

# Charles Robert Darwin (1809-1882)

---



*Biography of a man who changed the thinking of mankind*

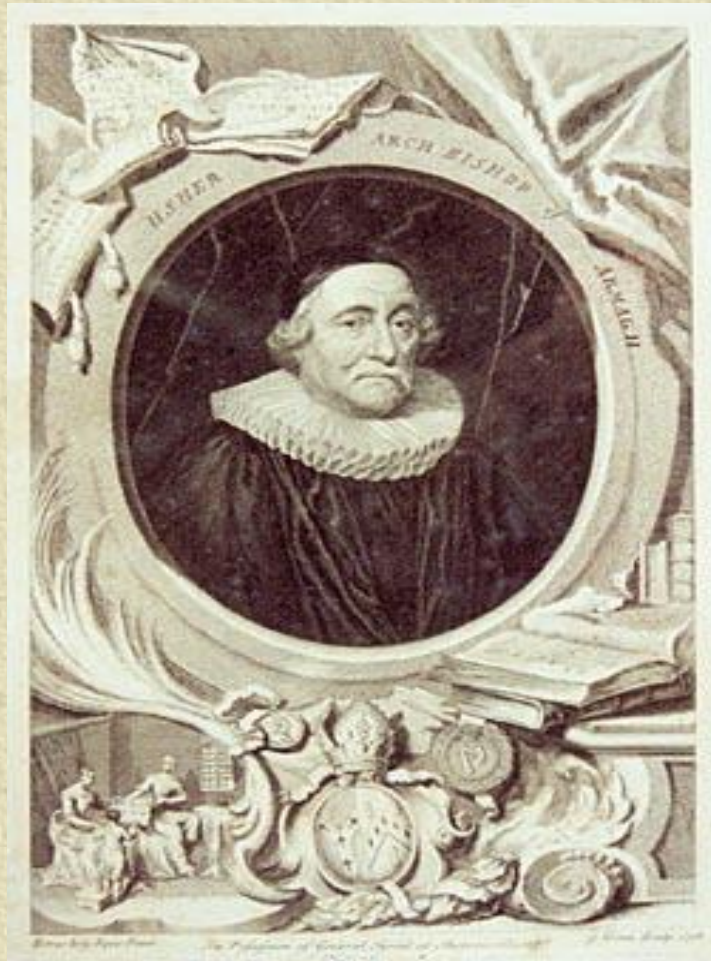
# Historical Background

---

- ✦ In the early 1800's it was commonly believed that the **Earth was only about 6,000 years old**.
- ✦ This belief was based on the work of **James Ussher**, an Irish archbishop, whose Biblical chronology in 1650 gave the date of the creation of Earth as **Sunday, Oct. 23, 4004 B.C.**
- ✦ All living organisms, it was believed, had been placed on the Earth in their **present forms** at that time by the Creator.

# James Ussher (1580-1655)

---



Archbishop of  
Armagh (1625)

# Historical Background

---

- ✦ The Earth itself, it was believed, had also remained **unchanged** from its time of creation.
- ✦ However, systematic excavations for mines, railways and roads revealed a wealth of fossils of extinct organisms in different layers of strata. This forced naturalists to admit that life in the past was very different from life today.

# Historical Background

---

✦ **Georges Cuvier**, a French paleontologist, noted that each layer of strata contained fossils that were different from the ones above and below it. **The deeper the strata, the more dissimilar the fossils were to modern life forms.** This led him to postulate that there had been many mass extinctions in the past.

# Georges Cuvier (1769-1832)

---

Cuvier postulated that there must have been at least 6 great epochs of creation, each followed by a massive extinction. This idea was called *catastrophism*.



# Historical Background

---

✦ In 1788, Scottish geologist James Hutton proposed that the Earth's features had changed gradually as the result of natural forces such as erosion. **Because this change is slow, Hutton argued that the Earth must be much older than a few thousand years. This concept became known as gradualism.**

# James Hutton (1726-1797)

---



James Hutton was a Scottish landowner and geologist. In his book, *Theory of the Earth* (1785), he proposed that geologic time had been indefinitely long: “we find no vestige of a beginning, - no prospect of an end.”



# Earth Changed Gradually over Time



# Darwin's Childhood

---

- ✦ It was into this world that Charles Darwin was born on **Feb. 12, 1809**, in Shrewsbury, England (same day as **Abe Lincoln** was born).
- ✦ Father was Robert Darwin, a prominent physician.
- ✦ His mother, Susannah, died when Charles was 8.
- ✦ He had 4 sisters and one brother.
- ✦ Charles had an affluent childhood, loved nature.
- ✦ He was an intelligent, but **indifferent** student, preferring to teach himself.

# Darwin's Education

---

- ✦ His father sent Charles, at age 16, to study medicine at Edinburgh University but Charles could not stomach the “blood and guts” so he dropped out.
- ✦ In an effort to please his demanding father, Charles, then 18, enrolled in Cambridge to study math, the classics and theology.
- ✦ Charles hated formal studying; instead, he spent hours taking long walks in the countryside collecting plants and insects and enjoying nature.

# Darwin's New Friend

---

- ✦ In an attempt to identify some of his collected specimens, Darwin befriended a Cambridge botany professor, **John S. Henslow**.
- ✦ Because of their common interests, they became close friends.
- ✦ It was through Professor Henslow that Darwin's life was forever changed.

# Darwin's New Job

---

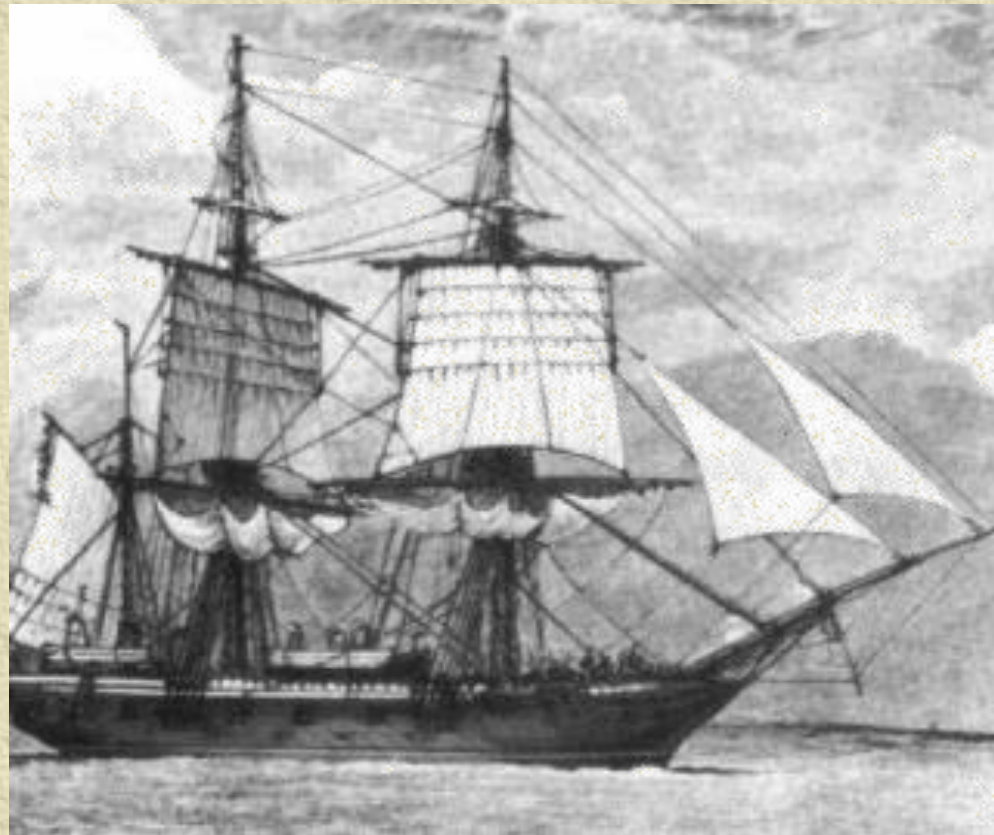
- ✦ Henslow introduced Darwin to Captain Robert Fitzroy, who commanded H.M.S. Beagle.
- ✦ Captain Fitzroy was looking for a cabin companion and naturalist for an upcoming voyage.
- ✦ Charles was interested because he would be able to get away and see new parts of the world.
- ✦ The *Beagle's* job was to survey and map the coastline of South America.

# Captain Robert Fitzroy (1805-1865)

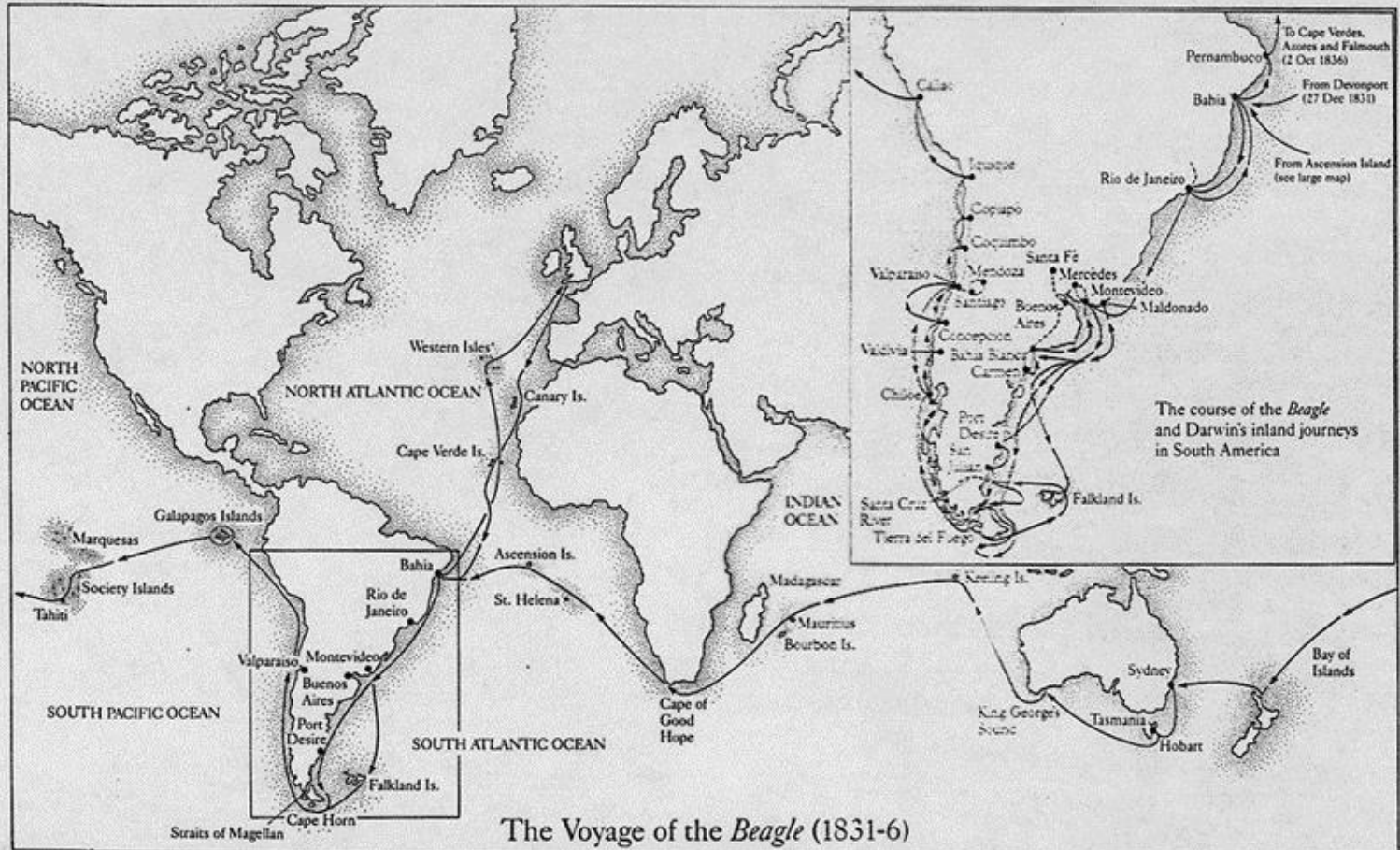
---



# *H.M.S. Beagle*



# Darwin's Route on *H.M.S. Beagle*





# Darwin's Problems at Sea

---

- ✦ *H.M.S. Beagle* left England on Dec. 27, 1831 to sail to South America.
- ✦ As it turned out Darwin & Fitzroy had many differences of opinion and ended up arguing frequently! Fitzroy became very angry whenever Darwin would bring up unorthodox opinions on matters of politics or religion.
- ✦ Darwin also got very seasick so he spent much time in his cabin reading books from Captain Fitzroy's library.

# Darwin's Readings

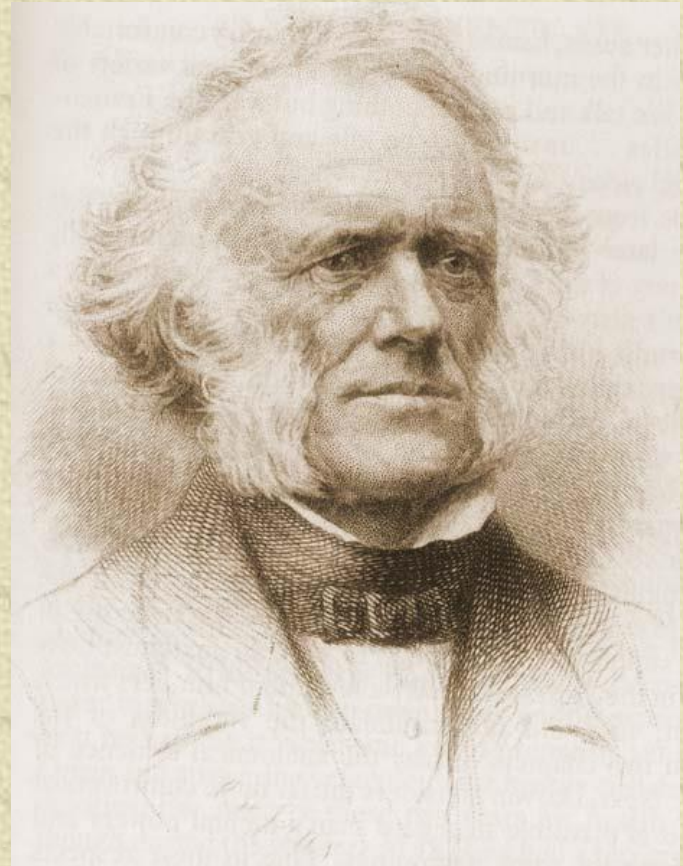
---

- ✦ One of the books that Darwin read during the voyage was *Principles of Geology* (1830), by Charles Lyell.
- ✦ Lyell, a lawyer turned geologist, argued that wind and water combined with volcanic activity had shaped the Earth. Changes in the Earth's crust were caused by these same forces over long periods of time. This idea was known as *uniformitarianism*.
- ✦ The writings of **Cuvier**, **Hutton** and **Lyell** greatly influenced Darwin's thinking about the age of the Earth. **He began to realize that the Earth must be much older than 6,000 years!**

# Charles Lyell (1797-1875)

---

Lyell became a lifelong friend of Charles Darwin and one of his closest confidants.



# Darwin in South America

---

- ✦ When the *Beagle* reached South America the crew began the process of surveying and mapping the coastline.
- ✦ Darwin was so sick of being confined to the ship that he volunteered to go ashore at every opportunity to get fresh water, food and other needed supplies.
- ✦ Instead of returning to the ship Darwin sent the supplies back and then he and a few helpers traveled overland to the next scheduled port.

# Darwin in South America

---

- ✦ Darwin loved South America because the jungle and rainforests provided him with plants and animals he'd never seen before.
- ✦ He collected many specimens and sent them back to the ship.
- ✦ He was especially impressed with the many variations he saw within organisms of the same species.

# Darwin in South America

---

✦ *“Delight itself, however, is a weak term to express the feelings of a naturalist who, for the first time, has wandered by himself in a Brazilian forest”* – Charles Darwin (1845) in *Voyage of the Beagle.*

# South American Rainforest

---



# Darwin in South America

---

- ✦ Darwin discovered many unique fossils in South America.
- ✦ One fossil in particular, an extinct giant ground sloth, intrigued Darwin greatly.
- ✦ He was puzzled: “*Why would God create something only to let it vanish forever? And how could a young Earth accommodate that many extinct species?”*”



# Darwin Encounters a Rattlesnake

---

- ✦ Confronted by a rattlesnake for the first time, Darwin was fascinated.
- ✦ *It was impossible to doubt that the Creator of species had given each rattlesnake an elaborate and beautifully contrived device for warning off its enemies. But why had the same creative force not bestowed a crude kind of noisemaker on another species of snake?*
- ✦ Was it possible – did Darwin dare to believe – that this species had somehow developed a hardened rattle all by itself? Could a species change in this way?

# Darwin Encounters a Rattlesnake

---

- ✦ The thought was almost blasphemous, for it meant denying that God had created each separate living thing individually.
- ✦ It would also be generally considered as scientifically absurd, and Darwin was not the kind of man to leap to conclusions over a few isolated facts.
- ✦ It did, however, puzzle him greatly and provided much food for thought.

# Darwin's Voyage Continues

---

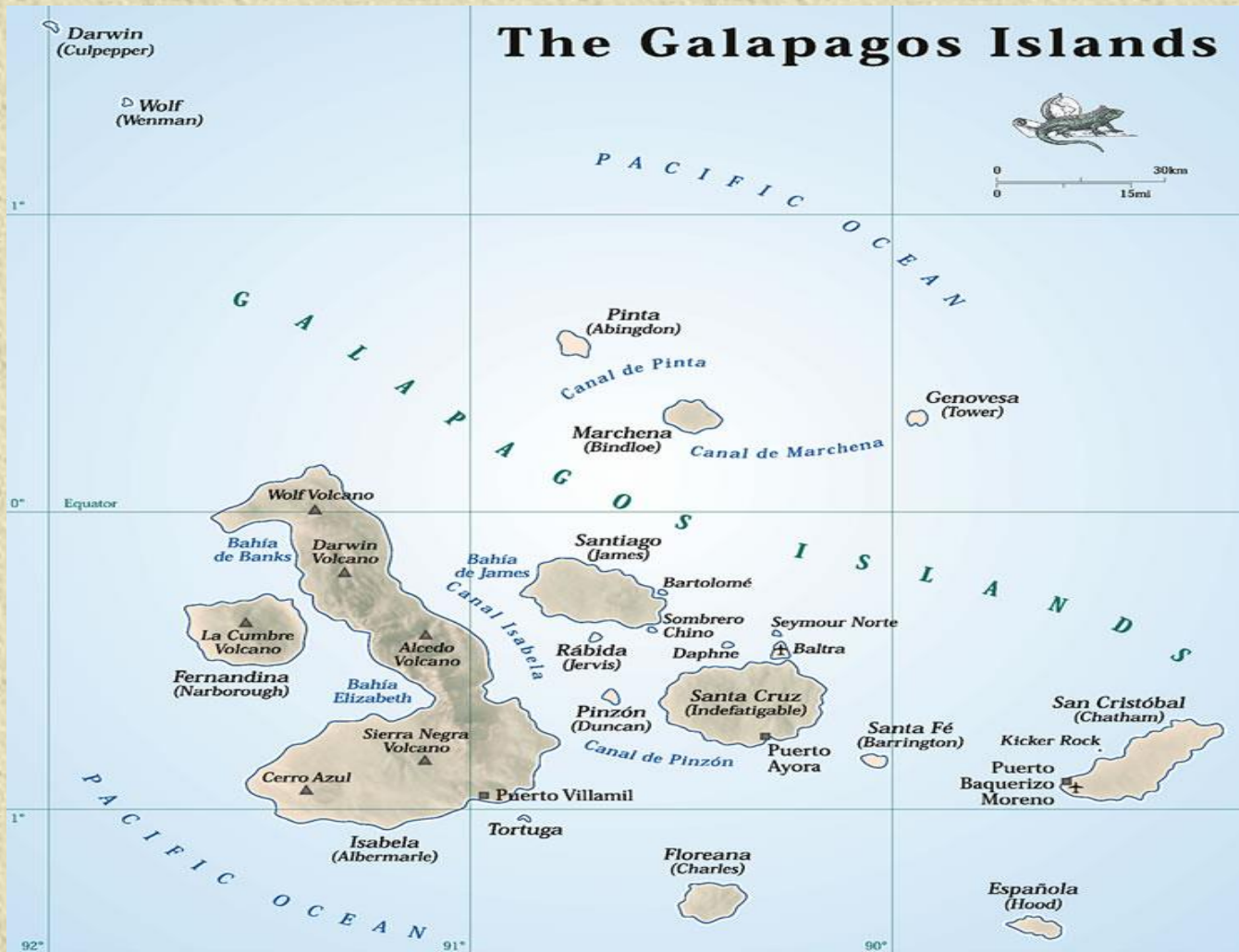
- ✦ After mapping the South American coast, the crew of the *Beagle* began its return trip to England.
- ✦ This trip would take them across the Pacific Ocean to Australia then over to the tip of Africa and eventually around the world.

# Darwin in the Galapagos Islands

---

- ✦ Before heading out across the Pacific, the *Beagle* stopped for 5 weeks (September - October, 1835) in the Galapagos Islands, an isolated, volcanic archipelago about 600 miles west of Ecuador.
- ✦ These isolated islands had species of plants and animals that, while similar to those on the mainland, were different enough to be separate species. Even between individual islands Darwin noted separate species of similar organisms.

# Galapagos Islands Map



# Darwin's Observations

---

✦ Darwin found that each island – and sometimes each mountain peak on the same island – had tortoises with different, distinguishable shell shapes.



# Darwin's Finches

- 
- ✦ Darwin observed 14 different species of finches on the Galapagos Islands.
  - ✦ Each island, it seemed, had a different species of finch.
  - ✦ All of these birds bore a striking resemblance to the finches he had seen in South America, yet each was different in some small way.
  - ✦ Darwin wondered how such an isolated group of islands could have so many species of finches. Did they all come from a single ancestral species?

# Darwin's Observations

---

✦ *“Seeing this gradation and diversity of structure in one small, intimately related group of birds, one might really fancy that from an original paucity of birds in this archipelago, one species had been taken and modified for different ends.”* – Charles Darwin in *Voyage of the Beagle*.



# Darwin's Galapagos Finches

---



# Darwin's Return to England

---

- ✦ *H.M.S. Beagle* returned to England in October, 1836. He had been gone for just under 5 years.
- ✦ Soon after, Darwin happened to read an essay on human population growth by **Rev. Thomas Malthus**.
- ✦ Malthus argued that the human population of Earth was growing faster than the food supply. If the trend continued, he argued, there would be a “struggle for existence”.

# Rev. Thomas Malthus (1766-1834)

---



The essay by Malthus on human population growth (1798) influenced Darwin's thinking about the struggles faced by all populations in nature.

# Darwin Gets Married

---

- ✦ Charles Darwin married **Emma Wedgwood, his first cousin** and a deeply religious woman, on **January 29, 1839**.
- ✦ **The Darwins had 10 children**: William, Annie, Mary, Henrietta, George, Elizabeth, Francis, Leonard, Horace and Charles. Three of them died during childhood. Their deaths, especially Annie's, had a profound effect on their father's faith in God.
- ✦ In July, 1842, they moved into a country home, **Down House, in Kent**, where he was to spend his remaining days.

# Emma Wedgwood (1808-1896)

---



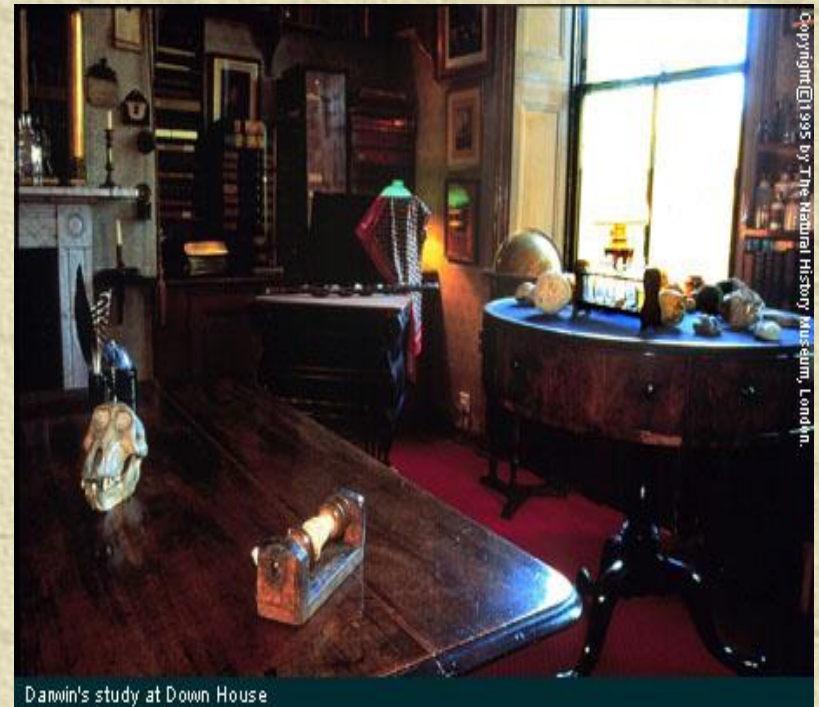
Darwin's wife

# Darwin's Home in Down, Kent

---



Down House view from the garden



Darwin's Study at Down House

# Darwin's Illness

---

- ✦ Shortly after his marriage Darwin began to suffer from mysterious and increasingly serious bouts of sickness.
- ✦ Some said he was **neurotically obsessed** because of his over-dominant father and his inability to measure up to his father's standards.
- ✦ Others said he was a **hypochondriac** and enjoyed being cared for by his wife.
- ✦ Most plausible was that he suffered from **Chagas' disease** which he got from a bug bite in a South America jungle.

# Darwin Gathers More Evidence

---

- ✦ English animal breeders were selectively breeding birds to get large, colorful feathers for ladies hats.
- ✦ This was a type of “artificial selection” because the breeders were controlling which traits were crossed.
- ✦ **Darwin wondered if some force in nature also selected which organisms would survive.**



# Results of Artificial Selection

---



# Darwin Recognizes Variations

---

- ✦ From the many specimens Darwin had seen and collected, he recognized that **variations exist in all populations.**
- ✦ Some variations were favorable, some were not.
- ✦ Those with favorable traits had a better chance for survival, thus they left more offspring. They were better suited to the environment.

# Variations Exist In All Species



# Variations Exist in All Species

---



Amazon Parrots



English Peppered Moths

# Darwin's Natural Selection Idea

---

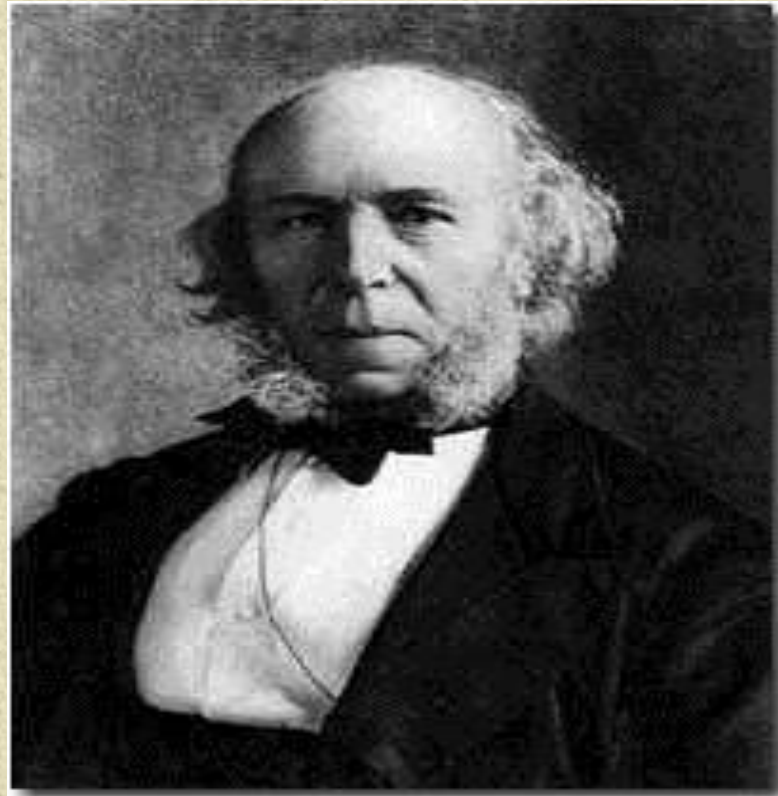
- ✦ Darwin realized that natural selection is not a conscious force; chance variations are either favorable or not favorable for a particular environment.
- ✦ Suitable variations are passed on, others are not.

# “Survival of the Fittest”

---

- ✦ In 1866, the English philosopher Herbert Spencer, in an attempt to explain what Darwin meant by the struggle of organisms in nature, coined the phrase “*survival of the fittest*”.
- ✦ The phrase is often attributed to Darwin but it does not appear in any of his writings.

# Herbert Spencer (1820-1903)



# Darwin's Grand Idea

---

- ✦ Darwin spent over 20 years gathering facts that might have some bearing on how species originated.
- ✦ Putting all of his amassed data together, Darwin developed his grand idea.
- ✦ Darwin didn't go public with his theory because it was unpopular and controversial, and he wanted more evidence.



# Darwin's Dangerous Idea

---

- ✦ In a letter to botanist **J.D. Hooker** in January of 1844, Darwin wrote “...*I am almost convinced (quite contrary to the opinion I started with) that species are not (it's like confessing murder) immutable.*”
- ✦ The day's conservative political and religious climate meant that Darwin was risking a lot to make such a statement.

# Darwin's Heritage

---

- ✦ The idea that living organisms had changed over time was not a totally new concept to Charles Darwin.
- ✦ His grandfather, **Erasmus Darwin**, had published a similar idea in a 1794 book called *Zoonomia*.
- ✦ Even so, it was not a popular idea.

# Erasmus Darwin (1731-1802)

---

Inventor, poet,  
physician ,scientist  
and grandfather of  
Charles Darwin



# Darwin's Dilemma

---

- ✦ On June 18, 1858, Darwin received a letter from a fellow scientist, Alfred Russell Wallace.
- ✦ In the letter was an abstract of a theory of evolution that Wallace was about to publish.
- ✦ He was asking Darwin for a peer review of his theory before submitting it for publication.

# Alfred Russel Wallace (1823-1913)

---



# Darwin is Stunned!

---

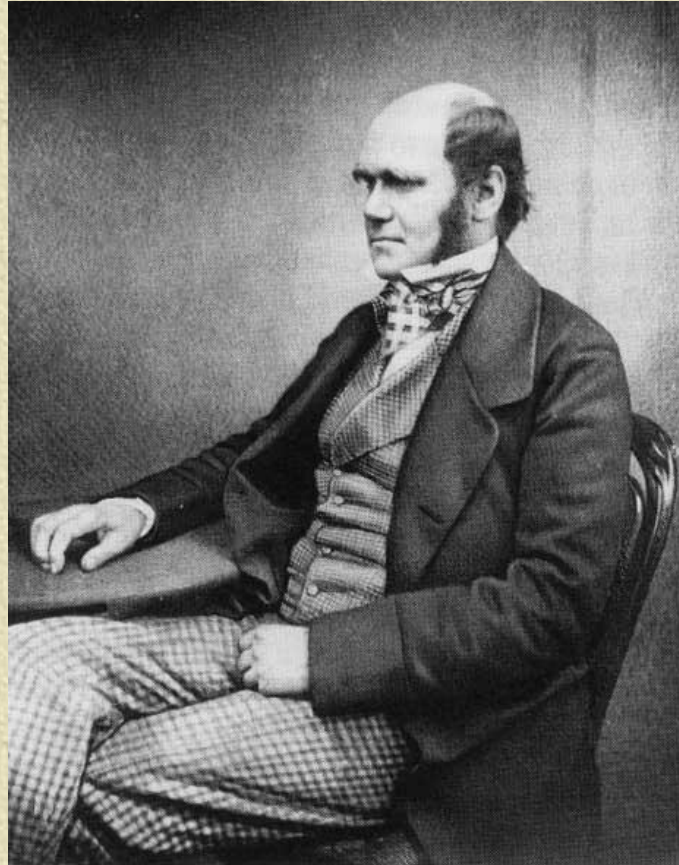
✦ In a letter to his friend, Charles Lyell, in June of 1858, Darwin wrote, *“I never saw a more stunning coincidence. If Wallace had my manuscript written out in 1842 he could not have made a better abstract! Even his terms stand as heads of my chapters!.....so all my originality, whatever it amount to, will be small.”*

# Darwin & Wallace

---

- ✦ **Wallace's theory was exactly the same as Darwin's!**
- ✦ Darwin was ready to concede, but mutual friends encouraged Darwin & Wallace to **allow their theory to be jointly presented.**
- ✦ Thus, on July 1, 1858, their theory was jointly presented to the **Linnaean Society of London.**

# Charles Robert Darwin in 1859





# Darwin Gets Credit

---

✦ Darwin is given primary credit for the theory of evolution by natural selection because: (1) he had collected more evidence than Wallace and (2) he had written, but not published, a general outline and an essay on evolution at an earlier date (1844).

✦ Although controversial, many prominent scientists supported Darwin & Wallace.

# Darwin's Book

---

- ✦ The following year, 1859, Darwin published his full theory with evidence.
- ✦ The title was: *On The Origin of Species by Means of Natural Selection*. All 1,250 copies of the first printing were sold on the first day!
- ✦ The major points of this book are summarized on the next slides.

# Darwin's Title Page

---

ON  
THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

OR THE  
PRESERVATION OF FAVOURED RACES IN THE STRUGGLE  
FOR LIFE.

By CHARLES DARWIN, M.A.,

FELLOW OF THE ROYAL, GEOLOGICAL, LINNEAN, ETC., SOCIETIES;  
AUTHOR OF 'JOURNAL OF RESEARCHES DURING H. M. S. BEAGLE'S VOYAGE  
ROUND THE WORLD.'

LONDON:  
JOHN MURRAY, ALBEMARLE STREET.

1859.

# Darwin's Major Points

---

- ✦ All species have common ancestors.
- ✦ There is variation in every species.
- ✦ Individuals with certain variations have a better chance of survival and reproduction than other individuals with different traits.
- ✦ Many more individuals are born than will survive and reproduce.

# Darwin's Major Points

---

- ✦ **Natural selection** allows offspring with the most favorable traits to survive (“*Survival of the Fittest*”).
- ✦ There is a **struggle** for **existence** in nature.
- ✦ Enormous spans of **time** are available for slow, gradual change to occur.

# Descent With Modification

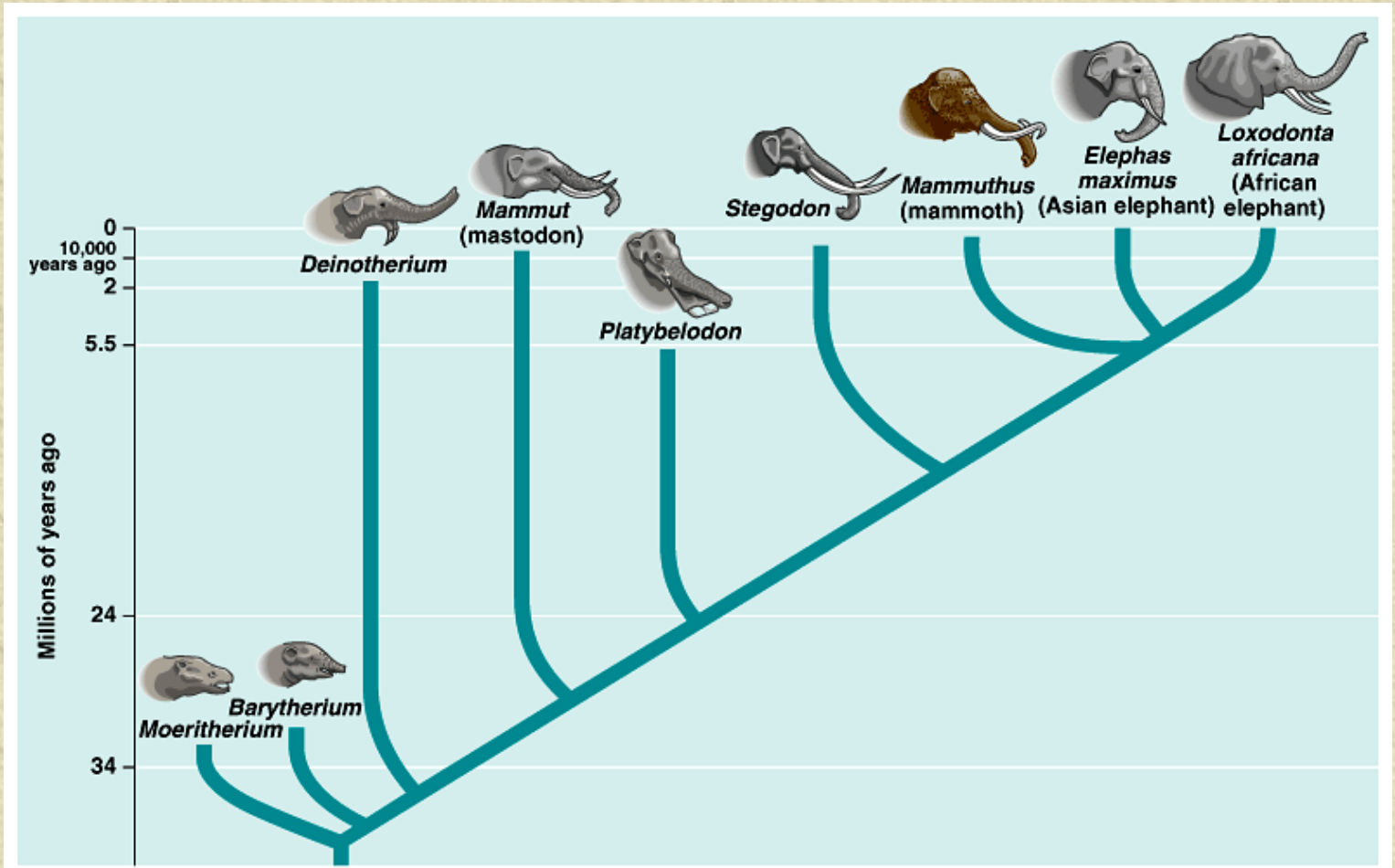
---

✦ Darwin did not use the word **evolution** in *The Origin of Species*.

✦ Instead, he referred to the changes in species over time as **“descent with modification”**.

✦ It was not until later that Darwin used the term evolution in his writings.

# Descent With Modification



# Darwin's Defender

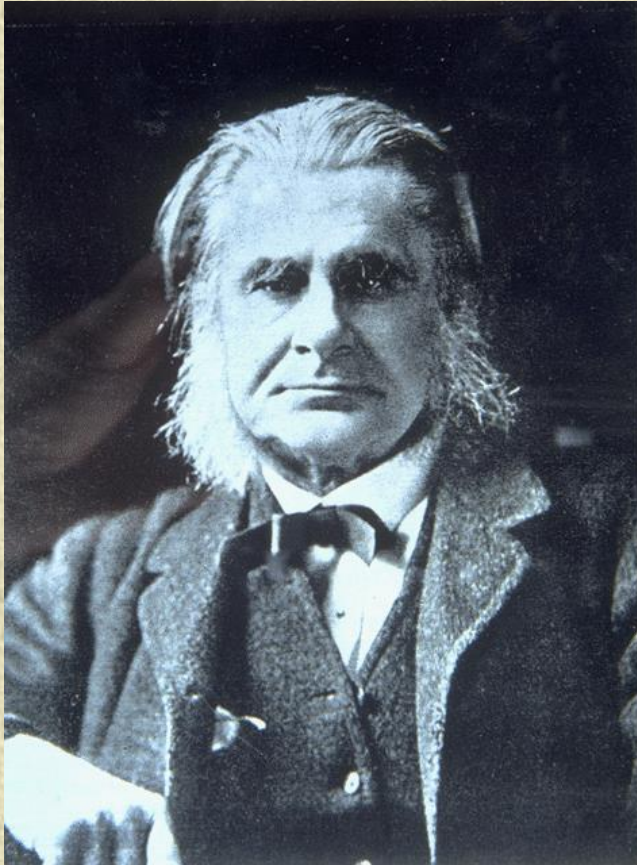
---

- ✦ Following the release of his book, Darwin again had failing health and was too ill to defend his ideas in public speeches and debate.
- ✦ Thomas Henry Huxley, a prominent scientist and lecturer, promoted and defended “Darwinism” so actively that he became known as “**Darwin's Bulldog**” although privately he disagreed with some of Darwin's details.



# Darwin's Bulldog

---



**Thomas Henry Huxley**

**(1825 – 1895)**

# Origin of Species Revisions

---

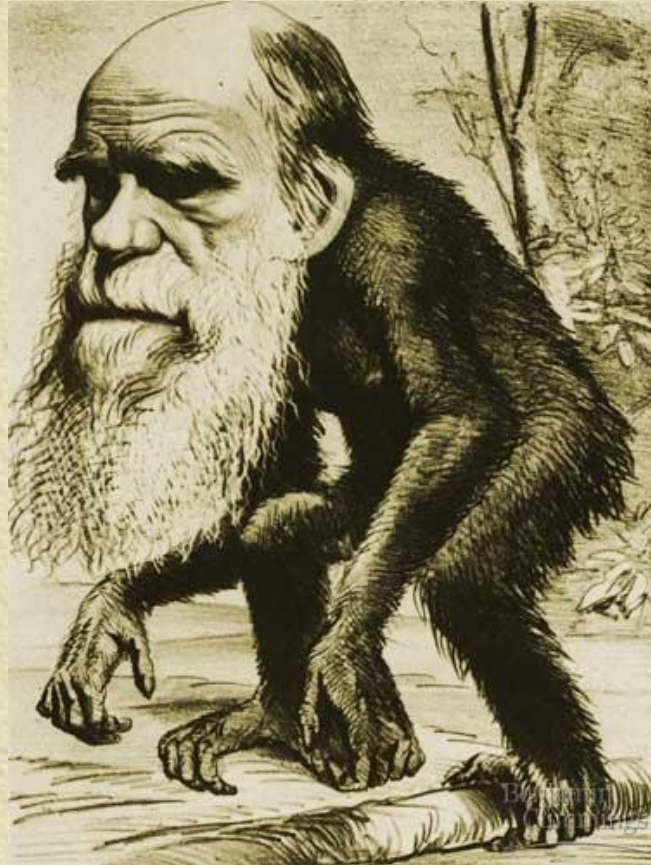
- ✦ **Six editions** of *The Origin of Species* were published during Darwin's lifetime.
- ✦ Each edition was heavily revised. 75% of the book's 3,000 sentences were revised anywhere from 1 to 5 times.
- ✦ More than 1500 sentences were added and 325 original sentences were dropped during editing.
- ✦ These revisions reflect Darwin's agonizing efforts to get his wording exactly right and also to respond to every possible objection others had to his work.

# Darwin was Misunderstood

---

- ✦ Even so, most people did not understand what Darwin was trying to say.
- ✦ For example, nowhere in the book *The Origin of Species* did Darwin suggest or say that *man evolved from monkeys!*
- ✦ He suggested nothing about the *origins* of man.
- ✦ That idea was popularized by cartoonists and by the “Scopes Monkey Trial” in 1925.

# Darwin Was Misunderstood



A popular cartoon

# Darwin's Attempt to Clarify

---

- ✦ Years later, in 1871, Darwin wrote another book, *The Descent of Man*, in which he proposed that man and apes evolved from a recent common ancestor, but along different lines of development.
- ✦ He also predicted that fossils of such common ancestors, if they could be found at all, would most likely be found in Africa, since that is where our great ape cousins now live.

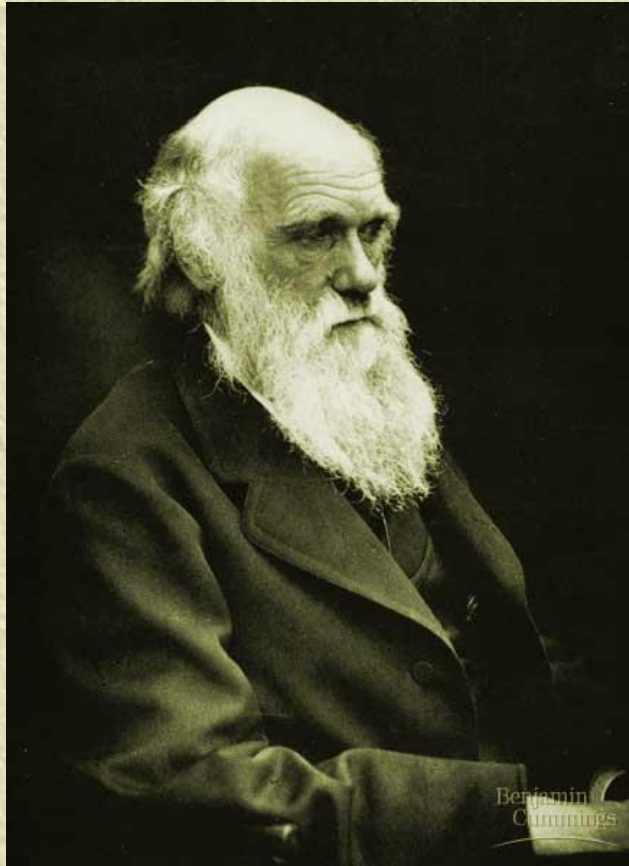
# The Fact of Evolution

---

- ✦ Darwinism is not “just a theory” as many believe.
- ✦ Darwin’s conclusion that species change over time is a **scientific, proven fact**.
- ✦ The mechanism suggested by Darwin for that change, *natural selection*, is a **theory**.

# Charles Darwin in 1880

---



Darwin's health continued to falter and he was unable to defend his theory to those who did not understand. In his latter years, Darwin preferred to stay at home in Down and remained somewhat reclusive until his death.

# Darwin's Religious Beliefs

---

- ✦ Darwin was trained at Cambridge to be a minister in the Church of England. He received a degree in theology in April, 1831.
- ✦ His voyage of discovery, the development of his theory, the death of his daughter and the public ridicule he was subjected to all caused his belief and faith in God to waiver.
- ✦ He never publicly discussed his faith and only privately expressed his doubts to a few close friends.



# Darwin's Religious Beliefs

---

- ✦ It was never Darwin's intent to attack organized religion, or even cast aspersions on personal faith.
- ✦ However, his theory did challenge the belief of many of his colleagues, friends and even his wife, Emma.
- ✦ In later editions of *The Origin of Species* he stressed that evolution can be reconciled with belief in God. ***“I see no good reason why the views given in this volume should shock the religious feelings of anyone.”***

# Darwin's Death

---

✦ Charles Darwin died of a heart attack in his home, Down House, in Kent, England, on the afternoon of April 19, 1882. He was 73 years old.

✦ He was buried in Westminster Abbey in London next to Sir Isaac Newton.

# Darwin's Influence

---

✦ Near the time of his death Charles Darwin is quoted as saying, “*With such modest abilities as I possess, it is truly surprising that I should have influenced to a considerable extent the belief of scientific men on some important points*”.

# Darwin's Legacy

- 
- ✦ Scientific evidence collected since Darwin's time has supported his theory.
  - ✦ Modern DNA biotechnology, in particular, has supported the idea that all mammals evolved from common ancestry but along different lines of development.
  - ✦ Today, **Charles Darwin's** works rank with those of **Mendel, Watson & Crick, and Pasteur** as the foundations of modern biology.

# Darwin's Legacy

---

✦ *“Darwin’s powerful idea, a biological explanation for the origins of living species, has exerted a transfixing hold on human thinking in the century and a half since it first kicked in the doors of Western intellectual life. Like a tide sweeping away old explanations of natural philosophy, Darwinian thought made scientists everywhere demand naturalistic, materialistic explanations for the way things are. The intellectual dominance of those ideas led to a new set of cultural assumptions about science, about the world, and even about the nature of reality.”*

-Kenneth R. Miller (1999) *Finding Darwin's God*

# Darwin's Legacy

---

✦ *“If I were to give an award for the single best idea anyone has ever had, I’d give it to Darwin, ahead of Newton and Einstein and everyone else. In a single stroke, the idea of evolution by natural selection unifies the realm of life, meaning and purpose with the realm of space and time, cause and effect, mechanism and physical law.”*

✦ - Daniel C. Dennett (1995) *Darwin's Dangerous Idea*

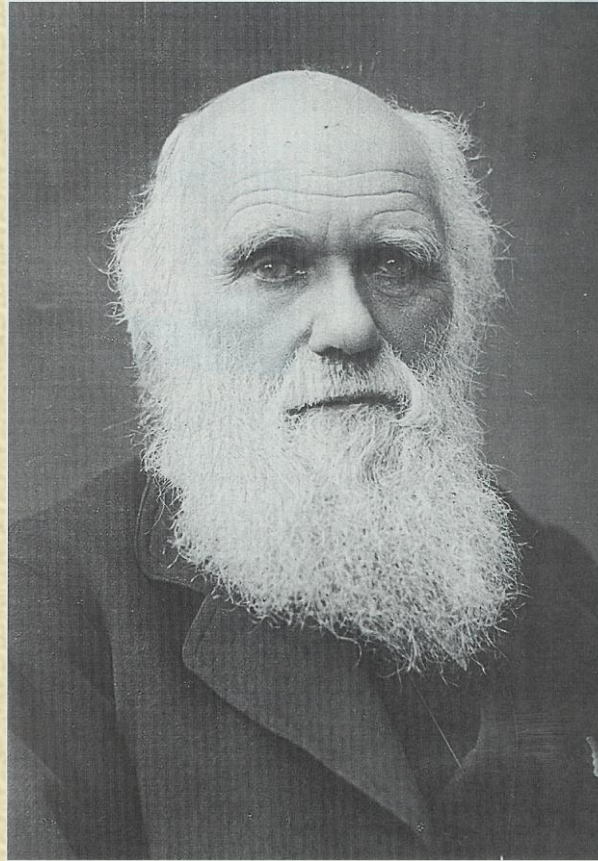
# Darwin's Legacy

---

✦ *“Every modern discussion of man’s future, the population explosion, the struggle for existence, the purpose of man and the universe, and man’s place in nature rests on Darwin.”* - Ernst Mayr (1974)

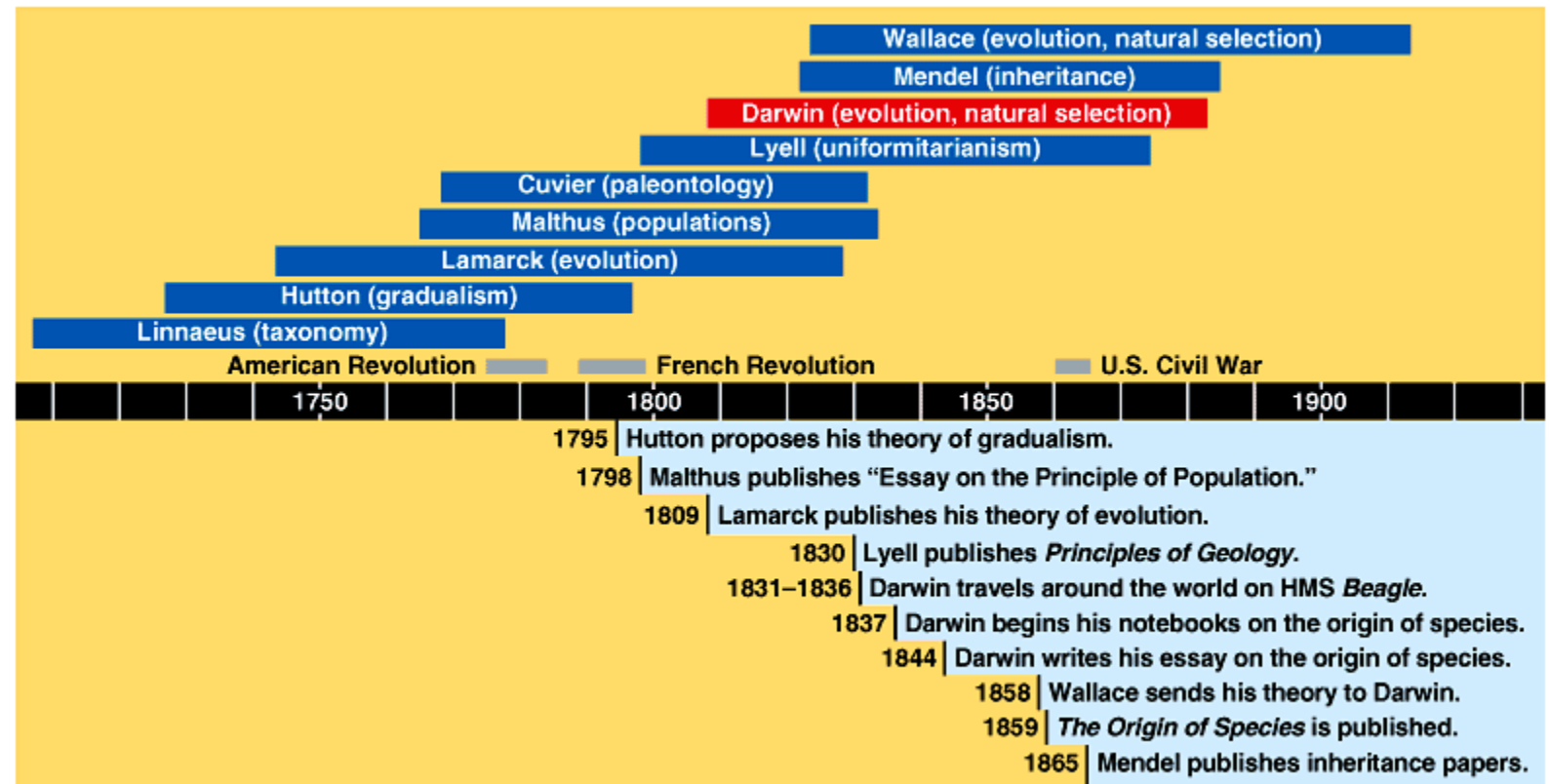
✦ *“Nothing in biology makes sense except in the light of evolution.”* – Theodosius Dobzhansky (1997)

# Charles Robert Darwin





# An Evolutionary Time Line



# Bibliography

---

- ✦ Campbell, Neil A. and Reece, Jane B.(2002) Biology, 6<sup>th</sup> Ed. Menlo Park, Ca: Benjamin/Cummings.
- ✦ Darwin, Charles. (1956) The Origin of Species (6<sup>th</sup> ed.). London: Oxford University Press. (Originally published in 1872).
- ✦ Karp, Walter. (1968) Charles Darwin and the Origin of Species. New York: American Heritage Publishing.
- ✦ Miller, Kenneth R. (1999) Finding Darwin's God. New York: Cliff Street Books.

# Bibliography

---

✦ [www.pbs.org/wgbh/evolution/darwin/diary/index.html](http://www.pbs.org/wgbh/evolution/darwin/diary/index.html)

✦ [www.inform.umd.edu/EdRes/Colleges/LFSC/life\\_sciences/.plant\\_biology/darwin](http://www.inform.umd.edu/EdRes/Colleges/LFSC/life_sciences/.plant_biology/darwin)

# Credits

---

- ✦ Researched and written by **Roy Baldwin**,  
John Marshall HS, 8000 Lobo Lane, San  
Antonio, TX 78240
- ✦ Send comments to: [roybaldwin@nisd.net](mailto:roybaldwin@nisd.net)
- ✦ Reviewed for accuracy by **Kenneth Miller**,  
Brown Univ. and **Robert Dennison**, Jersey  
Village HS, Houston, TX