Great minds on the origin of life

A review of
Singularities: Landmarks on the Pathways of Life
by Christian de Duve
Cambridge University Press, Cambridge, UK, 2005

Information Theory, Evolution, and the Origin of Life
by Hubert Yockey
Cambridge University Press, Cambridge, UK, 2005

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Two recent books on the origin of life by eminent and long-time researchers in the field have highlighted the challenges in stark and stunning detail. Christian de Duve's *Singularities: Landmarks on the Pathways of Life* gives us the biochemical view, and Hubert Yockey's *Information Theory, Evolution, and the Origin of Life* gives us the details in terms of Shannon and algorithmic information theory. Both are written for audiences educated to undergraduate-level (in biochemistry and mathematics respectively), so they provide the precision of thought and expression that critics need. Both reject creation/intelligent design quite fiercely, and espouse evolution without question. Hostile witnesses that speak so clearly and forthrightly on this subject are exactly what creationists need to sharpen their own minds and arguments. I highly recommend them both.

Singularities: Landmarks on the Pathways of Life

Biochemist Christian de Duve won his 1974 Nobel Prize for the discovery of peroxisomes and lysosomes. He dedicated the latter part of his long and distinguished career to origin-of-life research, publishing numerous articles and four other books on this topic. His long-time editor so admires the 88-year old that he inserted an 'Appreciation' at the beginning, calling him a 'national treasure'.

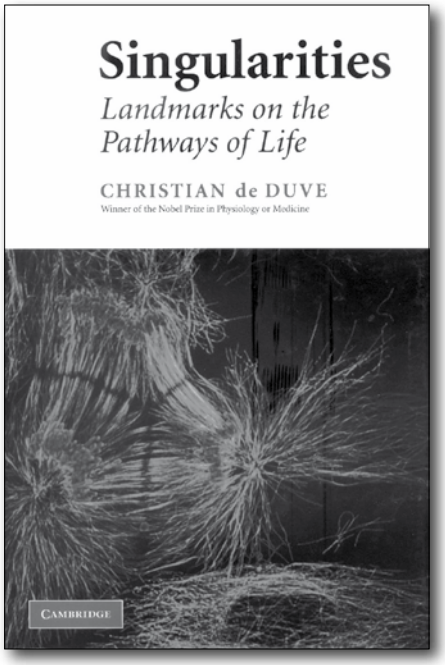
The book reads like the deathbed confessions of a 'serial-killer-in-reverse'. In this case they are the confessions of a grand old scientist who has repeatedly 'raised chemistry to life' without any scientific justification for doing so. The confession comes in the author's Foreword:

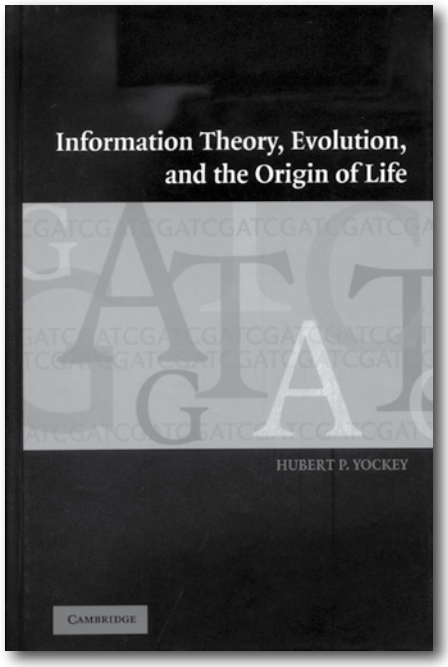
> 'This book was not meant to happen. When I finished *Life Evolving* (2002) I resolved not to write another book. … I changed my mind and began writing this book when I discovered that, in trying to reach a wide readership, I had buried a number of scientific points that I felt to be significant and original within more general expositions designed for lay readers. *The message I wished to convey had been blurred, even misinterpreted as reflecting the pursuit of an ideological agenda* … [emphasis added].'

To atone for his sins (allowing his ideological agenda—naturalistic materialism—to overrule his science), de Duve sets out to clarify the 'large number' of singularities that must be explained if one is to explain the origin and evolution of life on earth. A singularity, he says, is a unique event. It only happened once, and has never been repeated (and is thus indistinguishable from a miracle). In physics and mathematics, a singularity is a point at which no solution exists, even though points in the near vicinity do have solutions.

Events of history can be unique in that they occupy a time and space that no other similar event occupies, but the common events of history (e.g. births, deaths and marriages) are repeated every day and vary only in the details. De Duve's list consists of events that 'fifty years of vigorous and inventive research' have failed to repeat, so that 'Most steps towards greater complexity are so far *totally unelucidated* [emphasis added]' (p.152).

But he goes even further. As if to make plain to the world that his ideological agenda has been (at least partially) laid aside, the front inside





cover illustrates seven possible mechanisms of singularity. These consist of deterministic necessity (natural laws), three varieties of circumstance (Gould would perhaps have called them 'contingencies'), two varieties of chance, and yes, intelligent design! But the gloves are off against intelligent design (ID) from that point onwards.

> 'Strictly speaking, such a possibility hardly deserves mention in a scientific context, as it can come into account only after all natural explanations have been ruled out, and obviously they never can be' (pp. 4–5).

Every few pages thereafter, intelligent design is raised and rejected with frequent use of the words 'If we rule out intelligent design …' (p. 17), or a damning statement like 'crediting an "unseen hand" however, is no scientific solution' (p. 154), and a reference for further refutation to the Catholic compromiser Kenneth Miller's *Finding Darwin's God*.[1]

But reading de Duve's confessions is like watching a salmon swim up a towering waterfall against an avalanche of shipping containers (singularities), any one of which could (and should) crush his ideology to death. Miraculously, he reaches the top (i.e. life did evolve naturalistically), and concludes that his good fortune is due, not to intelligent design, but to 'strictly chemical phenomena that … were bound to occur under the physical-chemical conditions that prevailed … *leaving no room for chance* [emphasis added]' (p. 238).

Furthermore, since it happened on Earth it must have also happened elsewhere and the

> '… vast resources of astronomy, cosmology and space science can be harnessed in the search. … Should the search prove negative, as it seems very likely to be [because the universe is so vast], this failure would in no way provide proof of the singularity of life and mind, or even of their rarity. We shall always, when contemplating the skies, remain free to dream of "other worlds"' (pp. 240–241).

Abiotic chemistry	cosmic chemistry		volcanic chemistry
			thioesters
	organic molecules		pyrophosphates
Proto-metabolism	amino acids	mineral catalysts	ATP
	membranes	proteins	RNA
	protocells	enzymes	ribozymes
Metabolism	cells		metabolic pathways

Figure 1. How a Nobel Prize winning biochemist creates a naturalistic origin of life. First, by equivocation—using one word with two meanings in the same argument. Initially, he equated 'abiotic chemistry' with 'protometabolism' but then later separated the two and presented them as two different things. Second, he moved down into 'protometabolism' all the properties of life that he needed in order to transform non-life into life. (After de Duve, *Singularities*, p. 150).

In other words, after calling his book '*Singularities*' he concludes that life was *not* a singularity—but still without a skerrick of scientific evidence to support his case (that is, after all, what this book of 'confessions' is all about). After dismissing intelligent design because the alternative naturalistic scenarios can never be exhausted, he here anticipates that very exhaustion with a negative result, and still he refuses to accept intelligent design as a possible explanation. One could hardly ask for a better definition of what it means to be 'willingly ignorant' of the evidence of creation (Romans 1:20 ff.; 2 Peter 3:5–7).

So how does a Nobel laureate achieve the seemingly impossible task of maintaining naturalistic belief in the face of universally contradictory evidence? Well, he admits repeatedly that the evidence for his views is lacking, so there is no disputing that much. He repeatedly states, and then finally concludes, that life arose by deterministic chemical phenomena that 'were bound to occur under the physical-chemical conditions that prevailed … leaving no room for chance' (p. 238) so there is no doubt about the mechanism. The trick that he uses is *equivocation* (subconsciously, of course)—two different meanings for the same word in the same argument (figure 1).

On p. 15 he says,

> 'These early chemical processes [cosmically produced, and Miller-type, amino acids] are generally referred to as prebiotic, or abiotic, chemistry. They will be designated *protometabolism* in this book [emphasis in original].'

Then, on p. 150 he presents a summary table of his model, and there we find that the essential properties of metabolism (i.e. life chemistry) have been moved down into protometabolism

(the reader has already become aware of this happening progressively throughout the book), and before protometabolism, there we still have 'abiotic chemistry' continuing to churn out the building blocks.

The first of the metabolic processes that he moves down to populate his world of protometabolism—and the most crucial to his model—is selection. His first singularity is *homochirality* and his explanation for its existence is that if biological macromolecules that used chiral monomers were *not* homochiral they would not work. 'How this could have happened is not known. … but whatever the starting situation, one would expect homochirality to emerge by selection' (p. 12).[2] From that point on, selection is a crucial factor in just about every step in his model. He freely acknowledges what this implies. For example,

> 'How RNA could possibly have emerged from the clutter[3] [of what he calls the "dirty gemisch" of abiotic chemistry] without a "guiding hand" would baffle any chemist; it seems explainable only by *selection,* a process that presupposes *replication* [emphasis in original] (p. 78).

So he has to assume what he wants to prove—selection and replication only occur in living organisms!

Throughout the book, and especially in his 'Final Comments' chapter at the end, he attributes all the 'magic' that is needed for his model to work—in the face of all the negative and contradictory evidence—to special conditions in the environment. Yet he makes no systematic attempt to describe what these conditions might have been, simply saying things like 'it is not known'. However, on p. 167 he makes a slip and allows himself to speculate on what environmental conditions might have caused nascent life to jump the final hurdle into the LUCA (the Last Universal Common Ancestor). What were these 'magical' conditions? 'Starvation, acidification and excessive heat.'

This book will be an excellent resource for years to come because it gives us the biochemical detail and logic of naturalistic origin of life research that is so often covered with bluff.

Information Theory, evolution, and the origin of life

Physicist Hubert Yockey was one of the elite group that worked with Robert Oppenheimer on the Manhattan Project. He was among the first scientists to see the connection between Claude Shannon's 1948 formulation of information theory and the coding possibilities identified by George Gamow in Watson and Crick's DNA structure. With Henry Quastler, he organized the first *Symposium on Information Theory in Biology* at Gatlinburg, Tennessee, in 1956, and has been publishing in the field ever since. This is his second book on the subject, both from Cambridge University Press. It is presented as an undergraduate-level introduction to information theory and its application to biology, requiring some mathematics in parts of the text, with mathematical detail in appendices. His final chapter is entitled 'Does evolution need an intelligent designer?' There is an almost exhaustive reference to the technical literature and an adequate index. One of many strengths of the book is that it is concisely written and cogently argued, and has an appendix on the axiomatic method of reasoning at the end.

Yockey is an unapologetic iconoclast, criticizing 'true believers' of every kind, clearing the scientific decks of Oparin's blood-stained non-contribution to the origin of life, lampooning 'Western intellectuals, men of words' as self-deluded, and condemning the NASA origin-of-life program to the dustbin along with perpetual motion machines. He stands alone in the rubble, proclaiming that 'the *solution* to the problem [of the origin of life] is *undecidable*; it is beyond human reasoning [emphasis in original]' (p. 188). I agree with him (within his frame of reference) and this is an argument that is important to understand.

Information theory is also something that needs to be treated with more rigour, for it is now being widely applied. Physicists have chosen information over matter/energy as a description of the fundamental substance of the universe—it is the Shannon information contained in the Schrödinger equation that describes the potential states of quantum particles. Werner Gitt has highlighted the extra dimensions of information that most certainly apply to biology,[4] but Shannon's statistical theory still provides the basic foundation for understanding the genetic code, and Yockey does an excellent job of showing us how.

There is too much in this book to cover in a half-review, so I will focus on a few points of particular interest to creationists.

Proof of Darwinism?

He states on several occasions, most notably in the Preface, that the continuity of the genetic message (i.e. the similarity amongst genomes) is assured because the genetic information is segregated, linear and digital (see next point) and carries sufficient redundance to overcome errors, so that Darwin's theory of evolution is established 'as firmly as any in science'. This argument is invalid because it 'affirms the consequent'[5]—intelligently designed life would likely show the same pattern because the designer used similar materials for similar purposes—and it would have been considered honorable.[6]

Digital versus analogue information transmission

It is impossible to remove noise from an analogue signal, as those of us old enough to remember the days of vinyl records know, but digital signals allow the removal of noise almost to the theoretical limit (which is very small). Yockey says 'evolution would be quite impossible if inheritance were by analogue means' (p. 4) as the essentials of life would be worn away by noise.

Neglecting the meaning of information

Yockey follows exactly in Shannon's footsteps in denying the relevance of the semantic content of genetic messages (figure 2). Shannon was correct when he said 'these semantic aspects of communication are irrelevant to the engineering problem' (p. 33) but when Yockey extends this to evolution he extrapolates much too far. Biological information is communicated exactly as Shannon's theory describes, but if the meaning of that message says 'keep this species alive according to this particular pattern' [which it probably does] then evolution is overruled.

Origin of life is undecidable

His axioms are several and scattered. (i) The principles of biology cannot be derived from the laws of physics and chemistry because the information content of biology is far larger than that of physics and chemistry [Chaitin used his algorithmic theory of information to measure the latter and found it to be 'amazingly small'] (p. 2). 'Life is guided by information and inorganic processes are not' (p. 8). (ii) Kurt Gödel established that in any axiomatic and consistent system as complex as arithmetic, there will be statements that can be neither proved nor disproved, so we need not be afraid of undecidable matters (pp. 174–175). Physicists can mathematically describe the orbit of the moon around the earth (a two body problem) but they cannot describe the joint motion of these two around the sun (a three body problem)—nevertheless, the celestial bodies carry on regardless so we should not shy away from undecidable problems. (iii) The digital and redundant nature of the genetic code assures us of its essential continuity since the beginning of life (chs. 2 and 5). Pasteur's discoveries of homochirality and 'life comes from life' establish that no 'proteins first' origin of life theory can be correct (pp. 118–119). By implication, we can now derive a theorem that information must have come first, perhaps in a binary code [i.e. the simplest]. However, the DNA code consists of a four letter alphabet so the question remains unresolved (p. 173).

This argument fails on two points. First, similarity of genomes can be explained by design for similar purposes, and second, Gödel's incompleteness theorem merely *allows* undecidable statements, it does not identify them. By expanding our set of axioms to include an intelligent designer, we *can* decide the question of origins. In this expanded set we simply propose the theorem 'Life can be explained in terms of physics and chemistry' and then test it against the evidence. Yockey's already laid out steps of reasoning bring us to the conclusion that the theorem is false, and the alternative follows that an intelligent designer is required.

Complexity of protein families

Yockey makes much of the fact that most other origin-of-life researchers calculate protein probabilities without regard for the sometimes enormous amount of amino acid substitutions that are viable. His detailed studies of cytochrome c are very instructive and his predictive model is quite ingenious. However, he chose a notoriously variable protein to work on, which invalidates any application of an irreducible complexity argument. There are other proteins that are as notoriously *intolerant* of change in even *one* amino acid (e.g. histones, osteocalcin), and even the tolerant proteins usually have an intolerance in their core. A moving vehicle may be riddled with bullets and not stop, but one hit to the high-voltage connection to the fuel ignition system will stop it dead. There are redundancies in life to protect vital mechanisms but this analogy highlights the limitations of Yockey's argument.

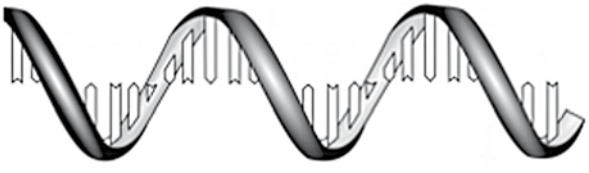


Figure 2. A single strand of RNA with its sequence of bases. Shannon's theory of information treats this as nothing more than a string of four symbols (G, A, U, C) which can be arranged in different ways. But everyone knows that these bases, taken in triplets, refer to the amino acid sequences of proteins. The strings of symbols thus have meaning, yet Hubert Yockey has presumed to discuss the origin of life without taking this meaning into account, and even saying 'It does not have to mean anything.'

The Central Dogma and the origin of life

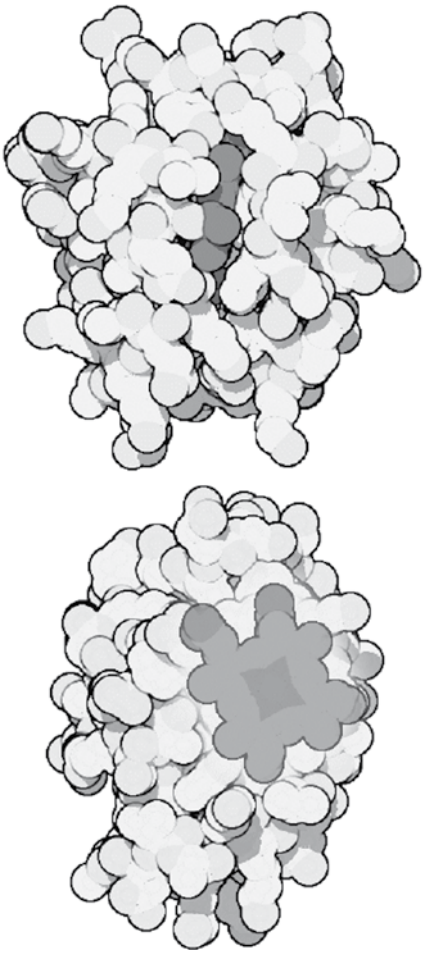
Yockey is scathing in his criticism of 'proteins first' origin of life scenarios (e.g. NASA) because the Central Dogma of molecular biology prohibits protein-to-RNA transfer of information. He argues that no code exists to effect this transfer, therefore it is impossible (p. 21). But this is an argument from ignorance, for there is much more information in living systems than is carried in the genes, and much left to be discovered. The recovery of lost DNA in plants[7] may be an example of a protein-RNA complex providing a 'revert to saved' option.

Eigen's error catastrophe

Yockey castigates Manfred Eigen for claiming that self-organizing systems trying to operate in the 'molecular chaos' ['dirty gemisch' of de Duve] 'in the beginning' would need to exceed a certain calculable threshold of functional order or they would suffer 'error catastrophe' and disintegrate. Yockey objects that Eigen is inadmissibly using 'order' [i.e. the semantic content of information] rather than Shannon information. In Yockey's view,

> '… the genetic information system, like all communication systems, operates without regard for the specificity, or value [i.e. meaning] of the message. … The genetic signal does not have to be "about something"' (p. 160).

Conversely, Popper pointed out that the genetic code has no function unless it is translated (into functional proteins).[8] This is a fatal flaw in



Cytochrome c is a notoriously variable protein to work on.

Yockey's whole book—he is quite correct in applying Shannon theory to the genetic code, but he cannot see beyond it—life is far more than statistics.

Does evolution need an intelligent designer?

This final chapter (12) is disappointingly weak. He discusses Paley's Watchmaker, Hume's Author of nature, and Behe's irreducible mousetrap, so we are under no illusion as to what is at stake. His answer is 'Neither Paley's watchmaker nor Behe's mousetrap is alive. They do not heal themselves nor do they produce little watches or little mousetraps' (pp. 178–179). There is more to his argument, but this first part uses life to explain life, so it is invalid because he assumes what he is trying to prove. The second part restricts his analysis of 'irreducible complexity' to what *he* defined as complexity (information content in the narrow Shannon sense) not what Behe defined it as (a machine that would not work unless fully assembled because the parts by themselves don't work), so he does not even address Behe's challenge.

In contradiction, in several places he notes the paradox that the information system requires the metabolic system for its function, and the metabolic system requires the information system for its function. This irreducible complexity *does* fit Behe's definition, but Yockey does not acknowledge it. Instead, he confidently goes on to assert,

> 'I have argued that the origin of life … is unknowable. But once life has appeared, Shannon's Channel Capacity Theorem assures us that genetic messages … can indeed survive for 3.85 billion years [because they are digital] without assistance from an Intelligent Designer. … The fact that there are many things unavailable to human knowledge and reasoning … does not mean that there must be an Intelligent Designer' (p. 181).

Again he uses life to explain life, and simply fails to rule out intelligent design.

There are numerous typographic errors in the book, and one annoyingly out-of-place subsection in Chapter 5, but they do not detract from any significant part of the content.

Summary

Both these books are important because they nail down the 'canvas' for all origin-of-life scenarios to be 'painted on' so that we can see clearly what the arguments and evidences are. To highlight this achievement, I could point to another long-time and well-respected contributor to this field, Emeritus Professor Freeman Dyson at the Institute for Advanced Study at Princeton. In the second edition of his book *Origins of Life* (Cambridge University Press, 1999) he used the complete absence of experimental evidence for any theory as a springboard to launch his own 'toy model'. His last line reads, 'I leave it now to the experimenters to see whether they can condense some solid facts out of this philosophical hot air.' In contrast, de Duve and Yockey have given us real evidence and concise reasoning (albeit often false) that we can use to great advantage in sharpening our own arguments.

References

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