



# Center for Environmental Research at Hornsby Bend



## MISSION

### Urban Ecology and Sustainability

- Community
- Education
- Research

## PARTNERS

- Austin Water Utility
- University of Texas
- Texas A&M University

## RESEARCH AREAS

- Soil Ecology, Sewage Recycling and Reuse
- Hydrogeology of the Alluvial Aquifer
- Riparian Ecology and Restoration
- Avian Ecology



50 YEARS OF BIRDING



AUSTIN, TEXAS  
*Hornsby Bend*  
1959-2009



# Center for Environmental Research at Hornsby Bend



## AWU-CER Lunchtime Lectures February – December 2012

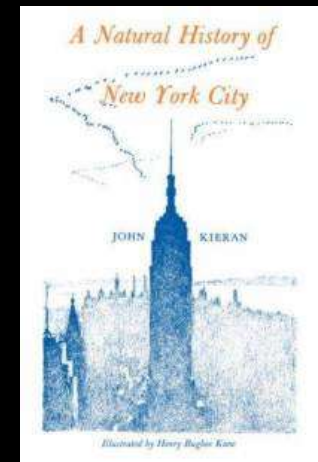
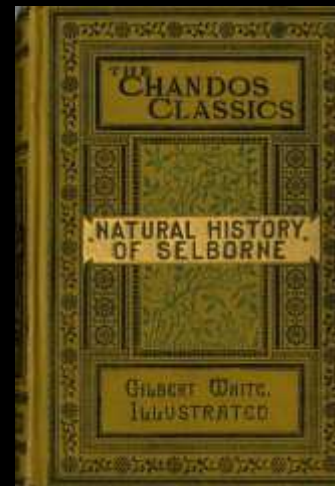
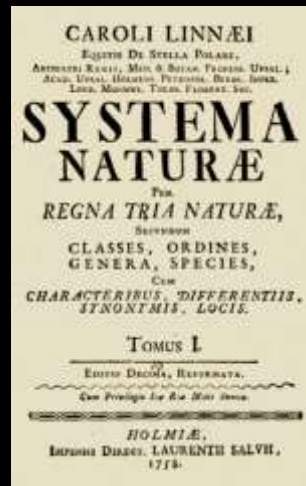
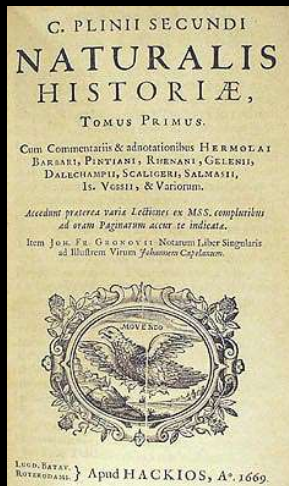
Each talk begins AT NOON Waller Center [625 East 10th Street – between I-35 and Red River] Room 104 or 105

The 1<sup>st</sup> Wednesday of the Month! Free and Open to the Public – bring a lunch and learn

## 2012 - A Year of Natural History: Origins, Practices, and Examples

Natural history is the study of plants and animals leaning more towards observational rather than experimental methods.

Over the next year, we will explore the history, the practice, and examples of natural history in America and Europe.





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### 2012 - A Year of Natural History: Origins, Practices, and Examples

**February 1** - The History of Natural History: Origins to 19<sup>th</sup> Century [Room 105]

**March 7** - The History of Natural History: 19<sup>th</sup> and 20<sup>th</sup> Century Science and Literature [Room 105]

**April 3** - The History of Natural History: Contemporary Natural History

**May 1** - The Natural History of the Americas: Discovery and Transformation

**June 5** - The Natural History of Texas: Biological Survey and Ecological Change

**July 3** - The Natural History of Austin: Biological Context and Urbanization

**August 7** - Urban Natural History: Life in the City

**September 4** - The Natural History of an Urban Creek: Waller Creek

**October 2** - The Natural History of an Urban Vacant Lot: Tannehill Urban Wild Woodland

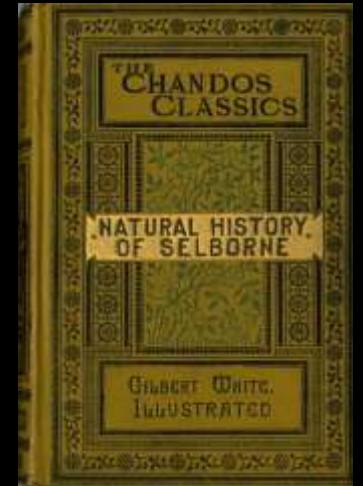
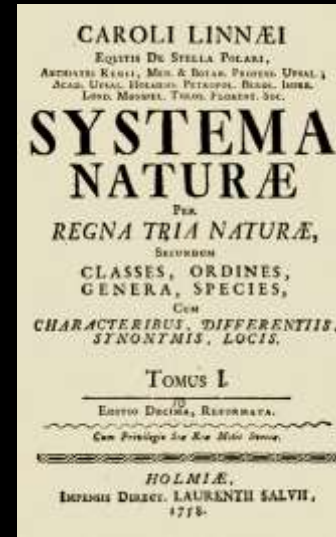
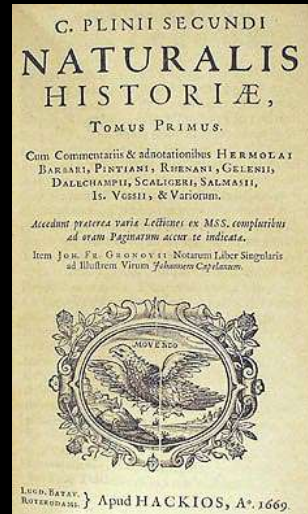
**November 6** - The Natural History of an Urban Wasteland: Hornsby Bend

**December 4** - Natural and Unnatural History: The Path Forward



# The History of Natural History: Origins to 19th Century

Kevin M. Anderson  
Austin Water Center for Environmental Research



## Natural History - Origins

Natural history is the study of plants and animals leaning more towards observational rather than experimental methods.

This definition satisfies depending on how much one likes to lean toward observation and if one is a scientist.

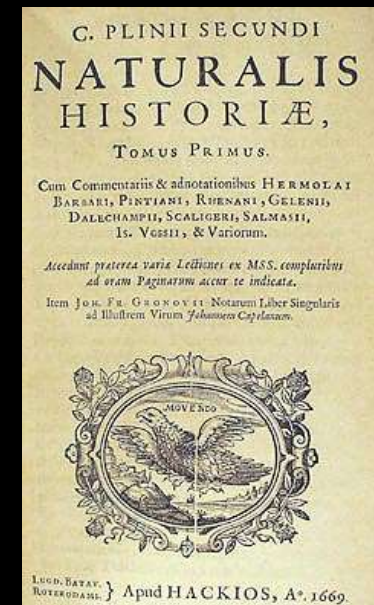
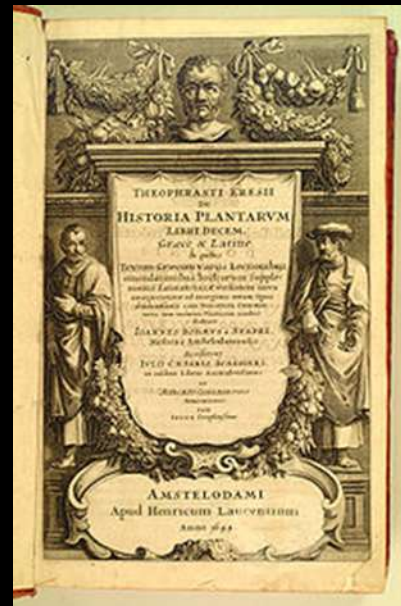
The originators of natural history were not scientists.

They were philosophers who studied nature and wrote *historia*

This Greek word is closer to investigation or research rather than our word “history”

But the books of their nature research were titled “Natural History”

...and the rest, as they say, is history.



## Themes

- Observation
- Description
- Classification
- Encyclopedias
- Biogeography
- Collecting
- Museums
- Evolution
- Amateurs to Professionals
- Naturalists to Biologists
- Artists as Naturalists
- Natural History as Literature





## Natural History

Understanding whole organisms in context

An ecological understanding



Aristotle  
384-322 BC  
The First Naturalist

In all nature, there is something of the marvellous.  
*De Partibus Animalium*

Like his teacher Plato, Aristotle's philosophy aims at the universal.

Aristotle, however, found the universal in particular things, which he called the essence of things, while Plato finds that the universal exists apart from particular things, and is related to them as their prototype or exemplar.

For Aristotle, therefore, philosophic method implies the ascent from the study of particular phenomena to the knowledge of essences, while for Plato philosophic method means the descent from a knowledge of universal Forms (or ideas) to a contemplation of particular imitations of these.

### Natural Philosophy

In Aristotle's terminology, "natural philosophy" is a branch of philosophy examining the phenomena of the natural world, and includes fields that would be regarded today as physics, biology and other natural sciences.



Plato (left) and Aristotle (right), a detail of The School of Athens, a fresco by Raphael. Aristotle gestures to the earth, representing his belief in knowledge through empirical observation and experience, while holding a copy of his Nicomachean Ethics in his hand.

Plato gestures to the heavens, representing his belief in The Forms.





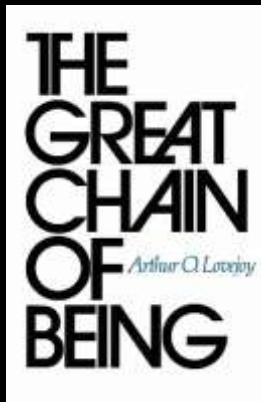
## Classification of Living Things

Aristotle's classification of living things contains some elements which still existed in the 19th century. What the modern zoologist would call vertebrates and invertebrates, Aristotle called 'animals with blood' and 'animals without blood'

Aristotle's *History of Animals* classified organisms in relation to a hierarchical "Ladder of Life" (*scala naturae*), placing them according to complexity of structure and function so that higher organisms showed greater vitality and ability to move

Aristotle believed that creatures were arranged in a graded scale of perfection rising from plants on up to man, the *scala naturae* or Great Chain of Being.

His system had eleven grades, arranged according "to the degree to which they are infected with potentiality", expressed in their form at birth. The highest animals laid warm and wet creatures alive, the lowest bore theirs cold, dry, and in thick eggs.



Arthur O. Lovejoy (1964. First published 1936), *The Great Chain of Being: A Study of the History of an Idea*, Cambridge, Massachusetts: Harvard University Press

# Theophrastus

371 – 287 BC

## The Father of Botany and Taxonomy

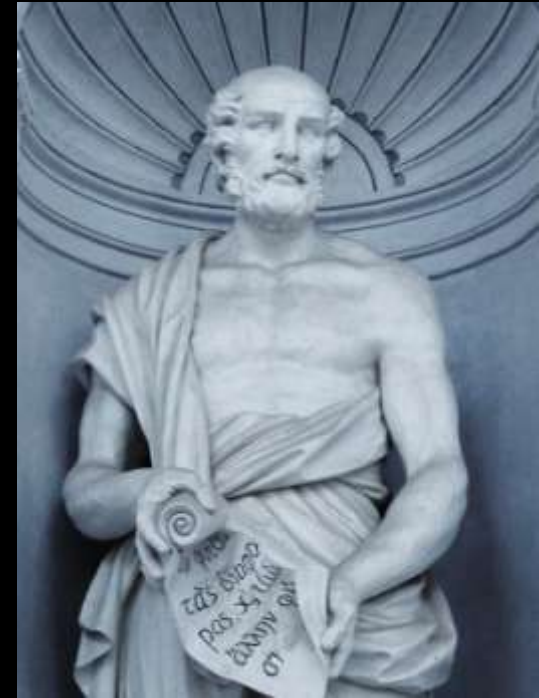
Studied in Plato's school and after Plato's death, he was Aristotle's student. Aristotle bequeathed to Theophrastus his writings and designated him as his successor at the Lyceum

The most important of his books are two large botanical treatises, *Enquiry into Plants*, and *On the Causes of Plants*, which constitute the most important contribution to botanical science during antiquity and the Middle Ages, the first systemization of the botanical world.

The *Enquiry into Plants* was originally ten books, of which nine survive. The work is arranged into a system whereby plants are classified according to their modes of generation, their localities, their sizes, and according to their practical uses such as foods, juices, herbs, etc.

*On the Causes of Plants* was originally eight books, of which six survive. It concerns the growth of plants; the influences on their fecundity; the proper times they should be sown and reaped; the methods of preparing the soil, manuring it, and the use of tools; and of the smells, tastes, and properties of many types of plants.

Another of his innovations was to classify plants using a hierarchical arrangement with an attention to defining characteristics based on morphology [external and internal form – trees, shrubs, under-shrubs, herbs], as well as understanding their life history, mode of reproduction and response to environmental factors earned him the title of “father of taxonomy.”



Pliny the Elder

23 – 79 AD

*Naturalis Historia*

A military officer and lawyer

Spending most of his spare time studying, writing or investigating natural and geographic phenomena in the field, he wrote an encyclopedic work, *Naturalis Historia*, which became a model for all natural histories and encyclopedias written subsequently, in terms of the breadth of subject matter examined, the need to reference original authors, and a comprehensive index list of the contents.

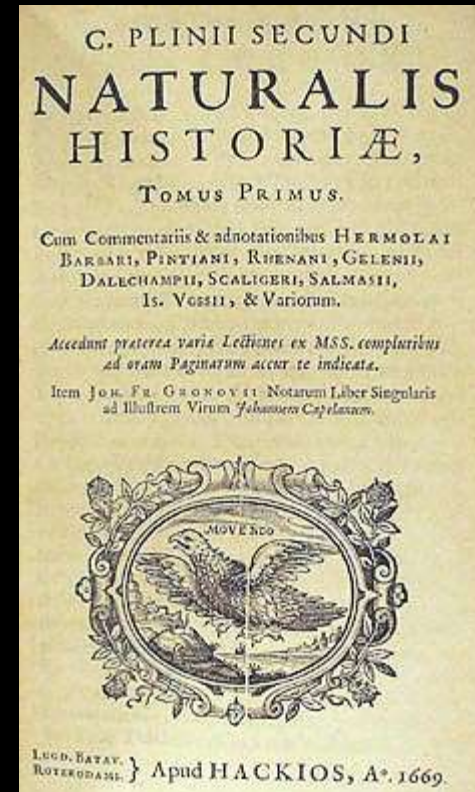
The *Naturalis Historia* is one of the largest single works to have survived from the Roman empire and purports to cover the entire field of ancient knowledge, based on the best authorities available to Pliny.

It encompasses the fields of botany, zoology, astronomy, geology and mineralogy as well as the exploitation of those resources.

“My subject is a barren one – the world of nature, or in other words life; and that subject in its least elevated department, and employing either rustic terms or foreign, nay barbarian words that actually have to be introduced with an apology.”

Amateurs to Professionals

A Naturalist?





# Renaissance 14<sup>th</sup> – 16<sup>th</sup> Centuries

## Rediscovery of Classical works

Scholars expanded knowledge of plants and animals by dissection and comparison and by recording them in much improved drawings and printed text.

### Artist as Naturalist

Konrad Gessner

1516-1565

His five-volume *Historiae animalium* (1551–1558) is considered the beginning of modern zoology



Leonhart Fuchs

1501 – 1566

*De historia stirpium commentarii insignes*

"Notable commentaries on the history of plants"

(Basel, 1542)



# The Enlightenment 17<sup>th</sup> and 18<sup>th</sup> Centuries

## Rise of Scientific Natural History

- Beginnings of Scientific Taxonomy
- New Worlds observed, described, collected, illustrated

Francis Bacon 1561 – 1626

an English philosopher, statesman, lawyer, and pioneer of the scientific method

In his magnum opus, *Novum Organum*, or "new instrument", Francis Bacon argued that although Scholastic philosophy at the time mainly used deductive syllogisms to interpret nature, mainly owing to Aristotle's logic.

The philosopher should instead proceed through inductive reasoning from fact to axiom to physical law.

*"take the question to nature"* and learn by observation and experiment



# Botanical Classification and Natural Theology

## John Ray 1627 – 1705

The father of English natural history, Ray published important works on botany, zoology, and natural theology.

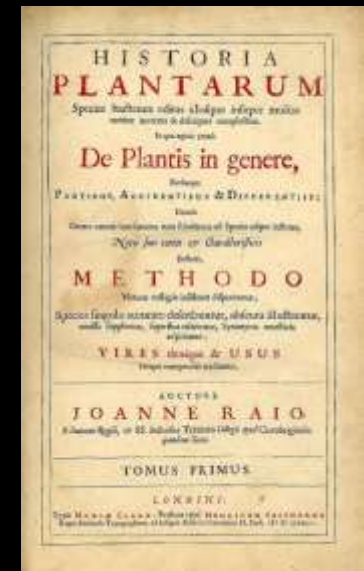
His classification of plants in his *Historia Plantarum*, was an important step towards modern taxonomy.

Ray rejected the system of dichotomous division by which species were classified according to a pre-conceived, either/or type system, and instead classified plants according to similarities and differences that emerged from observation. Thus, he advanced scientific empiricism against the deductive rationalism of the scholastics, but he still believed a natural theology that empirical study of Nature revealed divine order and design in the world.

*“Let us not suffice to be book-learned, to read what others have written and to take upon trust more falsehood than truth, but let us ourselves examine things as we have opportunity and converse with Nature as well as with books.”*

He was the first to give a biological definition of the term *species*

*“... no surer criterion for determining species has occurred to me than the distinguishing features that perpetuate themselves in propagation from seed. Thus, no matter what variations occur in the individuals or the species, if they spring from the seed of one and the same plant, they are accidental variations and not such as to distinguish a species... Animals likewise that differ specifically preserve their distinct species permanently; one species never springs from the seed of another nor vice versa”.*







## Classification and Natural Diversity Comte de Buffon 1707–1788

French naturalist, mathematician, cosmologist, and encyclopedic author.

Buffon published thirty-six quarto volumes of his *Histoire naturelle* during his lifetime; with additional volumes based on his notes and further research being published in the two decades following his death.

In the opening volumes of the *Histoire naturelle* Buffon questioned the usefulness of mathematics, criticized Carl Linnaeus's taxonomical approach to natural history.

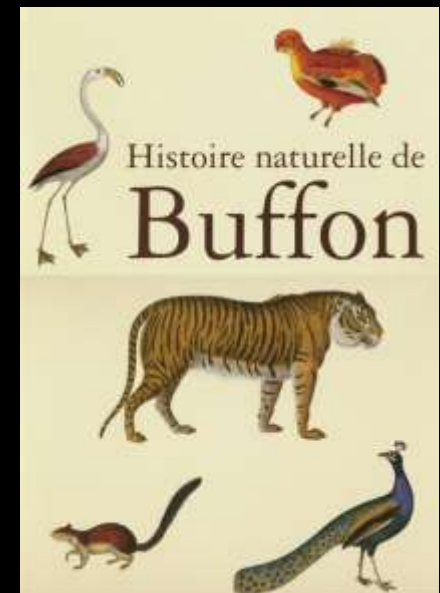
In the course of his examination of the animal world, Buffon noted that despite similar environments, different regions have distinct plants and animals, a concept later known as Buffon's Law.

This is considered to be the first principle of biogeography.

He was not an evolutionist, yet he was the father of evolutionism. He was the first person to discuss a large number of evolutionary problems.

In contrast to Linnaeus, Buffon was less concerned with identification and more interested in vividly illustrating plenitude, diversity, and continuity of animal species.

Buffon insisted we “must make use of all parts of the object” for classification, including internal anatomy, behavior, and distribution.



# French Development of Evolutionary Thought through Natural History

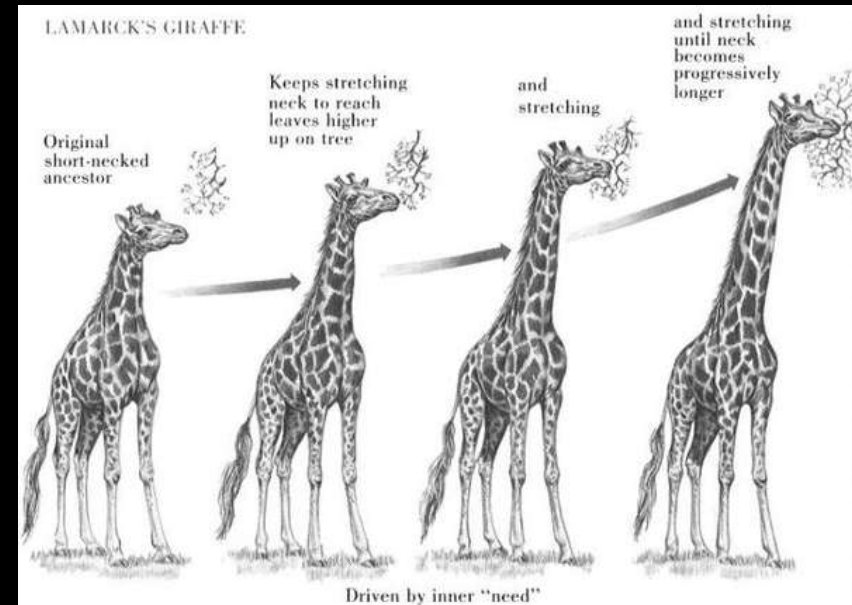
Jean-Baptiste Lamarck 1744-1829

Lamarckian evolution - the environment gives rise to changes in animals. He cited examples of blindness in moles, the presence of teeth in mammals and the absence of teeth in birds as evidence of this principle.

Lamarck is usually remembered for his belief in the inheritance of acquired characteristics, and the use and disuse model by which organisms developed their characteristics. Lamarck incorporated this belief into his theory of evolution, along with other more common beliefs of the time, such as spontaneous generation.

“A change in the environment brings about change in needs, resulting in change in behavior, bringing change in organ usage and development, bringing change in form over time – and thus the gradual transmutation of the species”

*La Philosophie zoologique* - Jean Baptiste Lamarck (1809)





# French Development of Evolutionary Thought through Natural History

## Georges Cuvier 1769-1832

Cuvier was instrumental in establishing the fields of comparative anatomy and paleontology through his work in comparing living animals with fossils. He is well known for establishing extinction as a fact.

Cuvier was critical of the evolutionary theories proposed by Lamarck which involved the gradual transmutation of one form into another.

He repeatedly emphasized that his extensive experience with fossil material indicated that one fossil form does not, as a rule, gradually change into a succeeding, distinct fossil form.

Instead, he said, the typical form makes an abrupt appearance in the fossil record, and persists unchanged to the time of its extinction (this is the well-documented paleontological phenomenon now referred to as "punctuated equilibrium").



# The Natural History of the Microcosmos

## Robert Hooke (1635-1703)

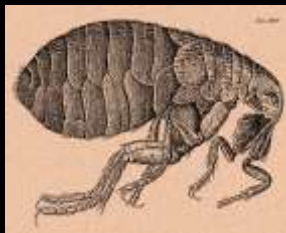
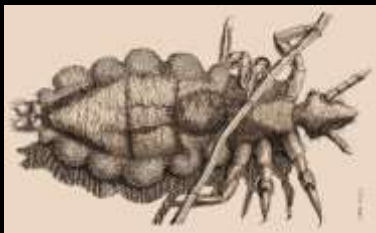
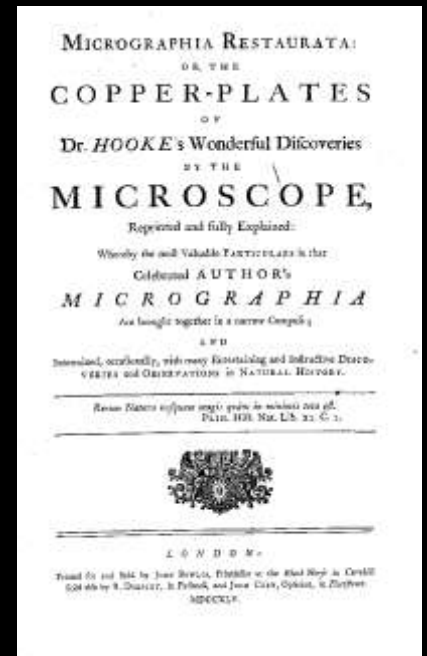
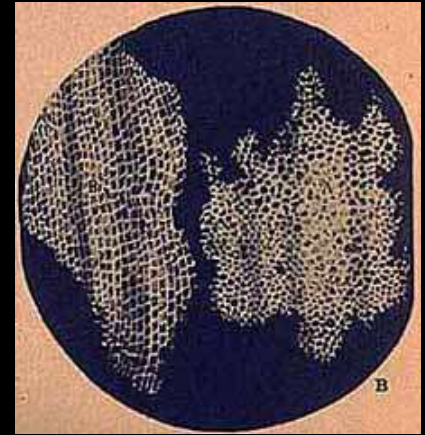
Hooke's reputation in the history of biology largely rests on his book *Micrographia*, published in 1665. Hooke devised the compound microscope and illumination system and used it in his demonstrations at the Royal Society's meetings.

With it he observed organisms as diverse as insects, sponges, bryozoans, foraminifera, and bird feathers. *Micrographia* was an accurate and detailed record of his observations, illustrated with magnificent drawings, such as the flea shown below, which Hooke described as "adorn'd with a curiously polish'd suite of sable Armour, neatly jointed. . ." It was a best-seller of its day.

Perhaps his most famous microscopical observation was his study of thin slices of cork, depicted above right. In "Observation XVIII" of the *Micrographia*, he wrote:

*. . . I could exceedingly plainly perceive it to be all perforated and porous, much like a Honey-comb, but that the pores of it were not regular. . . these pores, or cells, . . . were indeed the first microscopical pores I ever saw, and perhaps, that were ever seen, for I had not met with any Writer or Person, that had made any mention of them before this. . .*

Hooke had discovered plant cells -- more precisely, what Hooke saw were the cell walls in cork tissue. In fact, it was Hooke who coined the term "cells": the boxlike cells of cork reminded him of the cells of a monastery.



## The Natural History of the Microcosmos

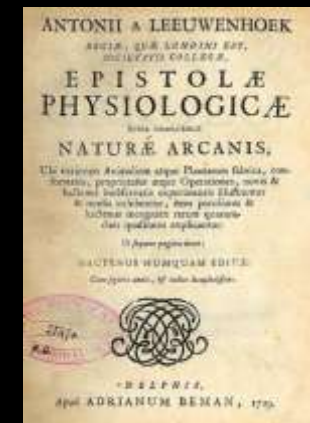
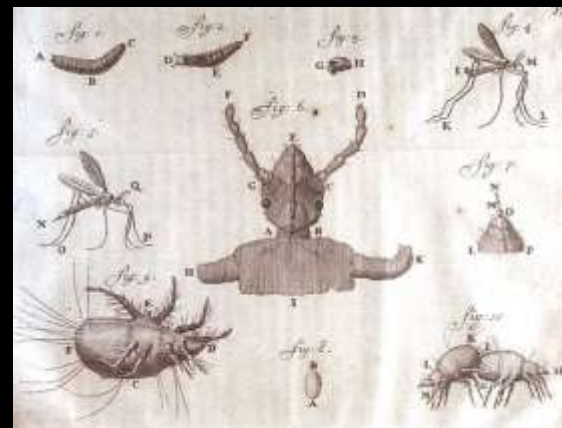
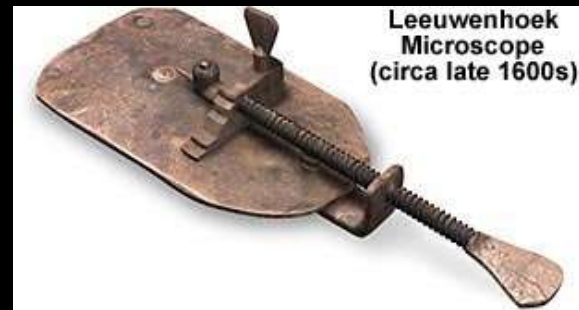
Antony van Leeuwenhoek 1632 – 1723  
Father of Microbiology

The first to see bacteria

*Looking at this water...the motion of most of these animalcules was so swift, and so various – upwards, downwards, and round about, that twas wonderful to see.*

Until the day Leeuwenhoek put a glass phial of lake water in front of his microscope lens, no one had any idea of the extent of the world's microbial populations.

The Utrecht museum has one of Leeuwenhoek's microscopes in its collection. This incredible instrument has a magnification factor of about 275x (even considering a scratch on the lens) with a resolution approaching one micron.





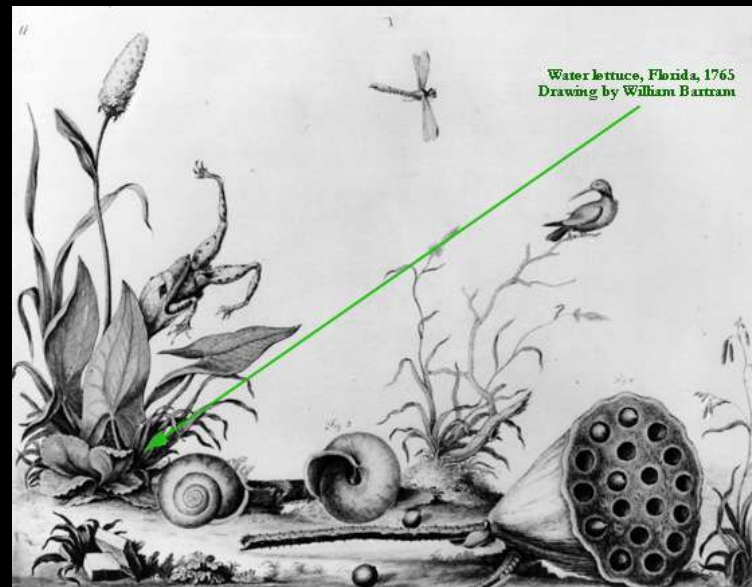
## Illustration – The Artist Naturalist in North America

Mark Catesby 1683-1749

*Natural History of Carolina, Florida, and the Bahama Islands* (Two volumes 1732-43)

William Bartram 1739-1823

*Travels through North and South Carolina, Georgia, East and West Florida* (1791)



## Voyages and Collections - Joseph Banks 1743-1820

### Three voyages

- HMS Niger (1766-67) to Canada – Newfoundland and Labrador
- HMS Endeavour (1768-1771) with Captain James Cook to the Southern Pacific, New Zealand, and Australia collecting with Daniel Solander [student of Linnaeus]
- HMS Sir Lawrence (1772) Hebrides, Iceland, Orkney Islands

Founds the Royal Botanic Gardens at Kew

Leads the Royal Society – major patron of further collecting



# 19<sup>th</sup> Century Natural History

## Biogeography, Collecting, Evolution, Museums, and the Beginning of American Nature Writing

### Biogeography

Alexander von Humboldt



### Evolution

Charles Darwin



Alfred Russell Wallace



### Museums

Louis Agassiz



### Artist Naturalist

John James Audubon



### The Beginning of American Nature Writing

Henry David Thoreau





# A vision of the unity of Nature

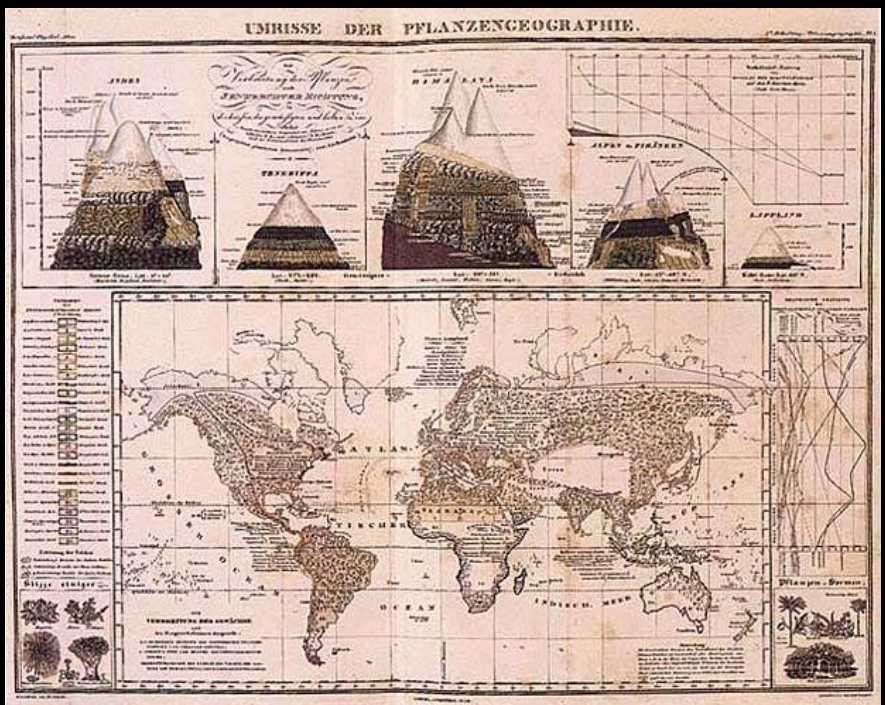
Alexander von Humboldt 1769 - 1859

*Unity in diversity, and of connection, resemblance, and order, among created things most dissimilar in their form, one fair harmonious whole...*

*Kosmos, 1845*

Charles Darwin described him as "the greatest scientific traveler who ever lived." He is widely respected as one of the founders of modern geography and ecology. Alexander von Humboldt's travels, experiments, and knowledge transformed western science in the nineteenth century.

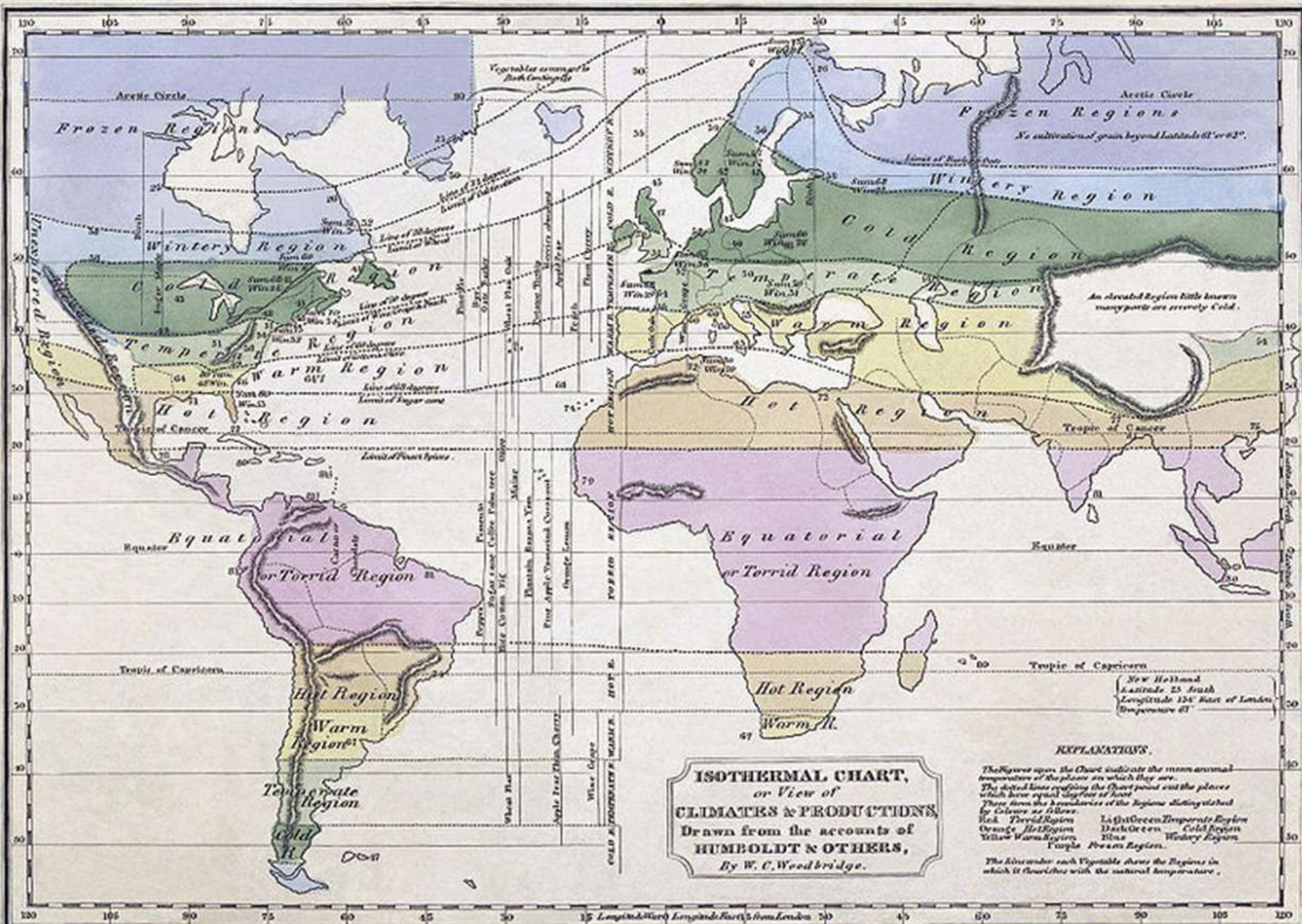
Between 1799 and 1804, Humboldt travelled extensively in Latin America, exploring and describing it. His description of the journey was written up and published in an enormous set of volumes over 21 years. Later, his five-volume work, *Kosmos* (1845), attempted to unify the various branches of scientific knowledge.











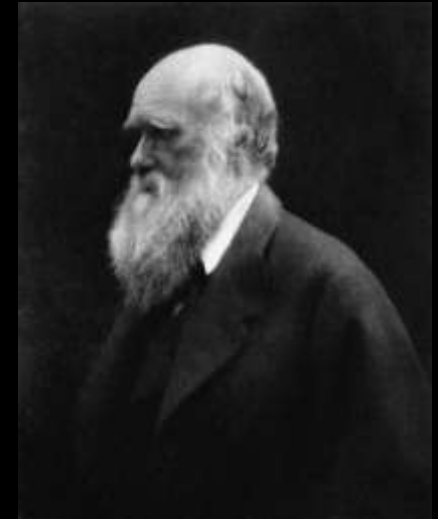
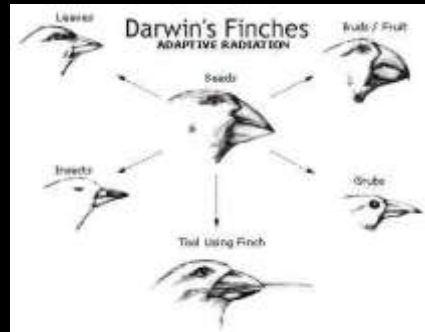
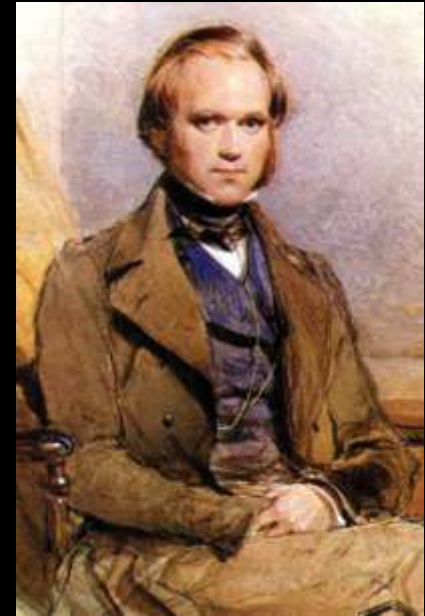


# Natural History and Evolution

## Charles Darwin 1809-1882

He established that all species of life have descended over time from common ancestry, and proposed the scientific theory that this branching pattern of evolution resulted from a process that he called natural selection in *On the Origin of the Species* (1859).

### The Voyage of the Beagle 1831-36 – Galapagos ground finches



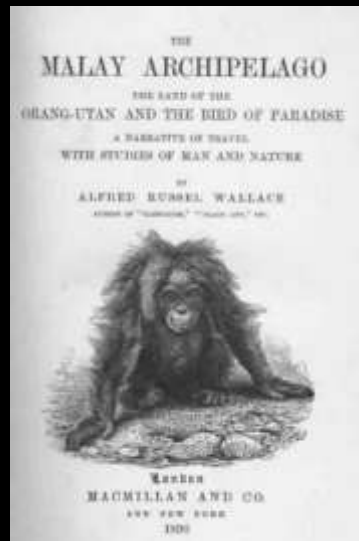
# Natural History and Evolution

## Alfred Russel Wallace 1823-1913

He is best known for independently proposing a theory of evolution due to natural selection that prompted Charles Darwin to publish his own theory.

Wallace did extensive fieldwork, first in the Amazon River basin and then in the Malay Archipelago, where he identified the Wallace Line that divides the Indonesian archipelago into two distinct parts, one in which animals closely related to those of Australia are common, and one in which the species are largely of Asian origin. He was considered the 19th century's leading expert on the geographical distribution of animal species and is sometimes called the "father of biogeography".

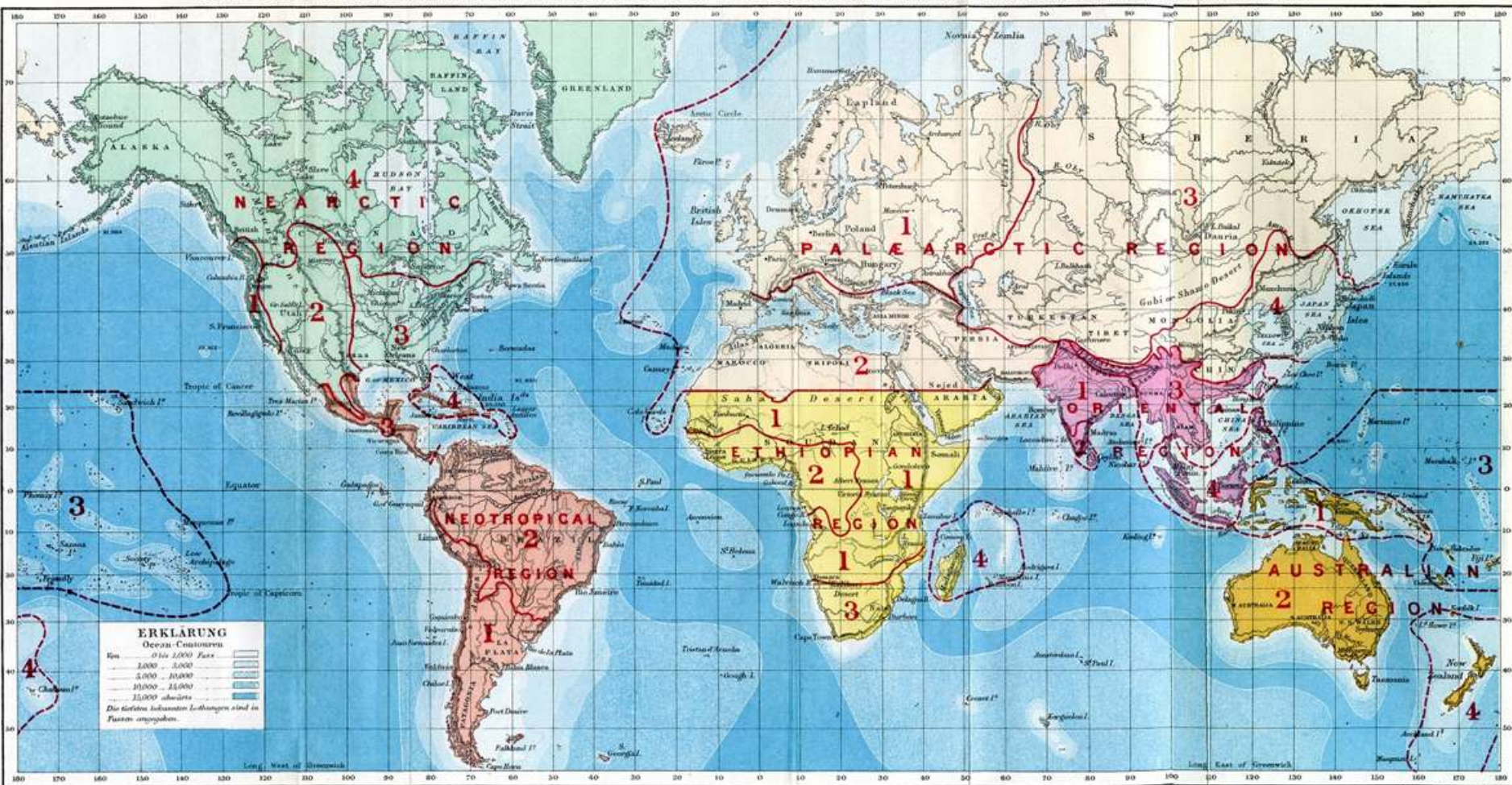
## Travels in the Amazon and Malay Archipelago (1848-1862)





# The Geographical Distribution of Animals (1876)

DIE ERDE IN MERCATOR'S PROJECTION MIT DEN ZOOGEOGRAPHISCHEN REGIONEN UND DEN APPROXIMATIVEN SCHWANKUNGEN DES OCEAN-BETTES



# Evolution, Museums, and Natural History

Louis Agassiz 1807 - 1873

He grew up in Switzerland and became a professor of natural history at University of Neuchâtel. In 1848 he accepted a professorship at Harvard. He immediately set about organizing and acquiring funding for a great museum of natural history. In 1859 his dream came true with the founding of the Harvard University Museum of Comparative Zoology, which opened its doors in 1860.

*I have devoted my whole life to the study of Nature, and yet a single sentence may express all that I have done. I have shown that there is a correspondence between the succession of Fishes in geological times and the different stages of their growth in the egg — that is all. It chanced to be a result that was found to apply to other groups and has led to other conclusions of a like nature.*

The "recapitulation of phylogeny by ontogeny" was seen as support for the theory of evolution by Ernst Haeckel.

But Agassiz was no evolutionist; in fact, he was probably the last reputable scientist to reject evolution outright. Agassiz saw the Divine Plan of God everywhere in nature, and could not reconcile himself to a theory that did not invoke design. Agassiz was a staunch creationist; he taught that after every global extinction of life God created every species anew. His philosophy of nature, aiming to understand the Divine Plan, is the last great expression of the old school of natural theology, started by men like John Ray almost two hundred years before.



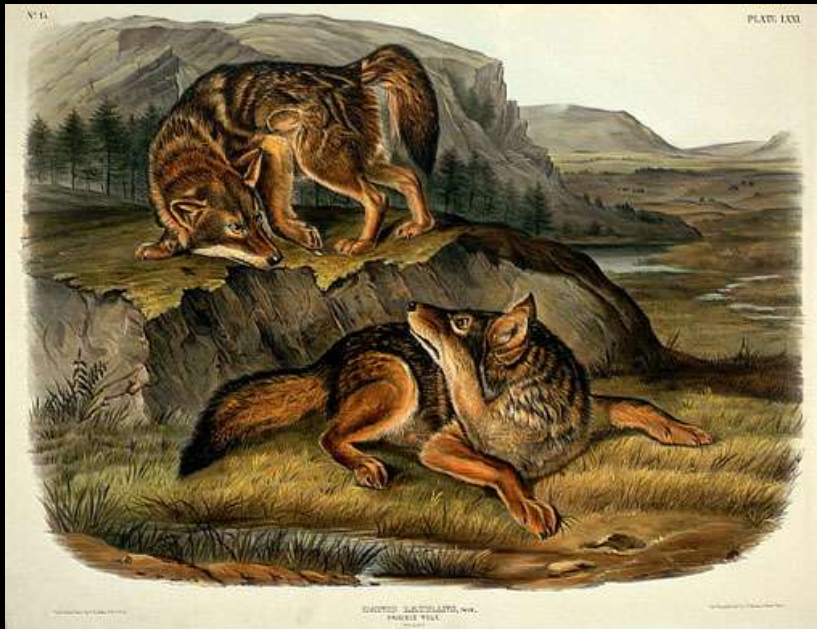




## Viviparous Quadrupeds of North America 1845-48

Following the success of his *Birds of America*, John James Audubon began to gather material for an equally ambitious project to document the animal life of North America. The results of the artist-naturalist's years of research and field study was the *Viviparous Quadrupeds of North America*. Audubon included many frontier animals never before depicted, and his landmark publication helped foster a public appreciation of American nature.

Audubon collaborated with the Reverend John Bachman, a Lutheran minister and experienced student of mammalogy, who later wrote much of the scientific text. Audubon collected specimens sent to him by friends, and in 1843 he made a final expedition up the Missouri to do more field work. He envisioned *Viviparous Quadrupeds* (literally meaning live young bearing four-footed animals) as the definitive record of all North American mammals. Bachman warned Audubon, who was not a trained naturalist, that he had underestimated the scope of the mammal population, and they agreed to eliminate bats and marine animals. By 1846 Audubon's health was failing and his son, John Woodhouse, made substantial artistic contributions, eventually completing half the plates for *Quadrupeds*. Another son, Victor, served as editor and business manager.

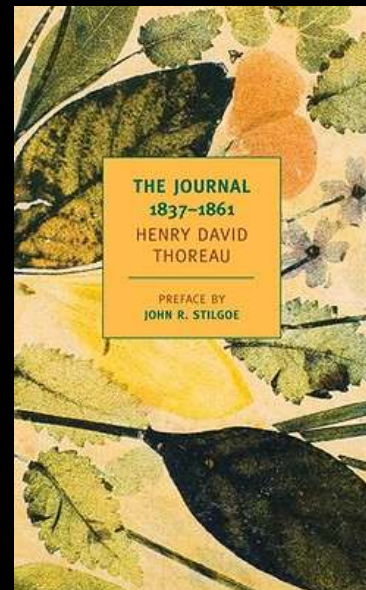
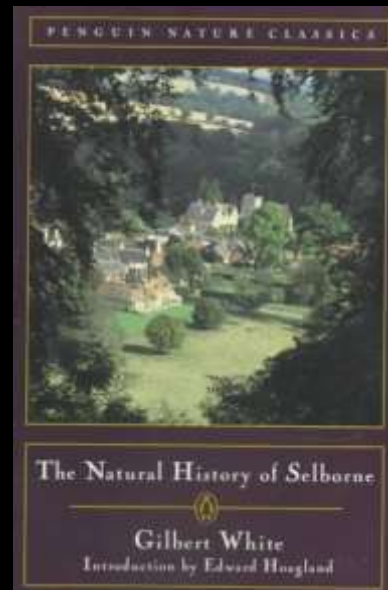




## Natural History and Literature

### The Literary Naturalists

#### Gilbert White and Henry David Thoreau



## The Literary Turn

Gilbert White 1720 – 1793

English clergyman and first literary naturalist

Born in his grandfather's vicarage at Selborne in Hampshire

White is best known for his *The Natural History and Antiquities of Selborne* (1789), one of the most frequently published books in the English language.

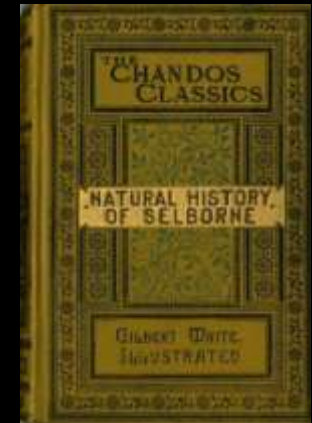
This was a compilation of his letters to Thomas Pennant, the leading British zoologist of the day, and the Hon. Daines Barrington, an English barrister and another Fellow of the Royal Society. These letters contained White's discoveries about local birds, animals and plants.

He believed in distinguishing birds by observation rather than by collecting specimens, and was thus one of the first people to separate the similar-looking Chiffchaff, Willow Warbler and Wood Warbler by means of their song.

White is regarded by many as one of the founders of modern respect for nature and an ecological understanding of place.

He said of the earthworm:

*Earthworms, though in appearance a small and despicable link in the chain of nature, yet, if lost, would make a lamentable chasm. [...] worms seem to be the great promoters of vegetation, which would proceed but lamely without them...*



# Documentation and Reflection - the Beginning of American Nature Writing

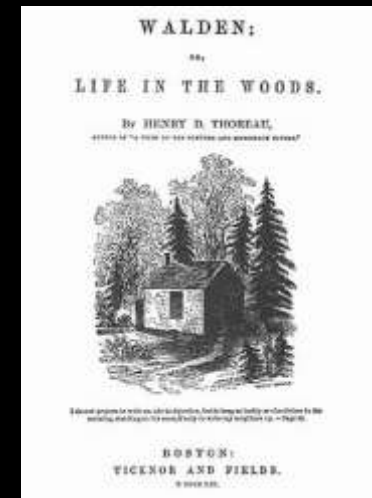
## Henry David Thoreau 1817-1862

He read avidly on botany and often wrote observations on this topic into his journal. He admired William Bartram, and Darwin's *Voyage of the Beagle*. He kept detailed observations of nature around Concord, recording everything from how the fruit ripened over time to the fluctuating depths of Walden Pond and the days certain birds migrated.

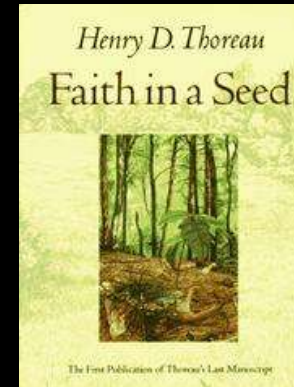
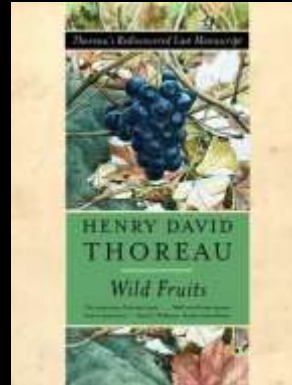
He became a land surveyor and continued to write increasingly detailed natural history observations about the Concord area in his journal, a two-million word document he kept for 24 years. He also kept a series of notebooks, and these observations became the source for Thoreau's late natural history writings, such as *Autumnal Tints*, *The Succession of Trees*, and *Wild Apples*, an essay lamenting the destruction of indigenous and wild apple species.

Until the 1970s, literary critics dismissed Thoreau's late pursuits as amateur science and philosophy. With the rise of environmental history and ecological literary criticism a new perception emerged, showing Thoreau to be both a philosopher and an analyst of ecological patterns in Concord's fields and woods – a naturalist.

The linkage to Gilbert White was clear, and contemporary American nature writing rediscovered its foundations in natural history.



Published 1854





Applause





# Questions?





# Center for Environmental Research at Hornsby Bend



## AWU-CER Lunchtime Lectures February – December 2012

Each talk begins AT NOON Waller Center [625 East 10th Street – between I-35 and Red River] Room 104  
The 1<sup>st</sup> Tuesday of the Month! Free and Open to the Public – bring a lunch and learn

### 2012 - A Year of Natural History: Origins, Practices, and Examples

**February 1** - The History of Natural History: Origins to 19<sup>th</sup> Century [Room 105]

**March 7** - The History of Natural History: 19<sup>th</sup> and 20<sup>th</sup> Century Science and Literature [Room 105]

**April 3** - The History of Natural History: Contemporary Natural History

**May 1** - The Natural History of the Americas: Discovery and Transformation

**June 5** - The Natural History of Texas: Biological Survey and Ecological Change

**July 3** - The Natural History of Austin: Biological Context and Urbanization

**August 7** - Urban Natural History: Life in the City

**September 4** - The Natural History of an Urban Creek: Waller Creek

**October 2** - The Natural History of an Urban Vacant Lot: Tannehill Urban Wild Woodland

**November 6** - The Natural History of an Urban Wasteland: Hornsby Bend

**December 4** - Natural and Unnatural History: The Path Forward