Reading Guide 11

Chance and evolution: I

This week, we continue discussing the debate about the evolution of complex adaptations. One version of the argument proceeds by attempting to calculate the probability that a complex adaptation might evolve by natural selection. Joseph John Murphy, writing in the 19th century, may have been the first to attempt such a calculation:

> But I say that mere spontaneous variation, and the preservation and transmission to descendants of favourable variations, with indefinite improvement on these through successive ages, will never account for the origin of the complex perfection of such an organ as the eye. The improbability of such a supposition admits of mathematical statement. Suppose, what is, I think, a very favourable supposition for the theory, that a favourable variation, of whatever kind, may be expected to occur once in every thousand animals that reach maturity, so that the expression of its probability is one in a thousand. And suppose, what is probably no exaggeration, that, in order to improve such an organ as the eye at all, it must be improved in ten different ways at once; then, in virtue of the law of probabilities, in common language, the chances against the improvement occurring are represented by one followed by thirty ciphers, a number incomparably greater than the number of seconds that have passed by since the beginning of historical time. In fact, the improbability of any complex organ being produced and brought to perfection in any such way is an improbability of the same kind and degree as the improbability of producing a poem or a mathematical demonstration by throwing letters at random on a table. [Murphy, 1866, col. 3]

11.1 Chandra Wickramasinghe's 1981 testimony at the Arkansas evolution trial (McLean v. Arkansas)

Chandra Wickramasinghe is an astronomer, who introduced probabilistic arguments into the modern debate about evolution. His 1981 testimony includes a passage similar Murphy's 1866 argument, which is quoted above.

Together with his co-author Fred Hoyle, Wickramasinghe is best known for discovering that organic molecules exist in space. This discovery has withstood the test of time. (For a modern contribution, see `http://www.sciencemag.org/content/345/6204/1584.short`.) It is possible that these extra-terrestrial organic molecules had something to do with the origin of life on earth.

Wickramasinghe argued not only that space contains organic molecules, but also that it contains forms of life. This claim has not received wide support. For modern views, see `https://leilabattison.wordpress.com/2011/03/11/microbes-on-a-moonbeam-disentangling-the-meteorite-microbe-claims`.

1. Summarize Wickramasinghe's probability calculation, leading to the conclusion that evolution is capable of accounting for protein sequences. Compare and contrast this argument to that of Joseph John Murphy (quoted above).

11.2 Denton [1985, ch. 13]: Beyond the Reach of Chance

1. Denton [1985, p. 308] argues that evolution by natural selection involves a "purely random search." Summarize this argument.

2. In the first few pages of this chapter, Denton argues that complex adaptations are inevitably separated by maladaptive intermediate forms. Why does he think this? What do you think?

3. Summarize Denton's version of the probability calculation. What does it add to Murphy's version? To Wikramisinghe's?

11.3 Dawkins [1986, pp. 43–49]: Accumulating small change

1. What does Dawkins mean by a "natural sieve?" How do such sieves generate order?

2. How does cumulative selection differ from a single-step sieve?

3. Dawkins would argue that Wickramasinghe and Denton ignore the cumulative nature of selection. Is this fair?

4. Describe Dawkins's "Methinks it is like a weasel" computer simulation. How does it bear on the efficacy of cumulative selection?

5. What about Denton's point that complex adaptations are separated by maladaptive intermediates? Does Dawkins have an answer?

Bibliography

Richard Dawkins. *The Blind Watchmaker*. W. W. Norton, New York, 1986.

Michael Denton. *Evolution: A Theory in Crisis*. Alder and Alder, Chevy Chase, Maryland, 1985.

Joseph John Murphy. Presidential address to the Belfast Natural History and Philosophical Society. *Northern Whig*, 19 November 1866.