

Evolution

Darwin's world



Darwin

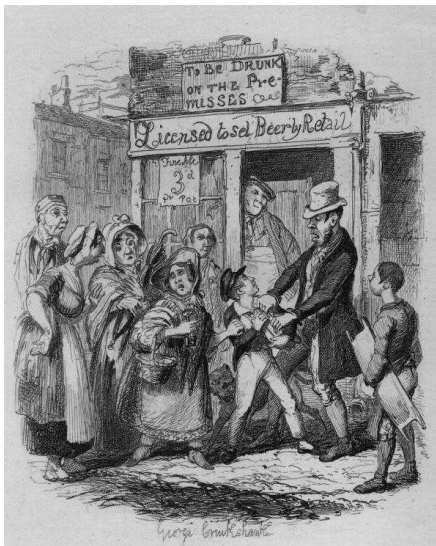


- Son of “landed gentry;” sent off to school to become a doctor, minister.
- At both schools he met naturalists and geologists who influenced his thinking
- Failed at both of these and signed on to travel the world and “find himself” as the shipboard companion and naturalist on the H.M.S. Beagle
- Grandfather Erasmus was a wealthy farmer who seriously studied and wrote about animal breeding, or “artificial selection”

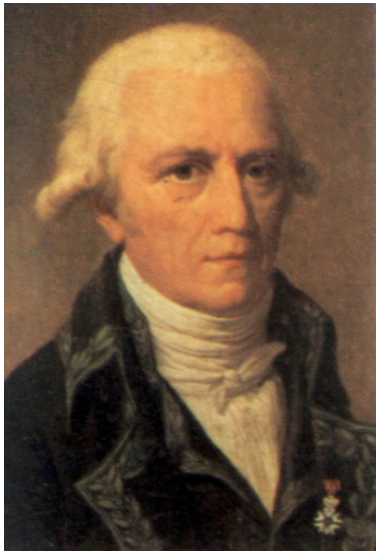
Darwin's age: Victorian England



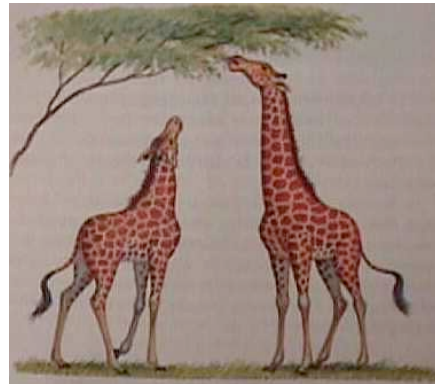
- Industrial Revolution of the mid-1800's
- Height of British colonialism
- Age of scientific debates, especially on the age of the Earth, and the meaning of fossils; recently published geologic map of British Isles, & Charles Lyell's "Principles of Geology"
- Urban squalor: the rise of social justice movements, the writings of Dickens



Darwin's mentors: Richard Grant, Charles Lyell, Rev. J.S. Henslow



Lamarck



Adam Sedgwick



- Richard Grant: Darwin's mentor in Edinburgh, introduced him to the ideas of Jean Babtiste Lamarck: "inheritance of acquired characteristics"
- At Cambridge he met Adam Sedgwick, who taught him field geology (in a letter home to a friend while sailing on the HMS Beagle, "tell Prof. Sedgwick he does not know how much I am indebted to him for the Welsh expedition - it has given me an interest in geology, which I would not give up for any consideration.")

A major influence on Darwin, along with Charles Lyell's *Principles of Geology*, which advanced the ideas of James Hutton, "no prospect of a beginning, no vestage of an end" (*Principle of Uniformitarianism*)

- J.S. Henslow - Botany professor at Cambridge- recommended Darwin for the position on the Beagle
- Charles Lyell, "the father of Geology"

The voyage of H.M.S. Beagle



Various views of the Galapagos



Darwin is also famous for his study of the origin of coral atolls (sunken volcanoes)



finches



mongabay.com



Flightless booby



tortoises

Some of the more famous residents of the Galapagos

Why the HMS Beagle cruise was important:

- Darwin had traveled widely and noted the geographic distribution of plants and animals, and he attributed much of what he saw as a reflection of the geographic (=climate) control on species.
- He had noted the effect of geographic barriers in separating breeding populations
- He noted the importance of finding fossils: “...this wonderful relationship in the same continent between the dead and the living, will, I do not doubt, hereafter throw more light on the appearance of organic beings on our Earth, and their disappearance from it, than any other class of facts” (Darwin in his field notes after hiking in the Andes of Argentina)

But why the Galapagos were MOST important:

- The Galapagos provided Darwin with new, different data that illustrated differences from island to island that could NOT be the result of physical differences in the environment, but had to result from the interaction of the organisms with one another and in competition with one another: in other words, as a natural laboratory the Galapagos are spectacular because other environmental variables are eliminated; differences between species reflects competition for limited food resources.
- Darwin noted, for example that the coloring of Galapagos birds was more subdued than similar species on land, so as to match the gray and black color of volcanic rocks on the islands. He also wondered, are the Galapagos species *varieties* on their way to becoming new species? “such facts undermine the stability of species.” Upon return to London an ornithologist confirmed that many of Darwin’s Galapagos bird specimens were all finches...different species of finch..in other words, the creation of new species had already happened.

Chronology of the development of Darwin's ideas on evolution

- 1831-1836 Darwin sails on the H.M.S. Beagle
- Returns to England, sends his samples off to experts for identification. James Gould identified Darwin's bird collections. Richard Owen studied the mammals (and fossils).
- Darwin resides in London for the first 5 years after his return. His first scientific presentation was to the Geological Society of London on the uplift of the Andes Mtns. Darwin climbed in the Andes during an H.M.S. Beagle layover; he experienced earthquakes and found mammal fossils, which he collected. Darwin recognized that mountains were uplifted, "slowly and by little starts" in a long, continuous series of earthquakes. Why is this important? He was recognizing that small events, repeated over long periods of geologic time, could produce huge change.

Darwin, chronology, continued:

* From 1842, when Darwin left London and retreated to the family home in Kent he begins work on his notebooks (5 of them), writing on and off for 20 years, developing his ideas about “descent with modification” and the impermanence of species. He also writes essays during this period, some of which describe the geology, flora and fauna of his travels, and some of which begin to lay out his observations on variation among different species. It is clear that he is ‘hung up’ on the mechanism for producing variation: “I keep on steadily collecting every sort of fact which may throw light on the origin and variation of species” (Notebook A).

Gould reported back to Darwin that his Galapagos bird collection were all finches, prompting Darwin to write, “one species had been taken and modified for different ends,” in other words, he recognized that ancestors from the S. Am. mainland had modified their appearance after colonizing the islands.

An influence on Darwin as he was writing... Thomas Malthus, an economist

Darwin's comments on reading Malthus are recorded in his Notebook D



Malthus: “An Essay on the Principle of Population” 1798:

“...that population must always be kept down to the level of the means of subsistence” or, resources are the limiting factor in the size of a population

Malthus not coin the phrase “struggle for existence,” which appears in many texts, including Lyell’s “Principles of Geology,” but this concept is often associated with him.

Malthus was writing about the effect of limited resources on human population in the urban slums of England.

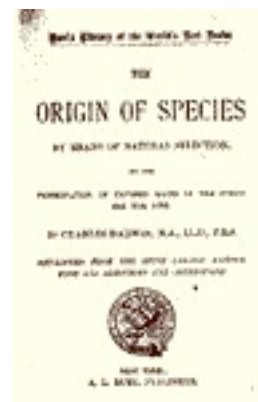
Darwin began to incorporate the concept of “struggle for existence” into his thoughts on adaptation. Only 1 month lapsed between Darwin starting his first notebook on “transmutation” and his construction of a crude evolutionary tree: July, 1837.

•Chronology of Darwin's thinking, continued:

• In 1839, in Notebook E, Darwin writes about adaptation and sketches out three observations he has made: (1) grandchildren are like grandfathers (in other words, there is inheritance of features); (2) the tendency to see change, especially physical change (generations don't stay the same); (3) great fertility in proportion to the support of parents (in other words, population pressure: more offspring survive if parents can feed and care for them).

•Darwin corresponds with Alfred Wallace, whose ideas about organisms' adaptations to local environmental conditions is much more fully developed than Darwin's. In 1859 Darwin and Wallace jointly present a paper to the Royal Society of London.

• Darwin publishes a more full account of his theory in 1859, "On the Origin of Species by Natural Selection"



Reaction to the theory

- Philosophical: What Darwin's writing did was force us to examine the concept of humans at the center of all things (versus the idea that God created this all for us to play with); it forced re-examination of the idea of a single period of Creation - was there now Creation with subsequent appearance/disappearance/modification?
- Scientific: What was the mechanism by which adaptation proceeded? Was the earth old enough for enough adaptation to occur to produce what we see?