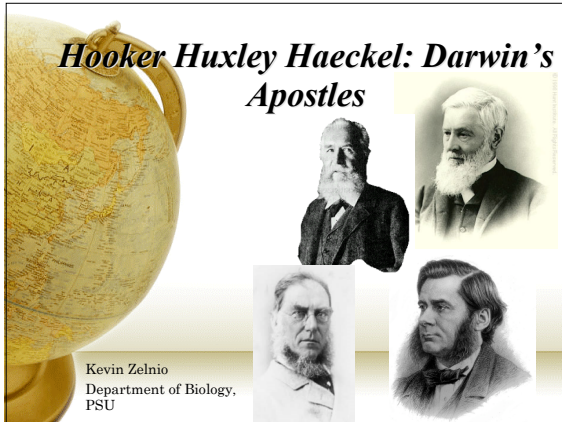


Hooker Huxley Haeckel: Darwin's Apostles



Kevin Zelnio
Department of Biology,
PSU


Victorian English Science

Social Dimension:

- Transition to Industrial Revolution
- Working class uprisings
- Huge gap between rich and poor
- Scientific elitist attitude
- Mechanics Institute



Scientific Dimension

- Catastrophism
- Literal Biblical Interpretations (i.e. Genesis, floods, young Earth)
- "Natural Theology" of Paley
- Lamarckian Evolution
- Owen's "Archetype" concept




Catastrophism

Premise: Earth's features were created by cataclysmic forces

Lyell 1830:
Uniformitarianism →
Landscape was formed by gradual geologic & geomorphic processes over long periods of time

Evolution Before Darwin




Anaximander 609-547 BCE

- Man and animal came into being by "like transmutations"
- Man sprung from some other animal, likely aquatic

Evolution Before Darwin

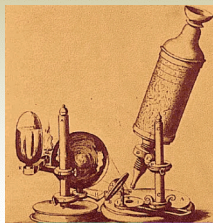
John Ray 1628-1705

- Wrote on plant systematics
- Developed the idea that the wisdom and power of God can be understood by studying His creation, the natural world
- Adaptations to environment was evidence of God's design
- Fossils were once living organisms
- Used total morphology in classifying organisms



Evolution Before Darwin

Robert Hooke (1635-1703)



- Compared Fossil wood and shells to living wood and shells
- The fossil record documents changes among organisms on Earth
- Species have both appeared and gone extinct throughout the history of life on Earth.

Evolution Before Darwin

- **Nicholas Steno** (1638-1686)
 - Law of superposition → able to give a sense of time to rock layers
 - Fossils were once living organisms that were chemically altered without altering their form



Evolution Before Darwin

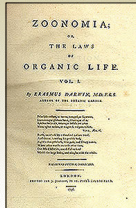
- **Georges-Louis Leclerc, Comte de Buffon** (1707-1788)
 - Described similarity and considered common ancestry between apes and humans
 - Earth's age is greater than 6,000 years (75,000)
 - Noted vestigial/useless structures in animals and suggested they didn't appear there spontaneously
 - Believed in organic change, but provided no mechanism
 - Environment acted directly on organisms through "organic particles"



Evolution Before Darwin

Erasmus Darwin (1731-1802)

- Physician, Inventor, Poet, Scientist
- *Zoönomia; Or, The Laws of Organic Life* (1794-96)
- Life on Earth "had risen from one living filament"



Evolution Before Darwin

Jean Baptiste Pierre Antoine de Monet, the Chevalier de Lamarck (1744-1829):

- Change in environment → change in needs of organisms → change in behaviour → change in use of structure → less use = shrinkage of structure while greater use = growth of structure
- Acquired traits were inherited

... *time and favorable conditions* are the two principal means which nature has employed in giving existence to all her productions. We know that for her time has no limit, and that consequently she always has it at her disposal. (*Système des Animaux sans vertèbres*, 1801)



Evolution Before Darwin

William Paley (1743-1805)

- Natural Theology; or, Evidences of the Existence and Attributes of the Deity, Collected from the Appearances of Nature (1802)



- Every watch has a watchmaker, therefore every creation has a Creator
- The creator is of course God

Evolution Before Darwin

Georges Cuvier (1769-1842)

- Passionately opposed organic evolution
- Form and function were tightly integrated in the entire body, hence no part can be modified
- Similarities were due to common function NOT common ancestry
- Established extinction as a fact
- 4 distinct branches of life: Vertebrata, Articulata, Mollusca and Radiata



Evolution Before Darwin

Étienne Geoffroy St. Hilaire (1772-1844)



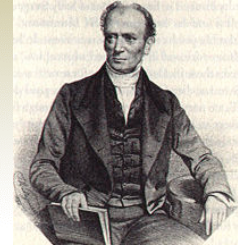
• Idea of the Archetype & Homology

"The external world is all-powerful in alteration of the form of organized bodies... these [modifications] are inherited, and they influence all the rest of the organization of the animal, because if these modifications lead to injurious effects, the animals which exhibit them perish and are replaced by others of a somewhat different form, a form changed so as to be adapted to the new environment." (*Influence du monde ambiant pour modifier les formes animales*, 1833)

Evolution Before Darwin

Robert E. Grant (1793-1874)

- Marine Invertebrate Zoologist at Edinburgh
- Tutored Darwin in dissection techniques and Lamarckian evolution
- Moved to London College and became England's 1st academic comparative anatomist
- Darwin's first paper (at the Plinian Society Meeting): black spores found in oyster shells were the eggs of a skate leech and observations on sea-slug larvae

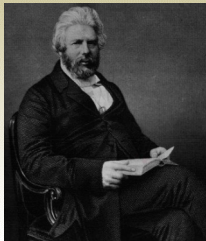


Evolution Before Darwin

Robert Chambers (1802-1871)

Vestiges of the Natural History of Creation (1845)

- Evolution steadily progressed towards increased complexity (Humans of course the apex) under unknown laws
- Opened up the evolution debate and popularized the concept
- Showed Darwin what he must overcome to get his theory accepted

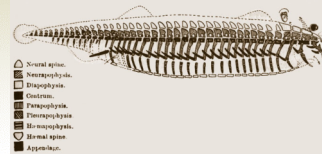


Robert Chambers (1802-1871)

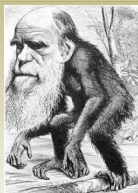
Evolution Before Darwin

Richard Owen (1804-1892)

- Archetype not as "real" ancestor, but as an idea in the Divine Mind
- Defined homology as "the same organ in different animals under every variety of form and function"



Darwin's Evolution



- Advanced natural selection as evolution's mechanism 1858 with Alfred Russel Wallace
- Introduced the Principle of Divergence
- Had many supporters and equally many opponents

Development of Darwin's Theory

- 1836 - "Red" and "B" notebooks – tendency of varieties to diverge, homology

"Astronomers might formerly have said that God ordered each planet to move in its particular destiny—in same manner God orders each animal created with certain form in certain country, but how much more simple and sublime power let attraction act according to certain laws such are as inevitable consequence let animal be created, then by the fixed laws of generation, such will be their successors—let the powers of transportal be such & so will be the form of one country to another—let geological changes go at such a rate, so will be the numbers & distribution of the species!"
- 1839 – Notebooks "D" and "E" - reads Malthus and determines natural selection as mechanism

"...instincts alter, reason is formed, & the world peopled with Myriads of distinct forms from a period short of eternity to the present time, to the future—How far grander than idea from cramped imagination that God created (warring against those very laws he established in all organic nature) the Rhinoceros of Java & Sumatra, that since the time of the Silurian, he has made a long succession of vile Molluscous animals—How beneath the dignity of him, who is supposed to have said let there be light and there was light..."

Development of Darwin's Theory

- 1842 - "Sketch of My Theory" (= evolution by natural selection) – first attempt at writing his theory
 - 10 chapters – 3 on the theory and 7 on applications
- 1844 - "Essay"
- 1856-1858 - "Big Species" and *Natural Selection*
- 1859 – *The Origin of Species* (6 eds. + US ed.)

"...there is grandeur in this view of life."

Asa Gray (1810-1888)



- Harvard Botanist
- Described Western & Northern American Flora
- Helped Darwin sell 2500 copies of *Origin's* 1st ed in USA (£636, 13 shillings, 4 pence)
- Darwin's 1855-57 outline
- Strong supporter and close friend of Darwin in USA

Asa Gray

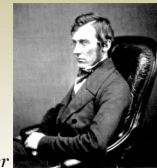
- Preached coexistence of religion and evolution (theistic evolutionism)

"Seriously it would be rash and wrong for us to declare that this conception is opposed to theism. Our idea of Nature is that of an ordered and fixed system of forms and means working to ultimate ends. If this is our idea of inorganic nature, shall we abandon or depreciate it when we pass from mere things to organisms, to creatures which are themselves both means and ends? Surely it would be suicidal to do so."
(*Natural Science and Religion: Lecture II, 1880*)



Joseph D. Hooker (1817-1911)

- Erebus Voyage
- Director of Kew Gardens (after his father)
- First (with Charles Lyell) to see Darwin's 1844 Essay



"I should be the happiest boy alive if ever I would see that wonderful arched rock, and knock penguins on the head"
(Huxley L., 1918)

Joseph D. Hooker: *Erebus* Voyage (1839-43)

- Sir James Clarke Ross' Antarctic Seas Expedition, as assistant surgeon and botanist
- Described the flora of the Antarctic, New Zealand, Tasmania
- Read Darwin's *Voyage of the Beagle* very enthusiastically



Joseph D. Hooker

Friendship with Darwin

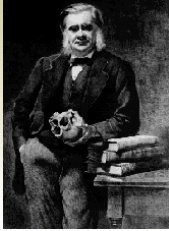
- Congratulations!
- Debated plant distributions – Rejected "multiple centres of creation" theory and looked for general laws (adopted Darwin's explanation of migration in 1866, as opposed to islands connected by landmasses now sunken)
- First to see hear of Darwin's theory
- First to cite the *Origin*



India and Himalayan Adventures (1847-51)

- Culminated in the description of Indian, Himalayan, Bengal and Nepal flora and fauna

Thomas Huxley (1825-95)



- Wanted to be an engineer but settled on being a medical student instead... at the age of 12
- Received the Gold Medal at 26 for working on Hydrozoans
- Raised Evangelical though rejected any form of state-sponsored religion
- Very much concerned for working poor, frequented London's slums
- Education Reformer
- "unity in diversity"

Thomas Huxley: *Rattlesnake Voyage* (1846-50)



- Purpose: to survey the Great Barrier Reef of Australia
- Signed on as Assistant Surgeon and Naturalist
- Sought to find "unity of diversity" in marine invertebrates

Thomas Huxley: Dedicated to Evolution



"I do most heartily thank you for the great store of new views you have given me. . . As for your doctrines I am prepared to go to the Stake if requisite. . ."

I trust you will not allow yourself to be in any way disgusted or annoyed by the considerable abuse & misrepresentation which unless I greatly mistake is in store for you. . . And as to the curs which will bark and yelp -- you must recollect that some of your friends at any rate are endowed with an amount of combativeness which (though you have often & justly rebuked it) may stand you in good stead --

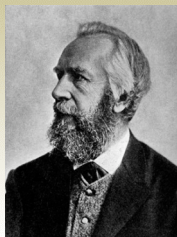
I am sharpening up my claws and beak in readiness" (Letter to Darwin, Nov, 1859)

Bishop Wilberforce Debate

- British Association Meeting 1860
- Bishop Wilberforce attempted scorn of biblical proportions on Darwin's theory (primed by Owen) and insulted Huxley
"Is it on your grandfather's or your grandmother's side that you claim descent from a monkey?"
- Huxley's Reply (earning him the title "Darwin's bulldog"):
"... would I rather have a miserable ape for a grandfather or a man highly endowed by nature, such as yourself, and possessing great means and influence, and yet who employs those faculties for the mere purpose of introducing ridicule into a grave scientific discussion—then I still unhesitatingly affirm my preference for the ape"
- Main arguments: 1) why can't we see transmutations in rapidly reproducing invertebrates, 2) insulted Darwin's grandfather Erasmus, 3) paucity of fossils
- Hooker was most vociferous about the technical details in terms of Botany and accused the Bishop of never having read the book

Ernst Haeckel (1834-1919)

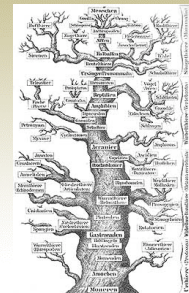
- Professor of Zoology at Jena
- HUGE fan of everything about Darwin
- Trained and worked as a physician but quit after reading *Origin* in 1859
- Propagated *Darwinismus* throughout German-speaking countries and had it translated
- Used the *Origin* mostly for socio-political ends
- Pilgrimage to Down House in 1866

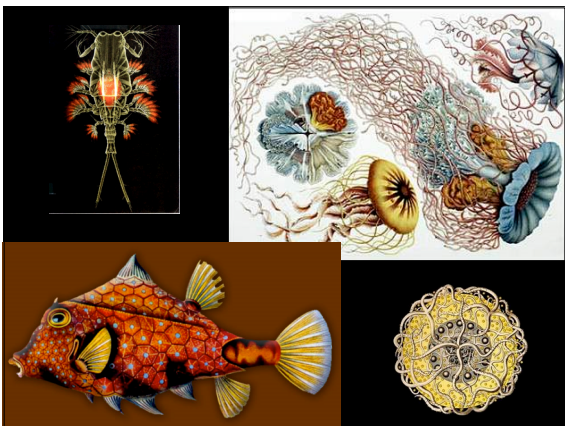
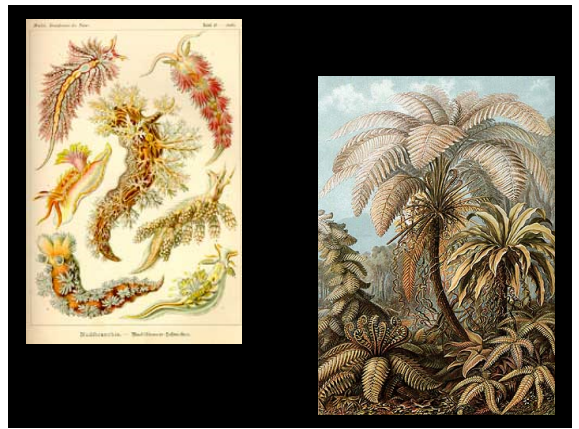
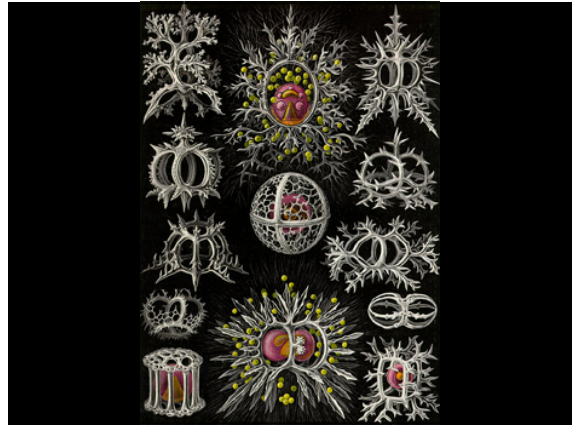
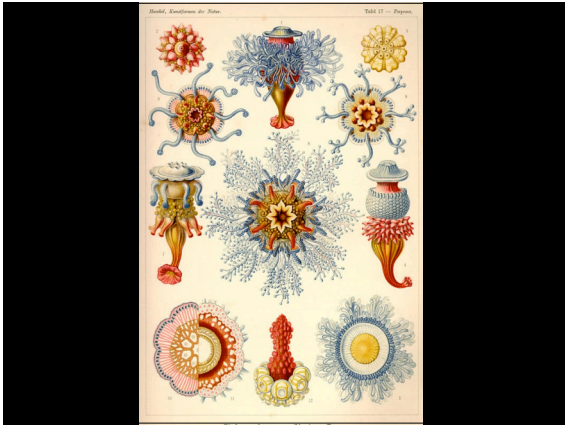


"ontogenesis is a brief and rapid recapitulation of phylogenesis, determined by the physiological functions of heredity (generation) and adaptation (maintenance)" (1899)

Ernst Haeckel (1834-1919)

- Extremely talented artist
- Brilliant invertebrate zoologist
- Had a habit of being extraordinarily speculative and a "data-fudger"
- Haeckel did not really believe in natural selection yet extended it and the "struggle for existence" to society
- Believed that the environment acted directly on organisms to produce new races
- *Generelle Morphologie (1866)* rearranged all biological knowledge along Darwinian lines







Sources and Further Reading

- All images shamelessly pilfered from the internet using Google
- Fantastic Websites:
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<http://www.ucmp.berkeley.edu>
 - Wikipedia
http://en.wikipedia.org/Main_Page
 - The Victorian Web
<http://www.victorianweb.org/>
- Desmond & Moore (1992) *Darwin: The Life of a Tormented Evolutionist*
- Ruse (1999) *The Darwinian Revolution: Science Red in Tooth and Claw*

