"You will at once perceive," continued Professor Ichthyosaurus, "that the skull before us belonged to some of the lower order of animals; the teeth are very insignificant, the power of the jaws trifling, and altogether it seems wonderful how the creature could have procured food." – Cartoon by H. de la Beche lampooning Charles Lyell’s non-progressionism.
Darwin had Many Predecessors.

- **Buffon** – homology, degeneration of American species.
- **Erasmus Darwin** – wove the concept into poetry.
- **Goethe** – serial homology in plants.
- **Lamarck** – The first evolutionist: misinterpreted, maligned.
- **Saint-Hilaire** – commonality of body plans; bested in public debate for going “a phylum too far.”
- **Robert Chambers** – anonymous author of *Vestiges of the Natural History of Creation*. Helped pave the way for public acceptance of *The Origin*.

**Alfred Russel Wallace.**

1. Anticipated (1855) many of Darwin’s arguments: distributional patterns, imperfection, vestigial organs, *etc*.

2. Co-discoverer of natural selection (1858).

- Of these, **only** Wallace realized that DwM could account for Darwin’s “facts.”
Lamarck.

• The First Evolutionist.

1. *Philosophie Zoologique* (Lamarck, 1809)

"*Conclusion Accepted Up Until Today:* Nature (or its author), in creating the animals, anticipated all the possible sorts of circumstances in which they would have to live and gave to each species a fixed organic structure ... which forces each species to live in those places and climates where it is located."

"*My Personal Conclusion:* Nature, by producing in succession all the animal species and beginning with ... the simplest, gradually made the organic structure more complicated; as these animals generally spread out into all the habitable regions of the world, from the influence of the circumstances which each species encountered, it acquired the habits which we know in it and the modifications in its parts which observation reveals to us in that species."


"All others before him had discussed evolution *en passant* ... . He was the first author to devote an entire book primarily to the presentation of a theory of organic evolution. He was the first to present the entire system of animals as a product of evolution."
Figure 2.1. Phylogenetic descent according to Lamarck in *Philosophie Zoologique* (1809). Infusoria, polyps and radiaria form one group. All other animals descend from worms.
Figure 2.2. Phylogenetic descent according to Lamarck in *Histoire Naturelle des Animaux sans Vertebres* (1815). Two ladders are imagined: one, “articules,” descending from primitive worms (vers) and leading to arthropods, annelids, etc.; the other, from “infusoria” (unicells) and leading to non-segmented forms. Note the independent acquisition of “sensibility”. See Gould (1999a; b) for further discussion.
• Inheritance of Acquired Characters.

1. In textbooks, “Lamarckism” frequently contrasted with Darwin’s “more scientific” views.

2. Rubbish – inheritance via use and disuse was accepted by “many naturalists” who wished “to dispense, as far as possible, with the repeated intervention of a First Cause” (Lyell, 1836).

3. Recall The Origin’s famous concluding paragraph:

   “These laws, taken in the largest sense, being Growth with reproduction; Inheritance which is almost implied by reproduction; Variability from the indirect and direct action of the conditions of life, and from use and disuse; a Ratio of Increase so high as to lead to a Struggle for Life, and as a consequence to Natural Selection, entailing Divergence of Character and the Extinction of less improved forms.” [Emphasis added]

4. Indeed, Darwin (1868, 1881) had a continuing interest in inherited injuries.

   ”Is the scar on your son's leg on the same side and on exactly the same spot where you were wounded?” Letter to John. J. Weir. 4 April, 1868.
• **Pairing Darwin and Lamarck as competing protagonists historically inaccurate.**

1. Yes – Darwin had little use for his predecessor:

   "Heaven forfend me from Lamarck nonsense of a `tendency to progression,' `adaptations from the slow willing of animals,' etc.!!" – Letter to Hooker in 1844.

2. **But** – Lamarck had long since gone to a pauper’s grave, widely perceived as a crank.

3. What Darwin really went up against was **scientific consensus**.

   a. **Fixity of Species.**

   b. **Special Creation.**

4. These doctrines the legacy of **Georges Cuvier** as transmitted to the English by **Kirby**¹ and **Lyell**².

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¹ William Kirby, founder of English entomology. The introduction to his massive tome, *On the History Habits and Instincts of Animals*, includes a refutation of Lamarck.

² Charles Lyell championed uniformitarian geology. Volume II of his *Principles of Geology* includes refutes Lamarck and lays out the theory of Special Creation.
An Almost Pathetic Figure – Why?

• Politics / Religion.

1. In England, French evolutionists closely identified with Jacobin materialism and the Terror.

2. According to Kirby³

   “Lamarck’s great error is materialism. He seems to have no faith in anything but body, attributing everything to a physical ... cause. Even when, in words, he admits the being of a God he employs the whole strength of his intellect to prove that he had nothing to do with the works of creation.“

3. Likewise, the poems of Darwin’s grandfather Erasmus were ridiculed by the anti-Jacobin press (Stott, 2012).

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³ Kirby, W. 1835. On the History, Habits and Instincts of Animals. Pickering, London – the seventh (of eight) treatises commissioned by the Earl of Bridgewater to explore “the Power, Wisdom, and Goodness of God, as manifested in the Creation”.

Figure 2.3 Playtpus eggs. So horrified were the English by Jacobin excess, that the Royal Navy was instructed to prevent specimens of the egg-laying platypus from falling into the hands of French scientists (Johnston, 1998).
Detail from “A Charm for Democracy, Reviewed, Analysed, & Destroyed …”, trumpeting the demise of the Analytical Review – “Fallen never to rise again” (bottom right corner). The picture was published by the Anti-Jacobin Review and Magazine on 1 February 1799. The Analytical Review was viewed by its detractors as a forum for radical ideas – see Luisa Calé, “Periodical Personae: Pseudonyms, Authorship and the Imagined Community of Joseph Priestley’s Theological Repository”. Note the references to Zoonomia and The Loves of Plants: “Darwin’s topsy turvy Plants and Animals Destruction” to the left of the tailed piper.
• **Language.**

1. Lamarck was **misrepresented** as urging that animals changed their form **by force of will**.

   “The hypothesis of Lamarck – that progressive changes in species have been produced by the attempts of animals to increase the development of their own organs ... has been repeatedly and easily refuted ...” – Wallace (1858).

2. Actually, Lamarck wrote of animal’s **needs** – **besoins** – that influenced behavior and induced heritable variation, *i.e.*, inheritance of acquired characters.

3. But “**needs**” became “**desires**” in translation, and Lamarck, a peddler of **medieval vitalism**.

• **Monads.**

1. Lamarck believed that the simplest life forms continuously being created – spontaneous generation.

2. “We must be on our guard not to tread in the footsteps of the naturalists of the middle ages, who believed the doctrine of spontaneous generation to be applicable to all those parts of the animal and vegetable kingdoms which they least understood ...” [Lyell, *Principles of Geology*. Vol. 2]
• Intellectually Isolated, Iconoclastic, a Theorist.

1. *L’esprit de System.*

“Even the character of the man could not otherwise be understood; for so intimately did he identify himself with his systems, and such was his desire that they be propagated, that all other objects seemed to him subordinate, and even his greatest and most useful works appeared in his own eyes merely as slight accessories … .” Cuvier (1835) [Emphasis added]

2. False assumptions.

“M. de Lamarck reproduced this theory of Life in all the zoological works which he afterwards published; and whatever interest these works may have excited by their positive merits, no one conceived their systematic part sufficiently dangerous to be made the subject of attack. It was left undisturbed ... because every one could perceive that, independently of many errors in the details, it likewise rested on two arbitrary suppositions; the one, that it is the seminal vapour which organizes the embryo; the other, that efforts and desires may engender organs. A system established on such foundations may amuse the imagination of a poet; a metaphysician may derive from it an entirely new series of systems; but it cannot for a moment bear the examination of any one who has dissected a hand, a viscus, or even a feather.” — Cuvier (1835) [Emphasis added]
3. Crackpot theories of chemistry and meteorology.

“Thus, while Lavoisier was creating ... a new chemistry founded on ... experiments, M. de Lamarck, without doing an experiment, ... imagined that he had discovered another, which he did not hesitate to set in opposition to the former, although nearly the whole of Europe had received it with the warmest approbation.” – Cuvier (1835) [Emphasis added]

“In order to demonstrate this theory [meteorology] in some measure by facts, and to attract the attention of the public to it, M. de Lamarck thought it would be useful to present it under the form of predictions. He had even the perseverance to print almanacs for eleven years successively, announcing the probable state of the temperature for each day; but it may be said that the weather took pleasure in exposing his fallacies.” Cuvier (1835) [Emphasis added]
4. No evidence for mutability.

“... some naturalists rely a great deal on the thousands of centuries which they add up with the stroke of a pen. But in such matters we can hardly judge what a lengthy time would produce, except by multiplying mentally what a lesser time produces. I have therefore sought to collect the oldest documents on the structures of animals.”

“We can easily distinguish there [in Roman pictures of Egyptian animals] the ibis, vulture, owl, falcon, ... , even the hippopotamus. In the ... monuments engraved in the important book on Egypt [4] we see ... the algazel...[Oryx].”

“My knowledgeable colleague, Geoffroy Saint-Hilaire, impressed with the importance of this research, has taken care to collect in the tombs and temples of ... Egypt as many animal mummies as he could. He brought back embalmed cats, ibises, birds of prey, dogs, monkeys, crocodiles, ... . We certainly do not observe more differences between these creatures and those which we see today than between human mummies and today's human skeletons.” (Cuvier, 1812).

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4 Ian Johnston (2009), translator of the version of Cuvier’s (1812) Discours from which this quote is taken, observes that “The important book on Egypt ... is the massive work of scholarship initially carried out ... as part of the French military expedition to Egypt ... . The military expedition was a failure, but the work completed by French scientists and published in a number of volumes from 1809 onwards was enormously popular and influential.”
• Cuvier’s Éloge de Lamarck.

1. Lamarck as isolated and pathetic traces to Cuvier’s Eulogy from which three of the preceding quotes taken.

“Notwithstanding the differences of interpretation, it is interesting to note that almost all the [critical] quotations here reproduced have their ... origin in only one source, sometimes unknown to the authors themselves ... . The thesis of Lamarck's isolation can only be maintained if one ignores the rich ... debates on natural history that took place between 1790 and 1859, or if one accepts Cuvier's funeral commemoration of Lamarck at face value – Corsi, 1997. [Emphasis added].

2. So who was Georges Cuvier?

   a. Most powerful scientist in France; politically adroit.
   b. “Father” of vertebrate paleontology.

3. A dyed-in-the-wool empiricist, he despised theorizing in general; Lamarck in particular.

4. Advocated
   a. Fixity of species
   b. “Revolutionary upheavals of the globe” “that periodically swept the biotic plate clean.”
The Lamarckian Balance of Nature.

• **Motivation.**
  1. Distinctness of species *illusory*.
  2. Transmutation the only *alternative* to extinction.

  "I am doubtful, whether the means adopted by nature to ensure the preservation of species or races have been so inadequate that entire races are now extinct or lost." (Lamarck, 1809)

• **Massive Parallelism.**

  … "[A]ll the organized bodies of our earth are true productions of nature, *wrought successively throughout long periods of time.*

  "… [N]ature began, and still begins by fashioning the simplest of organized bodies, and it is these alone which she fashions immediately, that is to say, only the rudiments …

  "[W]ith the help of time, … all of those [organized bodies] which now exist have imperceptibly been fashioned such as we see them."

  **Figure 2.5.** Lamarck imagined massive *parallelism*; Darwin and Wallace, *dichotomous branching*. 
• **Two Opposing Evolutionary Forces.**

1. **The Power of Life**, *la force qui tend sans cesse a composer l'organisation* – *i.e.*, the inherent tendency of lineages to increase in complexity and sophistication.

Result is increasing complexity “in the arrangement of the main groups,” though “not in that of species, nor always even of genera” (Lamarck, 1809, Ch. 5).

2. **Local Adaptation**, *l'influence des circonstances*, produced branchings from what would otherwise have been a single sequence.

   a. This is where *besoins / use and disuse enter* – for “apathetic” organisms, Lamarck appealed to “subtle fluids” and direct environmental induction.

   b. Initially, Lamarck believed tendency to progress **preeminent**. Later (Lamarck 1820) he **reversed** himself – see Gould (1999a; b):

   “This is, in effect, a cause whose power is absolute, superior even to nature, since it regulates all nature’s acts . . . . This cause resides in the power that circumstances have to . . . . change continually the laws that she [Nature] would have followed without [the intervention of] these circumstances . . . . [Emphasis added]
Figure 2.5. Lamarck’s theory of evolution. Increasing complexity results from the inherent “Power of Life”; adaptation to local environments (Conditions of Life), from changing patterns of use and disuse responding to an animal’s inner needs (besoins). For insensate organisms, such as polyps and plants, direct environmental induction via “subtle fluids” generated adaptive novelty.
Lamarck among the English.

• The people who would later give the world “Wipers” for “Ypres” didn’t read French.

• British opinion of Lamarck derived principally from Vol. II of Lyell’s Principles. His principal objections:

1. Paucity of evidence.

   “It is evident, that if some well authenticated facts could have been adduced to establish one complete step in the process of transformation, such as the appearance, in individuals descending from a common stock, of a sense or organ entirely new, and a complete disappearance of some other enjoyed by their progenitors, that time alone might then be supposed sufficient to bring about any amount of metamorphosis.” [Emphasis added]

   a. Would later advance same objection to Darwin after reading The Origin.

   b. This argument persists as “God in the gaps.”
2. Mechanism implausible.

“... when Lamarck talks ‘of the efforts of internal sentiment,’ ‘the influence of subtle fluids,’ and the ‘acts of organization,’ as causes whereby animals and plants may acquire new organs, he gives us names for things, and ... resorts to fictions, as ideal as the ‘plastic virtue,’ and other phantoms of the middle ages.” [Principles of Geology, vol. 2. Emphasis added]

3. The proposition that habits beget organs (as opposed to the converse) “staggering and absurd.”

4. Nonetheless, for Lyell, mutability, as opposed to mechanism, the principal sticking point – see below.
Lyell’s Theory of Special Creation (TSC).

• Variation limited.

“… the organization of individuals is capable of being modified to a limited extent by … external causes;”

“… there are fixed limits beyond which the descendants from common parents can never deviate from a certain type;”

• Transmission of variations limited.

“…these modifications are, to a certain extent, transmissible to their offspring;”

• Each species has a unique origin and retains its distinctness.

“… each species springs from one original stock, and can never be permanently confounded, by intermixing with the progeny of any other stock;”

• Extinction.

“… each species shall endure for a considerable period of time.”
Observations.

• TSC contained elements of both Lamarck and Cuvier.

• Species came into existence too infrequently for creation to be observed. Mechanism therefore unspecified – in Lyell’s terms, vera causa not assignable. “Creation” a placeholder for ignorance.

• Continuing creation and extinction of species necessitates an approximate balance between these two rates – see MacArthur and Wilson (1967), Rosenzweig (1972).

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Going the “Whole Orang”.

- Lamarck speculated that man had descended from an orangutan-like ancestor.

- Lyell’s refutation reflective of deep misgivings regarding the moral implications of evolution.

“... I have long seen most clearly that if any concession is made, all that you claim in your concluding pages will follow. It is this which has made me so long hesitate, always feeling that the case of Man ... and of other animals, ... is one and the same, and that if a "vera causa" be admitted for one, instead of a purely unknown and imaginary one, such as the word "Creation," all the consequences must follow.” – Letter to Darwin (10/3/1859) [Emphasis added].

“As to Lamarck, ... I remember that it was the conclusion he came to about man that fortified me thirty years ago against the great impression that his arguments at first made on my mind ... When I came to the conclusion that after all Lamarck was going to be shown right, that we must ‘go the whole orang,’ I re-read his book [Philosophie Zoologique], and remembering when it was written, I felt I had done him injustice.” – Letter to Darwin (3/15/1863) [Emphasis added].
Lyell’s Uniformity.

• Lyell substituted “uniformity” for Cuvier’s catastrophism.

1. “Uniformitarianism” was really four distinct postulates (Gould, 1985).
   a. Uniformity of law.
   b. Uniformity of process – verae causae.
   c. Uniformity of rate – gradualism.
   d. Uniformity of state – non-progressionism.

“Then might those genera of animals return… . The huge Iguanodon might reappear in the woods, and the ichthyosaur in the sea, while the pterodactyle might flit again through umbrageous groves of tree-ferns. Coral reefs might be prolonged beyond the Arctic Circle, where the whale and the narwal now abound.” Principles of Geology, Vol. 1.

Figure 2.6. Narwhales “tusking.” The tusk (males almost exclusively) is an elongated canine.
2. Only uniformity of law survives. As to the others –

a. **Uniformity of process.** Lyell was referring to processes observable in the here and now. Since modified to include low frequency events, *e.g.*, bolide impacts, “methane burps,” *etc*.

b. **Uniformity of rate.** Violated by adaptive radiations, mass extinctions, punctuated equilibrium, *etc*.

c. **Non-progressionism.** Widely rejected, even in Lyell’s day – hence the **de la Beche cartoon** [front piece] – *i.e.*, the fossil record *is* broadly progressive.

![Figure 2.7. Increasing numbers of cell types over the past 4 billion years. Reproduced from Hedges *et al.* (2004).](image)

d. **Gradualism** (uniformity of rate), embraced by Darwin; later a **key assumption** of the Modern Synthesis.
Darwin and Lyell.

- **Darwin brought with him** aboard HMS *Beagle* a copy of Vol I of the *Principles* and picked up a copy of Vol. II in Montevideo.

![Figure 2.8. Itinerary of HMS Beagle, on which Darwin served as ship's naturalist from 1831-1836. From http://www.brunette.brucity.be/PEGASE/darwin/enbeagl2.htm.](http://www.brunette.brucity.be/PEGASE/darwin/enbeagl2.htm)

- **He became a “transformist”** either during the voyage or shortly after his return in 1837.

- **Preliminary drafts** of his theory date to 1839, 1842 and 1844.
• Thereafter, he **hesitated**\(^5\) for fifteen years, reluctant to go up against the scientific establishment in general, Britain’s most famous scientist, in particular.

“... I am almost convinced (quite contrary to the opinion I started with) that species are not (it is like confessing a murder) immutable.” Letter to Hooker, 1/11/1844. [Emphasis added].

• Following publication of *The Origin*, Darwin anxiously awaited the judgment of the man who had become his friend, father figure and patron.

1. To Huxley, he wrote shortly after finishing *The Origin*,

... Exactly fifteen months ago, when I put pen to paper for this volume, I had awful misgivings; ... *I then fixed in my mind three*

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\(^5\) This interpretation recently disputed (Richards, 1983; van Wyhe 2007).
judges, on whose decision I determined mentally to abide. The judges were Lyell, Hooker, and yourself.” – Letter of 11/25/1859.

2. **Huxley and Hooker** became enthusiastic converts.

3. **Lyell** remained ambivalent.

“…when, as I fully expect, a new edition is soon called for, you may here and there insert *an actual case to relieve the vast number of abstract propositions.*” – Letter to Darwin, 10/3/1859. [Emphasis added].

4. Darwin’s responded plaintively on 11 October.

“If you admit in ever so little a degree, the explanation which I have given of Embryology, Homology and Classification, you will find it difficult to say: thus far the explanation holds good, but no further; here we must call in `the addition of new creative forces.’ I think you will be driven to reject all or admit all: *I fear by your letter it will be the former alternative …*” [Emphasis added]
5. In addition to Lyell’s reluctance to embrace *The Origin’s* conclusions, their correspondence further reveals a crucial difference in perspective.

a. For Darwin the critical points were **natural selection** – his contribution to the transformist thesis and the lack of continuity with Lamarck. Recalling the evolution of his views on religion (F. Darwin, 1887), he observed that

“The old argument from design in Nature, as given by Paley, which formerly seemed to me so conclusive, fails, now that the law of natural selection has been discovered.” – p. 309.

b. For Lyell, **pattern** (DwM), not mechanism was critical.

“...it cannot surely be said that the most eminent naturalists have rejected the view of the mutability of species? You do not mean to ignore G. St. Hilaire and Lamarck. As to the latter, you may say, that in regard to animals you substitute natural selection for volition to a certain considerable extent, but in his theory of the changes of plants he could not introduce volition; he may, no doubt, have laid an undue comparative stress on changes in physical conditions, and too little on those of contending organisms. He at least was for the universal mutability of species and for a genealogical link between the first and the present.” – Lyell to Darwin, 10/3/1859. [Emphasis added].

29
c. To this, he added

“The substitution of the variety-making power for ‘volition,’ muscular action,’ etc. (and in plants even volition was not called in) is in some respects only a change in names.” [Emphasis added]

6. In the event, it was Lyell who would be proved correct.

7. The next hundred and fifty years would witness the accumulation of mountains of evidence for common descent and a succession of theories to explain it.