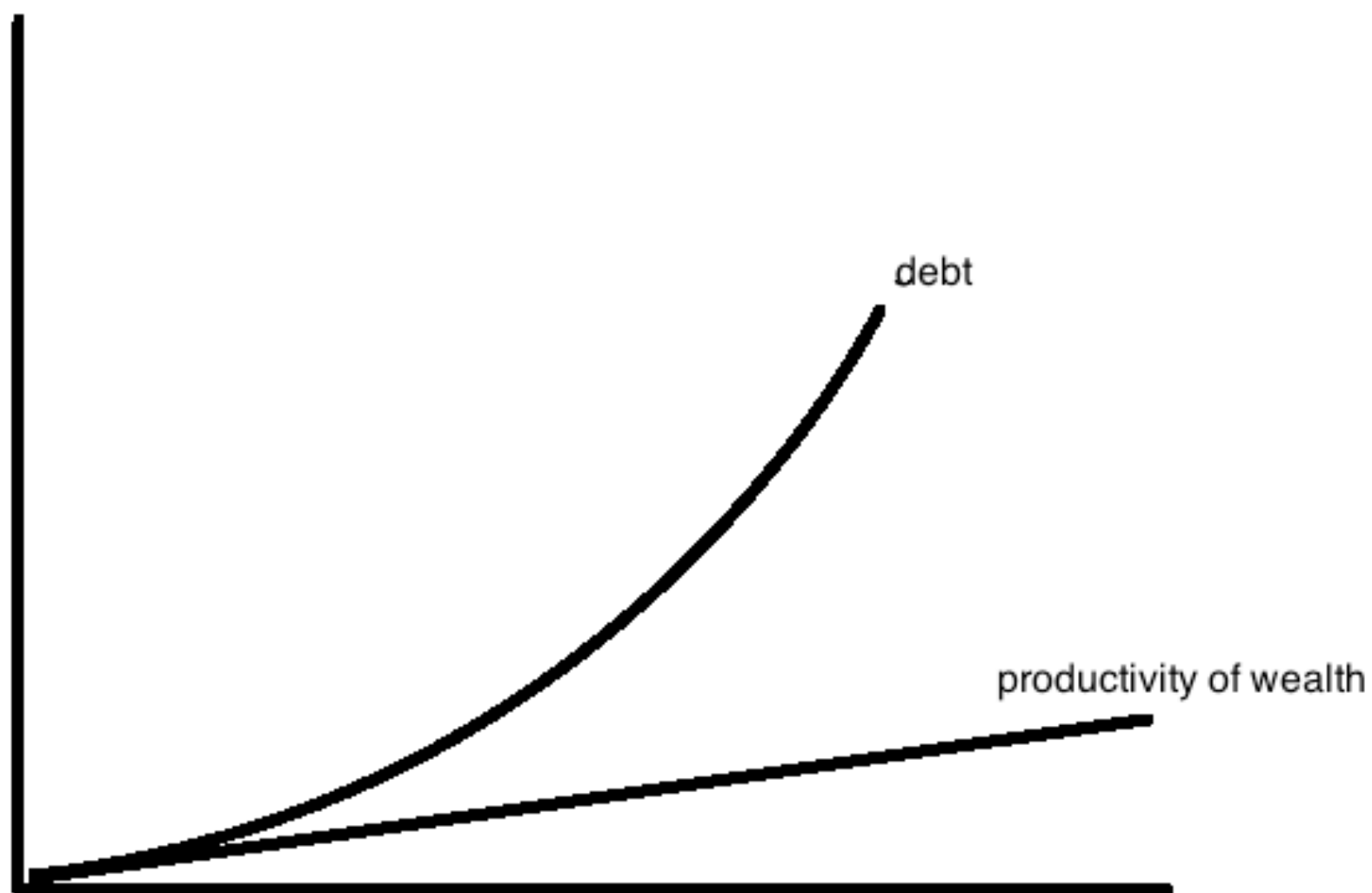
Frederick Soddy



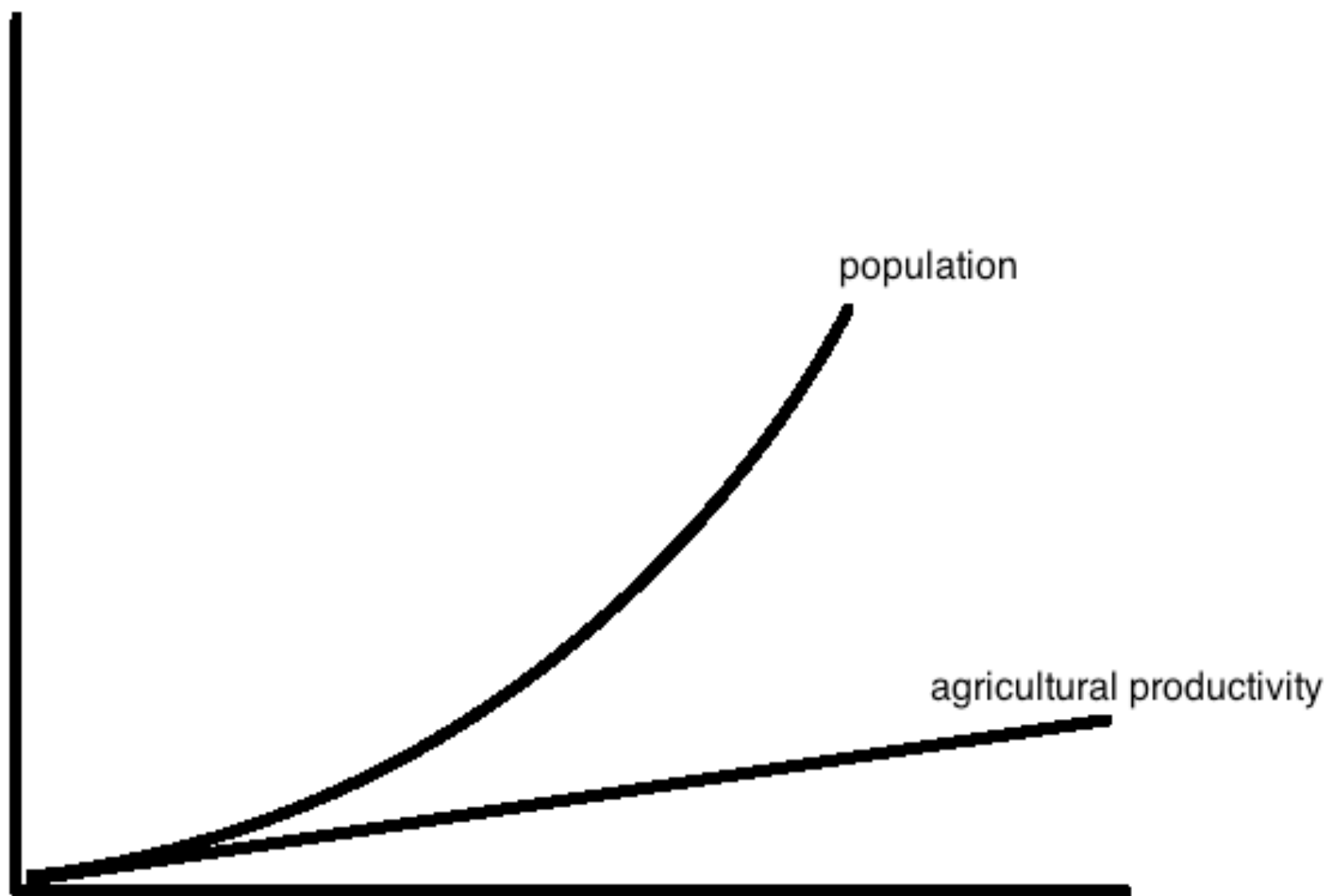
Frederick Soddy



- Wealth: real stuff, wrested from nature; matter shaped with energy, subject to entropy.
- Virtual wealth: money, a quantity of wealth foregone in order to have the convenience of a medium of exchange
- Debt: a claim on the future production of real wealth.



Soddy's basic theory



Malthus' basic theory

Soddy's monetary Malthusianism

Food

Wealth

Population

Debt

War, famine, disease

inflation, bankruptcy,
default, stock market
crash, foreclosures, etc.

Petrochemical
subsidy to ag

FDIC & other regs

Second Try: 1970s



Nicholas Georgescu-
Roegen

*The Entropy Law and
the Economic Process,*
1971

Second Try: 1970s

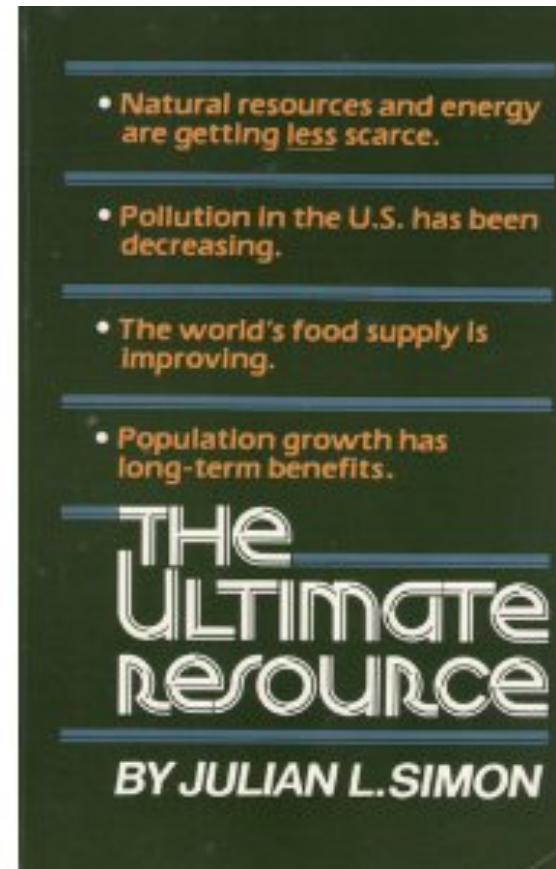


“Entropy is the taproot of economic scarcity.”

A choice irony



Julian Simon



1981

Julian Simon Says:

“Energy is the master resource”

He also said:

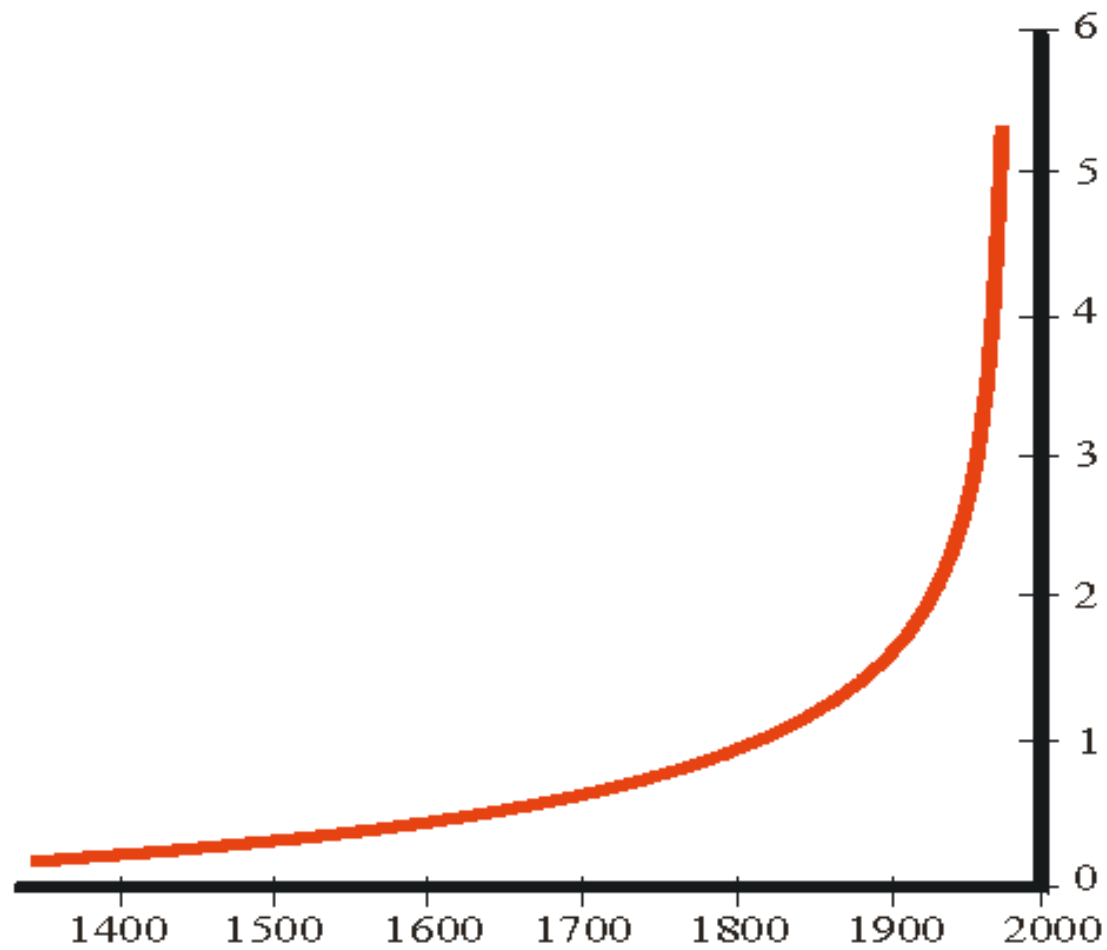
“Energy is infinite.”

“There are energy sources on other planets.”

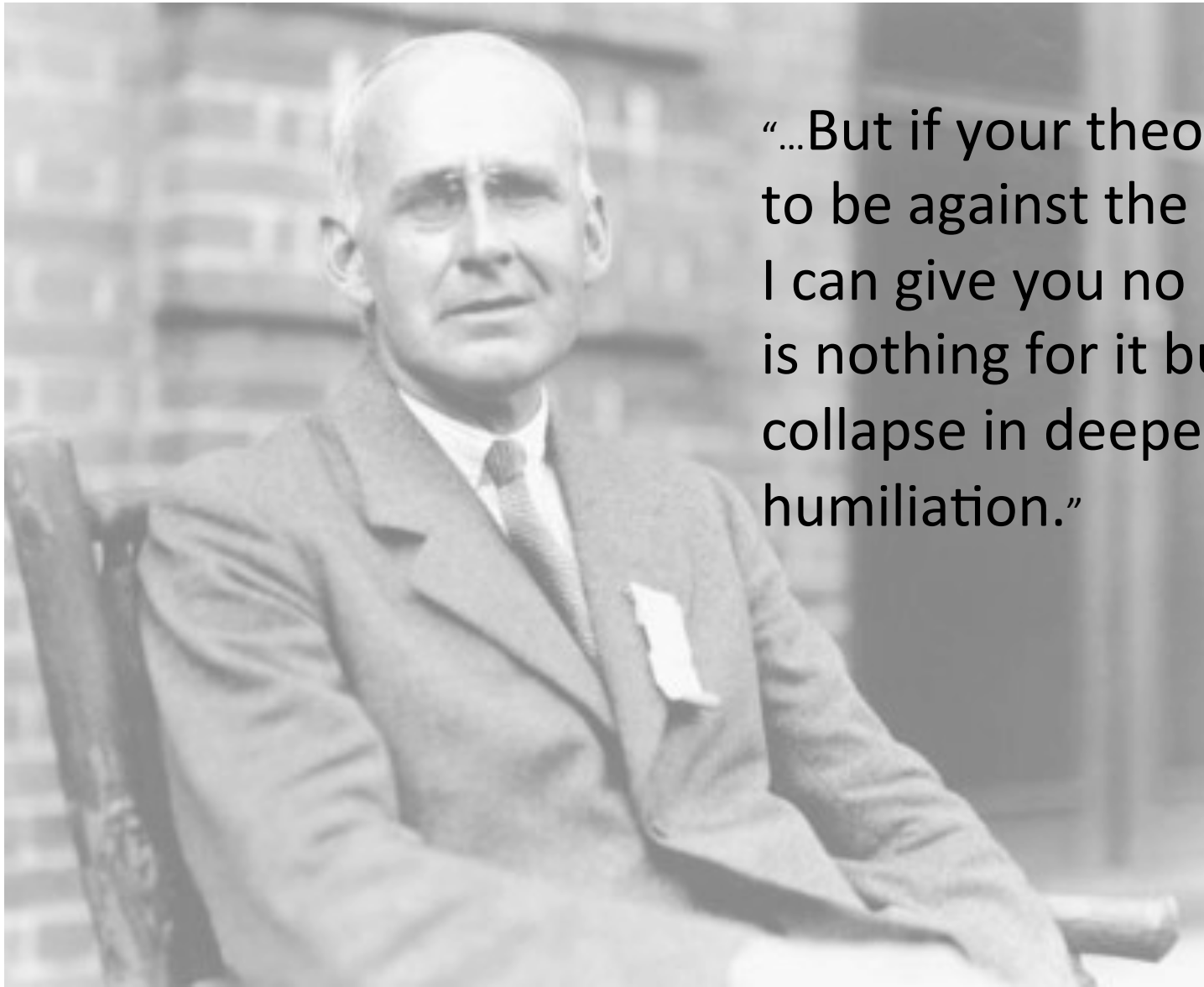
“We’ll never run out of oil.”

“The number of wells that will eventually produce oil...is not known...and hence is not meaningfully finite.”

And so.....







“...But if your theory is found to be against the second law, I can give you no hope; there is nothing for it but to collapse in deepest humiliation.”