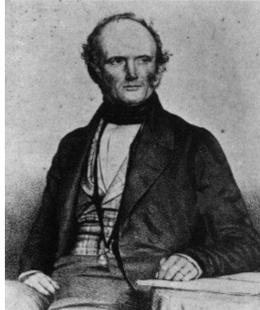


Sir Charles Lyell and Geology's Influence on Darwin's Theories



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Before Lyell

- Neptunian vs. Plutonian geology:
 - Alfred Gottlieb Werner: rocks precipitated out of primordial ocean (Biblical Flood)
 - James Hutton: Perpetual cycle of decay and renewal
 - Determinism vs. Infitism
- Catastrophism à surface features on earth originated suddenly, in the past, by different geological processes than those currently occurring
- Natural History had to be concurrent with Theology

Darwin the spoiled rich kid

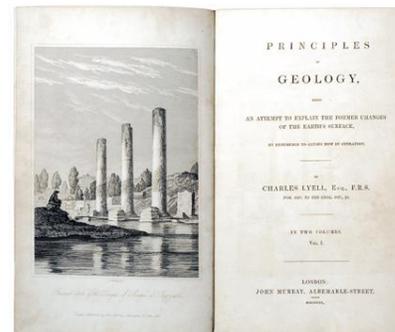
- Father was a wealthy lawyer and investor
- Mischievous kid, cut school to do chemistry experiments in the shed, shoot birds, play with dogs and catch rats
- Mother died when he was 8
- Never had a job, nor will have job
- Darwin needed permission from daddy to go on the Beagle voyage because position was unpaid

Lyell 1797-1875

- Born in Scotland – hotbed of scientific controversy
- 1819 – First scientific paper
- 1827 – Abandoned law for geology
- 1830 – *Principles of Geology* (12 editions)
- Obsessed by the evolution's implications, specifically Lamarkian evolution
- Very close with Darwin

Lyell's 3 Principles

- **Uniformitarianism** à Past forces had same order of magnitude as today, catastrophes don't explain present phenomena
- **Steady-State** à Endless cycle of decay and renewal with no particular direction
- **Actualism** à Events that happened in the past can be inferred to be happen by presently observable phenomena (*vera causa*)



Darwin the Doctor

- Went to Edinburgh to study medicine
- Apprenticed in taxidermy
- Hated seeing blood
- Found medicine boring
- Kept detailed notes on bird behaviour as well as the plants and animals of the museum
- Joined the Plinian Society
- Studied geology, hated it and vowed to never study it again!
- Befriended by Robert Grant à Evolution and Lamarck
- 1827à 1st talk: Larvae of sea mats can swim & black specks in oyster shells were skate leeches
- Quit medical school for good in April and toured Paris

Darwin the Clergy

- Displeased father arranges for Charles to study for the clergy at Cambridge
- Collects beetles, has dinner parties and reads Shakespeare instead of studying
- Rev'd Henslow introduces botany and natural history
- 1828 Fall took up residence in William Paley's old room at Christ's college
- Loved Paley's "logic and simple elegance"
- 1831 passed final exam placing 10th out of 178

Darwin the Geologist

- He considered himself a geologist from the outset
- Made several important geological observations
- Made several errors as well
- Applied Lyell's principles on faith and to everything



H.M.S. Beagle in the Strait of Magellan

Darwin's Geologic Bibliography

- *Observations of proofs of recent elevation on the coast of Chili* (1837)
- *A sketch of the Deposits containing extinct Mammalia in the neighbourhood of the Plata* (1837)
- *On certain areas of elevation and subsidence in the Pacific and Indian oceans, as deduced from the study of Coral Formations* (1837)
- *Geological Notes made during a survey of the East and West Coasts of South America in the years 1832, 1833, 1834, and 1835, with an account of a transverse section of the Cordillera of the Andes between Valparaiso and Mendoza* (1838)
- *On the connexion of certain volcanic phenomena, and on the formation of mountain-chains and volcanos, as the effects of continental elevations* (1838)
- *Note on a Rock seen on an Iceberg in 61° South Latitude* (1839)
- *Observations on the Parallel Roads of Glen Roy, and of other parts of Lochaber in Scotland, with an attempt to prove that they are of marine origin* (1839)
- *Journal of researches into the natural history and geology of the countries visited during the voyage round the world of H.M.S. Beagle (1839-1913, 11 editions)*
- *On the Connexion of certain Volcanic Phenomena in South America, and on the Formation of Mountain Chains and Volcanos, as the Effect of the same Power by which Continents are elevated.* (1840)
- *Fossil Mammalia*, by Richard Owen. With a Geological Introduction, by Charles Darwin (1840)
- *On the distribution of the erratic boulders and on the contemporaneous unstratified deposits of South America* (1841)
- *On a Remarkable Bar of Sandstone off Pernambuco, on the Coast of Brazil* (1841)
- *The Structure and Distribution of Coral Reefs* (1842)
- *Notes on the Effects Produced by the Ancient Glaciers of Caernarvonshire, and on the Boulders Transported by Floating Ice* (1842)
- *Geological observations on Coral Reefs, Volcanic Islands, and on South America* (1842-1846)
- *What is the Action of Common Salt on Carbonate of Lime?* (1844)
- *An Account of the Fine Dust which Often Falls on Vessels in the Atlantic Ocean* (1846)
- *On the Geology of the Falkland Islands* (1846)
- *Origin of Saliferous Deposits: Salt-Lakes of Patagonia and La Plata* (1846)
- *Salt* (1847)
- *On the Transport of Erratic Boulders from a Lower to a Higher Level* (1848)
- *A Manual of scientific enquiry, prepared for the use of Her Majesty's Navy, and adapted for travellers in general* (1849)
- *On British Fossil Lepididae* (1850)
- *Extracts from Letters to the General Secretary, on the Analogy of the Structure of Some Volcanic Rocks with That of Glaciers* (1851)
- *A Monograph of the Fossil Lepididae, or, Pedunculated Cimipedes of Great Britain* (1851)
- *A Monograph on the Fossil Balanidae and Verrucidae of Great Britain* (1854)
- *On the power of Icebergs to make rectilinear, uniformly-directed Grooves across a Submarine Undulatory Surface* (1855)
- *Shell Rain in the Isle of Wight* (1855)
- *The Subject of Deep Wells* (1857)
- *Transplantation of Shells* (1878)
- *The Omori Shell Mounds* (1880)
- *A letter (1876) on the 'Drift' near Southampton* (1881)

Darwin the Naturalist

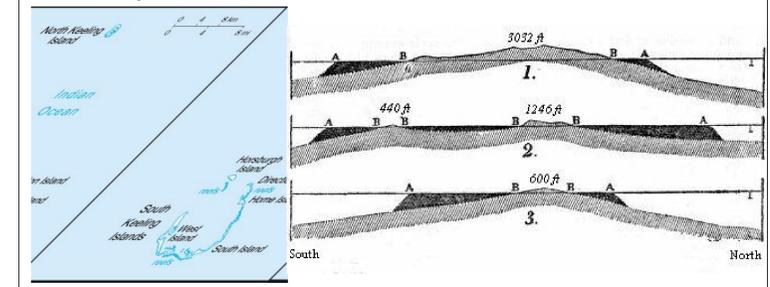
- Heavily influenced by Paley's *Natural Theology*, Sir John Herschel's *Preliminary Discourse on the Study of Natural Philosophy* and Alexander Von Humboldt's 7 volume *Personal Narrative*
- Attended Rev'd Adam Sedgewick's Geology lectures and actually found them exciting
- Spent the whole summer with Sedgewick doing field geology
- Offered position as Ship's Naturalist on the Beagle by Henslow
- Sailed from Plymouth harbour Dec. 21, 1831 and arrived back in England Oct. 2, 1836

Darwin the Geologist

- During the Beagle Voyage, Darwin commented on how he was seeing landforms "as though he had the eyes of Lyell"
- A few of his discoveries:
 - stepped plains of shingle and seashells in Patagonia were raised beaches
 - Experienced an earthquake that raised the land
 - Collected seashells on top of the Andes.
 - Discovered fossils of gigantic extinct Megatheriums and Glyptodons in strata that showed no signs of catastrophe or climate change
- 1st paper after the cruise argued that South America was raising as a landmass

Darwin's theory on coral atolls

- Coral atolls form on sinking volcanic mountains
- Confirmed when the Beagle reached and surveyed the Cocos Islands



Darwin's theory on coral atolls

"...there is but one alternative; namely, the prolonged subsidence of the foundations, on which the atolls were primarily based, together with the upward growth of the reef-constructing corals..."

– **The Structure and Distribution of Coral Reefs (1842)**

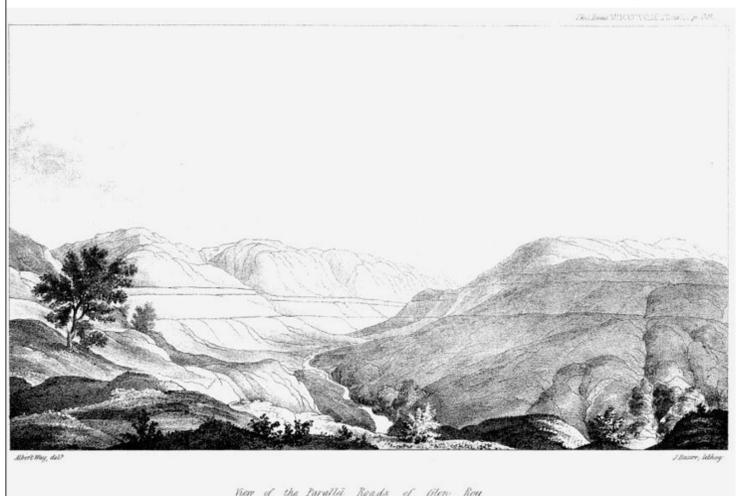
Parallel roads on Glen Roy

- "It is admitted by every one, that no other cause, except water acting for some period on the steep side of the mountains, could have traced these lines over an extensive district"
 - *Observations on the Parallel Roads of Glen Roy, and of other parts of Lochaber in Scotland, with an attempt to prove that they are of marine origin (1839)*
- Darwin applies Lyellian Principles between events he witnessed in Chile (uplift of mountains) to the Parallel Roads

Darwin and Steady-State

- Steady-State entails that events happened over long periods of time and that no directionality need be implied to explain events
- Therefore, natural selection can act solely by accumulating slight, successive, favorable variations and produces no great or sudden modifications

Parallel roads on Glen Roy



Parallel roads on Glen Roy

- Proven wrong in 1867 by Louis Agassiz à they were beaches formed at different levels as a glacier retreated that blocked the valley
- Darwin correctly applied Lyell's Principles...
Incorrectly
- Incorrectly predicts that one will find fossil shells à argues one shouldn't find evidence though... natural forces would wipe any evidence out



Evolution and Uniformitarianism

- Uniformitarianism postulates that past forces had the same order of magnitude as today
- No uniqueness should be attributed to events of large scale and long times

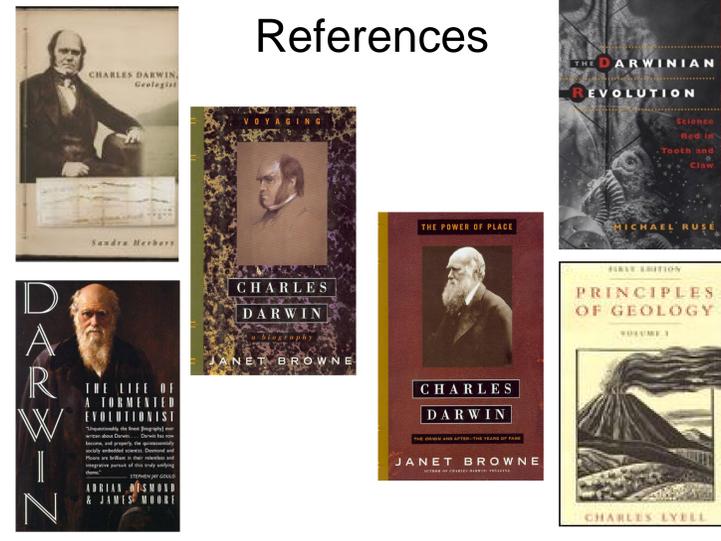
"How fleeting are the wishes and efforts of man! how short his time! and consequently how poor will his products be, compared with those accumulated by nature during whole geological periods" *Origin (1859)*

Darwin and Actualism

- Actualism explains the past by appealing only to forces presently observable
- Hence, if man can invoke changes in pigeons and crops on the time scale of civilization, “Nature with its infinite wisdom can surely be responsible for the much greater diversity of life”



References



“When we no longer look at an organic being as a savage looks at a ship, as something wholly beyond his comprehension; ... when we contemplate every complex structure and instinct as the summing up of many contrivances, each useful to the possessor, in the same way as any great mechanical invention is the summing up of the labour, the experience, the reason, and even the blunders of numerous workmen; when we thus view each organic being, how far more interesting—I speak from experience—does the study of natural history become!” *Origin* 1859

Thanks!

