Original study • DOI: 10.2478/biocosmos-2025-0003 • BIOCOSMOS • 1 • 2025 • 7-11

BioCosmos

LIFE, REPRODUCTION, AND THE PARADOX OF EVOLUTION

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Abstract

A neglected but challenging argument developed by Peter Geach, John Haldane, and Stephen Rothman purports to show that reproduction cannot be explained by natural selection and is irreducibly teleological. Meanwhile, the most plausible definitions of life include reproduction as a constitutive feature. The implication of combining these ideas is that life cannot be explained by natural selection and is irreducibly teleological. This does not entail that life cannot be explained in evolutionary terms of some kind, but it does lend support to the controversial view of Jerry Fodor and Thomas Nagel that evolutionists need to look beyond the constraints of Neo-Darwinism.

Keywords

natural selection • reproduction • Darwinian evolution • teleology

According to a neglected line of argument, natural selection cannot account for reproduction. The argument is of interest not only for the challenge it poses to the sufficiency of Darwinian explanations, but also for its possible relevance to the definition of life, at least if that definition includes a reference to reproduction. In particular, an implication of the argument is that it may be impossible to define life in non-teleological terms or to explain it in terms of natural selection. The section that follows provides an exposition of the argument. In the section after that, I will address its relevance to biological teleology, and in the final section its relevance to defining and explaining life.

The paradox of evolution

A brief formulation of the argument, and perhaps the earliest formulation, is given by Peter Geach in his book *Providence and Evil*:

> The reproductive mechanisms certainly cannot be explained just by saying that creatures which failed to develop them failed to reproduce their kind and perished: without these mechanisms there would be no raw material for any cause of evolution to work upon. So in this case there can be no story of natural selection to replace the ostensible teleological account.[1]

1 Geach P. *Providence and evil*. Cambridge: Cambridge University Press; 1977. p.77.

As Geach explained, he is not criticizing evolutionary explanations in general and he is not making a point about sex organs in particular.[2] He is talking about reproduction in general, and arguing that an appeal to natural selection, in particular, cannot replace a teleological account of reproduction.

The basic idea of Geach's argument is simple. It is commonly held that to explain a trait by way of natural selection is to obviate any basis for an irreducibly teleological account of it. For example, suppose we say that hearts first arose by way of a random mutation, that they pumped blood in those organisms which had them, that because they did so those organisms tended to survive and reproduce in greater numbers than those who lacked hearts, and that this in turn resulted in all their current descendants having hearts. This will be an explanation of the heart that makes reference only to what Aristotelians call efficient causes, without any need for final causes or teleology. Even if we still spoke of the heart as having the function of pumping blood, it is often claimed that such a description can be analyzed in terms of this causal story, so that it has no *irreducible* teleological component.

Geach's claim is that whatever we think of this approach to understanding other traits, it won't work in the case

2 He notes this in reply to a critic in Peter Geach and Gilbert Fulmer. "An Exchange between Peter Geach and Gilbert Fulmer," *Southwestern Journal of Philosophy*. 1980;11: 165–70. As he also says there, it should be clear enough in any case from a careful reading of what he says in *Providence and Evil*.

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of reproduction. For explaining a trait's existence within a population by appeal to natural selection involves proposing a scenario in which certain ancestors of that population survived *and reproduced* in greater numbers. Hence such explanations *presuppose* that reproduction already exists. In that case, they can hardly *explain* how reproduction came to exist. To appeal to natural selection in order to explain reproduction is like trying to get the cart to pull the horse.

Again, Geach's point is not to deny the evolutionary thesis that new species descended from previously existing species.[3] His point is that natural selection in particular cannot account for reproduction in particular, and thus does not obviate the need for a teleological conception of reproduction. (Geach also suggests that this ought to make us less confident that we should eschew irreducibly teleological explanations of other traits, but I put that issue aside for present purposes).

John Haldane and J. J. C. Smart debated a longer version of the argument in their book *Atheism and Theism*, with Haldane defending the argument and Smart criticizing it.[4] Haldane's basic position is essentially the same as Geach's, but he adds to it further details in anticipation of possible objections. Natural selection operates over generations, but successive generations come into existence only because reproduction occurs. Hence natural selection presupposes reproduction and therefore cannot account for it. But now, Haldane says, the response will be that natural selection might generate reproducing organisms out of organisms that lack reproduction, by way of an intermediate stage of 'proto-replication'.[5] Whatever 'proto-replication' amounts to, though, it will have to involve the transmission from an earlier generation to a later one of features that are the same as or similar to those of the earlier generation. We can distinguish the 'channels' through which this transmission is made and the 'communication' through these channels of the information by which the later generation comes to have the features in question.[6] The problem is that the existence of these 'channels' themselves is among the things the 'communication' process presumably brings about, but no communication can occur unless the channels are already in place. Hence, the appeal to proto-replication doesn't solve the original problem at all, but merely kicks it back a stage.

In reply, Smart suggests that while the emergence of proto-replicators is improbable, it could occur given enough time, and that current scientific speculation about them makes no reference to anything like the 'channels' of information transfer spoken of by Haldane.[7] But this misses Haldane's point. Replication involves more than just one thing bringing about another. Again, it involves the cause's transmitting to the effect features that are *the same as or similar to* those that the cause itself has. And that requires something like the 'channels' Haldane speaks of, whether or not researchers realize this or use that particular term. Moreover, if Haldane's argument is correct, it suggests that the emergence of proto-replicators by way of natural selection is impossible in principle, not merely improbable. Hence, to rebut the argument, it will not do to suggest that such emergence might occur given enough time.[8]

In general, argues Haldane, attempts to explain replication by reference to natural selection are going to entertain scenarios in which more complex forms of replication might arise from less complex forms, and then suppose that this approach might be extended to account for how replication could arise from non-replication. But this is fallacious, because whereas the difference between more and less complex replicators is one of degree, the difference between replicators and non-replicators is a difference in kind.[9] Adding sides to a polygon will in principle never yield a circle, even if it yields something that looks superficially like a circle. And if Haldane is right, adding complexity to non-replicating systems will in principle never yield replication, even if it were to yield something with the superficial appearance of replication.

A third and yet more detailed statement of the argument is developed by biologist Stephen Rothman in his book *The Paradox of Evolution*.[10] Though he does not cite Geach or Haldane, Rothman makes the same basic point they do, to the effect that natural selection presupposes reproduction and thus cannot explain it, so that at least in this connection Darwinism has not entirely succeeded in eliminating teleology from biology. But he also argues that there are additional problems in principle with the notion of a Darwinian explanation of reproduction. In order for natural selection to favor a trait, that trait must confer some survival advantage on the individual organisms that possess it. But reproduction, Rothman argues, confers no such advantage, and indeed if anything works against the survival of the individual. For example, at the level of the cell, Rothman notes:

3 Geach. *Providence and evil*. p.75.
4 Smart JJC, Haldane JJ. *Atheism and theism*. 2nd ed. Oxford: Blackwell; 2003, especially pp.92–96, 152–53, and 178–79.
5 Ibid., p.92.
6 Ibid., pp.92–93.
7 Ibid., p.152.
8 Ibid., pp.178–79.
9 Ibid., pp.93–96 and 179.
10 Rothman S. *The paradox of evolution: the strange relationship between natural selection and reproduction*. Amherst, NY: Prometheus Books; 2015.

> As new cells are produced, the progenitor or parent cell is *destroyed*. In asexual reproduction it is cut up, and in sexual reproduction it is made a part of something else (the fused cell). Either way the original object no longer exists; it is gone. And naturally a process that destroys something cannot be of value to it.[11]

Rothman offers several further illustrations of the thesis that reproduction confers no survival advantage.[12] In many species, one or both parents are absent when fertilization occurs, and a process cannot confer an advantage on an organism that is not present when it occurs. In some insects, the male does not survive the sexual act. The female mammal is put at a disadvantage by having to bear and give birth to offspring. Though offspring can, once mature, contribute to the survival of their parents, this is not usually true, and where it is true it is true only up to a point. For offspring are also new competitors for scarce resources. Some will suggest that reproduction confers an advantage to *groups* of organisms rather than on individuals, or on parts of organisms such as DNA. But groups of organisms and parts of organisms reproduce only insofar as the individual organisms that make up the groups and possess the parts reproduce, which brings us back to square one.[13]

Common to the arguments developed by Geach, Haldane, and Rothman are the theses that natural selection cannot explain reproduction insofar as it presupposes reproduction, and that this entails an unreduced teleological component in Darwinian explanation. This amounts to a 'paradox', as Rothman puts it, insofar as the whole point of the idea of natural selection, at least as it is commonly understood, is to open the way to a non-teleological explanation of all biological phenomena.[14] Geach, Haldane, and Rothman are also all agreed that this does not entail rejecting an evolutionary account of the origin of species. It entails only that there must be more to evolution than natural selection, and that teleology is among these additional ingredients.

Reproduction and teleology

Following Rothman, we might label the core thesis he shares in common with Geach and Haldane the 'paradox of evolution'. It is important to note that not every claim these writers make in the course of setting out this paradox is essential to it. For example, some readers will no doubt resist Rothman's claim that offspring afford no net survival advantage to parents. As Stephen Jay Gould might say, there is bound to be some speculative 'just-so story' that might seem to support the contrary thesis.[15] Yet any such story will presuppose that reproduction of *some* kind is already in place, and it is natural selection's inability to account for *that more fundamental fact* that is at the heart of the paradox of evolution. One could grant that, once reproduction exists, natural selection might favor some particular modes of reproduction over others. But what is primarily at issue is whether natural selection can account for how reproduction as such comes into the picture in the first place.

It might be objected that even if natural selection cannot account for reproduction, it doesn't follow that there couldn't be some other process, distinct from natural selection, by which reproduction evolved. That is true, but it misses the point. As I've said, the writers I've been discussing aren't denying that evolution occurred, and they aren't even necessarily denying that reproduction came about by evolution. What they are denying is that *natural selection* can be the mechanism by which it evolved. But neither is it terribly impressive to suggest that there might be *some* alternative process by which evolution brought about reproduction, unless one also has a suggestion about what, specifically, that process might have been. The main point that Geach, Haldane, and Rothman are making, though, is that without natural selection, the Darwinian has no way to give a *non-teleological* account of reproduction. Hence, even if there is some other evolutionary process by which reproduction came about, the Darwinian has no grounds for rejecting the possibility that it is a *teleological* evolutionary process. For natural selection was precisely the Darwinian's way of banishing teleology from biology.

Note that, contrary to the impression usually given by the public controversy over Darwinism, it doesn't necessarily follow that the teleology in question would entail theism or some other form of 'intelligent design'. As André Ariew and other contemporary philosophers of biology have emphasized, two importantly different conceptions of teleology have been developed in the history of philosophy.[16] What Ariew calls the 'Platonic' conception takes the teleological features of a natural phenomenon to be extrinsic to it, deriving from the

11 Ibid., p.62.
12 Ibid., pp.79–80.
13 Ibid., pp.64–66 and 163–64.
14 Though it seems Darwin himself did not think natural selection entirely banished teleology. See Lennox JG. Darwin was a Teleologist. *Biology and Philosophy.* 1993;8: 409–21.
15 Gould SJ. Return of the hopeful monster. In: *The Panda's thumb: more reflections in natural history*. New York: W. W. Norton; 1980. p.190.
16 Ariew A. Platonic and Aristotelian roots of teleological arguments. In: Ariew A, Cummins R, Perlman M. (eds.). *Functions: new essays in the philosophy of psychology and biology*. Oxford: Oxford University Press; 2002. pp. 7–32.

intentions of a designing mind. What he calls the 'Aristotelian' conception takes such features to be intrinsic to a natural phenomenon, a consequence of its nature. For the Platonic teleologist, the acorn aims toward becoming an oak only insofar as a designer put acorns together with that end in mind. For the Aristotelian teleologist, the acorn aims toward becoming an oak because that is simply part of what it is to have the nature of an acorn.

One could accept Geach's, Haldane's, and Rothman's 'paradox of evolution' argument and give it either a Platonic or Aristotelian interpretation. Which one to opt for is a separate issue. The point of the argument itself is simply that the notion of natural selection fails to obviate the need for a teleological conception of *some* sort.

Perhaps it is obvious why currently popular attempts to naturalize the teleological notion of *function* will not afford a way around the argument. But in case it isn't, a brief comment on the matter is in order. The two most influential approaches are *causal role* theories and *etiological* theories. According to causal role theories, the function of some part of a system is just the causal role it plays in the system.[17] For example, the heart can be said to have the function of pumping blood because pumping blood is the causal role it plays in organisms with hearts. Since such a causal role is a matter of *efficient* causation rather than *final* causation, this account purports to analyze function in non-teleological terms. Applied to reproduction, the idea would be that a capacity of an organism can be said to have the function of reproduction insofar as reproduction is the causal role it plays in the organism. In this way, it might be suggested, reproduction can be given a non-teleological analysis after all.

But the standard objection to causal role theories is that a part of a system may have more effects than it has functions. For example, the heart also makes a thumping sound, but making a thumping sound is not plausibly one of its functions. Hence there must be more to function than causal role. This additional element is often said to be identified by etiological theories, which factor in also the historical origins of a part of a system. For example, on Ruth Millikan's account, an organism's heart has the function of pumping blood insofar as the fact that its ancestors' hearts pumped blood caused them to survive and reproduce.[18] But now the problem should be obvious. Millikan's etiological analysis *presupposes* reproduction. Hence it can hardly open the way to a non-teleological analysis of reproduction, because the analysis would be circular. It would involve analyzing reproduction in terms of its etiology, where its etiology includes the prior existence of reproduction. It would merely leave us with another instance of the paradox of evolution, rather than a solution to the paradox.

17 Cummins R. Functional analysis. In: Buller D. (ed.). *Function, selection, and design*. Albany: State University of New York Press; 1999. pp. 57–83.

18 Millikan RG. Proper functions. In: Buller. *Function, selection, and design*. pp. 85–95.

Reproduction and life

Several proposed definitions of life, and it seems all the main alternative definitions, either directly or indirectly make reproduction essential to life. On Aristotle's classic account, argues Gareth Matthews, a living thing is essentially a species-preserving thing, and 'among *mortal*, living things, the common and fundamental species-preserving power is self-nutrition, plus the associated power of reproduction'.[19] Richard Dawkins proposes that primitive 'replicators' were either the first living things or the scaffolding on which the first living things built.[20] Mark Bedau analyzes life in terms of the notion of 'a population undergoing supple adaptation', which presupposes 'some form of self-replication'.[21] John Maynard Smith says that 'we shall regard as alive any population of entities which has the properties of multiplication, heredity, and variation'.[22] Though there are, of course, infertile living things such as mules, these accounts of life emphasize that such organisms are either damaged, or otherwise presuppose the existence of living things which do reproduce.

It is worth noting too that the favored ways of conceiving of *species* of living things in contemporary biology make reference to reproduction. For example, the 'biological concept' of species takes a species to be an isolated and interbreeding population. The 'phylogenetic-cladistic concept' defines a species in terms of its evolutionary lineage. Needless to say, interbreeding and lineages presuppose reproduction.

Biology after Darwin thus not only preserves the traditional Aristotelian view that reproduction is one of the fundamental properties of life, but if anything puts greater emphasis on reproduction. In *De Anima*, Aristotle allows that there could

19 Matthews GB. Aristotle on life. In: Boden MA. (ed.). *The philosophy of artificial life*. Oxford: Oxford University Press; 1996. p.311. Cf. Aristotle, *De Anima* II, 4. The "mortal" qualification is needed because Aristotle allows that there are also non-mortal living things.

20 Dawkins R. Chapter 2: *The selfish gene*. 9th ed. Oxford: Oxford University Press; 1989.

21 Bedau MA. The nature of life. In: Boden. *The philosophy of artificial life*. pp.340 and 342.

22 Smith JM. *The theory of evolution*. Cambridge: Cambridge University Press; 1993. p.109.

be non-mortal living things, and it seems that these would not need to reproduce, insofar as they preserve their kind precisely by being preserved themselves perpetually.[23] In fact, even more fundamental than reproduction in the traditional Aristotelian account of life is the notion that living things are *self-perfecting* in nature.[24] Plants perfect or complete themselves by carrying out activities like photosynthesis, animals by activities such as perceiving the world around them, human beings by activities such as exercising their rationality. Reproduction is a further capacity by which mortal living things, specifically, perfect themselves.

Now, this notion of self-perfection is teleological in nature, which makes it unattractive to post-Darwinian biologists keen to banish teleology. This aim of banishing teleology is also the motivation for the attempt to explain as much as possible by way of natural selection, which is thought to be the non-teleological mode of explanation *par excellence*. Since natural selection requires reproduction, reproduction is thus bound to be even more central to the Darwinian conception of life than to the Aristotelian conception. The irony, though, is that if Geach, Haldane, and Rothman are correct, reproduction is itself the paradigm of a biological phenomenon that *cannot* be either explained or analyzed in non-teleological terms via appeal to natural selection.

Their 'paradox of evolution' argument thus has the following implications for the nature of life, if reproduction is indeed partly definitive of life. First, if reproduction is essential to life and natural selection cannot explain the origin of reproduction, then natural selection cannot explain the origin of life. Second, if reproduction is essential to life and reproduction is irreducibly teleological in character, then life is irreducibly teleological in character.

This does not by itself strictly entail that reproduction and life are in fact irreducibly teleological, at least if there turns out to be some means other than appeal to natural selection to banish teleology from biology. But in the absence of some such alternative, it does put the biological anti-teleologist back to square one. Nor, as I have said, do these results by themselves entail that life cannot be given an evolutionary explanation of *some* sort, and neither do they by themselves vindicate 'intelligent design' or the like. What they *do* provide is further support for Jerry Fodor's judgment that natural selection cannot do the job evolutionists think it does,[25] and for Thomas Nagel's judgment that evolutionists need to consider the possibility that something like teleology as Aristotle understood it may really be intrinsic to the natural world after all.[26]

23 In *De Anima* II, 3, Aristotle notes that some living things have reason and some do not. As Matthews notes ("Aristotle on Life," p.308), Aristotle says there that it is *mortal* rational beings that would have other properties distinctive of living things, which indicates that non-mortal rational beings need not have them. The unmoved movers discussed in Aristotle's *Metaphysics* XII would be what he has in mind by non-mortal rational beings.

24 For a recent exposition and defense, see Oderberg DS. The great unifier: form and the unity of the organism. In: Simpson WMR, Koons RC, Teh NJ. (eds.) *Neo-Aristotelian perspectives on contemporary science*. London: Routledge; 2018. pp. 211–33.

25 Fodor J, Piattelli-Palmarini M. *What Darwin got wrong*. Updated ed. New York: Picador; 2011.

26 Nagel T. *Mind and cosmos: why the materialist Neo-Darwinian conception of nature is almost certainly false*. Oxford: Oxford University Press; 2012.