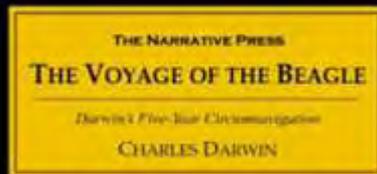
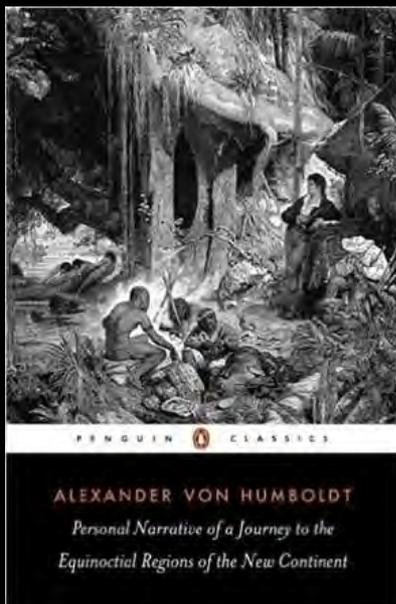


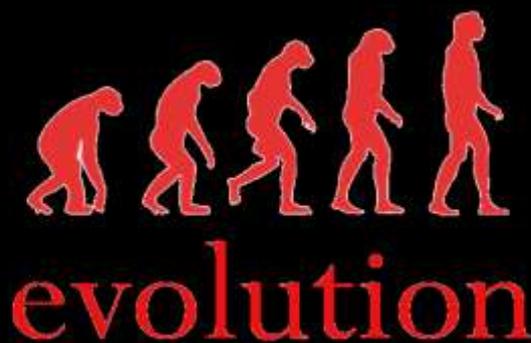
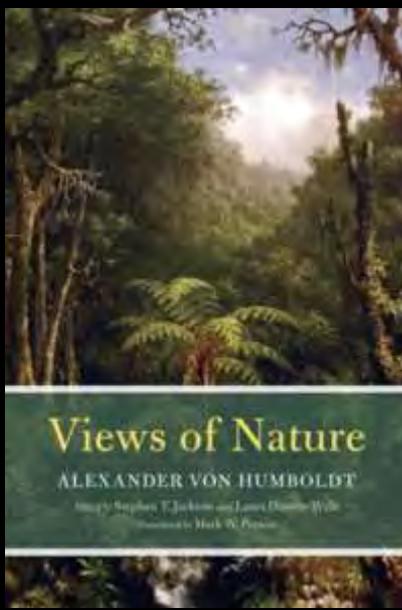
The Evolution of Nature: Von Humboldt, Darwin, and the Systematic Universe

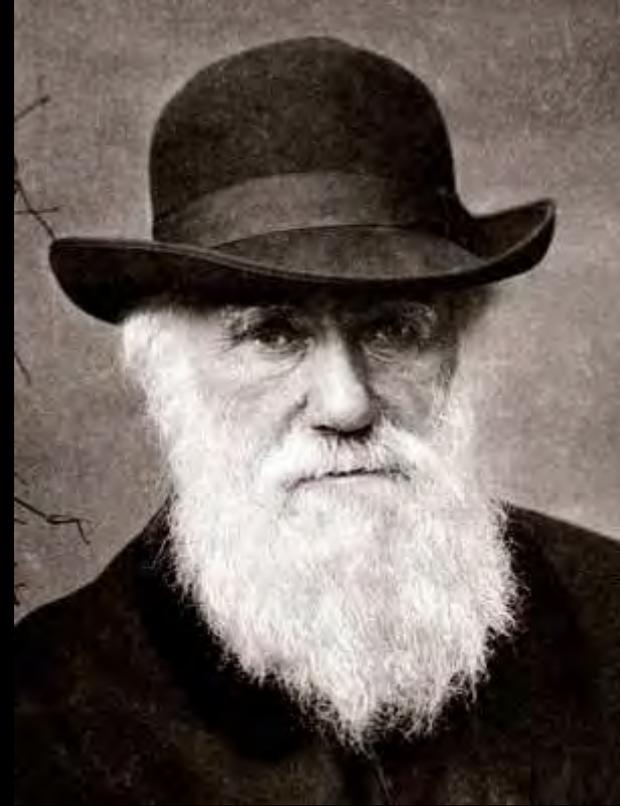
Kevin M. Anderson Ph.D.

Austin Water Center for Environmental Research



Portrait by John Thomson, National Portrait Gallery, London





Charles Darwin

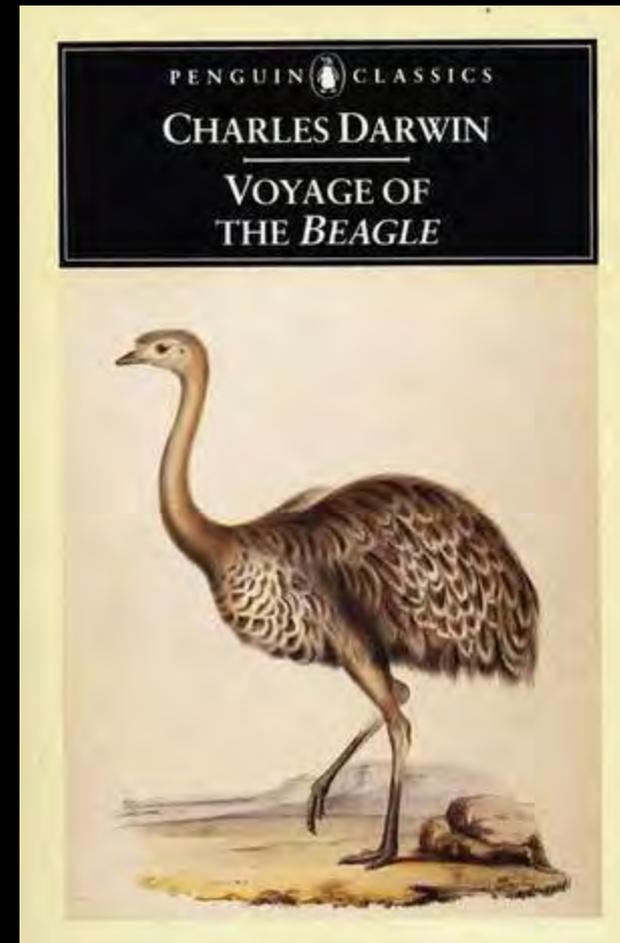
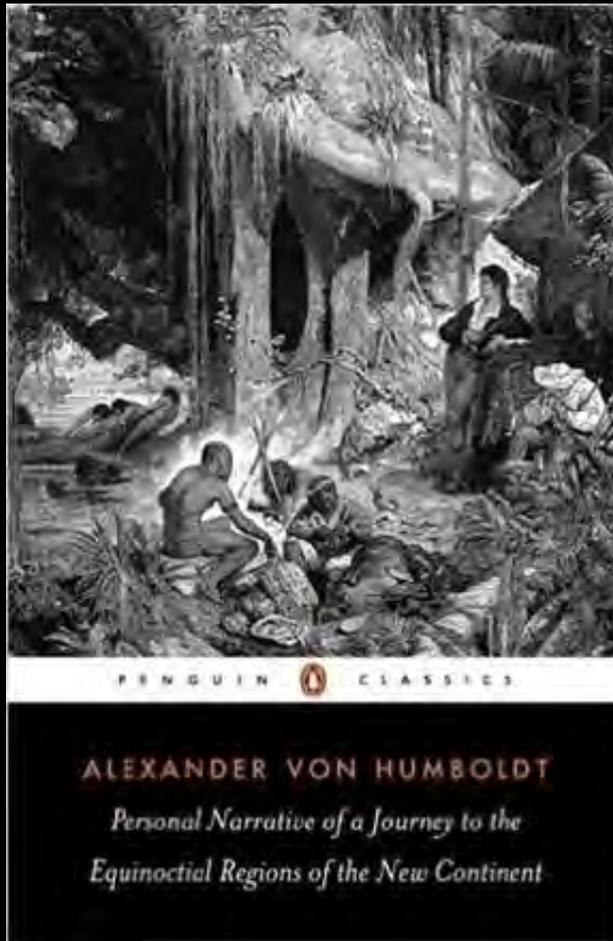
Darwin thought Humboldt peerless; on entering the forests of Brazil Darwin wrote that Humboldt 'alone gives any notion of the feelings which are raised in the mind on first entering the Tropics'

In the 1840s Humboldt sent a letter that Darwin prized as much as any he ever received.

“You told me,” Humboldt wrote, “that, when you were young, the manner in which I studied and depicted nature in the torrid zones contributed toward exciting in you the ardour and desire to travel in distant lands. Considering the importance of your work, Sir, this may be the greatest success that my humble work could bring. Works are of value only if they give rise to better ones.”

Humboldt died on May 6, 1859, six months before Darwin's *Origin of Species* was published.





In the 1840s Darwin asked his best friend Joseph Dalton Hooker (1817-1911) to tell Humboldt that his (Darwin's) 'whole course of life' was due to having 'read & re-read as a Youth' Humboldt's *Personal Narrative*

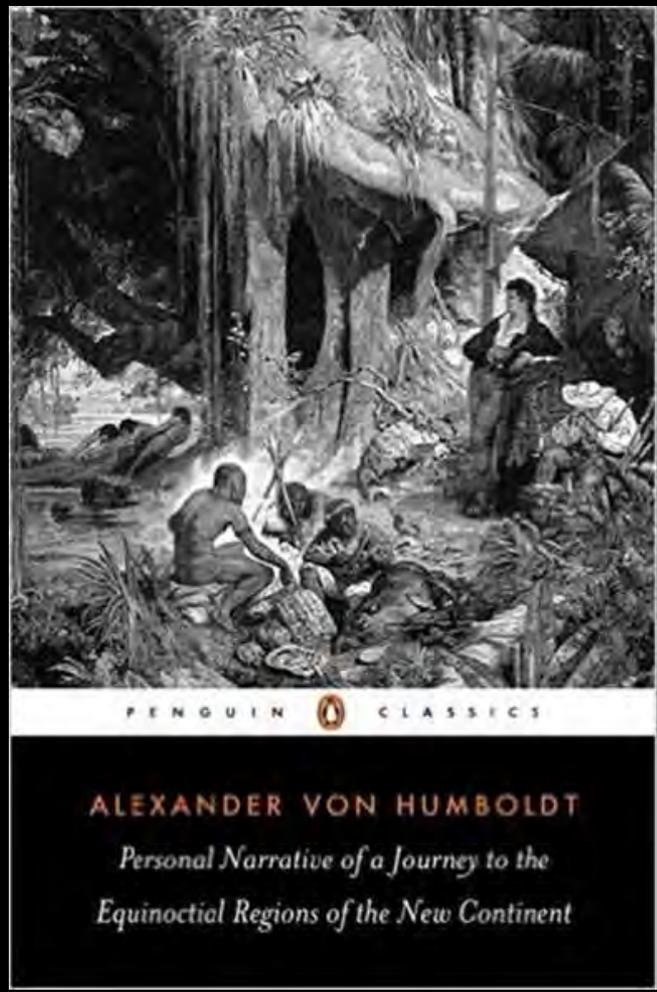
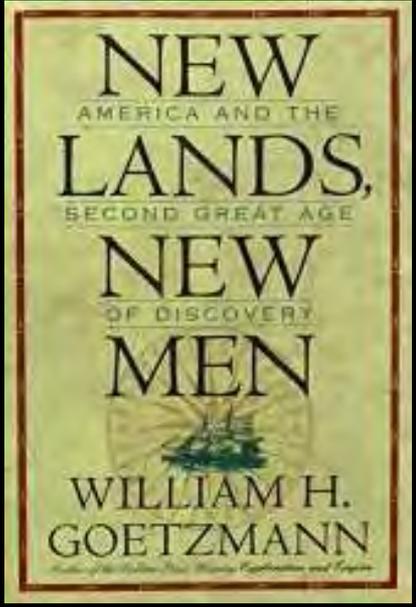


Darwin's epitaph for his hero Alexander Von Humboldt, written in a letter to his friend Hooker in 1881, the year before Darwin's own death.

"I believe that you are fully right in calling Humboldt the greatest scientific traveler who ever lived. You might truly call him the parent of a grand progeny of scientific travelers, who taken together have done much for science."

Humboldt's Progeny – *Personal Narrative* 1814

Inspires “Humboldt's Children” Darwin to Muir



Humboldtian Science – The Systematic Universe

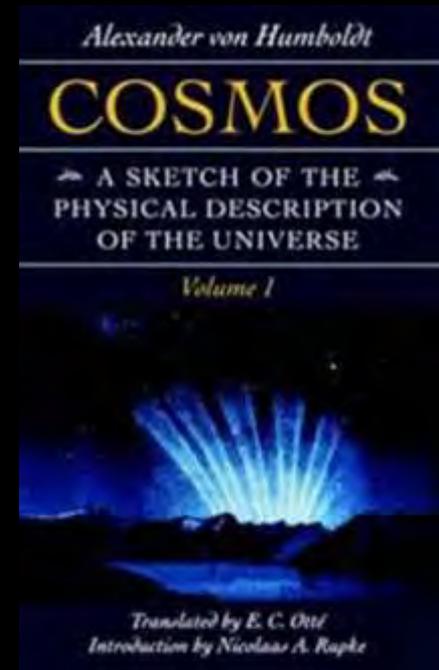
1. Explore – “Nature speaks and the scientist must go out and listen”
2. Collect – gather data for or against an idea/theory
3. Measure – widespread, accurate, collaborative
4. Connect – detect patterns that point to underlying laws
5. Cosmopolitan science – international collaboration



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

Earth’s magnetic field – advocated global monitoring network

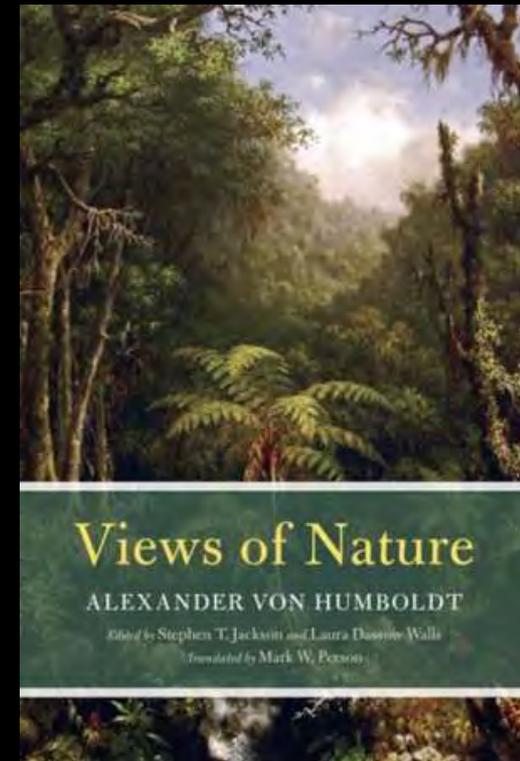
Scientific Collaboration, Friendship, Mutual Support, Mentorship



Humboldtian Science – Evolution

Views of Nature 1808 (1849)

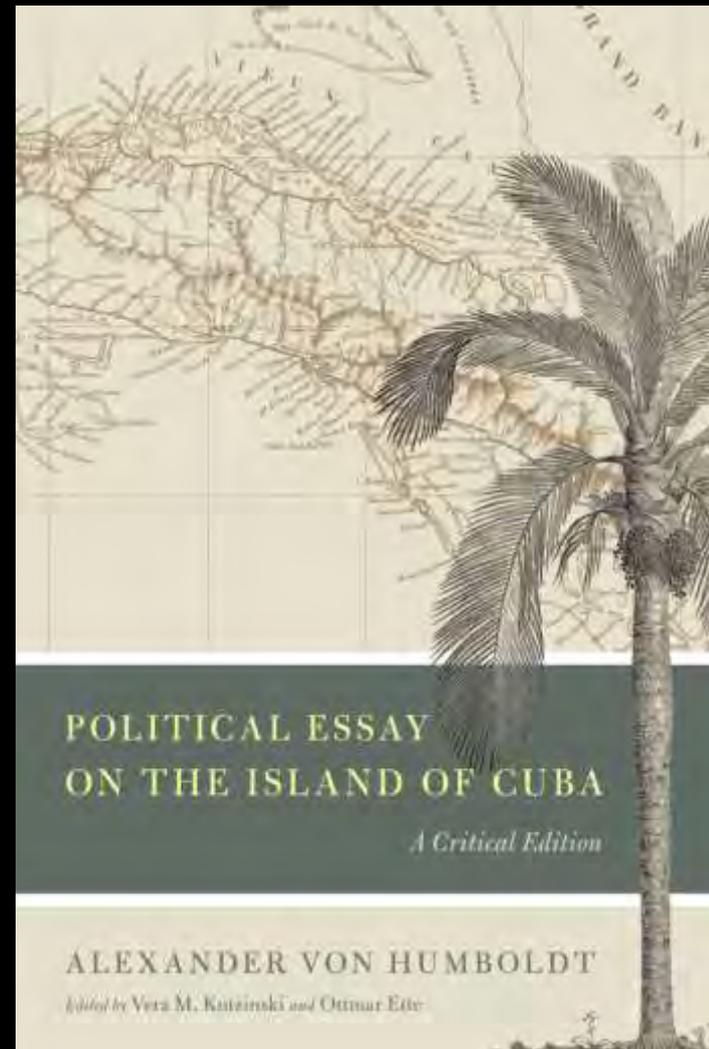
- Ansichten der Natur – “active viewing” Naturgemälde
- Seven ways of viewing nature – steppes, deserts, plant ecology, rivers, forests, volcanoes, human impacts in the Andes
- Each essay filled with extensive annotations
- Chapter 5 “Ideas for a Physiognomy of Plants”
- Endnote 13 “The forms of organic life are mutually dependent upon one another. The unity of Nature lies in the fact that these forms limit one another according to laws that are most likely bound to long periods of time...My investigations of the numerical laws of the distribution of forms will eventually be able to be applied with some success to the various classes of vertebrates...”



Humboldtian Science – Freedom and Equality

Slavery and *Political Essay Cuba* 1826

- a physical and cultural study (geography) of Cuba
- Humboldt denounces colonial slavery on both moral and economic grounds and stresses the vital importance of improving intercultural relations throughout the Americas.
- banned, censored, and willfully mistranslated to suppress Humboldt's strong antislavery sentiments.
- 1856 John Sidney Thrasher publishes "translation" changing it into a pro-slavery essay
- "my book against slavery...is not prohibited in Madrid, but cannot be purchased in the United States"
- "Slavery is no doubt the greatest of all the evils that afflict humanity"



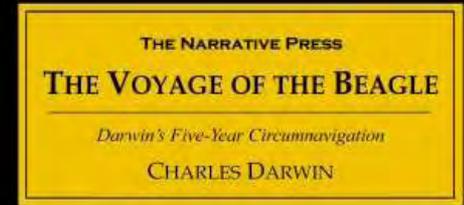
Humboldt's Progeny - Charles Darwin 1809-1882

Darwin spent two years at Edinburgh University from 1825 to 1827, studying for a medical degree. Although the teenage Darwin showed some aptitude for doctoring, the lectures bored him and he could not stand witnessing operations. He did not find it difficult to divert his attention from medicine to his real interest which, since childhood, was natural history.

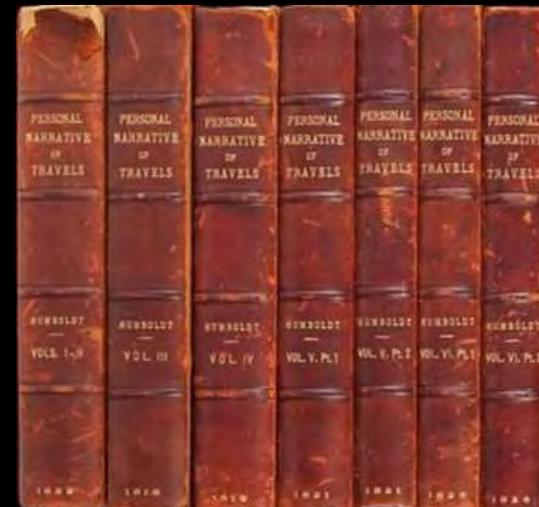
Having abandoned medicine as a career in April 1827, the only other career his father could imagine for Charles was that of clergyman. Darwin took the rest of the year off to revise his Greek ready to go to Christ's College, Cambridge. Darwin came up at the beginning of 1828 to obtain a BA.

It was in Cambridge that Charles met the man who fanned the flames of his scientific ambition. John Stevens Henslow (1796-1861), Professor of Botany, was perhaps the first man really to recognize Darwin's exceptional abilities. It was Henslow who nurtured Darwin's passion for travel and natural history and inspired him to resume his study of geology. Henslow encouraged Darwin to read Alexander von Humboldt's account of his travels to the 'New World'

Henslow's parting gift to Darwin when he set sail on the Beagle was a set of the seven volumes of Helen Maria Williams's English translation of Humboldt's Personal Narrative.



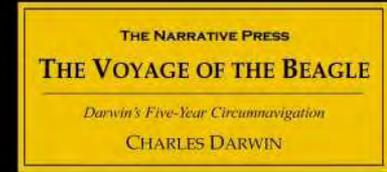
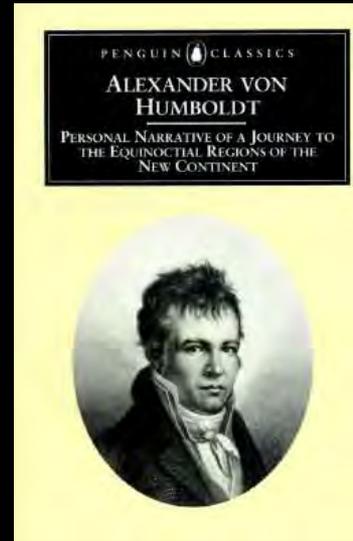
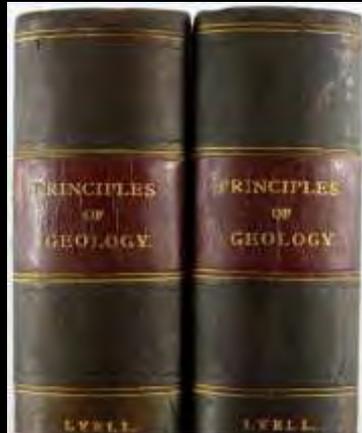
NUMBER 51 IN THE HISTORICAL ADVENTURE AND EXPLORATION SERIES



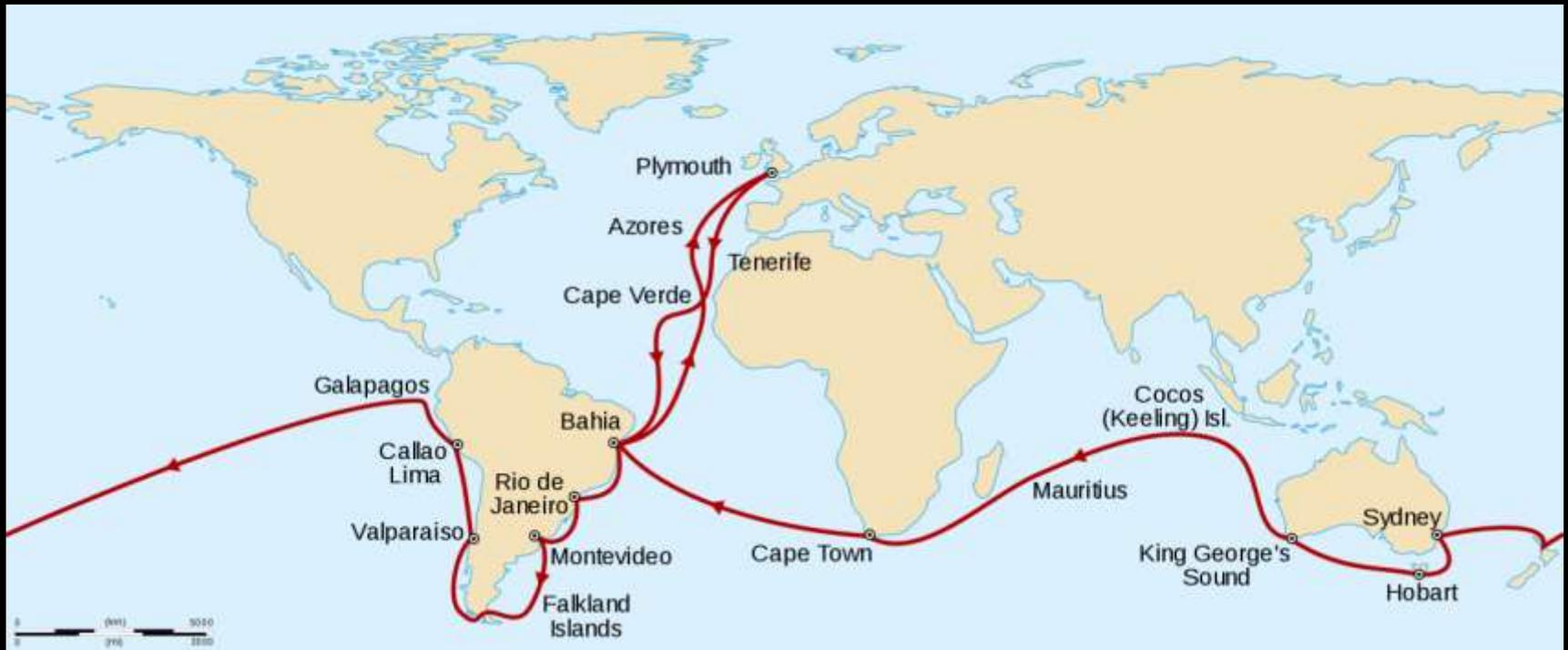
Charles Darwin 1809-1882

The Voyage of the Beagle 1831-36

Published 1839



NUMBER 51 IN THE HISTORICAL ADVENTURE AND EXPLORATION SERIES



Humboldt's Progeny - Biogeography and Evolution

Alfred Russel Wallace 1823-1913

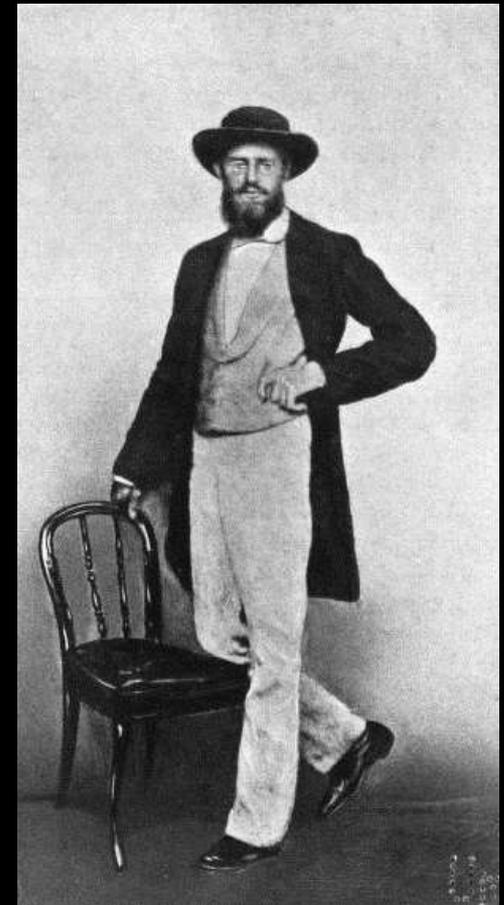
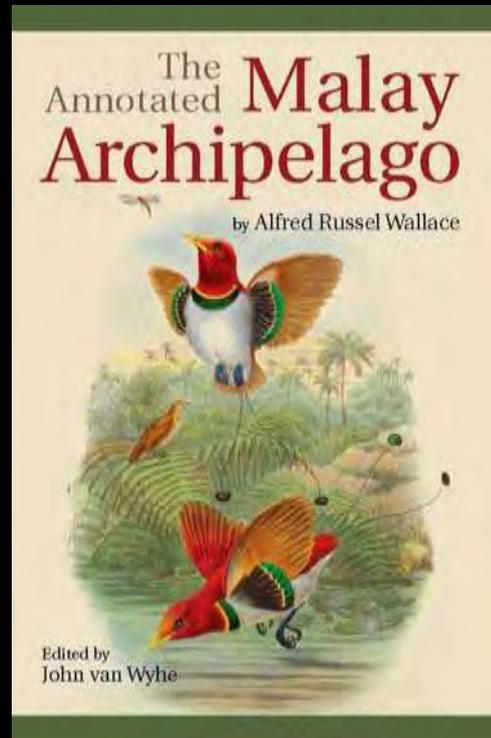
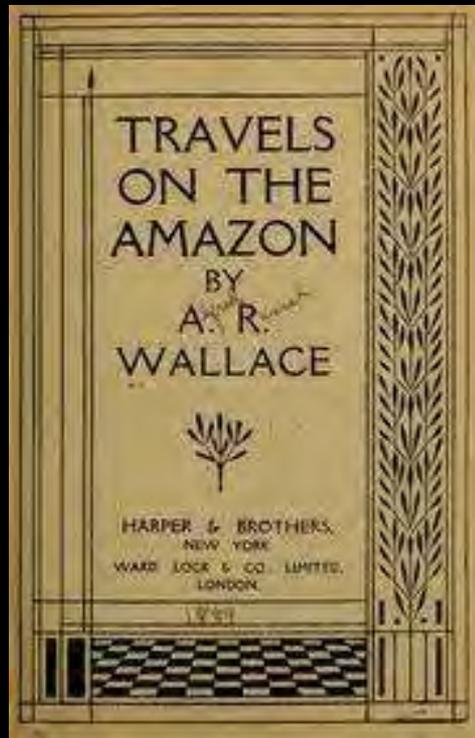
Cites two influences to travel to the tropics - Humboldt's *Personal Narrative* – “the first book that gave me the desire to visit the tropics” and Darwin's *Voyage of the Beagle*

Travels to the Amazon (1848-52)

Publishes *A narrative of travels on the Amazon and Rio Negro* (1853)

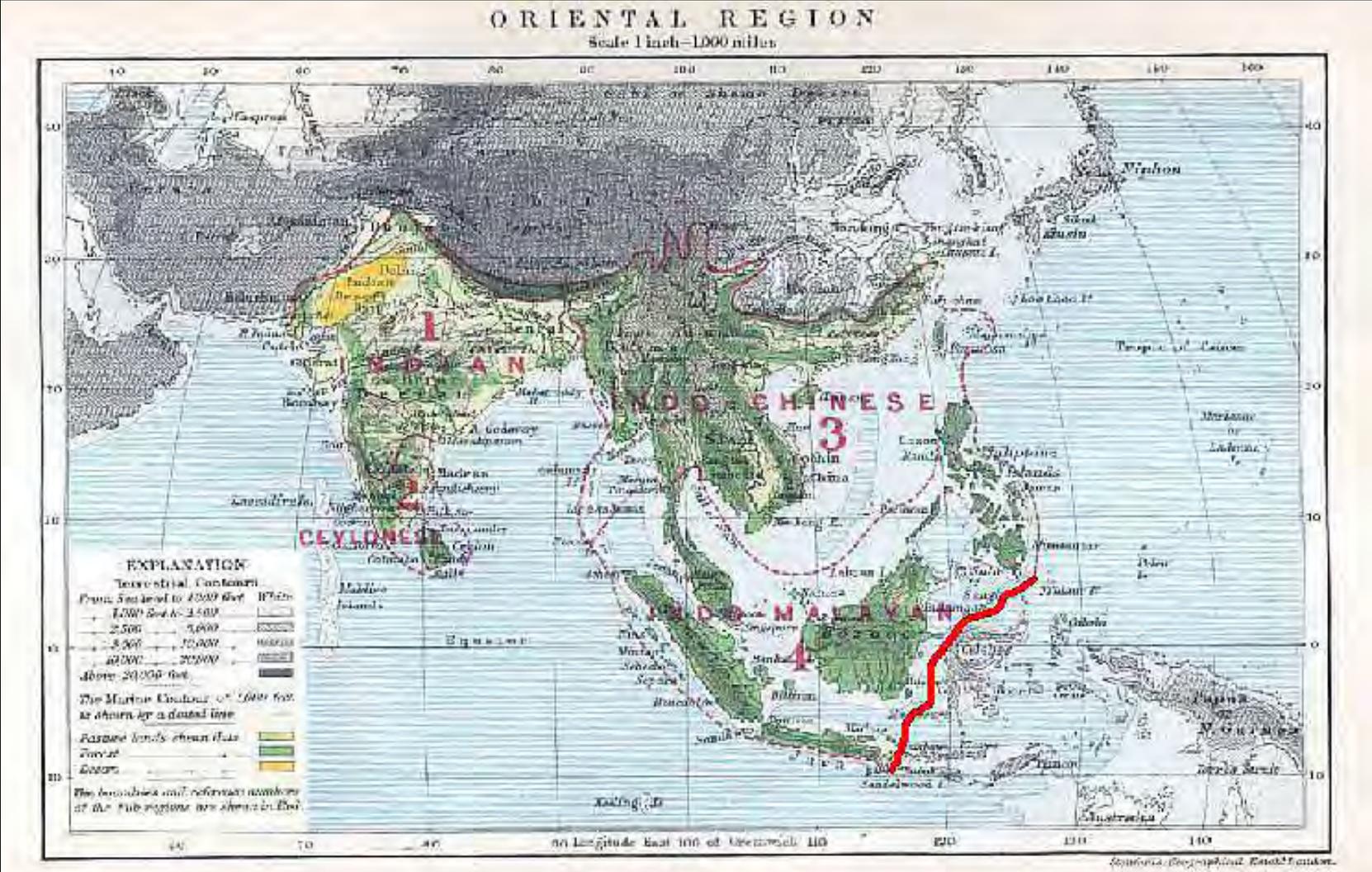
Travels to the Malay Archipelago (1854-1862)

Publishes *The Malay Archipelago* (1869)



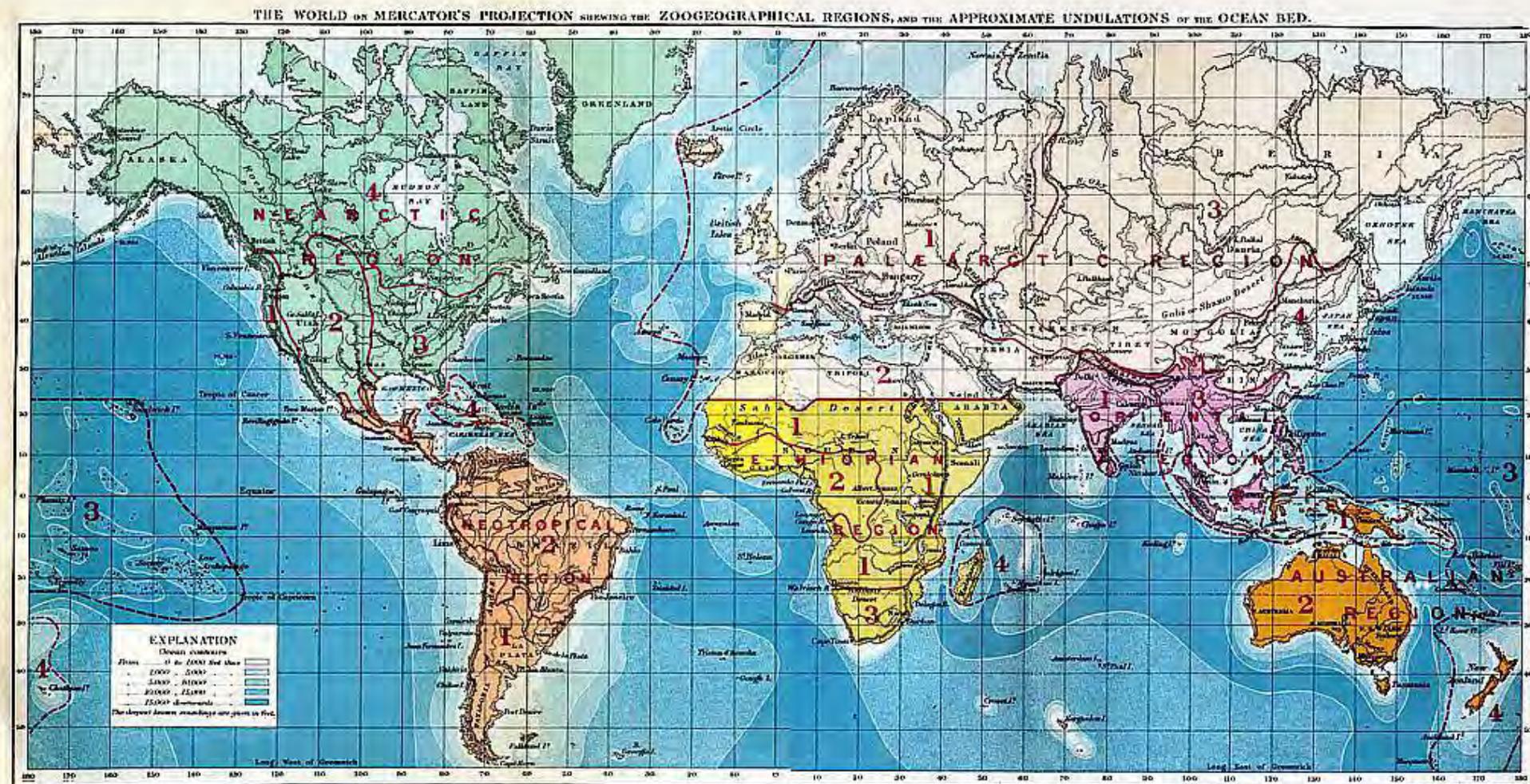
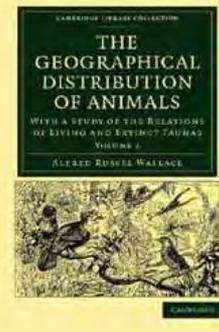
Wallace - "Father of Biogeography"?

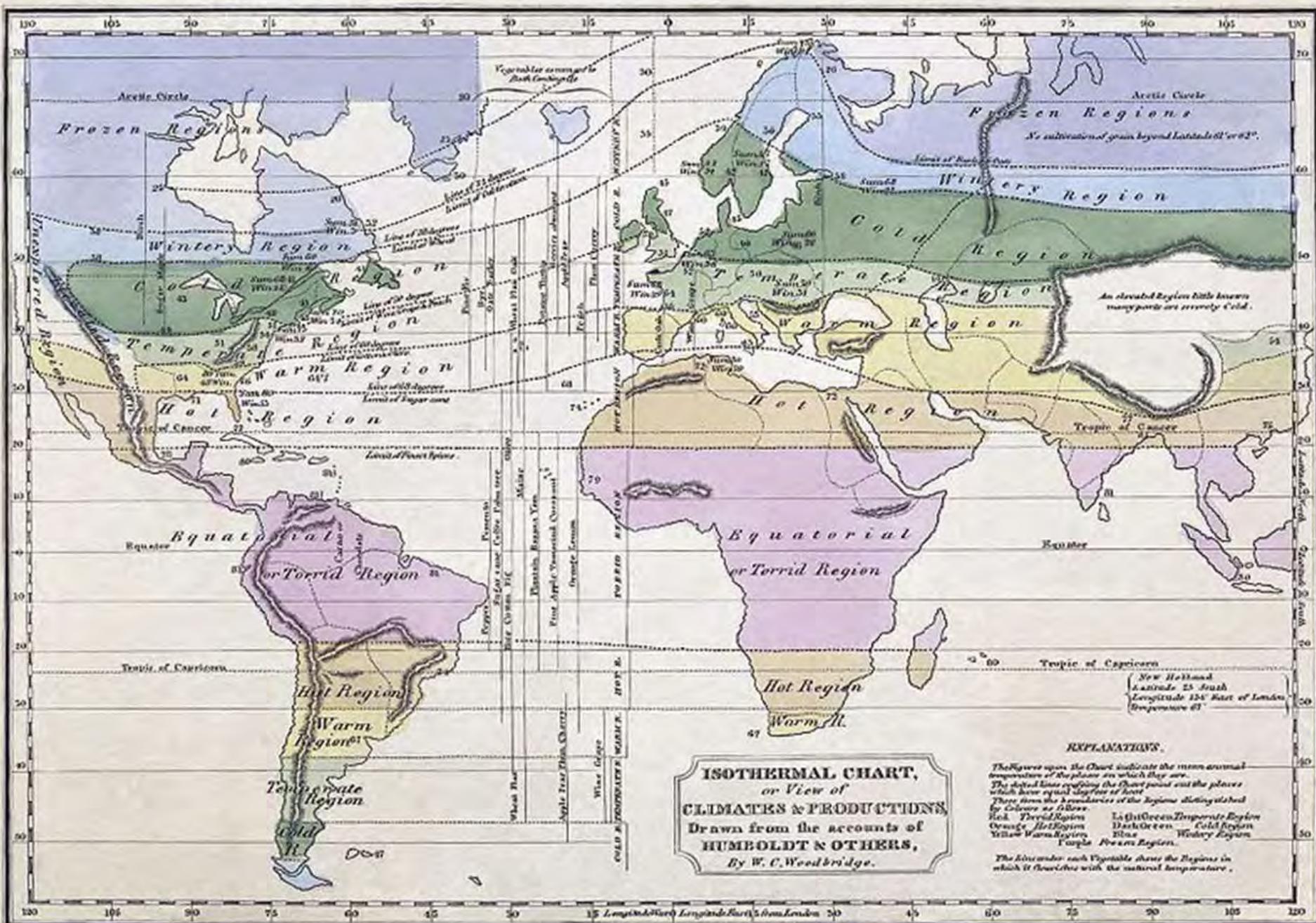
Identified the "Wallace Line" that divides the Indonesian archipelago into two distinct parts, one in which animals closely related to those of Australia are common, and one in which the species are largely of Asian origin.



Biogeography - Wallace

The geographical distribution of animals; with a study of the relations of living and extinct faunas as elucidating the past changes of the Earth's surface (1876)





ISOTHERMAL CHART,
or View of
CLIMATES & PRODUCTIONS,
 Drawn from the accounts of
HUMBOLDT & OTHERS,
By **W. C. Woodbridge.**

EXPLANATIONS.

The figures upon the Chart indicate the mean annual temperature of the places on which they are.
 The dotted lines crossing the Chart point out the places which have equal degrees of heat.

These from the boundaries of the Regions distinguished by Colours are as follows:

Red	Torrid Region	Light Green	Temperate Region
Orange	Hot Region	Dark Green	Cold Region
Yellow	Warm Region	Blue	Wintery Region
Purple	Frozen Region		

The lines under each Vegetable show the Regions in which it flourishes with the natural temperature.

Revised according to act of Congress the 15th day of January 1850. By William C. Woodbridge of the State of Massachusetts.

NEOTROPICAL REGION

Scale 1 inch=1,000 miles



New York: Harper & Brothers.

Stanley's Geographical Estate London

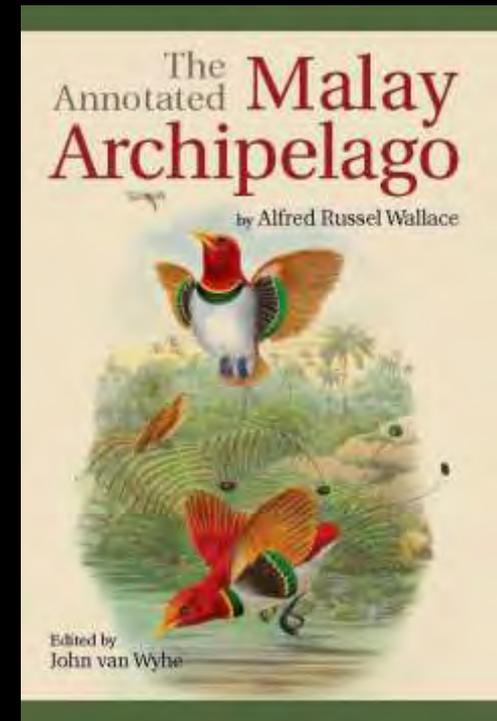
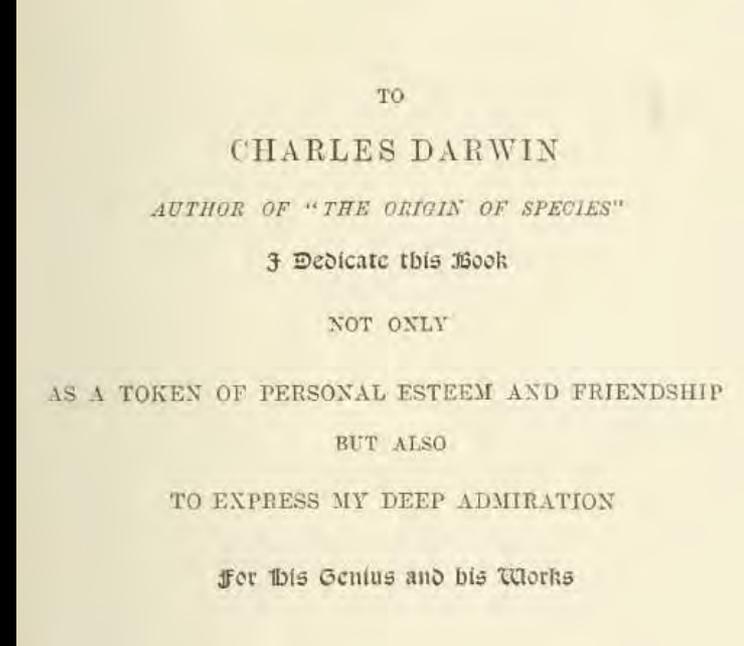
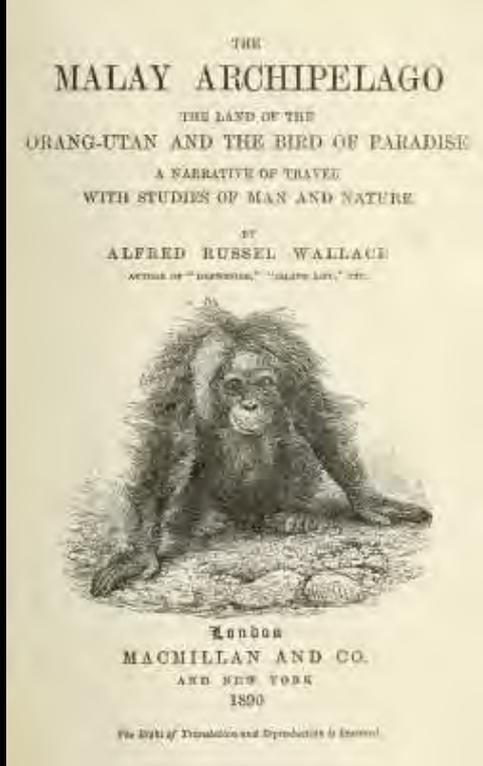
NEARCTIC REGION

Scale 1 inch=1,000 miles



New York: Harper & Brothers.

Stanley's Geographical Estate London



“Co-discovery” of the Theory of Evolution 1858

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

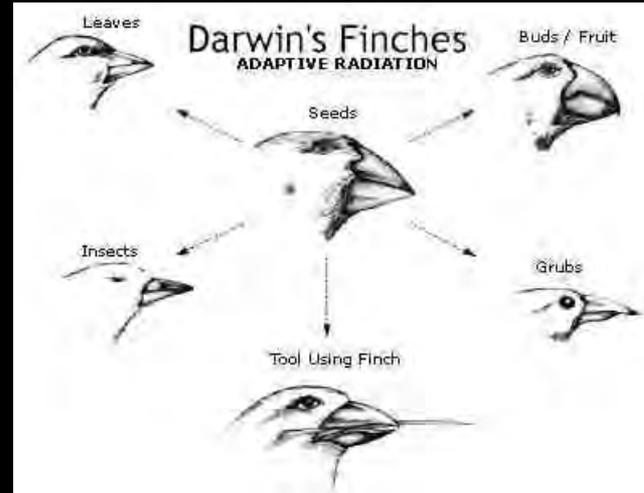
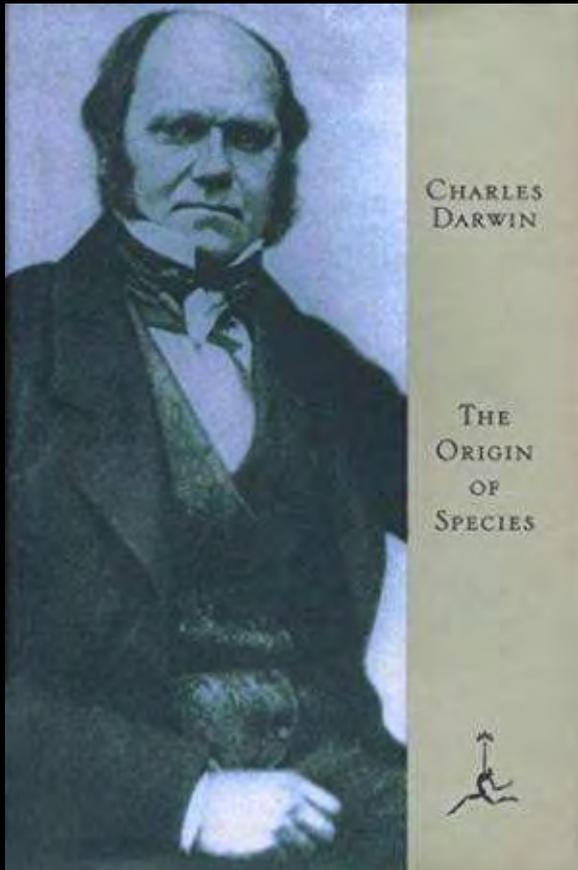
“On the Tendency of Varieties to depart indefinitely from the Original Type” (1858)

Darwinism: an exposition of the theory of natural selection with some of its applications (1889)

Darwin "Co-discovery" of the Theory of Evolution 1858-1859

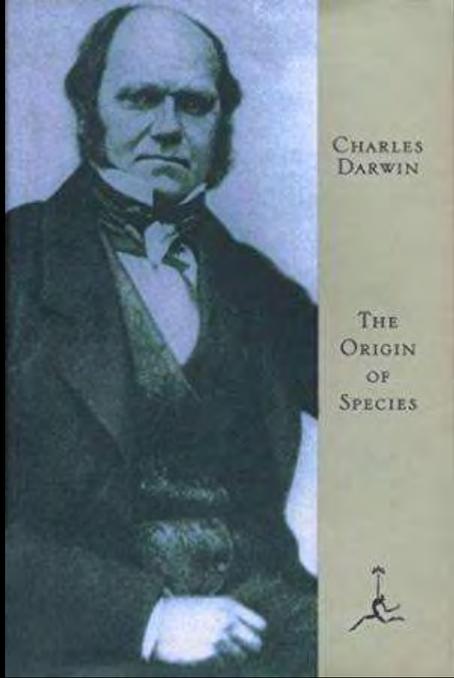
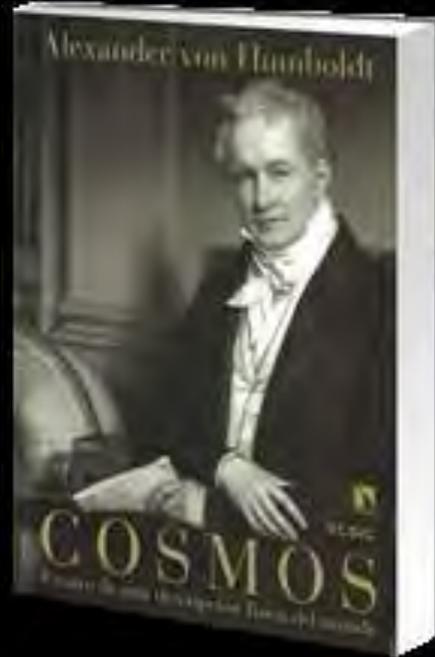
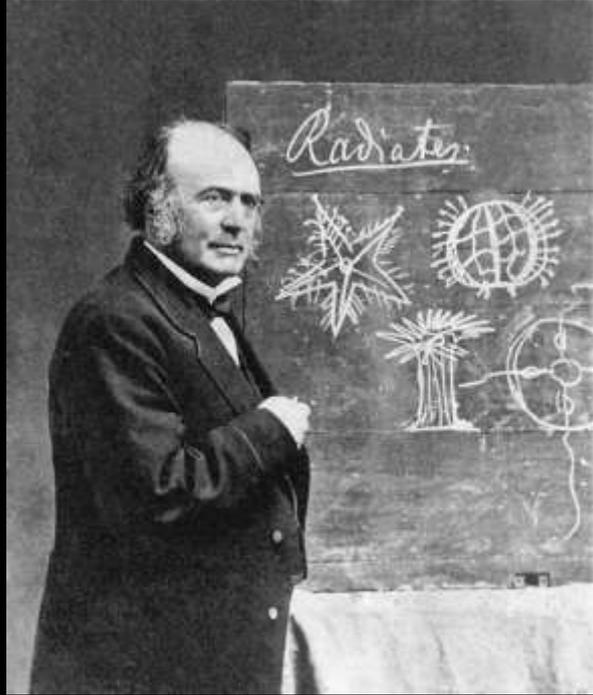
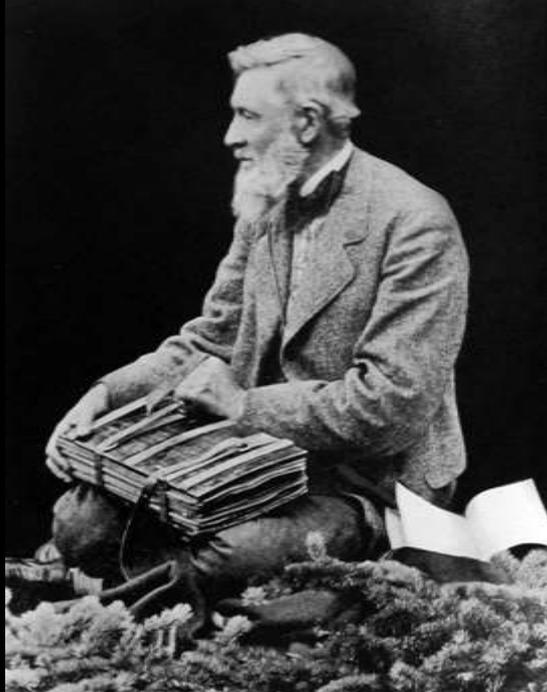
When Darwin received Alfred Russel Wallace's paper which described natural selection, he offered to give Wallace credit for the discovery. Joseph Hooker and Charles Lyell arranged for a joint reading of papers by Darwin and Wallace to the Linnean Society on July 1, 1858.

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).



Emergence of American Biology and the Great Evolution Debate

1800-1900



Biology and Natural Theology

John Ray 1627 – 1705

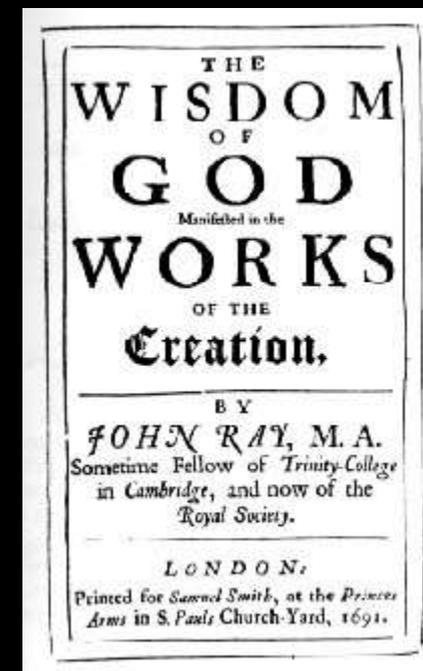
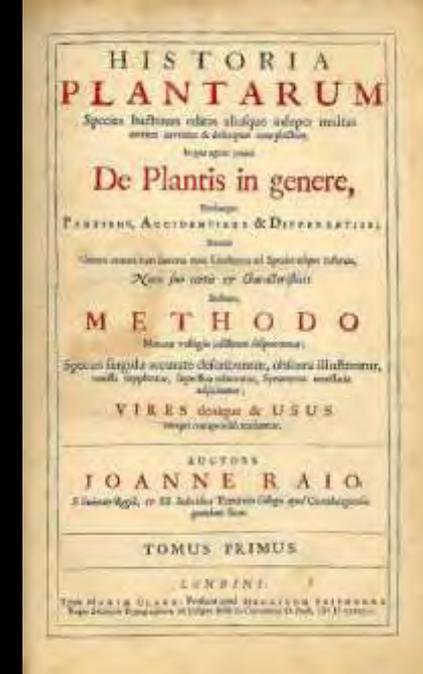
The father of English natural history, Ray published important works on botany, zoology, and natural theology.

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

“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.”

Ray 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.

"to illustrate the glory of God in the knowledge of the works of nature or creation"



American Natural History and Natural Theology

Theology of Nature - Natural History as a Window into the Divine

Ordinary Americans asked and answered why phenomena occurred, oftentimes with theological reasoning, adding religious import to nature study and nationalist gloss.

Cotton Mather 1663 – 1728

The Christian Philosopher. A Collection of the Best Discoveries in Nature, with Religious Improvements (1721)

“Natural Philosophers” were not a threat to religion but when properly construed they presented evidence of God’s perfection.

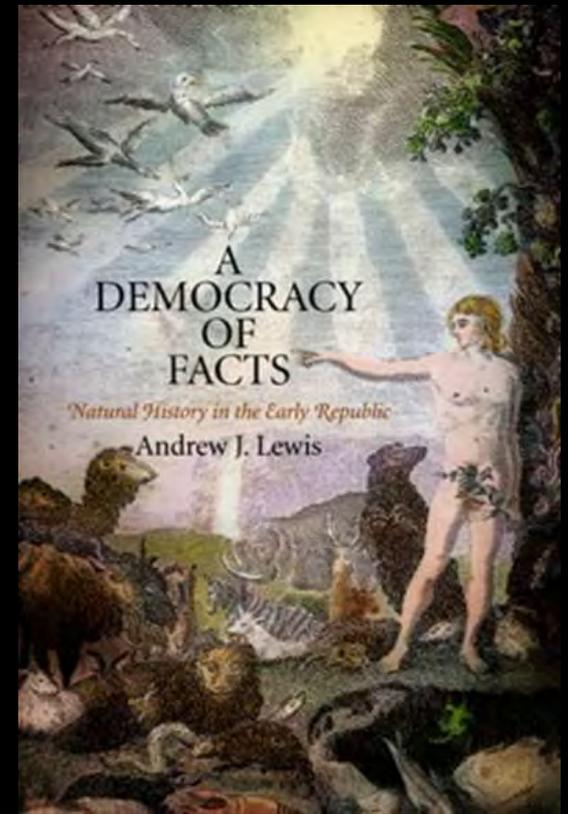
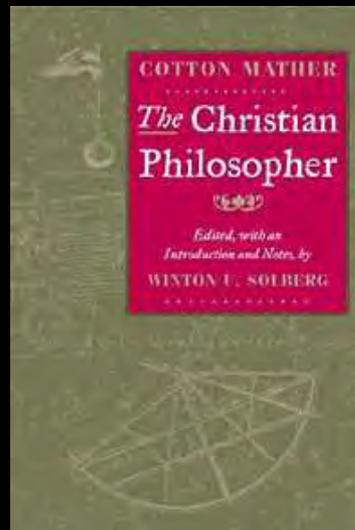


Image from
Natural History of the Bible
Thaddeus Mason Harris
1793

The Rise of American Botany – Mentorship and Europe

Asa Gray 1810 – 1888

Gray was born in Sauquoit, New York in 1810. Though he graduated with the degree of M.D. in 1831, he never practiced medicine. It was during this time that Gray began to mount botanical specimens.

On a trip to New York City, he attempted to meet with John Torrey to get assistance in identifying specimens, but Torrey was not home, so Gray left the specimens at Torrey's house. Torrey was so impressed with Gray's specimens that he began a correspondence with Gray.

Gray first met Torrey in person in September 1832 and they went on an expedition to New Jersey. Gray became an assistant to Torrey. Torrey's attempt to get Gray a job at Princeton University was unsuccessful, as were other attempts to find him a position in science. Gray and Torrey published *The Flora of North America* together in 1838.

In 1838, Gray became the very first professor at the newly founded University of Michigan. Appointed the Professor of Botany and Zoology, Gray was dispatched to Europe by the regents of the university for the purpose of purchasing a suitable array of books to form the university's library.

In England he is hosted by Sir William Hooker and meets his son, Joseph Dalton Hooker who introduces him to his friend, Charles Darwin, recently back from a voyage around the world.



John Torrey 1796 – 1873
First American Botanist

Asa Gray in 1841



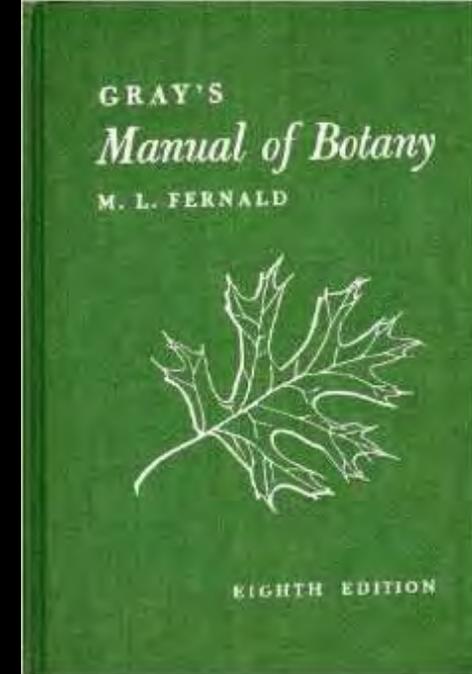
The Rise of American Botany – Gray's Manual

On returning from Europe, Gray discovers that the job in Michigan has evaporated, but that Harvard University has a position for him.

The offer was \$1000/year salary, teaching duties limited to only botany, and being superintendent of Harvard's botanic garden. Gray accepted this appointment as Fisher Professor of natural history at Harvard. The formal appointment was made in 1842.

Gray was considered a weak lecturer, but because of his expert knowledge, he was highly regarded by his peers. His skills were better suited to teaching advanced rather than introductory classes.

His most widely used book, *Manual of the Botany of the Northern United States, from New England to Wisconsin and South to Ohio and Pennsylvania Inclusive* (1848), commonly called *Gray's Manual*, has remained, in successive editions, a standard work in this subject.



Humboldtian Science

Gray's Botanical Network

George Engelmann 1809 – 1884

Gray met physician and botanist George Engelmann in the early 1840s and they remained friends and colleagues until Engelmann died in 1884

Jean Louis Berlandier 1830s

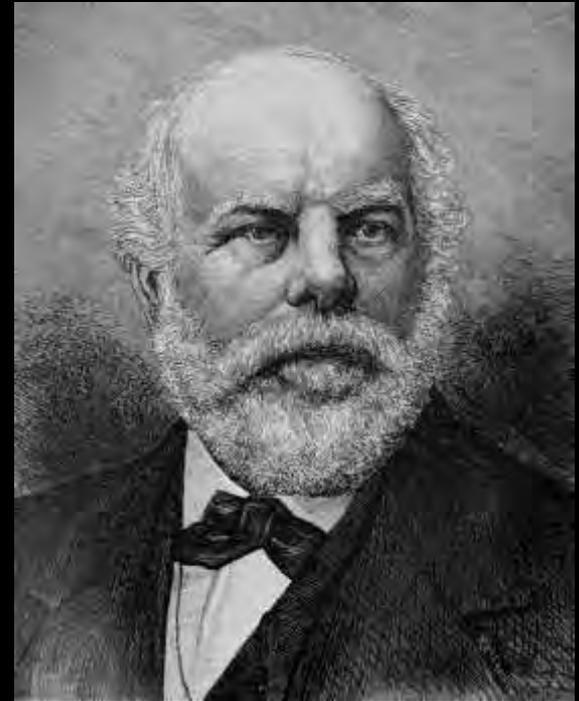
Thomas Drummond 1830s

Ferdinand Lindheimer 1830s

Ferdinand von Roemer 1840s

International Network

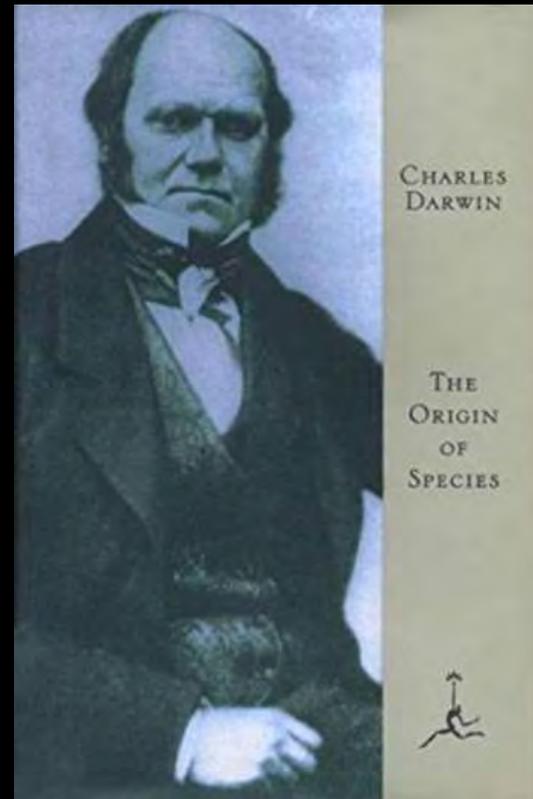
Shipped [Sold] to Kew Gardens - Joseph Hooker and other European botanical collections



Darwin and Gray

Of the several thousand letters that Charles Darwin wrote during his lifetime, few were more important than one he sent on September 5, 1857, to Asa Gray.

Darwin wrote in his semi-legible scrawl: "I will enclose the briefest abstract of my notions on the means by which nature makes her species....I ask you not to mention my doctrine." Asa Gray thus became the first person in North America to learn about Darwin's ideas on natural selection.



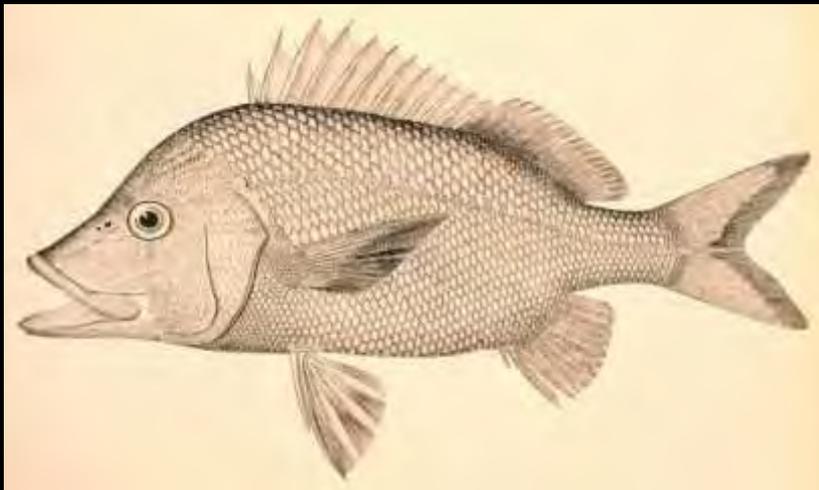
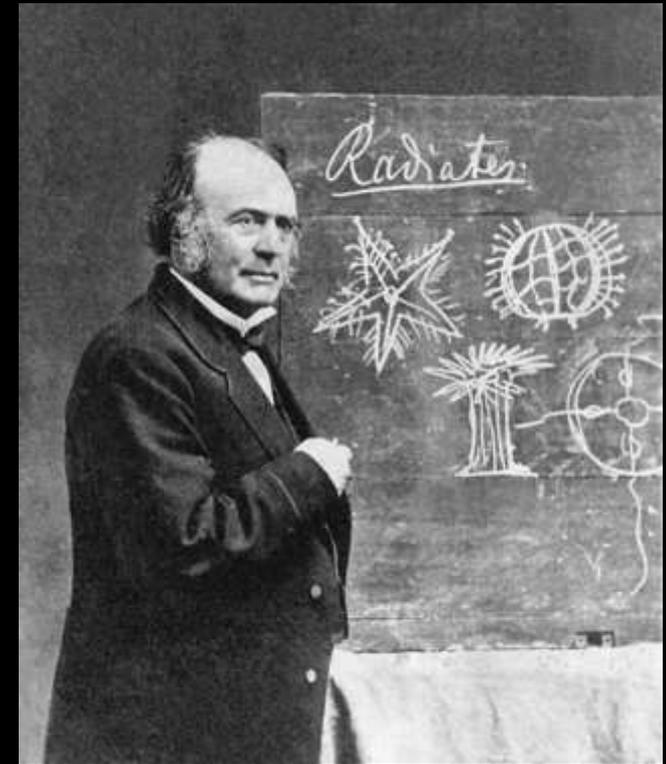
Humboldt Progeny - Agassiz and American Science

Louis Agassiz 1807 - 1873

He grew up in Switzerland and studied in France during 1831-32 working closely with Cuvier on fossil fish at the Museum of Natural History in Paris. There he became friends with Humboldt, who made a large cash gift to help Agassiz continue his work.

Later that year, he became a professor of natural history at University of Neuchâtel through Von Humboldt's support.

His two great areas of study were marine biology and glaciation. Agassiz made extensive contributions to ichthyological classification (including of extinct species) and to the study of geological history (including to the founding of glaciology).



Humboldtian Science - Agassiz and American Science

In 1846, Agassiz came to the United States on a lecture tour arranged by Humboldt; he was a huge popular success and his expertise was widely recognized and celebrated.

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 Museum of Comparative Zoology, which opened its doors in 1860. This was the first publicly funded science building in North America.



Agassiz vs. Humboldt - Natural Theology "A species is a thought of the Creator"

Agassiz was a staunch creationist, and 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.

Agassiz staunchly supported the fixity of species and special creation of man, and thus became an outspoken critic of Darwin's theory of evolution.

1802

WILLIAM PALEY, AN ENGLISH PHILOSOPHER, PUBLISHES HIS "NATURAL THEOLOGY".

IF THERE IS A WATCH, THERE MUST BE A WATCHMAKER!

THIS WAS THE ARGUMENT FROM INTELLIGENT DESIGN.

BUT...

IF I MADE THE WATCHMAKER, THEN WHO MADE ME?



Agassiz vs. Humboldt Polygenesis vs. Monogenesis

White Superiority and the Faces of Slavery

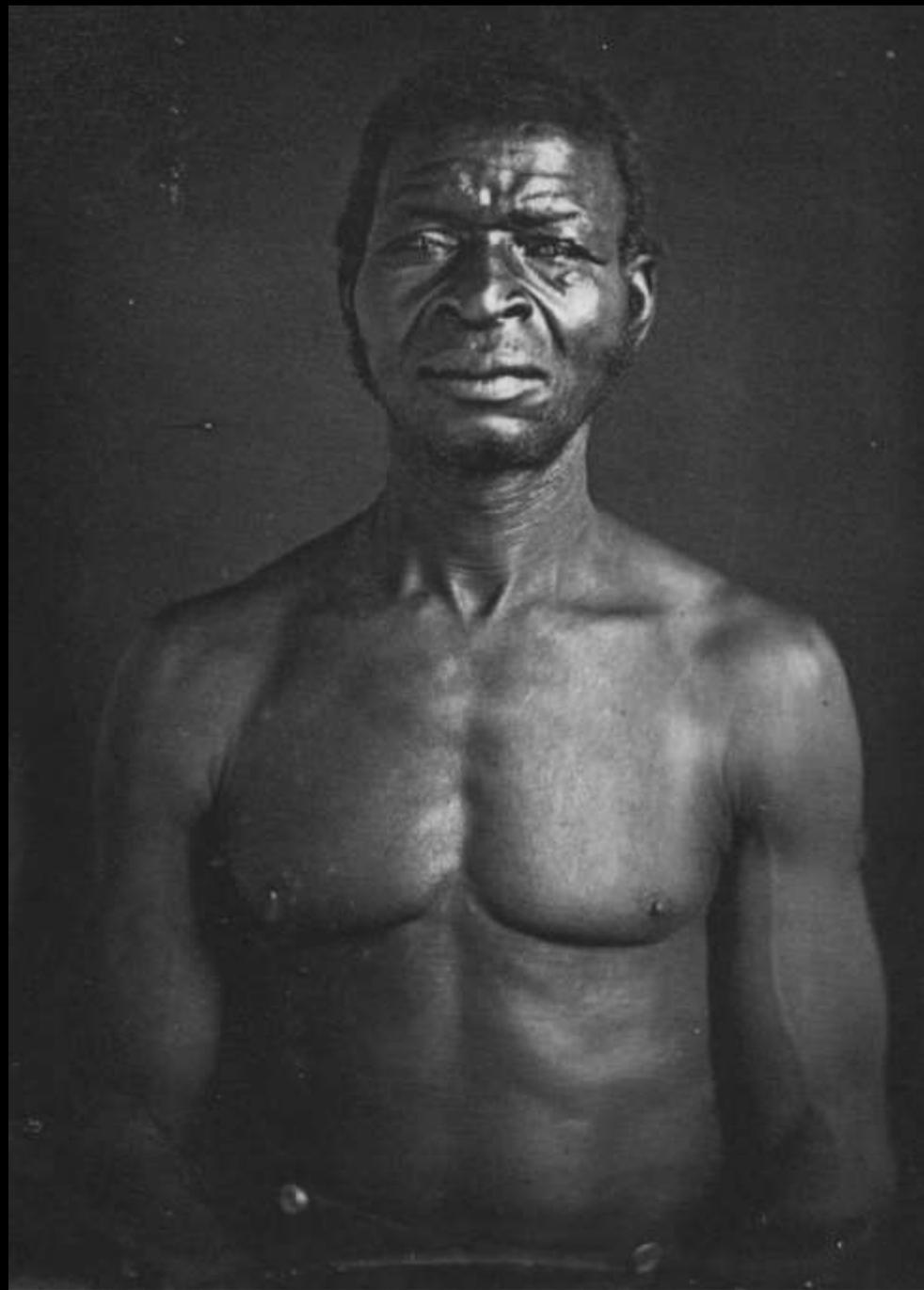
Joseph Zealy daguerreotypes, photographs of South Carolina plantation slaves that were commissioned in 1850 by Agassiz (and that ended up in the anthropology museum there).

Ironically Agassiz wanted these photographs to be read as evidence—specifically as scientific evidence for polygenesis, the idea that human races had separate origins and were thus inescapably and irrevocably different.

The chosen slaves, according to the captions found with the images, were either born in Africa or born of African parents. Somehow these images were supposed to convince presumably white viewers that the black African body was so alien that the African “race” must be, in effect, a separate species.

Von Humboldt was disgusted by Agassiz’s views on race, slavery, and the superiority of white humans.

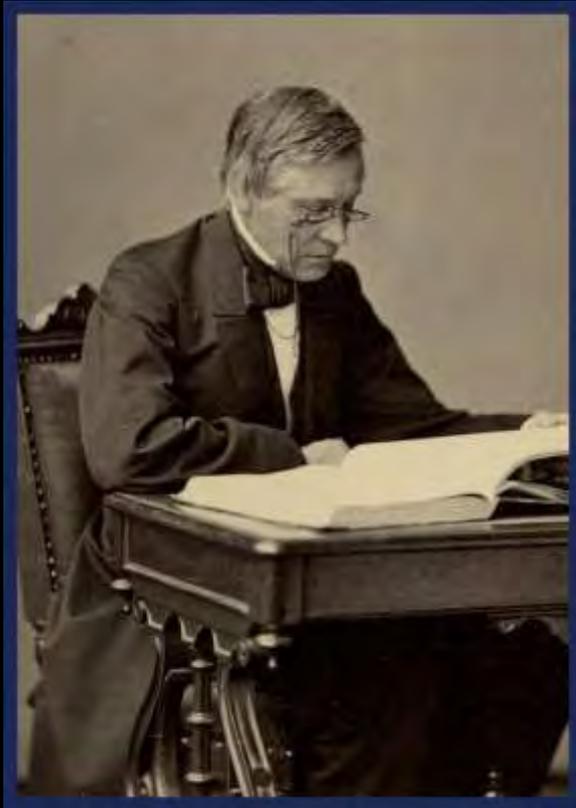




Agassiz and Gray – Slavery and Human Evolution

Gray abhorred slavery. In his view science proved the unity of all man because all human races can interbreed and produce fertile offspring; i.e., all members of a species are connected genetically.

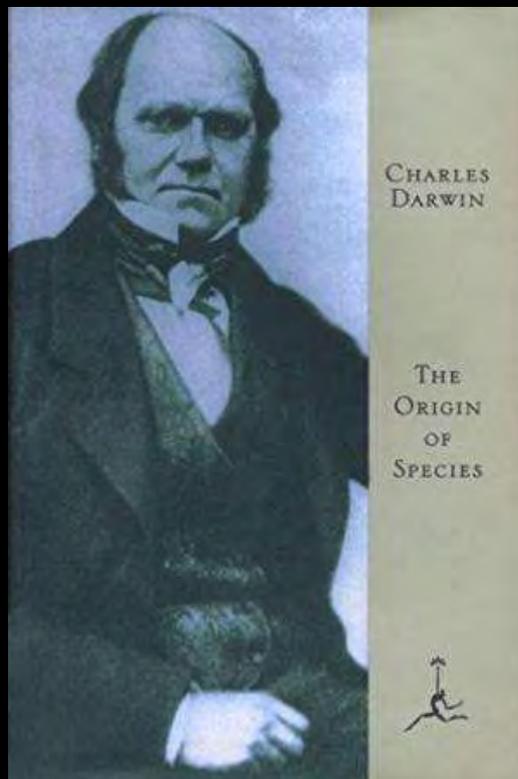
He also felt Christianity taught the unity of mankind.



Gray and the “Co-discovery” of the Theory of Evolution 1858-1859

When Darwin received Alfred Russel Wallace's paper which described natural selection, Hooker and Charles Lyell arranged for a joint reading of papers by Darwin and Wallace to the Linnean Society on July 1, 1858.

Since Darwin had nothing prepared, the reading included excerpts from his 1844 unpublished essay "On the Variation of Organic Beings in a state of Nature; on the Natural Means of Selection; on the Comparison of Domestic Races and true Species" and from the letter he had sent to Asa Gray in July 1857, outlining his theory on the origin of species.



Gray and the “Co-discovery” of the Theory of Evolution 1858-1859

To Asa Gray July 1857

As you seem interested in subject, & as it is an immense advantage to me to write to you & to hear ever so briefly, what you think, I will enclose (copied so as to save you trouble in reading) the briefest abstract of my notions on the means by which nature makes her species...In regard to my abstract you must take immensely on trust; each paragraph occupying one or two chapters in my Book. You will, perhaps, think it paltry in me, when I ask you not to mention my doctrine...



And it follows, I think, from the foregoing facts that the varying offspring of each species will try (only few will succeed) to seize on as many and as diverse places in the economy of nature, as possible. Each new variety or species, when formed will generally take the places of and so exterminate its less well-fitted parent. This, I believe, to be the origin of the classification or arrangement of all organic beings at all times. These always seem to branch and sub-branch like a tree from a common trunk; the flourishing twigs destroying the less vigorous,—the dead and lost branches rudely representing extinct genera and families



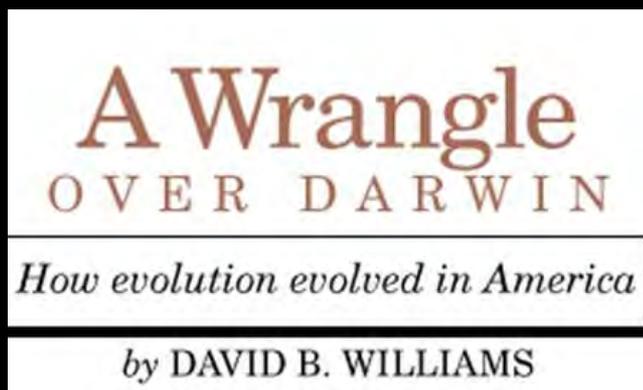
By that time Darwin was into writing his book *On the Origin of Species*. The correspondence with Gray was thus a key piece of evidence in establishing Darwin's intellectual priority with respect to the theory of evolution by natural selection. Its publication prompted fierce debate in America.

The Great American Evolution Debate

On one side arose Gray, Darwin's friend and supporter. In opposition stood Gray's Harvard colleague Louis Agassiz, a charming, brilliant lecturer and the most popular scientist in the land. Harvard thus became the most important battleground in the initial American engagement with natural selection.

Agassiz launched his public attack on Darwin at the American Academy of Arts and Sciences, Boston's most important learned society. He told the group gathered on January 10, 1860, that modern species and fossil species had no genetic relationship.

This tenet was central to the theory of special creationism, which held that God had created each and every species in its current location. Species did not change through time, but they did become extinct. Great catastrophes, like floods or the glaciers described by Agassiz in *Études*, had periodically destroyed life on earth.

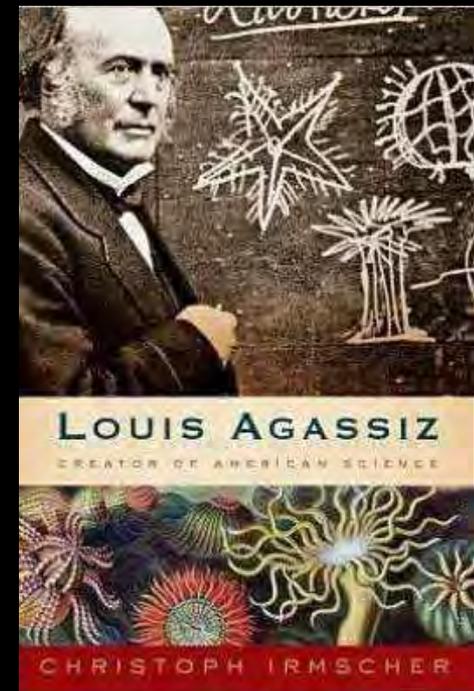
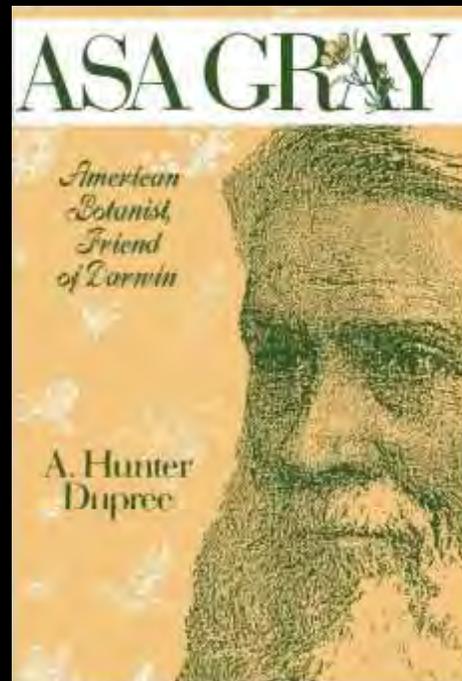


"Darwin's Dove" and Humboldt's Progeny

Gray began his public defense of Darwin, also in the American Journal of Science, with a positive review of Origin in the March 1860 issue. He wrote that Darwin's ideas on variation within plants and animals were "general, and even universal."

Despite Gray's strong religious feelings, he was at heart a scientist. Unlike Agassiz, he could separate his faith and his science.

Gray ultimately concluded that "The work [Origin] is a scientific one...and by its science it must stand or fall."



The Great Debate and the Rise of Evolution

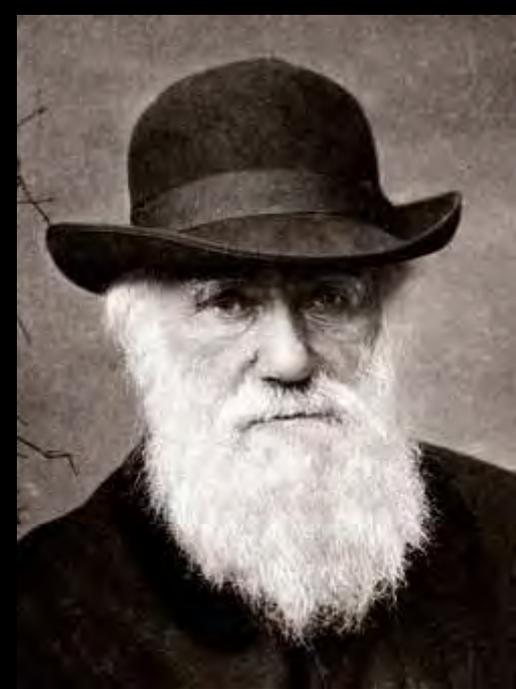
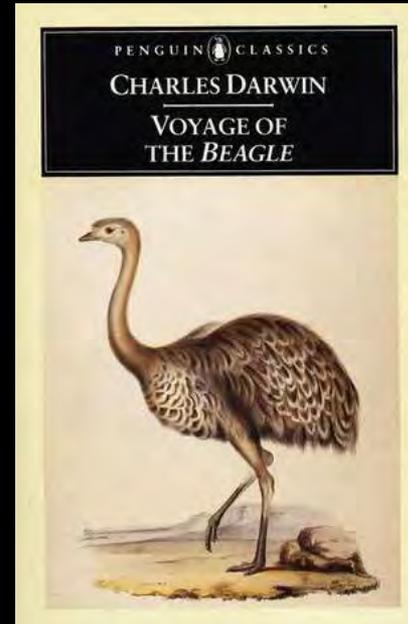
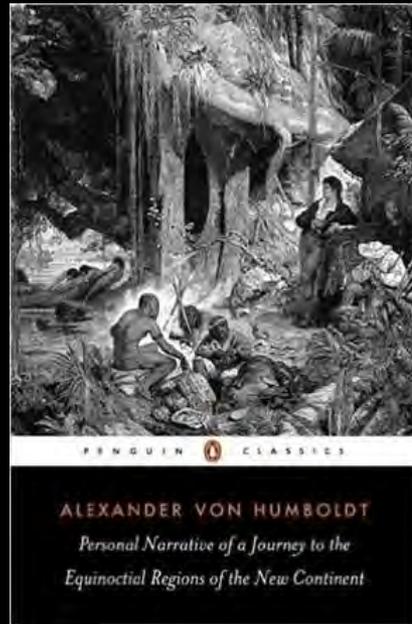
Asa Gray wrote a series of reviews of Darwin's works for American magazines such as *Atlantic Monthly* and *The Nation*. These gave publicity to Darwin's theories, and they also contained extended reflections on the possible implications of these theories for natural theology and religious belief. Darwin was particularly pleased with one of these reviews, and arranged for it to be republished in England as a pamphlet. A collection of Gray's reviews was published in book form in 1876 under the title *Darwiniana*.

"Finally, we advise nobody to accept Darwin's or any other derivative theory as true. The time has not come for that...Meanwhile an inevitable and legitimate hypothesis is on trial—an hypothesis thus far not untenable—a trial just now very useful to science, and, we conclude, not harmful to religion, unless injudicious assailants temporarily make it so. One good effect is already manifest; its enabling the advocates of the hypothesis of a multiplicity of human species to perceive the double insecurity of their ground. When the races of men are admitted to be of one species, the corollary, that they are of one origin, may be expected to follow."

By Agassiz's death in 1873, Darwin's theory as championed by Gray was broadly accepted by American biologists.



Humboldt's Progeny - Charles Darwin



There is no better proof of how Darwin treasured his Personal narrative to the end of his life than his ink note written inside the back cover of volume 3 of his own copy: "July 6 1881 to p. 417 – April 3rd 1882 finished".

So the book given to Darwin by Henslow half a century before must have been one of the last Darwin ever read, or in this case re-read. He was too ill in the following weeks to do much else.

Darwin died on 19 April 1882.