History of Genetics in Evolution

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The Great Chain of Being

Going back as far as the Ancient Greeks, a linear hierarchy of life forms was assumed, with inanimate objects at the bottom and deities at the top, such as this:

Deity
Angels
Man
Mammals
Birds
Reptiles
Amphibians
Fish
Insects
Worms
Protists
Rocks

Issues: placement of birds, insects not obvious. A scale of complexity? Or what? Note: can think of it as a “chain”, hence the phrase “missing link”
Carl Linnæus (Carl von Linné) (1707-1778)

The great figure in biological classification. Not a nice man.
Monophyly

Monophyletic: having a common ancestor which is not the ancestor of any of the other species being discussed.

(This definition works for cases where there are fossil forms being included, and those where they are not, and works whether we are discussing only a fixed set of species or all species descended from some ancestor.)
Linnæus’s classification of vertebrates

In the 10th edition of *Systema Naturae*:

Class Mammalia (mammals)
Class Aves (birds)
Class Amphibia (amphibians and reptiles)
  Order Reptiles
    Genus Testudo (turtles)
    Genus Draco (gliding lizards)
    Genus Lacerta (lizards, salamanders, crocodiles)
    Genus Rana (frogs and toads)
  Order Serpentes (snakes, slowworms, caecilians)
Class Pisces (most fishes)
  Order Nantes (lampreys, rays, sharks, anglerfishes, sturgeons)

Not exactly our current scheme!
Example: A phylogeny of the living Craniata
Vertebrates are a monophyletic group
Reptiles and fishes are paraphyletic groups
An intellectual world changes

From the 1600s on, changes of worldview in many fields:

- Commercial trade and exploration brings Europeans in contact with animals and plants of other continents

- Physics: Galileo and Newton in 1600s discover the laws of motion, a single mechanism for multiple phenomena. Hugely influential.

- Astronomy: Comets, galaxies, planets that have geology (Galileo, Thomas Wright, Laplace, William Herschel)

- Geology: Strata, sedimentation, and deep time (e.g. Lavoisier, Smith, Hutton, Lyell)

- Paleontology: Fossils are not artifacts but remains of real organisms, different from the ones we see today (Nicholas Steno, Smith, Cuvier)

- Anthropology: Diversity of people, similarity of apes to people

- Chemistry: Arbitrary properties of substances replaced by the periodic table and properties of atoms and molecules (Boyle, Lavoisier, Cavendish, Priestley, Mendeleyev)

- ... and of course politics: the English and French revolutions and the independence of the American colonies

All of this led biologists to look for unifying forces and connections between phenomena. As well as to be open to seeing ongoing changes in the natural world.
An American in Paris (2005)

Wandering east of the Panthéon on the Left Bank of Paris, you begin to notice unusual street names:

A street named for Linnaeus? This only hints at a little-known story.
Buffon

George-Louis Leclerc, Comte de Buffon (1707-1788)
Statue of Buffon at the Jardin des Plantes
Buffon, honored

Rue Buffon, next to the Jardin des Plantes
(with plastic mastodon, Golden Arches, traffic ticket)
Jean Baptiste Pierre Antoine de Monet, Chevalier de Lamarck (1744-1829)
Lamarck’s tree

As published in *Philosophie Zoologique*, 1809
Can you identify some of the groups? “M.” means mammals
Lamarck’s mechanism for evolution

In *Philosophie Zoologique*, 1809.

- Organisms’ characters are altered by the effects of use and disuse.
- These changes are passed on to descendants by inheritance of acquired characters.

Note that Lamarck did not originate “Lamarckian inheritance”: it was something everyone believed in at that time.
Old displays in the Museum of Natural History, Paris
Statue of Lamarck in the Jardin des Plantes, Paris
Lamarck’s works listed
“My father, you will be vindicated”
Buffon’s (and Lamarck’s) house next to the Museum
Plaque on house commemorating Buffon

“George Louis Leclerc, Count of Buffon, born in Montbard, 7 September 1707, director of the Royal Botanical Garden from 1739 on, died in this house, 16 April 1788”
“Jean Baptiste Lamarck, born in Bazentin Le Petit, 1 August 1744, Professor at the Museum, Author of the first theory of evolution, lived in this house from 1795 on, died on the 18th of December 1829”
Geoffroy versus Cuvier

Etienne Geoffroy St. Hilaire
(1772-1844)

Georges Lèopold Chrétien Frédéric Dagobert,
Baron Cuvier
(1769-1832)
Memorials in Paris

Fountain on corner of Rue Linné and Rue Cuvier ("Á GEORGES CUVIER")

Rue Cuvier, along side of fountain and side of Jardin des Plantes
Allee Cuvier, within the Jardin
Rue Geoffroy St. Hilaire
Paris: Rue Lamarck and Rue Darwin
Johann Wolfgang von Goethe (1749-1832)
Goethe (1790) on the origin of parts of flowers
The Naturphilosophen

The Naturphilosophen and Evolutionary views

common developmental pathway    evolutionary tree

Ape
   ↓
  Monkey
    ↓
Mouse
     ↓
Reptile
      ↓
Amphibian
       ↓
Fish

Note – The picture here is very much a Great Chain of Being
Fossil forms becoming known in 1700s, 1800s

Charles Willson Peale
The Exhumation of the Mastodon
(in 1801, painted 1808)

Mary Anning’s Plesiosaur, 1821
Robert Chambers discusses evolution in 1844
Alfred Russel Wallace (1823-1913) in 1869
### Lamarck’s theory versus Darwin’s

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<thead>
<tr>
<th></th>
<th>Lamarck</th>
<th>Darwin/Wallace</th>
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<tbody>
<tr>
<td>Genetic variation important?</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Differential survival or reproduction?</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Mutations are in what direction?</td>
<td>adaptive</td>
<td>random</td>
</tr>
<tr>
<td>Phenotypic changes inherited?</td>
<td>Yes</td>
<td>maybe</td>
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Fleeming Jenkin

Fleeming Jenkin (1833-1885)  
Fleeming Jenkin Building  
University of Edinburgh
Blending inheritance and selection

Value of character
The Biometricians

Francis Galton (1822-1911)  

Karl Pearson (1857-1936)
Gregor Mendel (1822-1884)
Mendel in his school

The faculty of Mendel’s monastery school
(Mendel is top center-right with flower)
Rediscoverers of Mendel

Carl Correns  Erich von Tschermak-Seysenegg  Hugo De Vries
Founders of theoretical population genetics

R. A. Fisher  J. B. S. Haldane  Sewall Wright
Developers and popularizers of the Neodarwinian Synthesis

Ernst Mayr
George Gaylord Simpson
Sir Julian Huxley
G. Ledyard Stebbins
Theodosius Dobzhansky