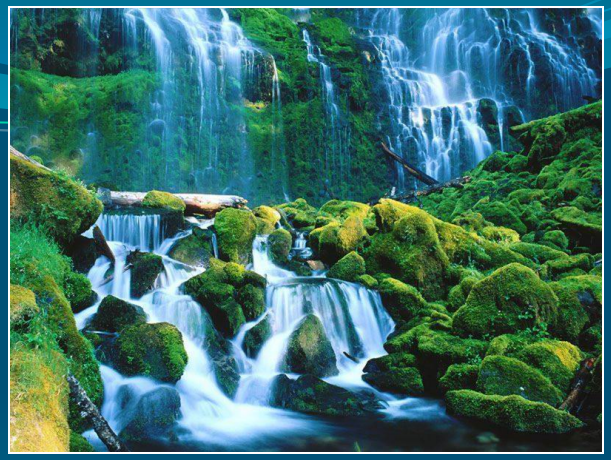
# Autonomous Nature:

## Resistance Versus Control

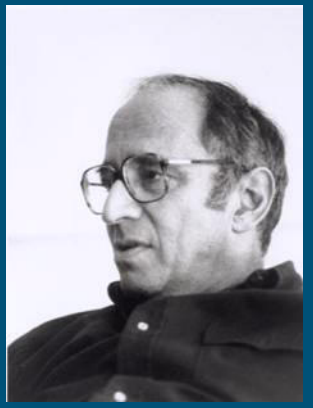
Carolyn Merchant

# Autonomous Nature

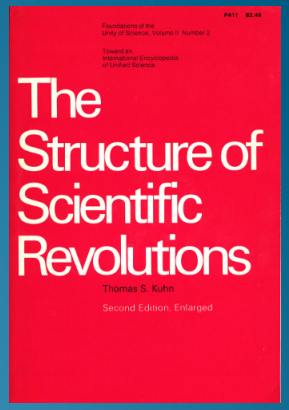


- What is nature?
- Raymond Williams. Nature is the most complex term in the English language. (*Keywords*, 1976)
- Nature as rational, lawful, logical, orderly.
- Nature as resistant, rebellious, rambunctious, recalcitrant.
- Hurricanes, tornados, earthquakes, weather, disease.
- Climate change as exemplar of autonomous nature in the 21st century. How can humans live with nature?
- Need a new ethic of partnership with nature.

# Thomas Kuhn (1922-1996)



- *The Structure of Scientific Revolutions* (1962).
- Paradigm shift.
- Major transformations in the history of science triggered by anomalies that do not fit into accepted theories.
- Need for a new paradigm for the 21st century.
- Chaos and Complexity.
- Unpredictability; limited predictability.
- Toward a Partnership with Nature.

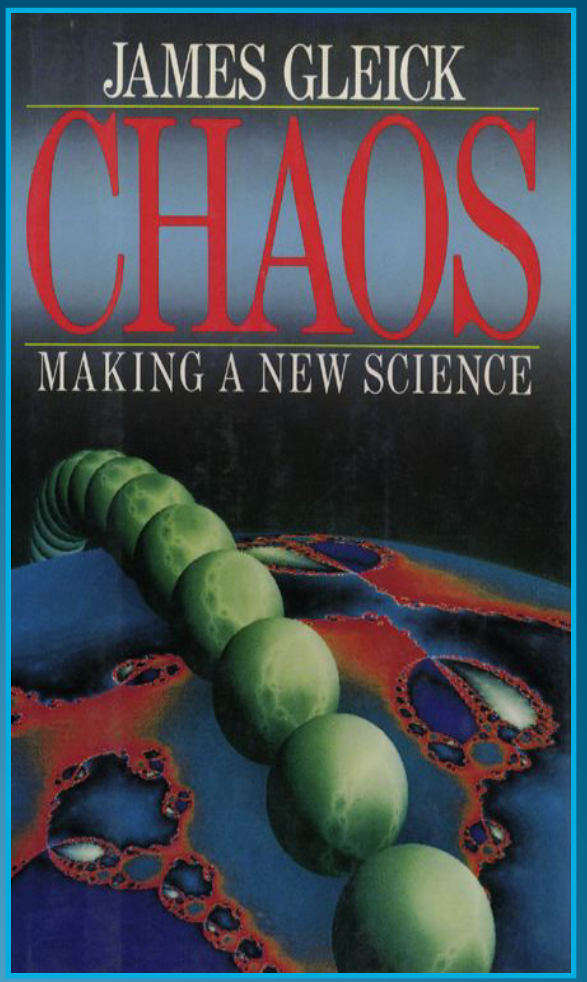


# Predictability and Control of Nature through Science and Technology

- Mechanistic science: 17th c. Mathematics and experimentation.
- Mechanics, hydrodynamics, thermodynamics, electromagnetism.
- Predictability leads to control and management.
- Dams, turbines, steam engines, trains, factories, telegraph, telephone, bridges, tunnels, airplanes.

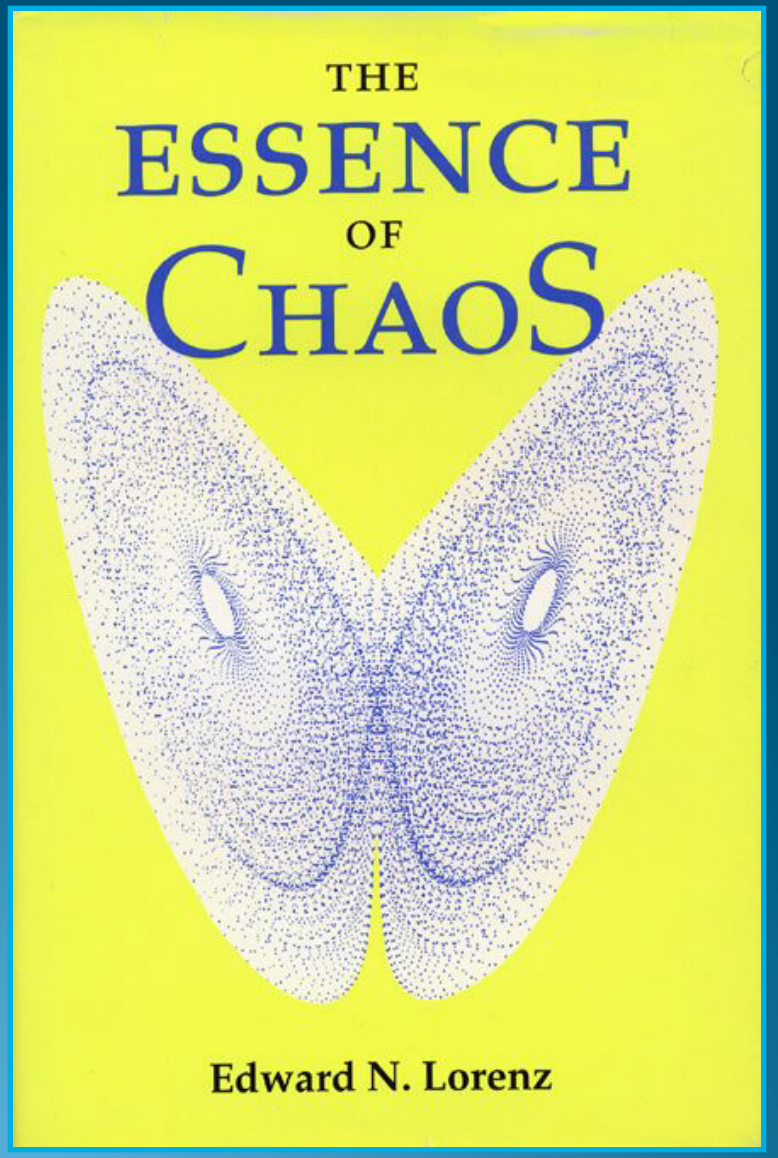
# Unpredictability of Nature and Resistance to Control

- Challenges to mechanistic science.
- Relativity and quantum mechanics. Early 20th c. Uncertainty principle.
- Chaos and complexity theories. Late 20th c. Limited predictability.
- James Gleick, *Chaos: Making a New Science* (1987). Nonlinearity.
- Edward Lorenz. "Predictability: Does the Flap of a Butterfly's Wings in Brazil set off a Tornado in Texas?" (1972)



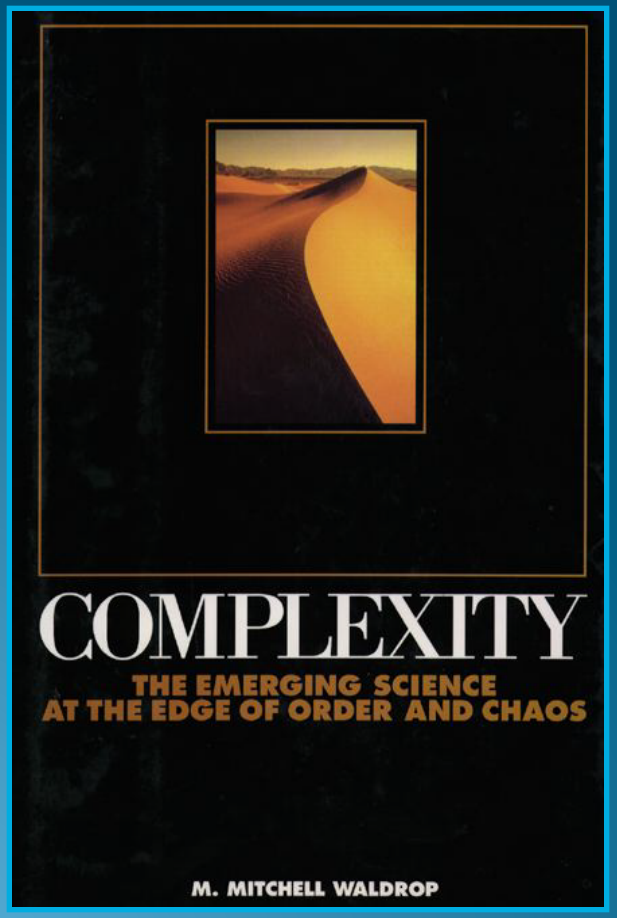
# Chaos Theory: Edward Lorenz

- Sensitive dependence on initial conditions.
- Weather patterns are chaotic, hence limited predictability.
- Irregularity is a fundamental property of the atmosphere.
- Most environmental and biological systems are nonlinear and chaotic.



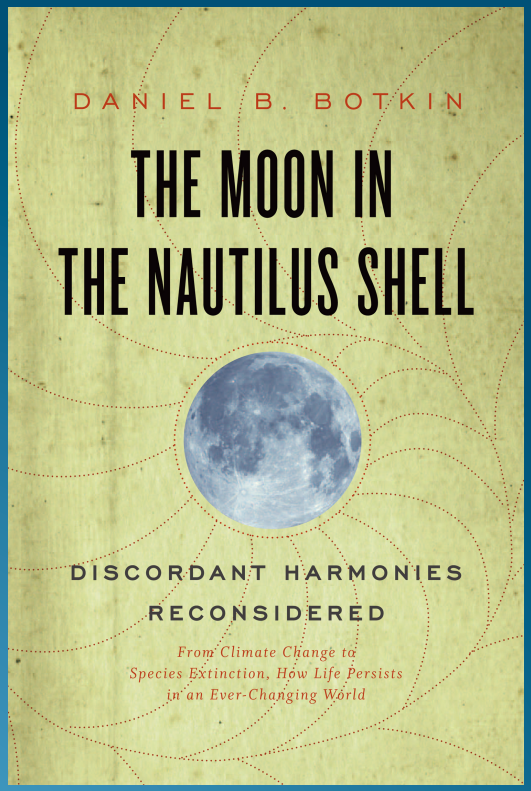
# Complexity Theory: M. Mitchell Waldrop

- *Complexity: The Emerging Science at the Edge of Order and Chaos* (1992).
- Santa Fe Institute.
- Edge of chaos: Transitions between order and disorder; stability and turbulence.
- Unpredictable behaviors.
- Galaxies, life, ecosystems, economies, societies.



# Need for a New Paradigm

- Daniel Botkin, *The Moon in the Nautilus Shell* (2012).
- Several levels of probability, uncertainty, and predictability.
- "We cannot know perfectly, exactly, the future of any specific series of events."
- Climate change is the most challenging aspect.
- What we need is "*a fundamental change in our paradigm*."



# Need for a New Paradigm

- Jennifer Wells. *Complexity and Sustainability* (2013).
- "Complexity science has flourished into not just a major new field, but also *the basis of a new paradigm*."
- "Discoveries of complex dynamic systems, relevant across the widest range . . . of reality—physical, living, and social systems—may play a central role in rearticulating our goals of sustainability."

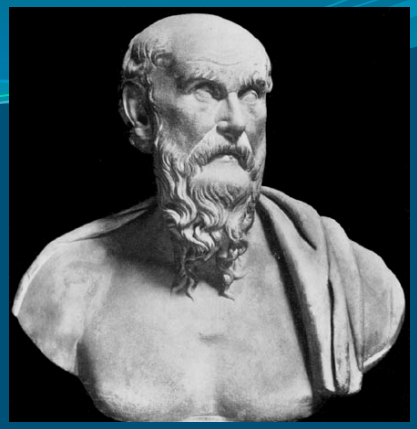
# Living within Unpredictability, Autonomy, and Resistance

- How to live within the new paradigm of chaos, complexity, and the unpredictability of nature.
- We need a new ethic for the the 21st century that acknowledges the resistance of nature to control.
- Partnership ethics for 21st c. Interaction with nature.
- But first, what is the background and history of nature as resistant and unpredictable?

# Nature as Active and Creative, Resistant and Recalcitrant

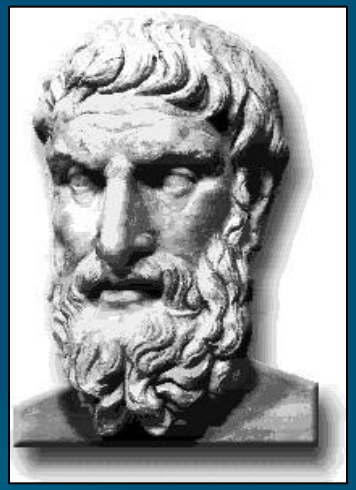
- Nature as active creative force vs. Nature as created world. Creating vs. created. Ancient terms. . . .
- *Natura naturans* (*Natura creans*) versus *Natura naturata* (*Natura creata*).
- Creative nature as beneficent goddess, *Natura*.
- Creative nature as recalcitrant villain.
- Heraclitus: "Nature loves to hide." (c. 500 BCE)
- Nature harbors secrets from worthy humans. But science and technology can extract nature's secrets.

# Hesiod (fl. 750-650 B.C.E)



- Hesiod, *Theogony* (ca. 700 B.C.E.).
- Chaotic, unpredictable nature.
- Chaos as primordial deity—the formless void out of which the world emerged. The chasm or open gap that gave birth to the gods and the cosmos.
- Greek and Roman attempts to understand the origins of nature, its laws and activities. How to predict what Nature might do next.
- Nature is sometimes lawful; sometimes unruly and resistant; sometimes simply the everyday world resulting from nature's creativity.

# Lucretius (99-55 B.C.E.)

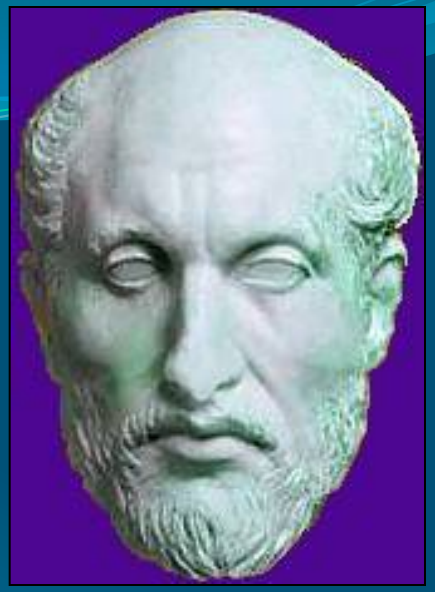


- *De Rerum Natura*. "On the Nature of Things."
- Nature as active, creative, and uncontrolled.
- *Natura creatrix*. Nature as creatress and perfectress: "At length everything is brought to its utmost limit of growth by Nature, the creatress and perfectress." Bk. II, 1116-1117.
- *Natura libera*. Nature as free and uncontrolled: "Nature is free and uncontrolled by proud masters and runs the universe herself without the aid of gods." Bk. II, 1090-1092.

# E.g. of Uncontrollable Nature: Mt. Vesuvius Eruption, 79 CE Pompeii, Italy

- Pliny the Elder perished; Pliny the Younger lived.
- Black clouds of ash, fumes, and pumice flew miles into the air for two days. Pliny the Younger wrote:
- "Broad sheets of fire and leaping flames blazed...."
- "They debated whether to stay indoors or take their chance in the open, for the buildings were now shaking with violent shocks, and seemed to be swaying to and fro as if they were torn from their foundations."
- "My uncle decided to go down to the shore and investigate the possibility of escape by sea, but he found the waves still wild and dangerous."

# Plotinus (205-270 C.E.)



- *Enneads* (ca. 270 C.E). Neoplatonism.
- Roots of Nature's rebellion and resistance.
- *Tolma*: willfulness, boldness, assertiveness.
- The One; the *Nous* (Mind); *Anima mundi* (World Soul).
- Emanation from the One.
- "The evil that has befallen them [the souls] is due to a *Rebellious Audacity*. . . . They begin to revel in free-will. . . . Smitten with longing for the Lower, rapt in love for it, they grew to depend upon it: so they broke away, as far as was in their power and came to slight the lofty sphere they had abandoned."

# St. Augustine (354-430 C.E.)

- God is eternally existing. An uncreated creator who creates ex nihilo.
- No emanation from the One.
- God's will and human will.
- God as *natura creans/naturans*. Active creator.
- "If then we see something above this nature, and see it truly, then it is God, namely, a nature that is not created, but creates (*natura scilicet non creata, sed creatrix*)."

# Johannes Scotus Erigena (c. 810- 877)

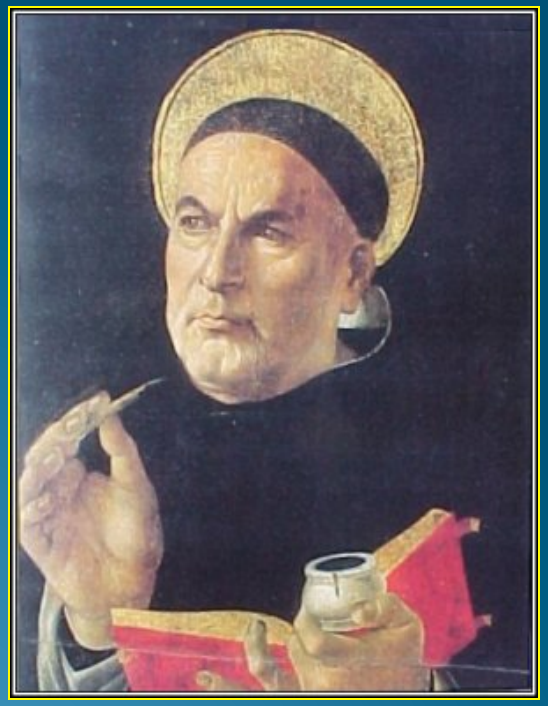
FIG. 55.

John Scotus Erigena

- *Periphyseon* (Greek, *Peri Phuseos*, Concerning Nature), 864-866 C.E.
- Trans. Gale, *The Division of Nature* (*De Divisione Naturae*), 1681.
- God/Nature. One thing, actively creating (*natura creans),* but not itself created (*non creata*).
- Nature created (*natura creata*), the created world, result of the creating process.
- God/Nature are a creating process.
- But condemned as pantheism.

# Thomas Aquinas (c. 1225-1274)

- *Summa Theologica* (written 1265-1274). God as active creator.
- *Natura naturans* (nature naturing).
- "All nature refers to an active power existing in some universal principle of nature . . . in the way in which some call God *natura naturans*."
- "Such a force intends the perfection and preservation of the entire universe."
- God as lawful, logical, predictable.
- Disorder is introduced by sin. By the human will. Matter is corruptible.

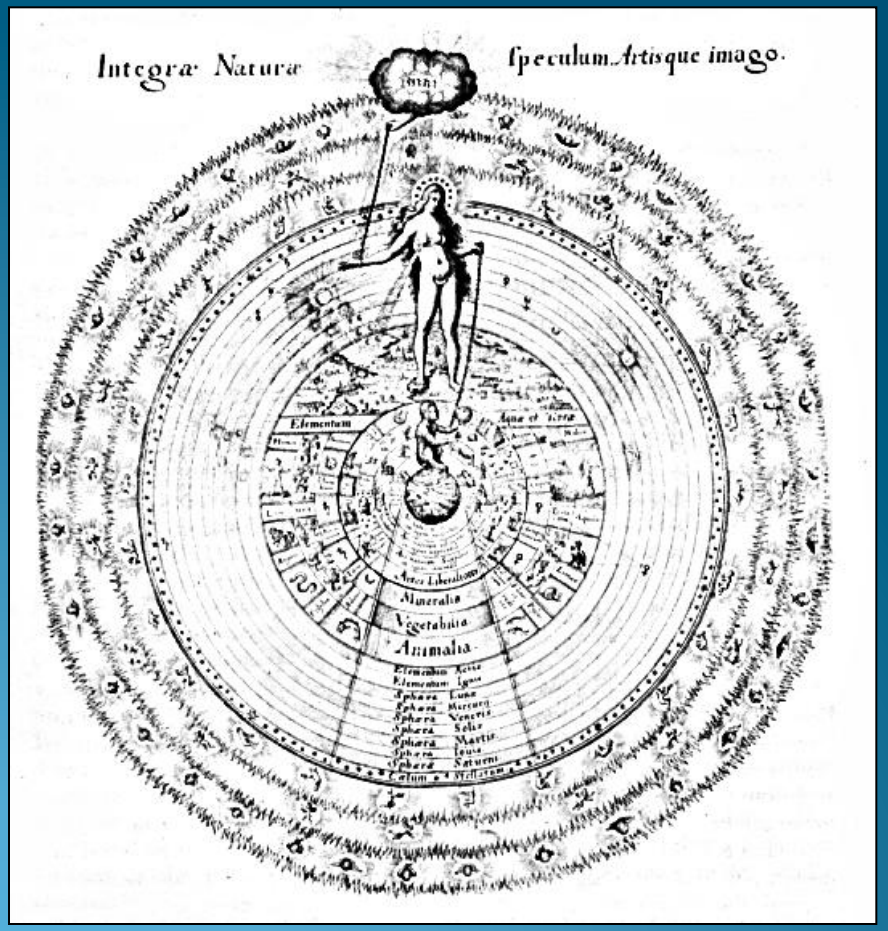


# Example of Uncontrollable Nature: The Bubonic Plague, 14th – 15th c.

- Boccaccio, *Decameron*, ca. 1351.
- "A most terrible plague; whether owing to the influence of the planets or sent from God as a just punishment for our sins."
- "No doctor's advice, no medicine could overcome or alleviate this disease. . . .Very few recovered."
- "To speak to or go near the sick brought infection and a common death to the living."

# Renaissance Cosmos: God Acting through Nature

- Nature as God's vice-regent in the created world.
- *Natura naturans* as tool of God, *but* can also have a will of "her" own.
- Nature can be willful, resistant, and uncontrollable.



# Renaissance Cosmos: Nature as a Witch

- Nature as willful, disorderly, unpredictable, resistant.
- Bringer of famine, drought, tornados, hurricanes, plagues.
- *Natura naturans:* Nature can be uncontrollable and rebellious.
- Nature harbors secrets to be extracted by science.
- Nature can be put to the question.
- Nature can be controlled by *techne*.

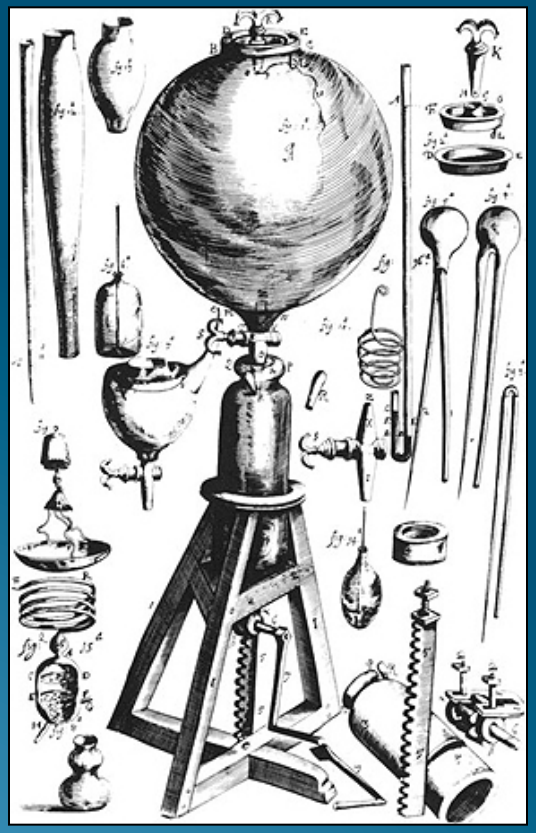
# Francis Bacon (1561-1626)

- Controlling Nature.
- Extracting “her” secrets.
- Technology helps us to think about "the secrets still locked in nature’s bosom."
- Miners and smiths: "the one searching into the bowels of nature, the other shaping nature as on an anvil.”
- The resistance of nature can be controlled and overcome by science and technology.

# Nature in Bonds: The contained, controlled experiment

- A question put to nature; nature put to the question.
- Controlled environment (moisture, temperature, pressure, spatial boundaries); closed systems.
- Experimenter who dictates the conditions for the procedure.
- Objects to be manipulated to answer the question.
- Observers/witnesses who can verify the answers.
- Recording and reduction of data.
- Repetition of the initial conditions in other places and times to yield the same answers.

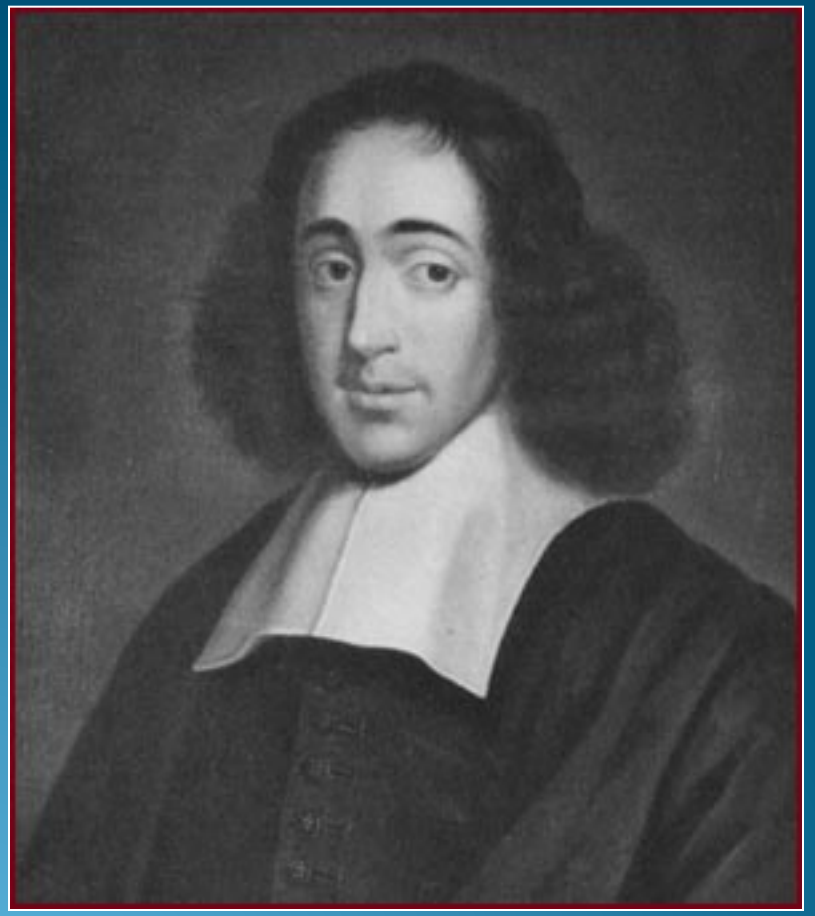
# Robert Boyle's Air Pump

- *New Experiments Physico-Mechanicall, Touching the Spring of the Air and Its Effects* (1660).
- The old experiments (furnace and alembic) on left versus new experiments (air pump and barometer) on right.
- Like the 20th c. cyclotron; 21st c. Large Hadron Collider, CERN.

# Pantheism

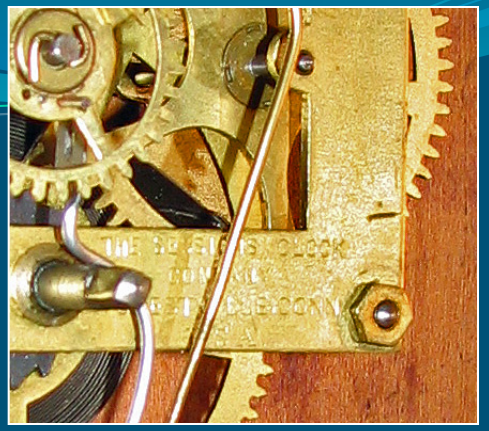
- Baruch Spinoza, Dutch philosopher, 1632-1677.
- *Natura naturans* (free, active force) and *natura naturata* (conforms to the laws of nature).
- God or Nature: *Deus sive Natura. (*Pantheism).
- Nature raised to the rank of God; follows from God's inner nature by laws of logic.
- Rational, explainable.
- No miracles.



# Mechanism:  Isaac Newton

- English Scientist, 1642-1727.
- Predictability via laws.
- Matter is inert and passive unless acted on by an external force.
- Mathematical cosmos.
- Ideal spheres, point sources of gravitation, identity through change.

# Mechanistic View of Nature



- Arises during the Scientific Revolution of the 17th century with the work of Kepler, Galileo, Bacon, Boyle, Newton, and others. Laws of Nature.
- Nature as a machine made up of parts that can be predicted and managed from outside by a scientist or engineer. Clocklike universe. God as engineer.
- Mathematics as source of valid knowledge of the external world. Frictionless planes, point sources of force, lack of air resistance (vacuum), idealized environments. Galileo, Descartes, Newton.
- Nature as controllable and predictable.

# Clocklike Universe

- Model of universe as a clock.
- Precise, controlled, predictable motions.
- God as clockmaker, engineer, mathematician.
- God winds up his clock and lets it tick away into eternity.
- Nature as lawful, orderly, predictable via mathematics and experimentation.
- Enlightenment, 18th century.

# Unpredictable Nature
# Lisbon Earthquake, 1755

- November 1, 1755, "All Saint's Day," at 9:30 a.m.
- Destroyed most of Lisbon, spawned a tsunami, caused 5 days of severe fires. 9.0 Richter scale (estimated).
- Churches, mosques, synagogues, castles, hospitals, palaces, opera houses, aqueducts & houses collapsed.

# John Gast, “American Progress,” 1872

*Natura naturans* (left); *Natura naturata* (right).
Unruly nature subdued by order, logic, and law


# Industrial Revolution, 19th cent.: Control vs. Resistance

- The Anthropocene. Human role in industrial nature.
- Burning of fossil fuels. Rise in $CO_2$ levels > 400 ppm.
- Small fluctuations can lead to cascading effects.
- Ecological tipping points; unpredictability; resistance.

# Climate Change as a planetary problem, 20th and 21st centuries

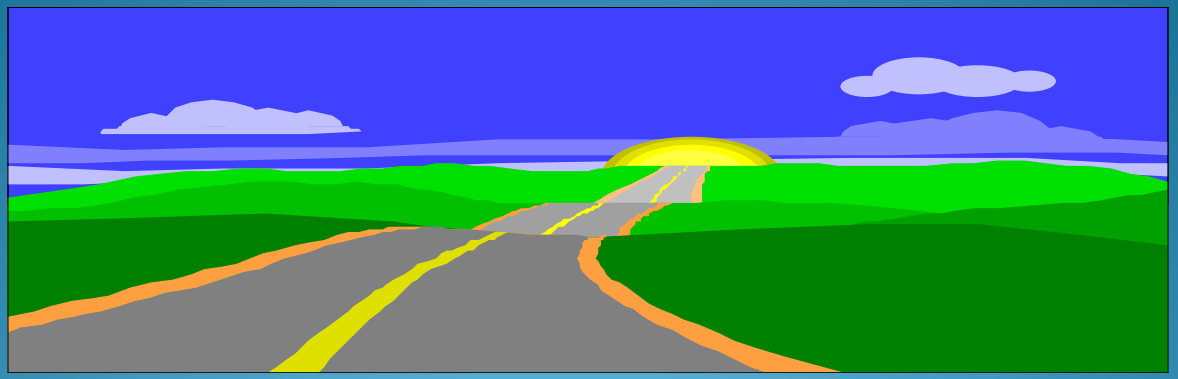
- Climate change as *Natura naturans;* nature resisting.
- Endangered species, biodiversity, planetary health.
- Can scientists, social scientists, politicians, and citizens work together to solve planetary problems?

# Autonomous Nature

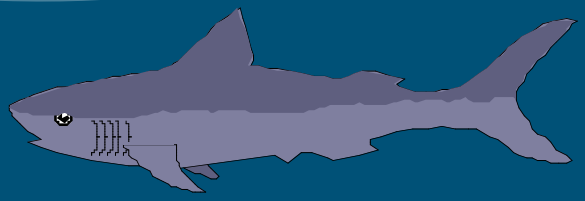
- Twenty-first century:  We are living within a new paradigm in which nature is autonomous and resistant.
- Active, creative, often uncontrollable; *Natura naturans*.
- Characterized by several levels of unpredictability, limited predictability, and degrees of forecasting.
- We must find new ways to live within autonomous nature, to stem the effects of climate change.
- Living within the new chaos/complexity paradigm will engage the best scientific, engineering, political, and ethical practices we can develop.
- Solar panels on every roof and bicycles in every garage.

# Partnership Ethics: People and Nature

- The Greatest Good for the Human and Nonhuman Communities is in their Mutual Living Interdependence



# Partnership Ethics



- Equity between the human and nonhuman communities.
- Moral consideration for both humans and other species.
- Respect for cultural diversity and biodiversity.
- Inclusion of women, minorities, and nonhuman nature in the code of ethical accountability.
- Ecologically sound management that is consistent with the continued health of both the human and nonhuman communities.

The End