1) Overview: Darwin Introduces a Revolutionary Theory

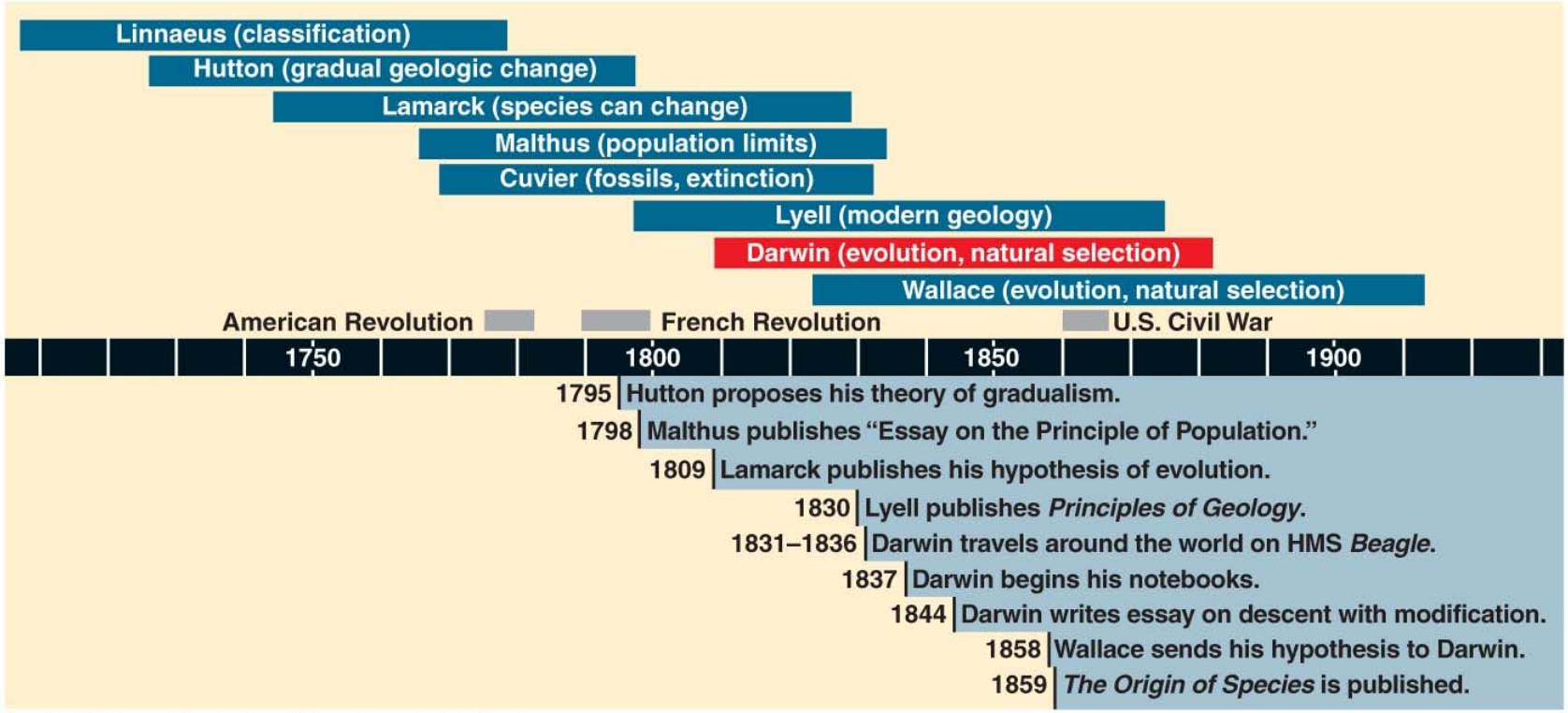
- A new era of biology began on November 24, 1859, the day Charles Darwin published ***On the Origin of Species by Means of Natural Selection***
- The *Origin of Species* focused biologists' attention on the great diversity of organisms

2) What were Darwin's points?

- Darwin made two major points in his book:
  - Many current species are descendants of ancestral species
  - **Natural selection** is a mechanism for this evolutionary process
- Darwin's phrase *descent with modification* has now been generally abbreviated by the word "evolution"
- Evolution can be viewed as both a pattern and a process

3) The Darwinian revolution challenged traditional views of a young Earth inhabited by unchanging species

- To understand why Darwin's ideas were revolutionary, we must examine them in relation to other Western ideas about Earth and its life
- See Fig. 22.2



4) Resistance to the Idea of Evolution

Darwin's book *The Origin of Species*

- Shook the deepest roots of Western culture and challenged a worldview that had been prevalent for centuries; why:
  - The Greek philosopher **Aristotle** viewed species as fixed and arranged them on a *scala naturae*
  - The Biblical Old Testament was interpreted as saying that species were individually designed by God and therefore perfect; if they changed, then God would then be imperfect
  - It was generally believed that species had remained unchanged since their creation

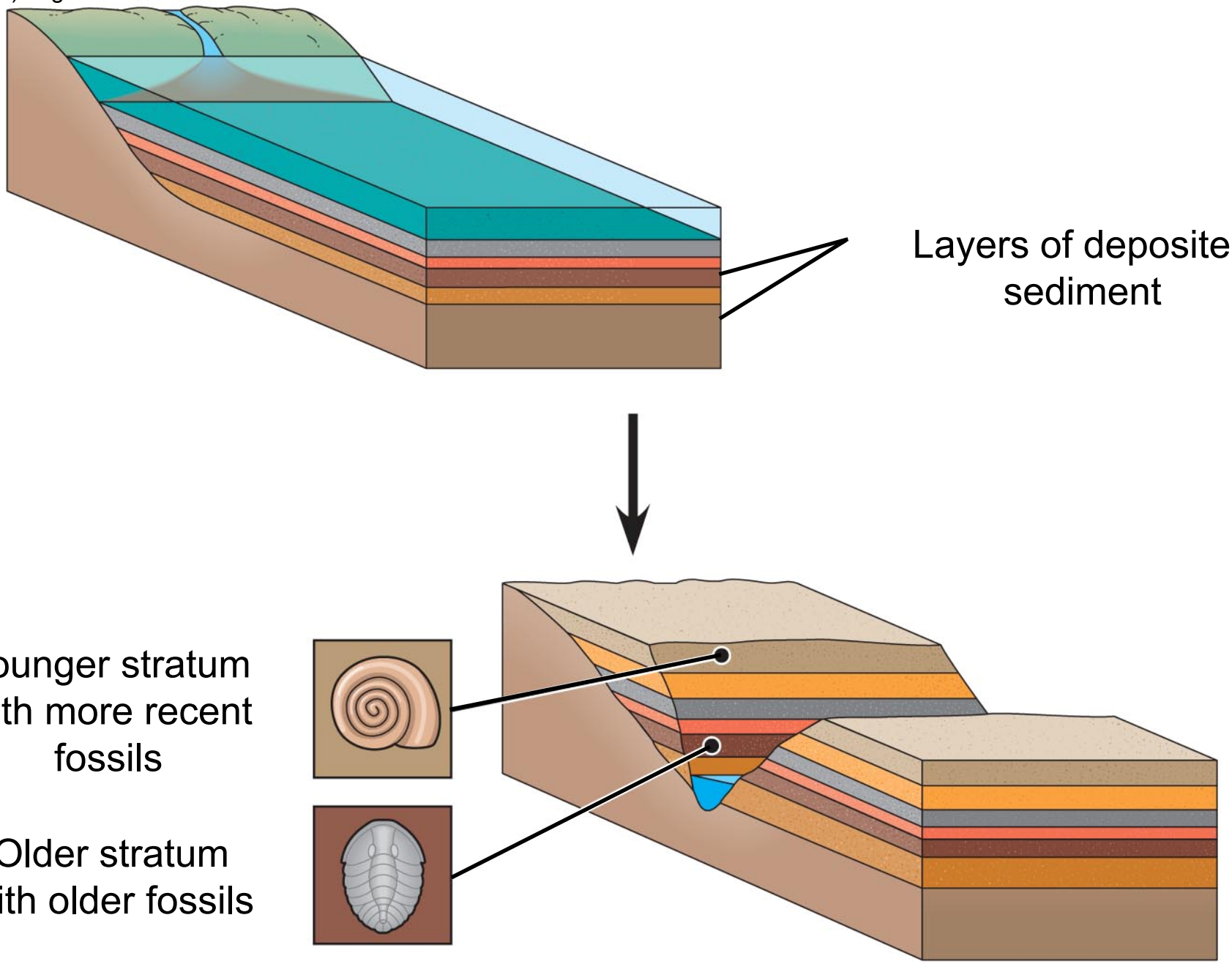
5) Linnaeus' idea regarding the Scale of Nature and Classification of Species

- **Carolus Linnaeus** interpreted organismal adaptations as evidence that the Creator had designed each species for a specific purpose
- Linnaeus was a founder of **taxonomy**, the branch of biology concerned with classifying organisms

6) Fossils & the "record in the rocks"

- The study of fossils helped to lay the groundwork for Darwin's ideas
- Fossils are remains or traces of organisms from the past, usually found in **sedimentary rock**, which appears in layers or **strata**
- See Fig. 22.3 (next slide)
- Older, simpler, largely extinct fossil organisms invariably lie in lower, older strata

7) Fig. 22-3



8) Georges Cuvier—inventor of Paleontology and the idea of catastrophism

- **Paleontology**, the study of fossils, was largely developed by French scientist Georges **Cuvier**
- Cuvier advocated **catastrophism**, speculating that each boundary between strata represents a catastrophe (volcanic eruption, major flood, fire, earthquake, etc)

9) Hutton and Lyell's ideas

- Geologists James **Hutton** and Charles **Lyell** perceived that changes in Earth's surface can result from slow continuous actions still operating today
- Lyell's principle of **uniformitarianism** states that the mechanisms of change are constant over time, i.e. profound changes can take place through the cumulative effect of slow but continuous processes
- Their views strongly influenced Darwin's thinking

10) Lamarck's Hypothesis of Evolution

- **Lamarck** hypothesized that species evolve *through use and disuse* and *the inheritance of acquired traits*
- The mechanisms he proposed are unsupported by evidence

11) More on the general understanding of the world in Darwin's day

- As the 19th century dawned, it was generally believed that species had remained *unchanged* since their creation
- However, a few doubts about the permanence of species were beginning to arise

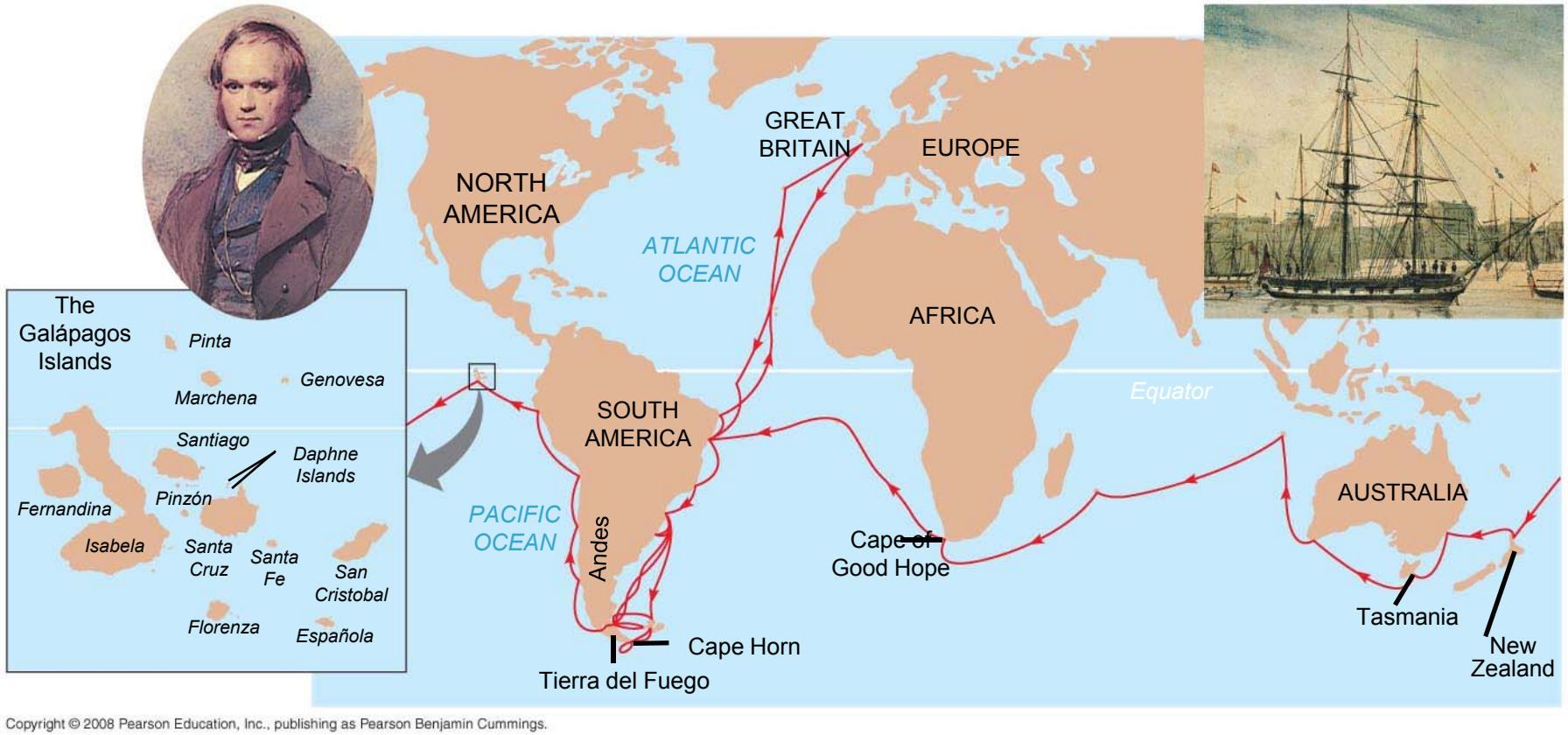
12) Darwin's Research

- As a boy and into adulthood, Charles Darwin had a consuming interest in nature
- Darwin first studied medicine (unsuccessfully), and then theology at Cambridge University
- After graduating, he took an unpaid position as naturalist and companion to Captain Robert FitzRoy for a 5-year around the world voyage on the *Beagle*

13) The Voyage of the Beagle

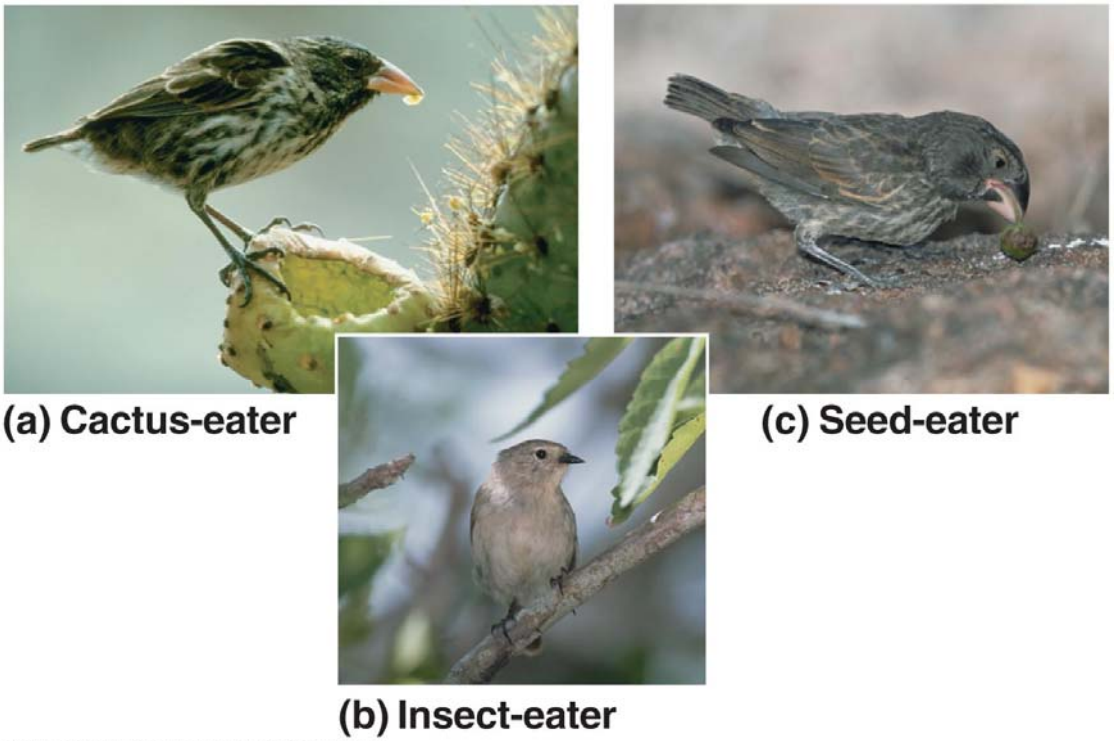
- During his travels on the *Beagle,* Darwin collected specimens of South American plants and animals
- He observed adaptations of plants and animals that inhabited many diverse environments
- His interest in geographic distribution of species was especially kindled by a stop at the Galápagos Islands near the equator west of South America
- Darwin was influenced by Lyell's *Principles of Geology* and began to see evidence that the earth was more than 6000 years old

14) Fig. 22-5



15) Darwin's focus on *Adaptation*

- In reassessing his observations, Darwin perceived **adaptation** to the environment and the origin of new species as closely related processes
- From studies made years after Darwin's voyage, biologists have concluded that this is indeed what happened to the Galápagos finches



16) More on Darwin's story

- In 1844, Darwin wrote an essay on the origin of species and natural selection but did not introduce his theory publicly, anticipating an uproar
- In June 1858, Darwin received a manuscript from Alfred Russell **Wallace**, who had developed a theory of natural selection similar to Darwin's
- Darwin quickly finished *The Origin of Species* and published it the next year

17) Restatement of Darwin's two main ideas

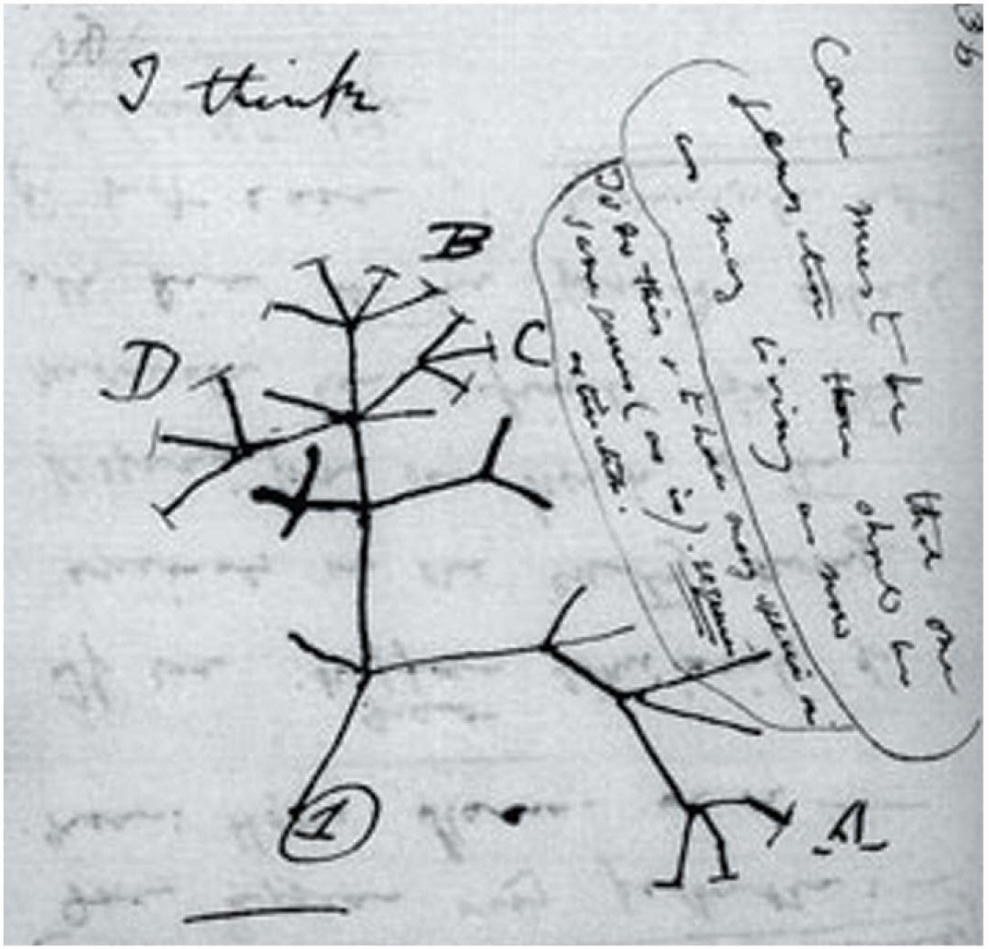
- Darwin developed two main ideas:
  - **Descent with modification** explains life's unity and diversity
  - **Natural selection** is the cause of adaptive evolution, and this explains the diversity of life seen on the planet

18) Descent with modification

- Darwin never used the word *evolution* in the first edition of *The Origin of Species*
- The phrase *descent with modification* summarized Darwin's perception of the unity of life
- The phrase refers to the view that all organisms are related through descent from an ancestor that lived in the remote past
- It is also important to understand that Darwin did not discuss ultimate origins; there is evidence that he believed God was the author of "life"

19) The history of life on planet Earth is like a tree

- In the Darwinian view, the history of life is like a tree with branches (Fig. 22.7) representing life's diversity
- Darwin's theory meshed well with the hierarchy of Linnaeus



20) One example, among many, of a modern evolutionary tree