



Lecture 6

“Catastrophism, Uniformitarianism,
and the growing fear of ‘Transmutation’
in early Victorian Society”

*“I do from my soul abhor the[se]
sentiments...”*

The Reverend Adam Sedgwick

Route map

- Catastrophist geology and natural theology up to 1830
- “Noises off”: Scriptural geology
- The emergence of uniformitarian geology in the 1830s
- Early evolutionary ideas, 1800–1840
 - Lamarck, Erasmus Darwin
- Evolution and (English) society, 1800–1840

Cuvier's 'Catastrophism'

- There has been a succession of sharply distinct eras in the history of life
- Each era is characterized by its own distinctive fossil fauna and flora
- Eras are separated by sudden, catastrophic (but enigmatic) events in which one set of plants and animals is swept away and replaced by another

Cuvier's influence

He transformed the study of both comparative anatomy and paleontology

He provided a theoretical system –
'catastrophism' – that became the principal organizational framework for historical geology for more than a generation

He provided multiple grounds for rejecting the speculative evolutionary ideas of the late Enlightenment (of which, more later...)

The new geology and natural theology

- In Britain, Cuvier's Catastrophism became the principal framework for understanding the significance of the "geological column"
- It was "progressivist" – i.e., it represented the history of life as a series of sharply separate and progressively more "advanced" eras
- It allowed natural theologians plenty of scope for harmonizing historical geology with traditional religious belief

The geological column

- An arrangement of all known sedimentary rocks, from oldest to youngest
- A practical and theoretical synthesis of a vast amount of stratigraphical evidence gathered in the first half of the 19th century
- Generally agreed to portray a “progressive” pattern of successive appearance of more complex forms

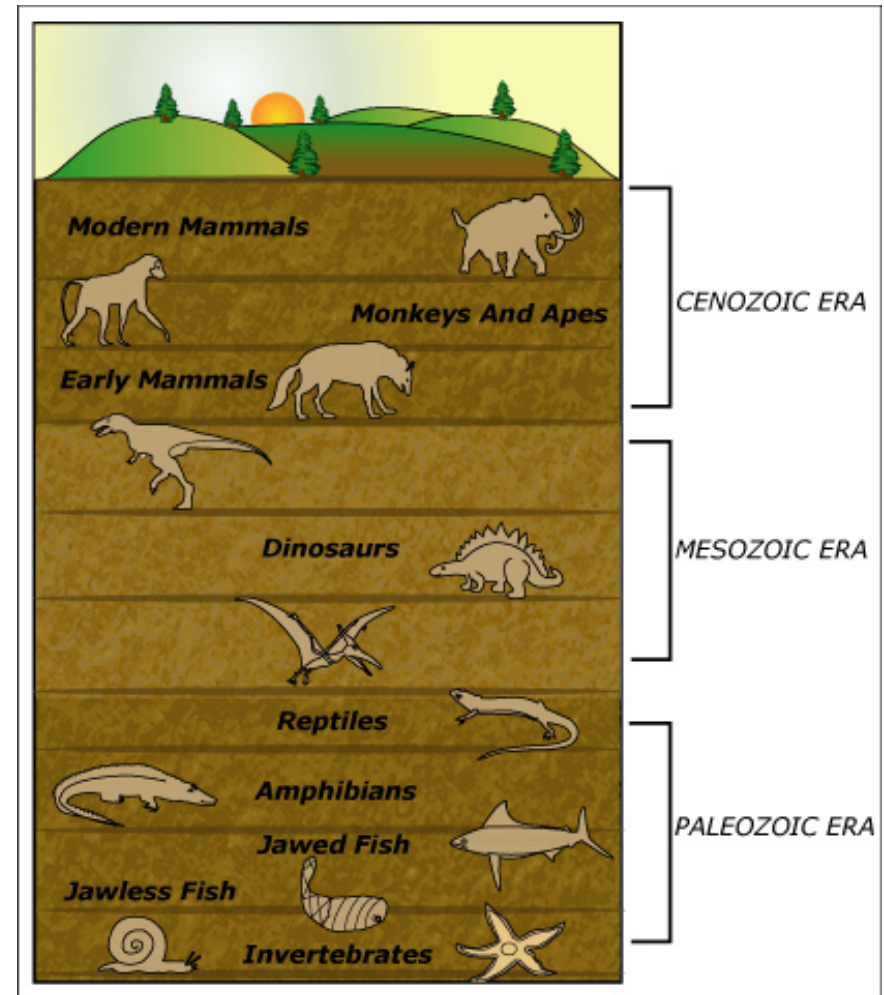
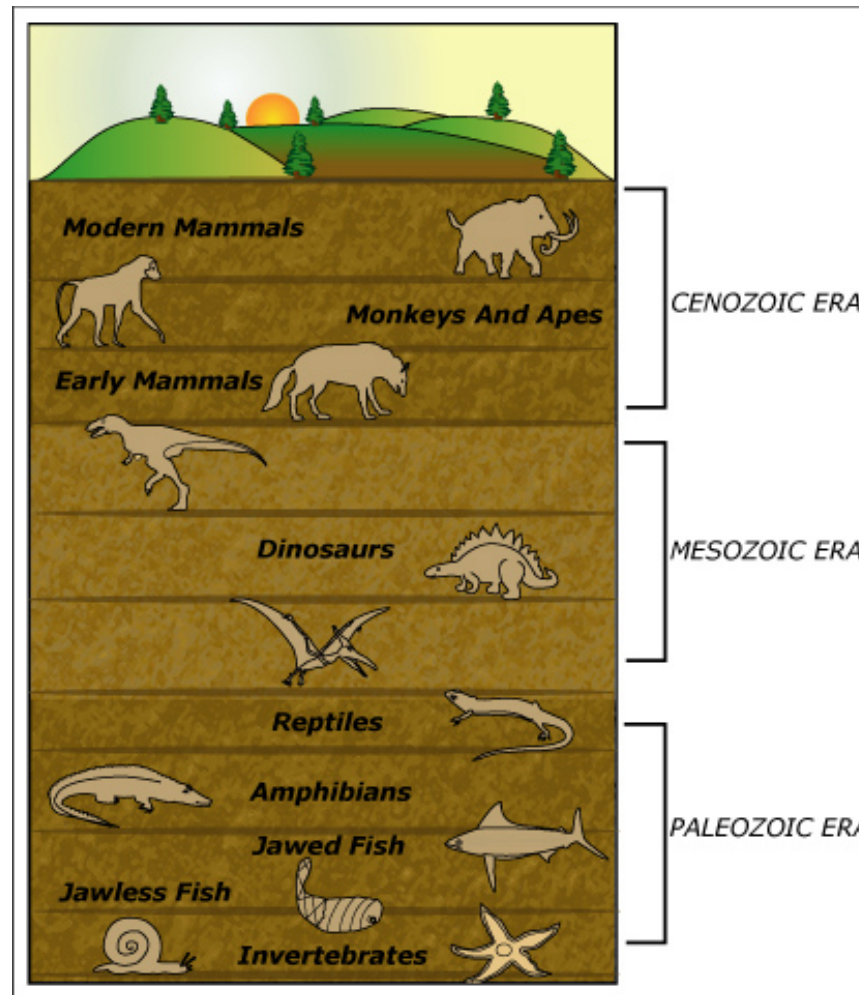


Image by MIT OpenCourseWare.

The geological column and Genesis

**“Gap” Theory –
e.g., Buckland**

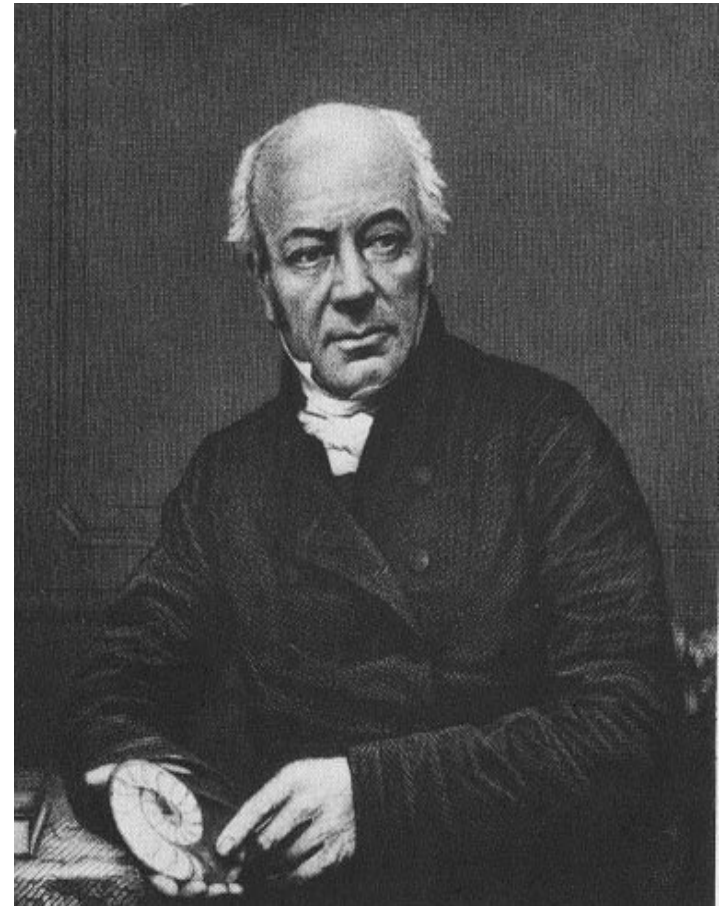


**“Day-Age”
Theory – e.g.,
Miller**

Image by MIT OpenCourseWare.

1. William Buckland, 1784–1856

- Geologist & Anglican clergyman, Fellow of Corpus Christi, Oxford & Dean of Westminster
- First Reader in Geology, University of Oxford
- *Key works include:*
 - *Vindiciae Geologicae*, 1820
 - *Reliquiæ Diluvianæ*, 1823
- Early advocate of 'catastrophist' geology



Buckland's Reputation

"Where shall we our great Professor inter
That in peace may rest his bones?
If we hew him a rocky sepulchre
He'll rise and break the stones
And examine each stratum that lies around
For he's quite in his element underground."

"Gap" Theory

Key Idea:

The word "beginning" in Genesis means an undefined period between the origin of the earth and the creation of its current inhabitants, during which geology reveals that a series of successive extinctions and creations of new kinds of plants and animals took place

Adam Sedgwick, 1785-1873

- Anglican clergyman and self-taught geologist
- Woodwardian Professor of Geology at Cambridge, 1818-1873
- Helped establish the 'Cambrian' and 'Devonian' periods
- Advocate of 'catastrophist' geology



Sedgwick and the geological column

- Sedgwick contributed to the establishment of the geological column
- Sedgwick's main contributions were made through study of older strata in southern England and Wales
- He proposed the existence of the "Devonian" period, sometimes known as the "age of fish"

Sedgwick as a natural theologian

- Sedgwick insisted that there could be no conflict between the two books of God's revelation
- He fought hard to establish geology's credentials with fellow-Christians
- He also fought hard for catastrophism and against all forms of evolutionism



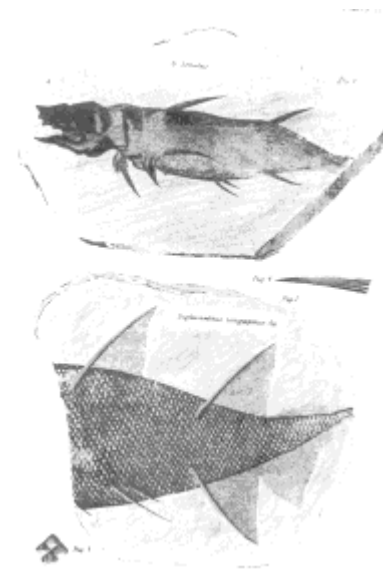
Hugh Miller, 1802 - 1856

- Scottish stone-mason, self-taught geologist, writer & evangelical Christian
- Made many important discoveries, e.g., Silurian sea-scorpions, Devonian fish
- Author, *The Old Red Sandstone* (1841), *Footprints of the Creator* (1850) and *The Testimony of the Rocks* (1856)
- Advocate of 'catastrophist' geology



Miller's "Day-Age" Theory

- The earth is very old
- Geology attests many different ages, each with its own distinctive animals & plants
- Geology offers a better account of the argument from design than Paley
- The Book of Genesis refers to the geological eras in the "days" of creation



"Day-Age" Theory

Key Idea:

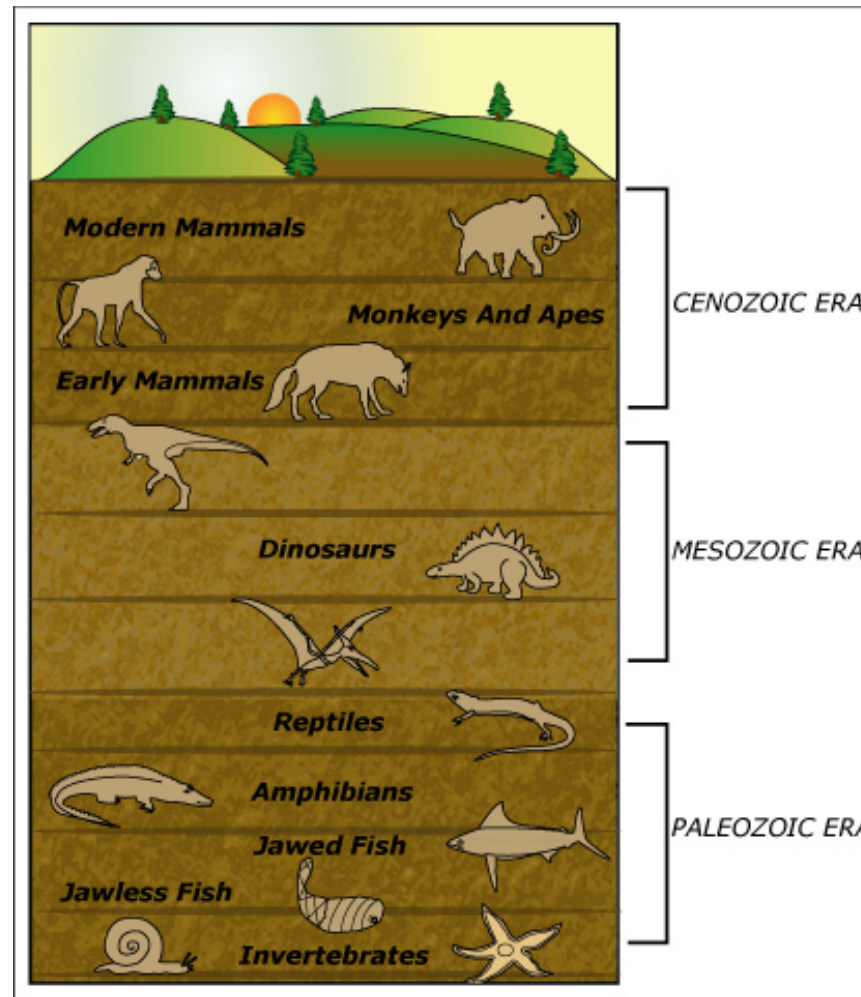
The "days" of creation recorded in the Book of Genesis are not literal days but rather separate geological "ages" in the history of life; thus, the book of God's words and the book of His works are mutually consistent

Taking stock

- By around 1830, historical geology is a rapidly maturing science
- It has established that life on earth is ancient, and that profoundly different kinds of plants and animals have come and gone over the course of time
- It has done all of these things within the context of natural theology, making various undoubtedly sincere attempts to reconcile the new geology with the Book of Genesis

Two alternatives to catastrophism, c. 1830

Scriptural Geology, - e.g., Ure



Separation of spheres – e.g., Lyell

Image by MIT OpenCourseWare.

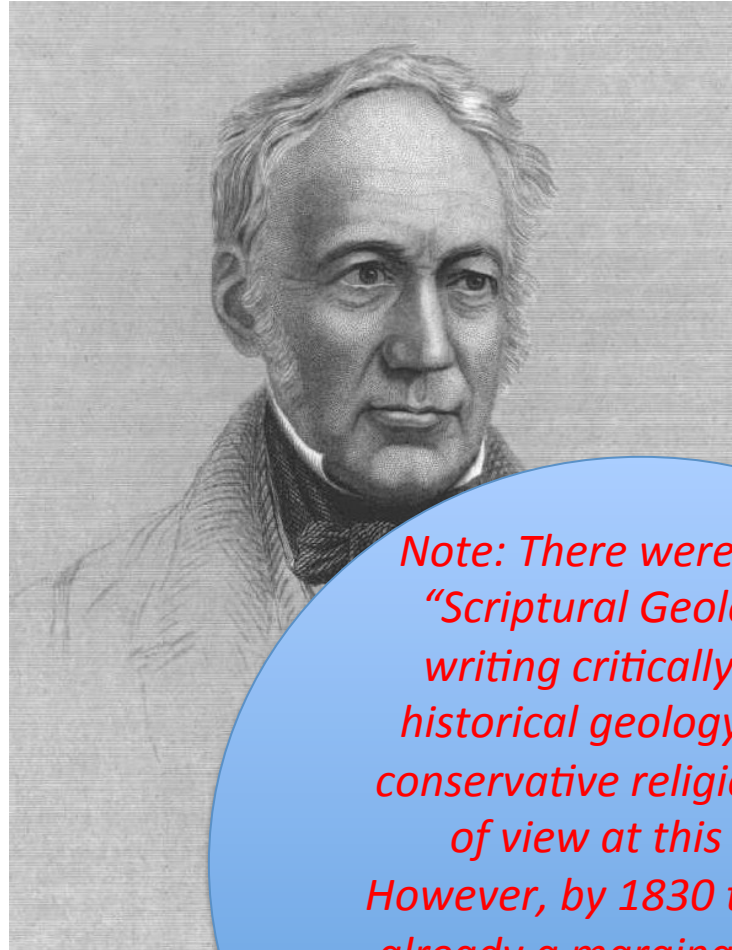
“Scriptural Geology”

- Andrew Ure (1778–1857)
- Scottish doctor, chemist & scholar
- A New System of Geology, 1829
- A critic of historical geology, who argued for the inevitably speculative (& unscientific) character of studies of the prehistoric past



“Scriptural Geology”

- Andrew Ure (1778–1857)
- Scottish doctor, chemist & scholar
- A New System of Geology, 1829
- A critic of historical geology, who argued for the inevitably speculative (& unscientific) character of studies of the prehistoric past



Note: There were several “Scriptural Geologists” writing critically about historical geology from a conservative religious point of view at this time. However, by 1830 they were already a marginal group – mainly comprised of “armchair” critics outside the emerging community of professional geologists

and then...

...just when it looked as if there was to be a happy consensus about science and religion around catastrophist geology...

...a leading British geologist forced a re-examination of the methods being used by his colleagues in developing their theories of earth history

Charles Lyell, 1797-1875

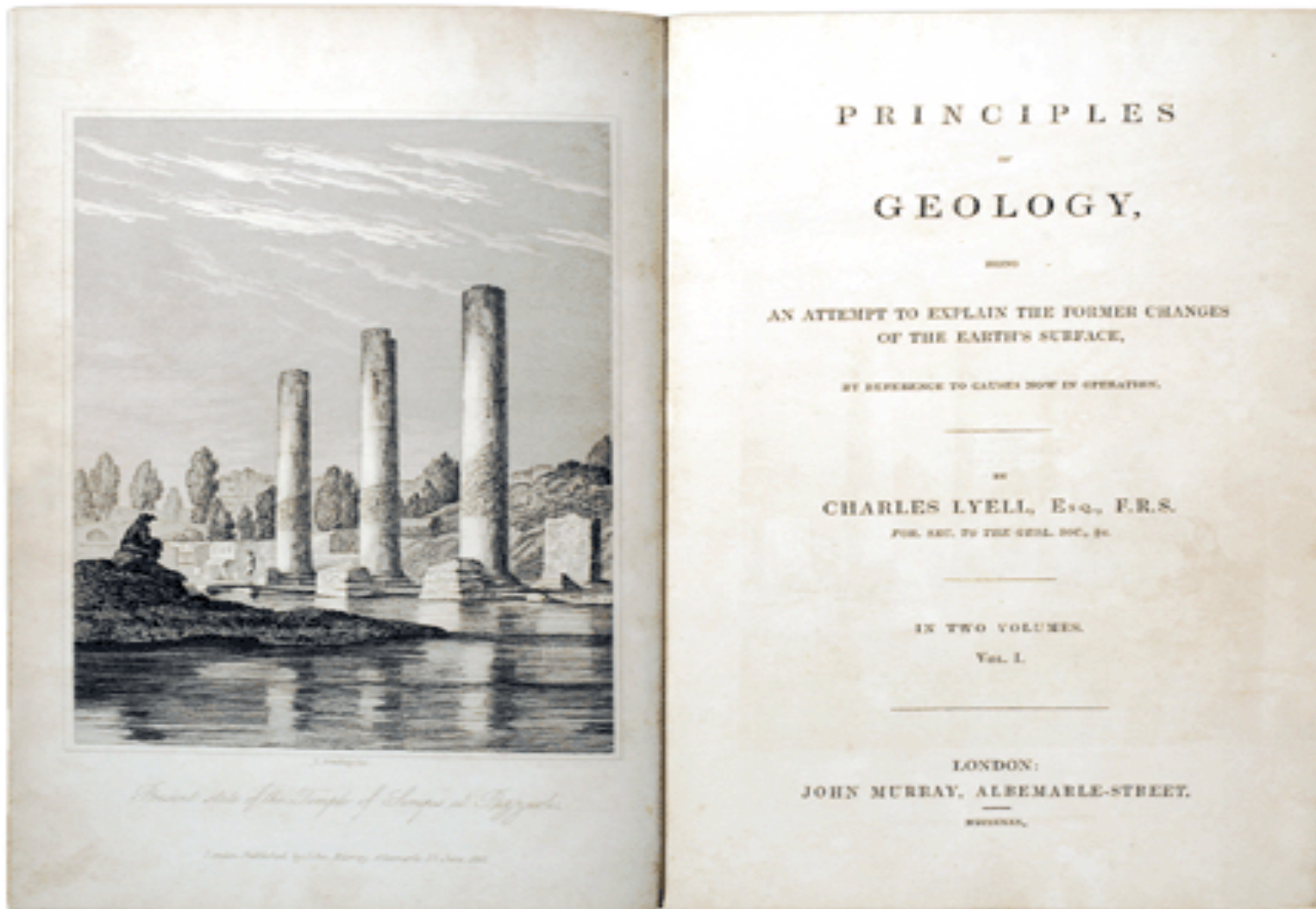
- Trained as a lawyer at Oxford, where he met Buckland
- Key figure in early Geological Society of London
- Traveled with Roderick Murchison to France and Italy (1828-9)
- Wrote *The Principles of Geology* (3 vols, 1831-4), perhaps the single most influential geological work in the early-19th century



Lyell's 'Uniformitarianism'

- The sacred scriptures should have no role in the formulation of geological theory
- The principal rule that should regulate geological theorizing is: the present is the key to the past:
 - *In other words, earth history is to be explained solely by reference to forces and processes that can be seen in action today*
- It follows that the history of the earth is almost unimaginably long

Lyell's title page and frontispiece



The principle of uniformity illustrated in Lyell's frontispiece

The frontispiece (right) shows the temple of Serapis at Pozzuoli, Italy as it appeared in the early 19th century. The pillars are covered by several generations of marine animal encrustations (visible as different bands) showing that since its construction there have been multiple episodes of vertical movement at the scale of several meters, alternately submerging and exposing the pillars to different levels.



Uniformitarianism and Natural Theology

*"As geologists, we learn that it is not only the present condition of the globe that has been suited to the accommodation of myriads of living creatures, but that many former states also have been equally adapted to the organization and habits of prior races of beings. The disposition of the seas, continents, and islands, and the climates have varied; so it appears that the species have been changed, and yet they have all been so modelled, on types analogous to those of existing plants and animals, as to indicate throughout **a perfect harmony of design and unity of purpose**. To assume that the evidence of the beginning or end of so vast a scheme lies within the reach of our philosophical inquiries, or even of our speculations, appears to us inconsistent with a just estimate of the relations which subsist between the finite powers of man and the attributes of an Infinite and Eternal Being"*

Lyell, *Principles of Geology*, 1831-4

Singular features of Lyell's views

- He refused to speculate about the first origins of living organisms, arguing that this was beyond the reach of science
- He denied "progressivism", claiming that
 - the same (very large) variety of plants and animals have come and gone in particular regions, and
 - there has been no gradual progress from simpler to more complex forms over the course of geological time

Why was Lyell “anti-progressivist”?

- Lyell was in a minority of virtually 1 in denying the reality of “progress” over the course of geological time
- He opposed progressivism because he believed that

progressivism + uniformitarianism = evolution

- *And he was determined to safeguard the uniqueness of humankind against any notion of a common origin for humans and other animals*

Lyell on Lamarck (take 1)

"I devoured Lamarck... his theories delighted me... I am glad that he has been courageous enough and logical enough to admit that his argument, if pushed as far as it must go, if worth anything, would prove that men may have come from the Ourang-Outang. But after all, what changes species may really undergo!. That the Earth is quite as old as he supposes, has long been my creed."

Lyell, letter to Gideon Mantell, 1827

Jean-Baptiste Pierre Antoine de Monet, Chevalier de Lamarck, 1744-1829

- French soldier,
naturalist, savant
- Professor of Botany,
Jardin des Plantes,
Paris, 1788
- Professor of Zoology,
Museum National
d'Histoire Naturelle,
1793



Out-take: what's in a word?

- In the 18th & early-19th centuries, the term *evolution* was most often used to describe ontogeny (the development of the individual from egg to adult)
- Terms more commonly used to describe phylogeny (the development of new species over the course of geological time) were
 - *transformism*
 - *transmutation*

Transformism in natural history, 1750-1820

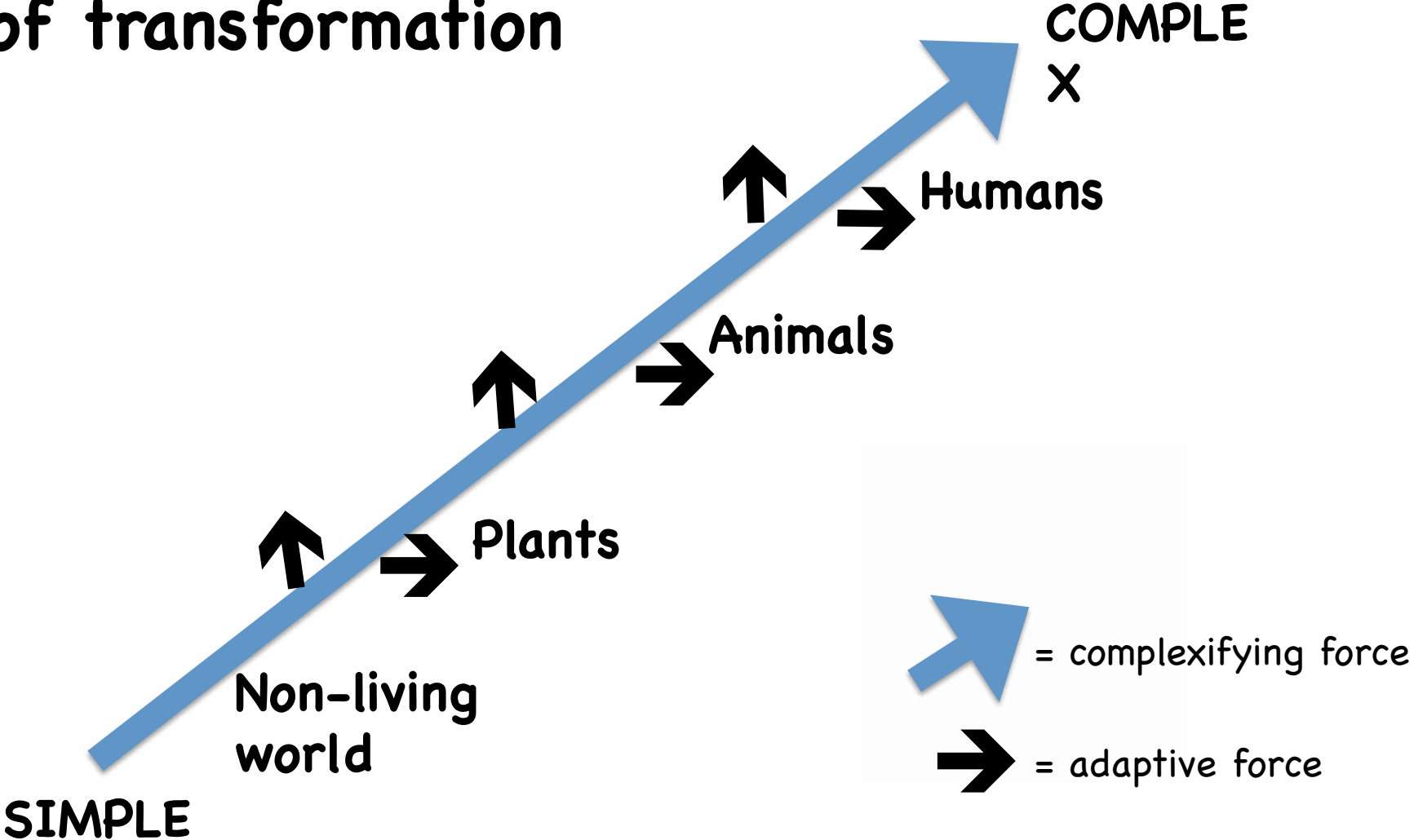
- Evolutionary ideas of all sorts proliferated in Enlightenment Europe
- The “nebular hypothesis” was essentially an evolutionary cosmology
- 2 generations of leading French naturalists in the 18th century played with notions of “transformism”, or what we would call evolution

Lamarck's theory of transformation

Two primary forces drive transformation:

- *Le pouvoir de la vie (a complexifying force)*
 - natural movements of fluids etch out organs from tissues, leading to ever more complex construction regardless of the organ's use or disuse
- *L'influence des circonstances (an adaptive force)*
 - use and disuse of characters leads organisms to become more adapted to their environment

Lamarck's theory of transformation



Lamarck's reputation

TODAY

- Known as an (un?) important "forerunner of Darwin"
- Associated almost exclusively with the notion of "inheritance of acquired characteristics" (which, ironically, was a commonplace belief in Lamarck's day)

EARLY-19TH CENTURY

- Known as a leading taxonomist, e.g., of "invertebrate" animals (his term)
- Known as a speculative natural philosopher with a wide-ranging theory of "transformation"
- Known as an opponent of Cuvier's approach to biology

MIT OpenCourseWare
<http://ocw.mit.edu>

STS.009 Evolution and Society
Spring 2012

For information about citing these materials or our Terms of Use, visit: <http://ocw.mit.edu/terms>.