

A brief guide to Darwin's theory of natural selection (evolution)

Origin of species and instant best seller. Hardly ever out of print since its publication in 1859; many editions.

One of the most influential books ever (for better or worse), but often misunderstood, misinterpreted and misappropriated.

Background

Previous ideas of evolution discussed by Lamarck, Buffon, even Darwin's grandfather, Erasmus. Lamarkian evolution suggested that environment and lifestyle directly shapes evolution.

FitzRoy's stubborn biblical literarism provoked the more liberal Darwin?

Lyell's "Principles of Geology" pointed to constantly changing environments over geologic time. Very influential in Darwin's thought.

Thomas Malthus' "An essay on the principle of population"

Darwin began first notebook on "transmutation of species" in 1837. Wrote a sketch in 1842; fuller development in 1844 which he asked his wife to publish in case he should meet a sudden demise. 1856: compiled notes for a book called "Natural Selection".

Darwin was not a lone discoverer of evolution. Alfred Wallace co-discovered natural selection in a malarial fever in Malaysia. Wrote to Darwin in July 1858. Forced a cautious Darwin to publish. Darwin a gentleman included Wallace as a coauthor in article of the Linnean Society.

Finally, 1859, "Origin of Species". First printing (small < 2000 sold out). Natural history at that time more like pop-psychology of today. If there had of been a "Oprah" at that time, Darwin would have been a guest.

So **why** did it take Darwin so long to go public?

Religious beliefs? Darwin a Christian until the age of 53 or so.
Fear of controversy and persecutions? A reality in Victorian England.
Scientific caution? Probably the most important. Idea of inductionism (Baconian philosophy), prominent in Darwin's time.

Darwin's evolution as revolution

Biologically - explanation for variety of species and for change of species observed in fossils.

Implications for origin of humans - to this day the most controversial
- continued the movement of removing humans from the center of creation : Copernicus -> Kepler -> Galileo -> Newton. Abhorrent notion to popularly led belief of the time that humans were God's paramount creation.

What Darwin's theory says

Darwin did two things (1) convinced us that evolution actually occurs (2) provided an mechanism by how it occurs. Latter the more controversial.

Darwin's theory proceeds from three easy observations.

- All species have variations within them. Individuals are not identical.
- Some of the variation is inherited (we look like our parents); some of it random.
- Organisms produce more offspring than survive. Survivors therefore have some characteristics which contribute to survival.

Variations within species are random, but if they are fortuitous they will be passed on to the offspring who will have a better chance of survival to age of sexual maturity and so can pass the characteristic onto the next generation. Disadvantageous variations are unlikely to survive as they less likely to be transmitted to the next generation. Neutral variations, however, survive.

Boils down to a principle of individual reproductive success. Simple, but consequences complex and rich.

Expanding further:

Natural environment is not the only selector

Sexual (gender) selection is also an important factor. "Survival of the sexy"! In some, cases may be primary factor (humans, bird plumage). If a particular feature makes the organism attractive to a mate, it will be selected for, even if it is disadvantageous (but not unduly so) in terms of environmental survival.

New variations can only proceed from what already exists - "ontogeny recapitulates phylogeny"

Successful adaptations can only evolve from what went before. Thus, basic body plans established early in the history of life. Dissection of a pig has meaning in understanding human physiology because pigs are not evolutionarily-speaking very distant from humans, - same body plan for all mammals, similar physiology etc.

The Panda's thumb.

Human neoteny - why we are the hairless ape.

Evolution is not necessarily gradual - idea of punctuated equilibrium

Post Darwinian concept. Are places and times of more rapid evolution. Small populations are particularly susceptible. Islands (such as Galapagos) or times following a mass extinction (end Cretaceous meteorite impact) are times of great **adaptive radiation**.

Myth of perfect adaptation

"Perfectly adapted to its environment" a myth. Many characteristics of an organism arise as genetic side effects. (Genetics not understood in Darwin's era). As long as a variation is not disadvantageous, it will be preserved. Only bad things selected against by nature. Thus, not "survival of the fittest" (Darwin), but "extinction of the least fittest". This negates the "**argument from design**" (Pailey) idea.

Example: Back problems in humans. Wisdom teeth (inherited from previous ancestor). Nerve loop in a giraffe's neck.

No "progress" in evolution

In artificial selection breeders aim for some kind of improvement (faster horse, better looking dog), but not so in natural selection. The selector is the natural environment, which by Lyell's teachings changes over geologic

time. All that natural selection does is increase the chances of survival in the new environment.

One of the most revolutionary aspects of Darwin's idea is its negation of "progress". Victorians very into the idea of progress; a common assumption. The "**Great chain of being**" a concept that life consists of "lower" to "higher" forms.

Darwin struggled with this but avoided using the word "evolution" as this implied some sort of progress

Still probably the most misunderstood aspect the Darwinian idea of evolution, and still the most radical

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Scientific Aftermath

Objections - but mostly from non-scientists, but some scientific opposition (this is normal)

1 Absence of transitional forms in fossil record-Transitional forms unusual Archeopteryx (naturally), but have been found. Species stable for long time, but transitional forms develop quickly in small population

2 Not enough time - Lord Kelvin's estimate of the age of the Earth turned out to a gross underestimate

3 Dilution of favorable adaptations in normal population

4 Incipient organs could not have had a recognizable function, so could not be selected for. In fact organs change function. Example: scales to feathers

Some of these led to natural selection falling out of fashion, although evolution accepted.

Complete picture could not be developed until science of genetics developed after Gregor Mendel. Then full significance of sexual reproduction and genetic mutation was understood as basis for natural selection

Social aftermath

Darwin's ideas hijacked and perverted (Social Darwinism) or taken out of context (over emphasis on "nature" vs nurture; evolutionary psychology?).

Many still find Darwin's biological ideas unpalatable and have tried to suppress it, particularly religious organizations. Creationists believe in literal truth of bible.

Tennessee legislature outlawed the teaching of evolution in 1925 resulting in famous "Scopes monkey trial" in Dayton, Tenn.

More recently, Kansas tried to legislate to give Creationism equal time with evolution in biology classes

High school biology texts in US often suppress treatment of evolution because of lobbying by religious organizations.