

The Greatest Show on Earth

The Evidence for Evolution

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At least forty percent of the population in Western countries do not believe in Evolution, and in fact the percentages are probably much higher in Muslim countries. This scandalizes Dawkins no end. In fairness one may probably get similar responses of scientific ignorance, would one instead ask simple questions about the distance to the sun, the orbital period of the Earth, the reason why we have seasons; but with the understanding that such ignorance is not the effect of external pressure, there are after all no concerted efforts to stop the teaching of modern physics in school, while there are such pressures in the States to suppress the teaching of evolution or at least to give equal time to alternatives such as so called creationist science. The present book is written in an effort to stem this trend, to convince evolution-deniers by rational argument of the waywardness of their positions. Such an ambition is, I believe, doomed to failure, but of course that does not mean that the book itself is doomed to languish on shelves. Books by Dawkins sell, and that publishers know, so no doubt he is hurried into producing them at regular intervals. His persona as a crusader against religion is of a deeply unsympathetic kind, he manifests the same dogmatic approach as an old-testament prophet, and I do not think this is part of an intentional strategy but more of a reflection of his personality and the light in which he views his mission. In fact his book is in many ways in the nature of a sequence of sermons, which become very clear in one of the latter chapters, when he takes a passage out of *the Origin of Species* and subsequently expounds on its successive lines, as if it would be a text out of a holy book.

You may find Dawkins hectoring sympathetic or unsympathetic, it has no bearing on Darwin's insights on Evolution and Natural Selection per se, which stands or falls on their own merits regardless of the emotions that Dawkins brings to the case. Dawkins emphasis is that the theory of evolution is no theory in the sense of a hypothesis, but is a firmly established scientific fact that is beyond doubt by any rational person. And never will it be contradicted. Russell famously observed that it is generally assumed that in Science we know but in Religion we merely believe, when it is actually the other way around. Dawkins could do well to assume a certain amount of humility. What attracts people to Darwinism compared to rival explanations is its intellectual potential. When I first encountered it I remember being struck by the fact that beautiful ideas could be found not only in mathematics. Dawkins is too hectoring. It is not his role to shout aloud, arguments should speak for themselves, not be rammed down your throat. One may wonder whether Dawkins on the balance has contributed to the spreading of the gospel, or whether he has turned more people off than he has attracted. This kind of count is of course pointless, one may probe deeper into what it really means to reject Evolution. Maybe it is no different from most people refusing to see any beauty in mathematics. The

hostility to mathematics may very well be larger than hostility to evolution. Education has little to do with it. Dawkins quotes with approval the elitist remark of Peter Medawar, that a large section of the public has been educated beyond their capability for analytic reasoning. People may learn to appreciate Shakespeare and maybe even develop a taste for avant garde literature, but this is no substitute for improving your intellectual powers.

Dawkins does not make any reference to Popper but he does of course dismiss the view of Popper that all theories are tentative and may in principle be refuted by findings in the future. No such compunctions are harbored by Dawkins, he claims that they will never be, although he makes one concession to the notion of falsifiability, by pointing out that if say mammal fossils would be found in ancient layers, that would cut off the ground for evolution. Thus evolution is falsible he points out triumphantly as if falsifiability itself would be a confirmation of being scientific and hence true. Furthermore his brief treatment of essentialism and Platonism reveals a rather philosophically untutored mind (or rather a mind not of a philosophical temperament), and his argument that Platonism prevented the minds of men to open up to the possibility of the mutability of species is plain wrong. The 'facts' of Evolution had been known long before the birth of Darwin, to Darwin belongs the suggestion of a mechanism that drives it. Before Darwin there had been many eminent zoologists and anatomists, notably Robert Owen, who among other things pointed out the striking resemblance of birds to dinosaurs at least a hundred years before that became fashionable. Owen may have been a critic of Darwin's theory of Natural Selection, as was his duty as a colleague, but that does not make him into a fool. Dawkins has too much of the religious Marxist in him, condemning people as heretics who stand in the way of history¹.

Darwin is one of the most sympathetic figures in the annals of science. He is also one of the last figures of the heroic age of natural scientists. His knowledge was encyclopedic and he was his own master and not just an administrator of a large research group, although to some extent his massive correspondence around the world was a kind of presaging such a development. The life of Darwin appears so charmingly and fully satisfying in all essential aspects, although one should not turn a blind eye to the usual calamities in terms of infant mortality, that plagued most families in the Victorian century. Darwin was not isolated, in fact as has later been acknowledged, many of his ideas were in the air² and he was part of a teeming tradition of gentlemen scientists and Anglican ministers with plenty of free time on their hands³. Darwinism should be thought of not as much of a science, as a metascience, to use an ad hoc terminology to avoid the negatively loaded - metaphysics.

¹ Admittedly Dawkins pays Owen a compliment upon his skill as an anatomist in connection with his own participation in a media-event involving the autopsy of a young giraffe, trying to isolate certain nerves in the neck, a task at which Owen supposedly had excelled.

² The obvious reference is of course Wallace, who in recent decades have been brought back from oblivion.

³ To be a minister in the Victorian Age was close to enjoying a sine cure, which was taken advantage of by admittedly a minority, but what a minority of devoted and curious minds. The Church provided at the time an outlet and a means of support for an intellectual elite, which probably more than anything else contributed to the growth of natural science during the century. Nowadays such avenues are not even available through universities.

It is above all a philosophical idea of how order can arise out of chaos with no designing hand. An idea inspired by the economists of the previous century, such as Adam Smith and Malthus⁴. What strikes one at first is the almost tautological nature of it. If you reduce it to the maxim of 'the survival of the fittest' and explain the notion of 'fitness' in terms of survival, you end up in a circular setting. Thus in its simplest form it is non-falsifiable, non-empirical not in the sense of not being true, but in the sense of having no content. But what also strikes the sympathetic mind is its potential. In a sense Darwin was ahead of his time. He had of course a notion of inheritance, which of course is an old almost common sensical notion, without which breeders of plants and dogs would have had no purchase for their strategies; but he has no specific idea of the mechanism of inheritance, that would wait until Mendel⁵. Only when you make the settings of selections much more precise are you able to make it into a real science. However, Darwinism can be thought of a master ideology, giving a unifying theme to many diverse explorations, as well as suggesting lines of research. Poppers own theory of science is very much influenced by Darwin, and should also be thought of, not as a science, but as a metaphysical reflection on its nature⁶.

As Popper tells us, natural laws forbid things, and the more powerful the more they forbid, and hence more unlikely and more likely to be falsified. Thus strongly worded laws which have so far been corroborated permit you to draw a lot of conclusions. When it comes to Evolution and Natural Selection it allows a lot of things and hence is not so easy to falsify. This does not mean that it is not securely founded, on the contrary it makes it more plausible, but as a science it will be slower to develop and less likely to be striking in its applications.

According to the theory of evolution given any two organisms they will have a common ancestor. Such a claim is of course extremely hard to falsify, but that does not mean that it will not have consequences, the search for so called missing links is such a consequence. Dawkins points out rightly that the establishments of missing links is not essential to the case of evolution, and in fact the process of fossilization is a random and unlikely process, pointing out that absence of evidence is not the same thing as evidence of absence, but of course without the presence of fossils the idea of evolution would probably have taken a very long time in forming⁷. Now the assumption of a common origin of life has become scientifically far stronger after the advent of DNA. There is now a perfectly precise

⁴ The acknowledgment of Malthus is explicit in Darwin, while the notion of 'the invisible hand' with its emphasis on local laws and no planning permeates all evolutionary thinking. It is hardly a coincidence that economists using Game Theory often veer into models of evolution as organisms are thought of as economic entities set to maximize their options, at least in a metaphorical sense.

⁵ Mendel knew about Darwin and may very well have read his Origin of Species; while Darwin had no idea of Mendel who published in obscure journals. However, works by Mendel was present in his library, but the relevant pages were uncut, according to Dawkins. Poor Darwin could not read everything which came his way. Dawkins also presents some tantalizing suggestions that Darwin himself was on the verge of discovering Mendel's law, in particular noting that inheritance is not a matter of blending characteristics from both parents, but a matter of either-or.

⁶ Serious scientists are well aware of the limits of science, and unlike the now discredited positivists, they are very careful to distance themselves from the idea that anything that is not science is meaningless

⁷ Fossils have of course been observed for a long time, although their correct interpretation took some

definition of life on earth as being based on DNA. Whether or not it is possible to have life based on something else remains an open question. The origin of life was considered by Darwin to be a non-scientific question, on par with the problem of the origin of matter⁸. Dawkins is of the opinion, which I share, that the spontaneous origin of life is a very unlikely event, and maybe we are the unique example in the entire universe. DNA is an eminently replicable molecule, due to its essentially linear structure, while proteins are very unreplicable, unless there is DNA, and conversely DNA would be useless without its ability to direct the manufacture of proteins. Thus we need a combination of both to get started. Of course there might be other kinds of life based on entirely different principles of which we can have no inkling unless we encounter it.

There is a common dogma that every change is caused by natural selection. This is exceedingly hard to falsify as there are so many ways you could in retrospect explain a change. This in particular makes it very hard to predict the course of evolution, testified by the great variety of organisms extant. You may come up with any number of evolutionary explanation to any perceived change⁹, and you may come up with any number of mathematical models to retrospectively explain some phenomenon or other. Then of course a gene may serve many things, only some of which may have a reproductive edge, which further complicates the matters. To explain our ability to recognize faces by humans having been evolved to do so is hardly scientific unless you can make the connection more precise, but of course it is something that goes with the general ideology and may or may not be useful. It is in a sense similar to the case of energy being constant, whenever there is a discrepancy you find a new source of energy to make up for the deficit. This idea has turned out to be very useful in physics, the idea of evolutionary adaptation serves a similar purpose.

There is no such thing as a species when thought of in the historical context. The notion of being closely related is not a transitive one, thus we are unable to divide neatly all the organisms that have ever existed into equivalence classes. The remarkable thing, however, is that if you restrict yourself to a time slice, this is very much the case. There are minor exceptions of course, but on the whole you can talk about species, isolated populations that interbreed¹⁰. In particular there is no continuous contemporary chain of populations that relate individuals as distant as say goats and lions. There must be some kind of evolutionary explanation for this.

The genes play a very important role in embryology directing by local laws how cells change depending on location. But one should not think of this as a computer program that inevitably leads to a fixed result given the same initial conditions. In fact many features are only indirectly controlled genetically by the production of proteins, examples are the

time in coming. The presence of fossils did point to evolution long before there were mechanisms introduced to explain it

⁸ Which in a sense has turned out to be an easier problem, as it is part of physics, whose higher degree of falsifiability has allowed a deeper penetration into the phase space of theories.

⁹ This is particularly common in the dubious field of evolutionary psychology

¹⁰ There is supposed to be a species change of terns which are interbreedable as you move eastwards around the north pole, but once you go come back one revolution they are not any longer. A nice example of the mathematical notion of monodromy.

finer points of fingerprints or markings of a Zebra, which may very well differ (and will) among identical twins. Another matter is how genes actually influence our daily living as adults, beyond the constraints that has already been set by the architecture given by the embryological development. In particular how are our thoughts and propensities defined by our genes? It has to do with the demarcation of what really constitutes the fenotype of an organism. Before such questions are more fully understood many of the evolutionary explanations one may generate are but wild speculations.

Some evolutions work at very high speed, such as the breedings of dogs, while most of evolution proceeds at a much slower pace. It is safe to conclude that modern man appeared some 50'000 years ago and has not been significantly changed since then¹¹. How to explain this discrepancy? One explanation is that under controlled circumstances, changes occur more quickly and purposefully, while in real life, there are so many different evolutionary processes going on, that they tend to cancel each other out¹². Gould gave the analogy of the various dents and protuberances of a coastline. They exist at all kinds of levels, but most of them make no contribution to the real shapes as we see on a map.

Finally the most exciting discovery in modern evolution is the molecular clock. The principle is simple, to identify sources of changes that proceed at a steady pace. It could be change of proteins that have no bearing on survival, or better still neutral genes, that do not partake in the forming of the fenotype. One looks at DNA sequences as records of change, just as the old anatomists of the past, looked at the changes of skeletons and vestigial parts. In this way one has been able to reconstruct the tree of speciation predicted by evolution. Every body contains traces of the past, mostly in terms of organs that once were useful but no longer are, and that is of course a matter of being able to interpret those properly. Once again we have the spectre of falsification, without which it is impossible to chose between rival explanations and on the basis of that go forward. One of the most impressive indications of evolution, which already Darwin was at pains to emphasize, is the clumsiness of the process. Evolution is not a case of design. It has no foresight but can only work at material at hand. The solutions may not be very good, an example is the retina of a vertebrate eye, where the wiring gets in the way of the light, and a half-decent designer would simply have reverted things. Evolution is conservative, it follows a tradition and can seldom make any radical change, but has to work within the constraints already set. Another tantalizing phenomenon is that of convergent evolution. The environment imposes similar constraints which must be met in essentially similar ways, although there will be great differences as to the details. The eye of a vertebrate is an extension of the brain, but that of a mollusk, such as that of a squid, was derived from a skin fold; yet the architectures are remarkably similar. Of course the genes responsible will be very different. Another example is the sonic navigation used by bats and whales.

¹¹ There is some striking variation in humans, mostly among African tribes, all non-African ones being just the descendant of a few single African ones. One may think of the very tall slender Africans just south of Sahara and the pygmes of the equatorial jungles. Yet, human populations show a remarkable genetic uniformity, and any human, regardless of race, can learn to speak the Native language, regardless of where they grow up.

¹² Any change in the genetic make-up is doe at some cost. Greater adaptation to one environmental pressure automatically translates into a lesser one with respect to some other aspect.

Dawkins made his reputation for upholding the radical view that natural selection works on the level of the single gene. This makes so called arm races inevitable. However, given the flexibility of the genetic manifestation it is hard to make any definite claims on this score. Dawkins in fact makes a case in this book that there are higher levels of natural selection, that it can work on the level of clads. Some of them are very successful, such as that of the insects or more generally anthropoids, which occupy a lot of niches and diversify in many species; others are very obscure. The explanation is to be found in their basic 'Bauplans' some of which allow for far more versatility when it comes to change and modification. Once again an example of the non-falsifiability of the discipline. And this cannot be emphasized too often. Non-falsifiability simply means that it is harder to do science, by it being harder to exclude things once and for all, and thereby penetrate deeper in the space of ideas. Constraints stimulate your imagination. If there are fewer constraints there is more freedom to exercise your imagination, and hence it will not be as challenged.

So will a skeptic be persuaded by Dawkins? Hardly. If you are able to appreciate the arguments, chances are that you have already done so. A preaching to the already faithful. And of course the latter is the avowed aim of the book, anything else the author recognizes as unrealistic. He is thus out to serve the crusaders with arguments to use against the infidels. But of course this only postpones the inevitable problem. Arguments, as opposed to real weapons, only work if the victim co-operates.

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