Chance or more than chance?

The Logic of Chance: The Nature and Origin of Biological Evolution
Eugene V. Koonin
Pearson Education, NJ, 2012

John Woodmorappe

Written by a scientist from the former Soviet Union (born Евгений В. Кунин), this book is not an easy read, even for someone moderately familiar with biology. However, it has numerous helpful visual aids, as well as references to works for further reading.

The subjects covered are of somewhat of an arcane nature. There is almost nothing on macroscopic forms of life! Koonin instead focuses on such matters as principles of evolution, genomics, and especially viruses and bacteria.

Significance of evolution and non-theism

Unlike those who suggest that evolution is a non-issue (even bogeyman), or 'only a theory', Koonin does not, as he comments:

> "Considering the profound and indelible effect that *Origin* had on all of science, philosophy, and human thinking in general (far beyond the confines of biology), 150 years feels like a very short time" (pp. 1–2).

The author not only rejects all hints of theism, but even frowns upon the anthropic principle if it even hints at theistic implications. He writes:

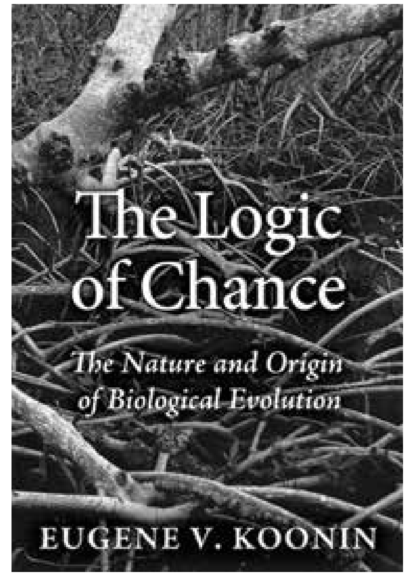
> "The term 'anthropic principle' might be unfortunate as it could be construed to imply some special importance to humans or more generally conscious observers, and worse, might invoke teleological implications. Nothing could be further from the correct view of the anthropic principle. At the end of the day, it is nothing more than 'observation selection'" (p. 384).

Koonin falls back on the 'infinite number of universes' idea for what he considers the supposed specialness of our universe.

Origin of life

The author devotes much attention to this subject. He suggests an origin of life according to some kind of Eigen-style self-replicating system. To overcome the 'chicken and egg' question about the origins of DNA and proteins, Koonin suggests that the first forms of life were RNA-based, and that such things as DNA and proteins, along with their codependency, were later evolutionary 'add-ons'. However, he admits the limitations of any kind of RNA-life situation, "Even under the best-case scenario, the RNA World hardly has the potential to evolve beyond very simple 'organisms'" (p. 366). And that's after overcoming the enormous chemical problems in generating such an unstable and complex molecule.

In the past, creationist scientists have performed calculations that illustrate the vanishing probability of a naturalistic origin of life, and they have even been despised for making them. Interestingly, Koonin performs similar rough calculations (pp. 434–435) to make his point. He uses estimates for the number of stars, number of habitable planets, effective volume in which effective RNA synthesis takes place per planet, concentration of RNA, billions of years of available time, etc. A polymer consisting of 102 nucleotides is considered possible. However, the emergence of a primitive, coupled replication-translation system falls to one in about $10^{1,018}$ (p. 435). To put this number in perspective, the chance of guessing the correct atom in the known universe is only about one in 10^{80}.



Pointedly, Koonin acknowledges that there is no real basis for the evolutionary premise that life arose from non-life.

> "The origin of life is the most difficult problem that faces evolutionary biology and, arguably, biology in general. Indeed, the problem is so hard and the current state of the art seems so frustrating that some researchers prefer to dismiss the entire issue as being outside the scientific domain altogether, on the grounds that unique events are not conducive to scientific study" (p. 351).

In fact, so baffling is the naturalistic origin of life that Koonin cannot even suggest if it is ostensibly the product of presently unknown factors or if it is the product of chance writ large.

> "The profound difficulty of the origin of life problem might appear effectively insurmountable, compelling one to ask extremely general questions that go beyond the realm of biology. Did certain factors that were critical at the time of the origin of life but that are hidden from our view now significantly change these numbers and make the origin of life more likely? Or

> is it possible that the processes that form the foundation for the origin of life are as difficult as we imagine, but the number of trials is so huge that the appearance of life forms in one or more of them is likely or even inevitable? In other words, is it conceivable that our very concepts of probability are inadequate?" (pp. 382–383).

In other words, when all else fails, fall back on the 'given enough time, anything can happen' notion.

All known living things are composed of cells. The author's expertise on viruses does not enable him to demonstrate the evolutionary origin of living cells. All he has to offer is storytelling.

> "The primordial Virus World model of precellular evolution sketched here seems to offer plausible, even if largely speculative, solutions to many puzzles associated with the origin of cells … . We are unaware of any intermediate stages in cell evolution … . No uniformitarian explanation exists for the evolution of cells—the precellular 'biota' necessarily must have been dramatically different from all life known to us" (p. 346).

Some evolutionists try to dodge the problem of the origin of life by asserting that it is not part of biological evolutionary theory. This merely relocates the problem, and is an exercise in semantics. According to standard evolutionistic thinking, even the simplest kind of life seen today must have been preceded by a long series of simpler forms of life. These postulated primitive life forms then evolved to the kinds of life found today. If this was not biological evolution, then what was? Koonin realizes this. He considers the origin of monomers, oligomers, and ribosomes as matters that are primarily in the realm of chance and chemical evolution. The origin of organisms is unambiguously in the realm of biological evolution. Finally, the origins of replication and translation (fundamental to virtually all definitions of life) are, according to Koonin, in the transitional zone between chemical evolution and biological evolution.

Evolutionary basics—a nuanced view

In dismissing irreducible complexity while discussing the evolution of the human eye, Koonin accepts Darwin's suggestion that the human eye could have evolved from the kind of less-complex eyes exhibited by other organisms, while acknowledging the limited explanatory power of this premise.

> "However, all the brilliance of Darwin's scheme notwithstanding, it should be taken for what it is: a partially supported speculative scenario for the evolution of one particular complex organ. Darwin's account shows one possible trajectory for the evolution of complexity but does not solve this major problem in general" (p. 5).

Is it incorrect to consider natural selection a tautology? Koonin takes a middle view. He believes that natural selection has both tautological and non-tautological aspects. (p. 17). He adds:

> "Viewed from that perspective, the 'invisible hand' of natural selection appears almost miraculously powerful, and one cannot help wondering whether it is actually sufficient to account for the history of life. This question has been repeatedly used as a rhetoric device by all kinds of creationists, but it also has been asked in earnest by evolutionary biologists" (p. 18).

The author touches on molecular 'clocks'. He emphasizes the frequent disagreement between them, and other lines of evolutionary timing (pp. 26, 32).

All evolutionary 'trees', whether descriptive or cladistic, rely on patterns of inferred evolutionary relatedness of organisms. These rely on synapomorphies (traits which uniquely define a 'branch', but often suffer from problems of homoplasy, or convergent evolution) in which unique traits appear in an evolutionarily incongruent manner. Koonin acknowledges that contradictory associations (blamed on convergent evolution) are a significant problem.

> "In principle, a single valid synapomorphy can define a clade. However, this is the case only in the absence of homoplasy, which is impossible to guarantee for most characters" (p. 30).

[The 'homoplasy-free' characters which Koonin is emphasizing, in context, such as mobile-element-insertions, have their own problems. Besides, phylogenetically informative ones are relatively uncommon.]

Koonin touches on the discontinuities in the fossil record, "The general lack of transitional forms between species in the fossil record is a constant theme in evolutionary biology" (p. 37). He then elaborates on the decades-old punctuated equilibrium concept.

Owing to such factors as the near-universality of the genetic code for proteins, Koonin shares the common belief that all cellular life has a LUCA (Least Universal Common Ancestor). However, even given evolutionary suppositions, living things do not straightforwardly reduce to an unambiguous ancestral state. Koonin notes that, "However, no consensus exists on the nature of the LUCA and the degree to which it resembled modern cells … . The difficulty of the problem cannot be overestimated" (p. 329).

The author is candid about the fact that much evolutionary thinking consists of storytelling—biologically informed storytelling but storytelling nonetheless. He comments:

> "Until recently, and sometimes even these days, any 'Why?' question almost automatically triggered the concoction of an adaptationist ('just so') story… now we tend to come up with more balanced, complex stories that, in addition to selection, include non-adaptive factors such as drift, draft, and various neutral ratchets. Are the new stories any better than the previous ones?" (p. 424).

Evolution in three modalities

Koonin assigns evolutionary processes to three fundamental modalities (pp. 261, 288)—the Darwinian, the Wrightian, and the Lamarckian. (You read it right. Some organisms, notably bacteria, as we shall see, can direct evolution according to their immediate needs, thus fulfilling the apparently long-discredited ideas of the Frenchman Lamarck.)

This form of Lamarckian inheritance should not be confused with the ones proposed and rejected long ago. For example, when discussing Lamarckism, Koonin condemns Lysenkoism, which was once part of his native former Soviet Union.

For the longest time, hereditary information has been thought of as being transferred only from parent to offspring. We now realize that genetic information can sometimes be transferred directly ('horizontally') from individual to individual, especially among bacteria. Koonin assesses the significance of HGT (horizontal gene transfer) in bacterial antibiotic resistance as follows:

> "When a sensitive bacterium enters an environment where an antibiotic is present, the only chance for a newcomer to survive is to acquire a resistance gene(s) by HGT, typically via a plasmid. This common (and extremely practically important) phenomenon appears to be a clear-cut case of Lamarckian inheritance" (p. 267).

There are also forms of semi-Lamarckian inheritance. In these situations, organisms do not direct their own evolution, but they do experience an increase in the rate of mutations, however non-specific, in stressful environments. This increases the fodder for natural selection in a relatively short period of time, and thus enables the organisms' lineages to have a better sense of happening to be adapted to these harsh environmental challenges.

The better-known Darwinian modality works through random mutations, which are subject to environmental factors that cause the mutations to become common in the population through natural selection. The Wrightian modality also works through random mutations, but these are fixed in the population by chance, not natural selection. Finally, in the Lamarckian modality, it is the environment provoking organisms to select mutations of direct benefit to them.

The world of horizontal gene transfer (HGT)

Perhaps the most fascinating aspect of this book is the discovery of HGT between many diverse unicellular forms of life. Once believed to be exotic curiosities, and then largely limited to the kind of genetic exchange exhibited by bacteria facing a challenge from antibiotics, HGT is now believed to be fairly common.

So how does one know that HGT has taken place? One infers this when evolutionary nested hierarchies are violated! Koonin comments:

> "… phylogenetic trees for individual genes are often incongruent. These findings suggested that HGT was extremely common among bacteria and archaea, and was important also in the evolution of eukaryotes, especially in the context of endosymbiotic events" (p. 147).

HGT events are thought to partly reinforce, and partly overprint, pre-existing evolutionary nested hierarchies. Koonin says that

> "It has been suggested that HGT between closely related organisms (as judged by the sequence similarity of rRNAs and other conserved genes) is more common than HGT between distant organisms, and this gradient of HGT might substantially contribute to the apparent phylogenetic coherence of prokaryotic groups" (p. 126).

Finally, some evolutionists suggest that inferred HGT events were so common that they have completely scrambled the phylogenetic signal of the supposed evolutionary relatedness among many kinds of unicellular organisms. Koonin quips:

> "The radical view counters that massive HGT obliterates the very distinction between the vertical and horizontal routes of genetic information transmission, so the TOL [Tree of Life] concept should be abandoned in favor of a (broadly defined) network representation of evolution" (p. 148).

Surprises on viruses

Koonin has published in scientific journals about viruses. Their world is much more extensive than formerly realized, and they are more common than cellular life itself. He considers it a 'metaphysical question' as to whether viruses themselves are living things. Interestingly, Koonin rejects the common view that, owing to the fact that viruses do not encode all the information necessary for their replication, they are degenerate cells or escaped bits of genetic information.

The author devotes considerable detail to the many kinds of viruses and their complexity. His reasoning is not entirely clear. Does he believe that free-living viruses once existed, but have since become extinct? If so, how does he explain that this supposed extinction was so complete and so selective? Does he suppose that cell-parasitic viruses had so overwhelmingly out-competed their free-living counterparts that they had driven them all to extinction?

Conclusion

Vocabulary and conceptual schemes aside, Koonin acknowledges the fundamental inadequacies of evolutionary theory. Is it chance or plan? To one who is not closed-minded to the possibility, the Creator remains a very viable concept. All of the relevant evidence continues to point in that direction.