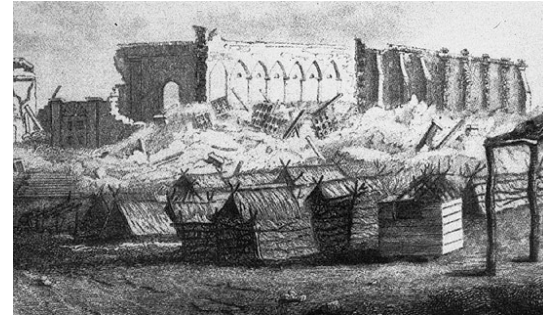


## History of Evolutionary Thought

### Part III: Of Finches and Tortoises

BIOL 4415: Evolution  
Dr. Ben Waggoner

Sailing up the Pacific coast of Chile, the *Beagle* reached the town of Concepción. . .

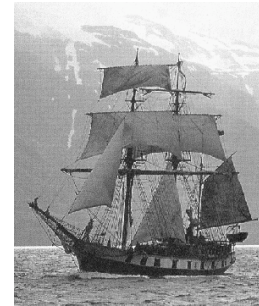


which, unfortunately, had just been leveled by an earthquake. (February 20, 1834)

Darwin had been reading Lyell's *Principles of Geology* on the trip. . .

- He was able to see that the earthquake had lifted the shoreline by as much as ten feet
- He had also explored the Andes Mountains, and knew that fossil seashells were found at elevations of thousands of feet
- His conclusion: A long series of quakes was causing the slow, gradual uplift of South America—a fine example of Lyell's uniformitarian thinking!

After three years of sailing, the mission was accomplished and everyone was ready to go home. . .



so the *Beagle* left South America, sailing across the Pacific to Australia, across the Indian Ocean to South Africa, and back through the Atlantic to England.





Galápagos wildlife includes many distinctive and unique forms. . . including *Sula nebouxii*, the blue-footed booby. *Sula nebouxii* isn't unique to the Galápagos—it's found on the coasts of mainland South and Central America—but many species *are* unique to the Galápagos. . .

Most Galápagos species are similar to South American ones, but NOT identical. . . and found nowhere else in the world. This gull is unique to the Galápagos, although it resembles South American gulls. . .



*Larus fuliginosus*, the Galápagos gull

The Galápagos hawk (*Buteo galapagoensis*) is in the same genus as familiar American birds such as the red-tailed hawk, but nonetheless it's unique to the Galápagos Islands as well.



The Galápagos penguin is the most northerly species of penguin—in fact, it's the only species found naturally (and just barely) in the Northern Hemisphere.

*Spheniscus mendiculus*, the Galápagos penguin

Iguanas are typical of Central and South America, but the swimming, seaweed-munching Galápagos marine iguana is unique to these islands.



*Amblyrhynchus cristatus*, the Galápagos marine iguana

Prickly pear cacti are found in North and South America, but they don't usually form trees. . . except in the Galápagos Islands. . .

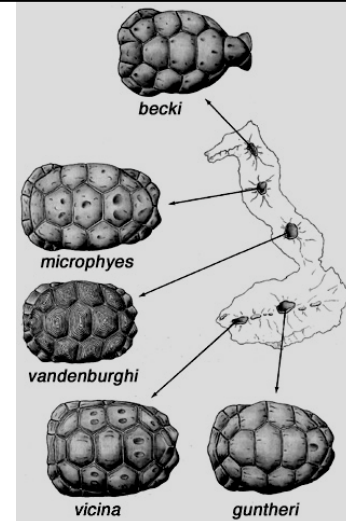


*Opuntia echios*, the Galápagos prickly pear cactus

*Geochelone elephantopus*, the Galápagos tortoise, gave the islands their name—they're similar to American "gopher tortoises", but not the same! (They're much larger, for one thing. . .)



Darwin found that each island—and sometimes each mountain peak on the same island—has tortoises with consistently different, distinguishable shell shapes. (The map shows the tortoise varieties from the largest island in the Galápagos, Isabela, which consists of six major volcanoes.)



Now consider the case of the Galápagos finches. . .



Small ground finch, *Geospiza fuliginosa*

Not only are the fourteen different species found on different islands (although they often overlap), but each species has a distinctive way of life—sometimes a very un-finchlike way of life—and each shows adaptations to that way of life.



Cactus finch  
*Geospiza scandens*



Large ground finch  
*Geospiza magnirostris*

The finches all share a common structure, and yet with diverse adaptations to different lifestyles, reflected most obviously in their beaks.



Woodpecker finch  
*Cactospiza pallida*



Vampire finch  
*Geospiza difficilis*

“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.”—*Voyage of the Beagle*, ch. 17



sugar glider (*Petaurus breviceps*)

quoll (*Dasyurus viverrinus*)

After a week's stay, the *Beagle* left the Galápagos and crossed the Pacific to Australia—where Darwin noticed the uncanny way in which Australian marsupials seemed to mimic mammals from elsewhere in the world.



European mole



Australian marsupial mole



African flying squirrel



Australian sugar glider



South American anteater



Australian numbat

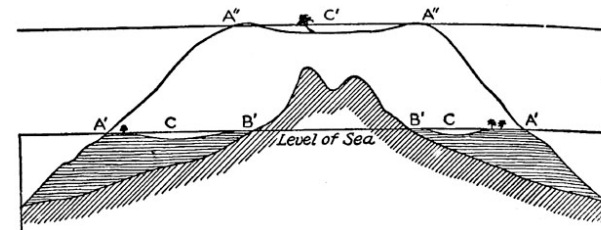
“Earlier in the evening I had been lying on a sunny bank & was reflecting on the strange character of the Animals of this country as compared to the rest of the World. A Disbeliever in everything beyond his own reason, might exclaim, ‘Surely two distinct Creators must have been [at] work; their object however has been the same. . . .’”

—Charles Darwin’s diary, Jan. 19, 1836

Then the *Beagle* crossed the Indian Ocean, where Darwin came up with a very Lyellian theory for how *atolls* (ring-shaped coral islands) formed: as extinct volcanoes slowly sink downwards, coral reefs on their flanks slowly grow upwards.



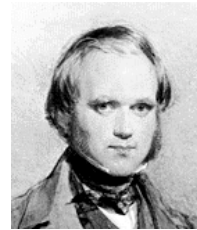
Darwin would later publish his ideas in 1842, in his first book *On the Structure of Coral Reefs*, to much acclaim. His explanation was absolutely correct, although it wasn’t confirmed until the 1950s.



Anyway, the *Beagle* rounded Africa, sailed up the Atlantic, and returned to England on October 2, 1836.



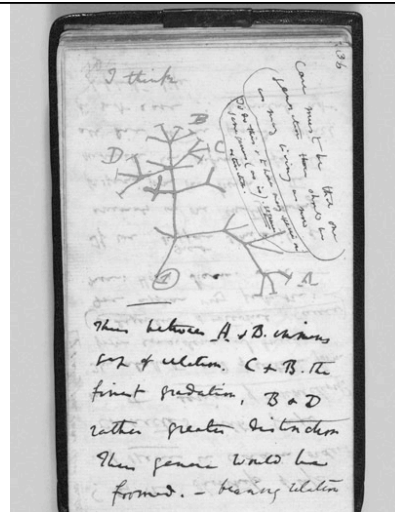
Down House, near London, where Darwin lived from 1842 until his death in 1882



Darwin's discoveries on the *Beagle* had made for him a very good reputation among the naturalists of his day. He had his hands full, writing up his discoveries and collaborating with various experts. He also occupied himself with finding a wife (which he did, in 1839) . . . and, unfortunately, with recurrent attacks of a chronic illness that left him terribly weak. (No one is sure exactly what it was.)

Nonetheless, he found time and energy to ponder the problem of where species came from. . .

(p. 36, "Notebook B", 1837)



He started reading — not just biology, but economics, history, sociology. . . including the works of these two gentlemen, which had a powerful effect on his thinking.



Thomas Malthus



Adam Smith

## Adam Smith

(1723-1790)



- Author of *Wealth of Nations* (1776)
- Argued that free, unregulated economic competition would maximize profits, boost quality and innovation, create division of labor, and make prices reasonable.
- Referred to competition as "an invisible hand," which kept the economy stable and orderly—without the need for any external "designers". . .

## Thomas Malthus

(1766-1834)



- Author of *Essay on the Principles of Population* (1798)
- Argued that the food supply increased in a linear fashion, while population increased "geometrically" (meaning exponentially)
- Malthus's conclusion: There will always be social inequality and poverty, and want. (Politically, this means that share-the-wealth liberalism won't work.)

## Darwin on Malthus



In October 1838. . . I happened to read for amusement Malthus on *Population*, and being well prepared to appreciate the struggle for existence which everywhere goes on . . . it at once struck me that under these circumstances favourable variations would tend to be preserved, and unfavourable ones to be destroyed. The results of this would be the formation of a new species. Here, then, I had at last got a theory by which to work.

—Charles Darwin, *Autobiography*