



## Carl Sagan: The Skeptic's Sceptic Part 2

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*In 1985, Carl Sagan, better known for his book and television series Cosmos, delivered the Gifford Lectures. The transcripts were only recently published as The Varieties of Scientific Experience. Peter S. Williams has written an extended review of the book. His review provides some excellent responses to arguments that Sagan uses and which keep cropping up today.*

*This is Part 2 of the review, covering the origin of life and the possibility of extra-terrestrial intelligence. Read Part 1, Part 3, Part 4.*

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Carl Sagan's *The Varieties of Scientific Experience*:

*A Personal View of the Search for God* (Penguin, 2006)

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### Part 2: The origin of life and the possibility of extra-terrestrial intelligence

Having examined Sagan's thoughts on the significance of life on Earth given modern knowledge of cosmology in Part 1 of this four part review, our attention now turns to his speculations about the origin of life and extra-terrestrial intelligence.

Following on from his thoughts about the Earth being 'burnt to a crisp' in the distant future, Sagan raises a wider speculative argument in the traditional 'problem of evil' mould:

'if, as I will speculate later, life and perhaps even intelligence is a cosmic commonplace, then it must follow that there is massive destruction,

obliteration of whole planets, that routinely occurs, frequently, throughout the universe. Well, that it a different view than the traditional Western sense of a deity carefully taking pains to promote the well-being of intelligent creatures.' (pp. 28-29)

In syllogistic form:

- 1) If intelligent life is commonplace in the universe then, given the way the universe works, intelligent life must get routinely obliterated
- 2) Intelligent life is commonplace in the universe
- 3) Therefore, intelligent life must get routinely obliterated
- 4) If God were all-knowing and all-powerful and all-good, then intelligent life would not get routinely obliterated
- 5) Therefore, God cannot be all-knowing and all-powerful and all-good

Sagan recognizes that the 'problem of evil' is not an argument against theism *per se*, for his conclusion is that whether one can find 'Him in the shining of the stars' (a quote from Tennyson): 'depends on who the Him is.' (p. 29) That is, perhaps 'God' exists but doesn't care much for intelligent life (isn't 'all-good'). But what of Sagan's argument for this limited conclusion? It seems to me that all three of his crucial premises (1, 2 & 4) are suspect.

Supposing premise 4 is correct (an assumption I will question in a little while), anyone with reason to believe in the existence of God would deduce that premise 1 is false. Of course, *if* intelligent life is commonplace *and* the universe is allowed to blindly impinge upon the existence of intelligence, *then* much of that intelligence might well meet its end in the unfeeling mechanism of the cosmos. But what if God does *not* allow the universe to blindly impinge upon the existence of intelligence, but miraculously preserves intelligent life in existence? It is hard to dispute the *possibility* of miracles *if* God exists. Hence, in assuming that intelligent life will not be miraculously preserved against the laws of nature when they threaten it, premise 1 is guilty of begging the question against theism.

But why, exactly, is the routine obliteration of intelligent life incompatible with God being all-knowing and all-powerful and all-good (premise 4)? After all, on an individual level I don't find the

fact that one day *my* intelligence will be 'obliterated' from the universe incompatible with my belief in God. Indeed, if I were never 'obliterated' from the universe I would have to live in this universe for eternity – a fate I find far worse than going to heaven. The point here is that on a theistic worldview death (despite the heartbreaking severing of human relationships it involves) needn't be seen as the *absolute* and *final* tragedy that it is on a naturalistic worldview. The theistic worldview opens up at least the possibility of life after death. Sagan's argument seems to illegitimately import a naturalistic view of death into proceedings.

Sagan thinks that an immortal creator who creates mortal creatures is by definition: 'a cruel god... If He's omniscient, He could be kinder and create immortals, secure from the danger of death.' (p. 29). However, the only way to provide essentially embodied intelligences with immortality without fear of *physical* death is to create them in an environment inimical to the full exercise of free will. Christian theism at least holds out the hope of an eternal embodied life without the sinful misuse of free will to essentially embodied creatures who are allowed to choose whether or not to forgo use of the full range of freedom available to them by being transposed into such a state of being after death. And whatever God's reasons for creating this universe, Christians believe that in the person of Jesus God himself was actually born, lived, and suffered a horrible death on our behalf.

Finally, and perhaps most importantly, Sagan's argument depends upon the premise that intelligent life is commonplace in the universe – and this premise can be denied with a greater degree of confidence today than was the case twenty-two years ago when Sagan delivered his lectures. And if this premise is false, Sagan's argument doesn't even get off the ground.

## From the Origin of Life Here to the Existence of Life Out There

Sagan's argument for the crucial premise that intelligent life (or at least life) is commonplace comes in two steps. In the first step, Sagan argues that life on Earth began naturalistically and rather easily. In the second step, he argues that it is reasonable to expect this naturalistic process to

operate whenever opportune conditions exist, and that it is reasonable to think that our universe offers a multitude of opportune conditions.

According to Sagan:

'as science advances, there seems to be less for God to do. It's a big universe, of course, so He, She or It could be profitably employed in many places. But what has clearly been happening is that evolving before our eyes has been a God of the Gaps; that is, whatever it is we cannot explain lately is attributed to God. And then after a while, we explain it [without reference to God], and so that's no longer God's realm. The theologians give that one up, and it walks over onto the science side of the duty roster... Well, I want to describe one of the most major gaps that is in the course of being filled in. (We cannot surely say it is fully filled in yet.) And that has to do with the origin of life.' (p. 64)

A great many questionable assumptions underlie this passage – such as the assumption that 'theologians' always attribute things they don't understand to God's primary causal activity (they do not); the assumption that when science explains something in terms of secondary causes (natural causes that the theologian would ultimately attribute to God) 'that's no longer God's realm' (of course it is); and the assumption that scientific explanations must, by definition, exclude God's primary causal activity (it needn't).

For example, one can distinguish between 'Empirical Science' and 'Historical Science':

'empirical science is a non-historical, empirical approach to the world that focuses on repeatable, regularly reoccurring events or patterns in nature... By contrast, historical science is historical in nature and focuses on past singularities that are not repeatable...'[42]

Empirical science deals with physical processes that can be studied *directly* and/or *repeatedly* in the present (e.g. laws of nature, such as gravity). Historical science deals with phenomena which are non-repeatable, and which can therefore only be studied *indirectly* in the present:

'Advocates of this distinction claim that appealing to God [i.e. miracles] is legitimate in historical

science even if illegitimate in empirical science, because [historical science] deals with cases where, theologically speaking, God's primary causal activity is to be found, while [empirical science] deals with God's secondary causal activity.'[43]

Indeed, philosophers of science have found it impossible to provide a sustainable definition of science which prevents appeals to either intelligent or supernatural causes from counting as a legitimate aspect of scientific theory making (the former is after-all an explanation that features in many mainstream scientific fields). Historical sciences positing empirically detectable intelligent design (which may be philosophically interpreted as divine design), or even explicitly theistic origin theories (e.g. various types of creationism), may or may not be *good* science, but there is no adequate justification for the view that they are *not* science.[44] As Dominic J. Balestra, Professor of Philosophy at Fordham University in New York writes:

'the last twenty-five years of scientific discussions about origins, and the new, post-Kuhnian philosophy of science, present a significantly transformed context [which] removes an old barrier (the hard demarcation) between science and theology and, thereby, clears a way for new avenues of exchange between these disciplines... [This is] a time when the results of science in cosmology and biochemistry have produced findings salutary to religion, and philosophy of science has removed old walls of separation...'[45]

While some people still attempt to exclude theories of design from science by erecting methodological rules, most philosophers of science recognize such rules as being arbitrary and as getting in the way of the principle goal of science, which is to pursue the truth about reality. Philosophically naïve demarcation criteria should not prevent scholars from following evidence from cosmology and biochemistry when it points in the direction of design, even if the other side of the elephant marked 'intelligent design' might be marked 'God.' Writing about the 'old walls of separation', Balestra comments:

'Because certain types of explanations (for example, moral duty as an explanation for someone's behaviour) are ruled out of science for

methodological reasons, it does not follow that such explanations *tout court* do not contribute to our understanding... [Hence] The issue of scientism stands in a critical intellectual juncture between science and theology...'[46]

In other words, having a rule that excludes a certain type of explanation from science (e.g. explanation in terms of design) does nothing to justify the conclusion that such an explanation is not in fact the best explanation, or indeed, the true explanation, for a given set of data. Hence, even were it not the case that 'Most philosophers of science have abandoned the quest for demarcation...'[47], given that it is logically possible for an explanation in terms of design to be the best explanation for a given set of data *tout court* - indeed, if design might be the *true* explanation - then one must admit that science defined so as to exclude explanations in terms of design is neither a search for the best explanation, nor a search for truth! The only alternative to such an admission is to allow scientists *as scientists* to *follow the evidence as far as it leads them*, even if it leads them to the conclusion of design.

The 'god-of-the-gaps' is God proposed as an explanation for gaps in the current scientific account of creation *simply on the grounds that no non-teleological scientific explanation is currently available*. However, the phrase is often used to caution against the fragility of belief in God based merely on the provision of explanations for natural phenomena or for aspects of current scientific theories. For example, rather than positing God to explain why there are reliable laws of physics in the first place, or why those laws are 'fine-tuned', Newton posited a 'god-of-the-gaps' to explain why planets don't fall into the sun (i.e. 'because God keeps adjusting their orbits'). If science later provides a non-teleological explanation for the phenomena in question (in this case it did), this 'god-of-the-gaps' is thereby apt to appear an unnecessary hypothesis (such a change in explanation does not of course *contradict* belief in God). This is in turn often taken to imply that God is thereby rendered an unnecessary hypothesis to be dispensed with by Occam's razor. However, this does not follow, except in the case of theism lacking any warrant for belief in God besides the 'gap' argument in question. Any warranted theistic believer will therefore legitimately interpret the

collapse of a 'gap' argument as simply providing a more accurate picture of the nature of God's relationship with the aspect of reality in question, not as disproving the hypothesis that God has *some sort of relationship* with the aspect of reality in question.

Moreover, a 'god-of-the-gaps' explanation, *when it is not an argument from ignorance*, is not necessarily unsound.[48] The 'gap' in question might be a *lucuna naturae causa* (a gap on account of nature) rather than a *lacuna ignorantiae* (a gap on account of ignorance); that is, a genuine gap in the proximate self-explanatory abilities of the natural world, a gap that can therefore never be 'filled-in' with an adequate non-teleological explanation.[49] No one would think it reasonable to accuse an engineer of committing a 'designer of the gaps' fallacy when they posit an aircraft designer to explain the existence of an aircraft, because there appears to be a *lucuna naturae causa* between the creative capacities of nature as understood by contemporary science and the aircraft as understood by contemporary science. Indeed, this gap is arguably larger today than it was in the days before Pasteur, when scientists believed in the spontaneous generation of life from dirt. The design inference in this instance (as in any other) is not an invincible deductive proof; but a sound, if falsifiable, inference to the best explanation. Hence 'gaps' are legitimate grist to the mill of both intelligent design theory and natural theology, if and when they have at least a *prima facie* claim to being *lucuna naturae causa* rather than *lacuna ignorantiae*. As J.P. Moreland concludes:

'Thus, for example, if one discovered that living systems are discontinuous with nonliving systems in such a way that living systems bear certain features that usually result from personal agency (e.g., information in DNA, different kinds of design such as beauty, order, etc.), and if one has grounds for thinking that it is improbable that a naturalist mechanism will be found to account for this, then one could legitimately see the origin of life as a gap in the history of the universe due to a primary causal act of God.'[50]

Those 'grounds for thinking that it is improbable that a naturalist mechanism will be found' to account for the 'gap' in question may well be falsifiable, but they are nevertheless *grounds*,

rather than a lack of grounds that can be dismissed as mere 'ignorance'. As philosopher of science Phil Dowe writes:

'One of the marks of scientific knowledge is that it is defeasible, that is, open to revision. No scientific theory can be regarded as the final word, no matter how well confirmed and established it is today. There may yet be a different, even more accurate and successful theory to take its place at some time in the future. This is all the more true for the more speculative and tentative results of many arguments to the best explanation... According to [the 'god-of-the-gaps' objection] it is a mistake to believe in God on the grounds that doing so will explain some particular fact about nature, because such reasoning is open to refutation the moment subsequent scientific development uncovers perfectly good natural explanations for the facts in question... However, this objection is faulty... We must draw conclusions based on the evidence we have. All scientific reasoning works like that - it is by nature defeasible. That it is defeasible is no reason to ignore the conclusions as we now see them. The same may sometimes be true of reasons for God. If the reason is removed at a later time, then unless that was our only evidence for God, that is no reason to think God does not exist, and should, logically, be no reason to doubt.'[51]

Unfortunately the 'god-of-the-gaps' label is often used as a derogatory designator attached to arguments that, in reality, do not deserve the name. The current lack of a non-teleological explanation can represent an empirically defeasible failure to rebut a perfectly respectable argument by analogy, or an argument applying the principle of credulity to a set of data, or an inference to the best explanation.

When Sagan observes that 'All organisms on Earth use a kind of molecule called a nucleic acid to encode the hereditary information and to reproduce it in the next generation' (p. 67), he puts his finger upon the central question of origins – *the origin of information*: 'All organisms on Earth use the identical *code book* for *translating* nucleic acid *language* into protein *language*.' (p. 67, my italics) Of course, we know of one causally adequate explanation for coded information that can be translated from one language into another –

intelligence. The inference from the informational properties of life to the hypothesis of intelligent design is an inference based upon our everyday knowledge of causality – information (such as the information exhibited by this paper, or by the computer programme used by the word processing package I'm using to write it) comes from minds, not from random processes, or from natural laws, or from natural laws working upon random processes. That is no more an illegitimate 'gap' argument than is the argument of a forensic scientist who concludes that someone was the victim of murder rather than an accident or other 'natural causes'. Indeed, the only 'gap' in this scenario is the one admitted by Sagan himself, the gap between our actual knowledge of reality and any plausible sufficient explanation of the origin of life in purely natural terms. Of *this* gap, Sagan admits: 'We cannot surely say it is fully filled in yet.' (p. 64) Crucially, *this* gap is *not the basis for the design inference, but a naturalistic failure to rebut the design inference.*

Nor has *this* gap been closed in the intervening years. Writing in the 50th Anniversary special edition of *New Scientist* in 2006, Paul Davies confirmed that: 'One of the great outstanding mysteries is the origin of life' and affirmed that: 'The truth is, nobody has a clue.'<sup>[52]</sup> In February 2007 *Wired* magazine ran an article entitled 'What We Don't Know About' which included a section on 'Where did life come from?' by Gregg Easterbrook, who wrote:

'What creates life out of the inanimate compounds that make up living things? No one knows. How were the first organisms assembled? Nature hasn't given us the slightest hint. If anything, the mystery has deepened over time. After all, if life began unaided under primordial conditions in a natural system containing zero knowledge, then it should be possible - it should be easy - to create life in a laboratory today. But determined attempts have failed... no one has come close... Did God or some other higher being create life? ...Until such time as a wholly natural origin of life is found, these questions have power. We're improbable, we're here, and we have no idea why. Or how.'<sup>[53]</sup>

In a March 2007 interview, cell biologist and atheist Lewis Wolpert candidly commented:

'How the cell came about is just... Wow! It's

absolutely mind-blowing. It's truly miraculous – almost in a religious sense. I think we understand quite a lot about evolution – although even in later evolution there are problems for which we don't have good explanations – but the origin of life itself, the origin of the cell itself, that's not solved at all.'<sup>[54]</sup>

Indeed, far from closing the gap between nature and naturalism, research has consistently *widened* it. As biochemist Michael J. Behe writes:

'it's been the very progress of science itself that has made intelligent design plausible. Fifty years ago much less was known about the cell, and it was much easier then to think that Darwinian evolution was true. But with the discovery of more and more complexity at the foundation of life, the idea of intelligent design has gained strength. That trend is continuing. As science pushes on, the complexity of the cell is not getting less; on the contrary, it is getting much greater.'<sup>[55]</sup>

Allow me to make it perfectly clear that *if* an explanation for the origin of life framed purely in terms of secondary causes could be sustained, then I would have no problem with that. However, Sagan cannot afford to be similarly relaxed about things (for naturalism, some sort of naturalistic explanation is a necessity), and his attempt to narrow the gap between the scientific data and his philosophical dogma contains an amusing leap of logic.

Sagan notes that 'there is a range of evidence for microfossils dating back... to as much as 3,500 million years ago' (p. 98), and that the Earth formed 'about 4,600 million years ago' but was 'not suitable for the origin of life back then...' (p. 98) Indeed:

'the Earth was not in a suitable state for the origin of life until perhaps 4,000 million years ago. So... there was only about 500 million years for the origin of life. But those early fossils are by no means extremely simple organisms. They are, in fact, colonial algal stromatolites, and a great deal of evolution had to precede them. And that therefore says that the origin of life happened in significantly less than 500 million years.' (p. 99)

Updating Sagan's figures, we can note with Peter D. Ward and Donald Brownlee that:

'scientists are confident that life had already arisen 3.8 to 3.9 billion years ago... simultaneously with the cessation of the heavy bombardment. As soon as the rain of asteroids ceased and surface temperatures on Earth permanently fell below the boiling point of water, life seems to have appeared.'[56]

Of course, such figures, when combined with calculations concerning the likelihood of the chance assembly of an organism complex enough to undergo any evolutionary changes (not to mention calculations about the rate and plausible scope of evolutionary change once evolution is underway), constitute *prima facie* evidence against the theory that life arose by purely naturalistic processes. However, Sagan is content to beg the entire question by noting that the origin and evolution of life:

'must have happened very fast. A process that happens quickly is a process that in some sense is likely. The faster it happens, the more likely it is. There is difficulty in extrapolating from a single case; nevertheless this evidence suggests that the origin of life was in some sense easy, in some sense sitting in the laws of physics and chemistry. And if that's true, that is a very important fact for the consideration of extraterrestrial life.' (p. 99)

There is simply no 'evidence' given here to show that the origin of life happened as a result of a physical 'process', likely or otherwise. Rather, there is a philosophical *assumption* that the origin of life must have happened as the result of a physical process, combined with a philosophical *deduction* that since life appeared and became even more complex over a (geologically speaking) very short period of time, the assumed physical process in question must have been a 'likely' and 'easy' one.

Sagan does reference carefully controlled experiments that create amino acids. However, not only are there well documented problems with such experiments, but the creation of amino acids falls a long way short of the creation of DNA or RNA. As Walter L. Bradley observes: 'the origin of a sophisticated system that is both rich in information and capable of reproducing itself has absolutely stymied origin-of-life scientists'.[57]

The concept of abiogenesis was originally held by ancient Greek thinkers such as Anaximander and Aristotle, and was revived in the mid-twentieth century when Stanley Miller and Harold Urey recreated in the laboratory what they believed to be an accurate representation of the early earth's atmosphere, and managed (whilst mostly producing oils and tars) to produce some amino acids by passing an electric spark through their mixture of gases. However: 'The "prebiotic soup hypothesis," popularized by Miller's experiment, came under withering criticism from chemists for ignoring the role of competing and destructive cross-reactions... that would be expected in any hypothetical ocean or pond.'[58] Moreover: 'Miller and Urey's experiment only works as long as oxygen is absent and certain critical ratios of hydrogen and carbon dioxide are maintained.'[59] As Dean L. Overman explains: 'The presence of even a small amount of oxygen, assiduously avoided in the laboratories of these experiments, would prevent the formation of amino acids and nucleotides...'[60] Of course, if oxygen were not present, the molecules of life would have been unprotected from deadly ultraviolet radiation: 'What we have then is a sort of "Catch 22" situation. If we have oxygen we have no organic compounds, but if we don't have oxygen we have none either.'[61]

Scientists now think that oxygen was present in the early earth's atmosphere, and that 'the atmosphere of the early earth was mostly made up of carbon dioxide and ammonia [meaning that the Miller-Urey] experiment was not relevant to origin of life scenarios.'[62] As Hubert P. Yockey comments:

'The "Warm little pond" scenario was invented *ad hoc* as a materialistic reductionist explanation of the origin of life. It is unsupported by any other evidence and it will remain *ad hoc* until such evidence is found.'[63]

Stephen C. Meyer calculates that: 'the probability of constructing a rather short functional protein at random [is] so small as to be effectively zero...'[64] In other words, not only does naturalistic science lack an explanation of *how* the chemistry of life arose, or evidence to show *that* life 'just happened', it also flies in the face of evidence that life *didn't* 'just' happen! As Keith Ward argues:

'It seems hugely improbable that... amino acids should meet and combine to form large molecular structures capable of self-replication... The motive for positing some sort of intelligent design is almost overwhelming.'[65]

## Life Transcending Physics and Chemistry

Sagan's suggestion that 'the origin of life was in some sense easy, in some sense sitting in the laws of physics and chemistry' (p. 99) is contradicted by our knowledge of the role played by information in life. Dean Kenyon, Professor Emeritus of Biology at San Francisco State University, and co-author of the book *Biochemical Predestination* (McGraw-Hill, 1969) which advocated the 'written into the laws of chemistry' view of life, abandoned the theory as unworkable in the 1980s.[66] As biologist Neil Broom explains:

'The sequence making up a particular DNA strand is not dependent on any preferred bonding between the individual bases. Each base is the molecular equivalent of the dot or dash in the Morse Code and can be arranged in any linear combination without breaking the rules of chemical bonding.'[67]

I once lived in shared accommodation with friends. The fridge in our kitchen was home to a set of magnetic letters that we used to leave each other messages. The magnetic attraction between the letters and the fridge door explained why the letters attached themselves to the fridge, but it did not explain *the order* in which the letters attached themselves to the fridge (if the laws of magnetism *had* explained the order of letters, then we could not have used the letters to leave each other messages!). For a message to grace our fridge, the magnetic laws that bound each letter to the door had to come under the control of a 'higher principle', a teleological explanation: one of the housemates had sequenced the letters using the laws of magnetism in order to leave us a message. A sight-unseen, random placement of magnetic letters on the fridge might have resulted in un-specified complex sequences (gibberish), or un-complex specified sequences (short words), but not in a sequence exhibiting specified complexity (e.g. 'we need to purchase more milk today'). Just as a meaningful sequence of letters on our fridge could not be explained by the laws of magnetism alone, so the sequence of amino

acids in biological macromolecules, from enzymes to DNA, cannot be explained by the laws of physics or chemistry alone without reference to intelligence. As J.T. Trevors and D.L. Abel note:

'if chemistry determined functional sequencing... sequences would have such a high order and high redundancy that genes could not begin to carry the extraordinary prescriptive information that they carry.'[68]

By its very nature as a code, then, DNA cannot be explained in terms of physics or chemistry: 'the physical and chemical regularities that scientists describe as laws do not (by definition) produce the information-rich configurations of matter that the origin of life requires. God may have created natural law, but he does not use natural laws to create specified biological information.'[69]

As Michael Polanyi argued (even before Dean Kenyon published his now abandoned theory of biological predestination):

'objects conveying information are irreducible to the terms of physics and chemistry... As the arrangement of a printed page is extraneous to the chemistry of the printed page, so is the base sequence in a DNA molecule extraneous to the chemical forces at work in the DNA molecule.'[70]

Interestingly, Sagan's suggestion that 'the origin of life was in some sense easy, in some sense sitting in the laws of physics and chemistry' (p. 99) is contradicted by Sagan himself, who writes: 'what we have here is in some sense rare... This says that life is not guaranteed, that life requires something special, something improbable.' (p. 195) He quickly adds: 'I'm not for a moment suggesting it requires miraculous, divine, mystical intervention.' (p. 195) Perish the thought! But Sagan fails to provide any reason not to think it...

## Not asking for much?

Sagan cautions that in seeking a naturalistic origin theory:

'We're not trying to make a human being from scratch, to have all the molecules of a human

being fall simultaneously together in a primitive ocean and then have someone swim out of the water. That's not what we're asking for. What we're asking for is something that get's life going, so this enormously powerful sieve of Darwinian natural selection can start pulling out the natural experiments that work... and neglecting the cases that don't work.'

By presenting us with the ridiculously improbable request that a fully functional human spontaneously self-assemble from amino-acids of a primitive ocean (this is Sagan's parallel to Fred Hoyle's notorious comparison between the spontaneous origin of life and a tornado constructing a Boeing 747 out of a scrap heap), Sagan produces a rhetorically powerful contrast with the task he actually requires nature to perform: the spontaneous self-assembly of something living that can undergo evolutionary change (a task with which evolution is by definition unable to help). So Sagan isn't really asking for much, is he?

Recent research shows that the minimum number of protein-producing genes a single-celled organism needs to survive and reproduce in the laboratory is somewhere between 265 and 350![71] One of the simplest self-reproducing organism known outside the laboratory is the bacterium *Mycoplasma Genitalium*, which has 482 genes. Dr Chris Hutchison and his team experimented on *Mycoplasma Genitalium* by randomly inserting bits of unrelated DNA into the middle of genes to disrupt their function and seeing if the organism thrived anyway. They found that only around a third of the *Mycoplasma*'s genes were unnecessary to its survival in the laboratory, whereas the other two thirds were necessary to its survival. Outside of the laboratory *Mycoplasma Genitalium* is 'unable to sustain itself without parasitizing on an even more complex organism... Therefore a hypothetical first cell that could sustain itself would have to be even *more* complex.'[72] Fazale Rana & Hugh Ross argue that:

'the minimum complexity for independent life must reside somewhere between about 500 and 1,500 gene products. So far, as scientists have continued their sequencing efforts, all microbial genomes that fall below 1,500 belong to parasites. Organisms capable of permanent

independent existence require more gene products. A minimum genome size (for independent life) of 1,500 to 1,900 gene products comports with what geochemical and fossil evidence reveals about the complexity of Earth's first life. Earliest life forms displayed metabolic complexity that included photosynthetic and chemoautotrophic processes, protein synthesis, the capacity to produce amino acids, nucleotides, fatty acids and sugars [as well as] the machinery to reproduce. Some 1,500 different gene products would seem the bare minimum to sustain this level of metabolic activity.'[73]

Hence, in point of fact, Sagan *is* asking for rather a lot! Indeed, protestations to the contrary, he is asking for something analogous to Hoyle's Boeing 747. Sagan responds to Hoyle's analogy:

'That's a vivid image. It's also a very useful image, because, of course, the Boeing 747 did not spring full-blown into the world of aviation; it is the end product of a long evolutionary sequence, which... goes back to... the Wright biplane. Now, the Wright biplane does look as if it were spontaneously assembled by a whirlwind in a junkyard. And while I don't mean to criticize the brilliant achievement of the Wright brothers, as long as you remember that there is an evolutionary history, it's a lot easier to understand the origin of the first example.'

As long as you ignore:

a) the fact that the Boeing 747 is the end product of a sequence of *intelligently designed* evolution

And:

b) the fact that that the Wright brother's biplane was not, and does not look like it was 'spontaneously assembled by a whirlwind in a junkyard' (it would hardly be the 'brilliant achievement' Sagan acknowledges it to be if it were, or if it did)

And as long as you are unprepared to question the dogma that:

c) anything complex with an evolutionary history (designed or otherwise) *must* be traced back to something simple enough to be explained by 'a whirlwind in a junkyard' or its equivalent

Then you will not have found what Sagan has just said (which completely ignores the actual evidence concerning the complexity of life) laughable!

## Extraterrestrial Intelligence?

Whether or not you think aliens exist depends primarily upon what assumptions about the origin of life you bring to the question. The relevant assumptions were organized into an equation by pioneer SETI researcher Frank Drake.[74] The Drake Equation[75], as it has become known, suggests that the number of detectable civilizations ( $N$ ) is determined by: multiplying the rate of formation of stars suitable for life ( $R^*$ ) by the fraction of those with planets ( $f_p$ ), by the number of those planets that are suitable for life ( $n_e$ ), by the fraction of these planets where life actually evolves ( $f_l$ ), by the fraction of these on which intelligent life evolves ( $f_i$ ), by the fraction of these that develop civilizations that produce detectable signs of their existence ( $f_c$ ), by the length of time such civilizations will produce detectable signs of their existence ( $L$ ). That is:

$$N = R^* \times f_p \times n_e \times f_l \times f_i \times f_c \times L$$

Sagan notes that he can only offer: 'my wild guesses about what those numbers are... we don't know these numbers very well... our uncertainty progressively increases as we go from the leftmost to the rightmost factor.' (p. 110) His guesses are laced with terms like 'probably' and 'maybe' (p. 111)

Sagan makes conservative and non-conservative calculations, and derives a number for  $N$  of between 1 (us) and 106. The value of  $N$  (and, of course, the value for  $f_i$  crucial to Sagan's problem of evil argument) derived from this equation depends more upon the philosophical assumptions underlying the values assigned to its component parts (especially  $f_l$  and  $f_i$ ) than it does to hard scientific evidence. We have already observed how Sagan's argument for  $f_l$  is question-begging because it simply assumes that evolution by natural selection is true. While a Christian *can* accept evolution by natural selection as God's way of populating creation, there can be no '*has to be*' about it for anyone who believes in God, and there are a range of other options that Christians

should seriously consider. As Alvin Plantinga writes:

'a Christian (naturally) believes that there is such a person as God, and believes that God has created and sustains the world. Starting from this position... we recognize that there are many ways in which God could have created the living things he has in fact created: how, in fact, did he do it?... Did it all happen just by way of the working of the laws of physics, or was there further divine activity..? That's the question... Starting from the belief in God, we must look at the evidence and consider the probabilities as best we can.'[76]

Moreover, as Jimmy H. Davis and Harry L. Poe write: 'recently scientists have been rethinking the assumptions behind the Drake Equation.'[77] As noted in Part I, there are around 200 parameters required for a life-bearing planet. Comparing the chances of a planet falling within all of these parameters by chance with our best estimate of the total number of planets in the universe astronomer Hugh Ross estimates that there is 'less than 1 chance in 10<sup>215</sup>' of even one habitable planet existing in the universe.[78] By natural processes alone, we shouldn't even be here – let alone alien life forms on another planet.

## Detecting Intelligence

Sagan readily acknowledges that intelligence can be scientifically detected, by discovering unlikely and independently specified patterns ('specified complexity') in nature.[79] In discussing the search for extra-terrestrials via radio signals, Sagan argues:

'Now suppose we get a message. What would it be like? Here is a possibility... it might be a sequence of pulses that could not possibly be of natural origin. For example, a sequence of prime numbers... There is no natural process that could produce such numbers.' (p. 120)

Note that inferring intelligence as the cause of such a sequence of prime numbers does not constitute an 'alien of the gaps' argument (Sagan would not rule intelligence out of court as an explanation for this sequence, nor demand that scientists continue searching for a naturalistic explanation). Such a sequence of pulses exhibiting specified complexity could be picked

out by a computer from the background noise: 'leaving no doubt that this was an artificial signal of extra-terrestrial origin...' (p. 118)

But of course, if the numbers for various factors in the Drake equation are so low as to be staked against the independently specifiable pattern of intelligent life existing, then such specified complexity is precisely the same sort of evidence for intelligence – and evidence plausibly interpreted in theistic terms - looked for by the SETI programme. Sagan admits that the arguments for alien and divine intelligence can be treated at least analogously:

'At what moment do you say that the evidence is sufficient to deduce the presence of extraterrestrial intelligence? I believe that while the details are slightly different, the argument is not significantly different from the question, what would be convincing evidence of the existence of an angel or a demigod or a god?' (p. 108.)

Moreover, if our existence on its own is enough to trigger a design inference, then the discovery that aliens exist despite the odds against it, far from undermining the rationality of theism (as Sagan suggests) would actually *increase* the evidence for design.

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[43] *ibid.*

[44] cf. Bradley Monton, 'Is Intelligent Design Science? Dissecting the Dover Decision' @ [http://philsci-archive.pitt.edu/archive/00002583/01/Methodological\\_Naturalism\\_2.pdf](http://philsci-archive.pitt.edu/archive/00002583/01/Methodological_Naturalism_2.pdf); Alvin Plantinga, 'Methodological Naturalism?' @ <http://www.asa3.org/ASA/topics/Philosophy/PSCF9-97Plantinga.html>; Francis J. Beckwith, *Law, Darwinism, and Public Education: The Establishment Clause and the Challenge of Intelligent Design*, (Rowman & Littlefield, 2003); J.P. Moreland, *Christianity and the Nature of Science*, (Baker, 1989).

[45] Dominic J. Balestra, 'Science and Religion' in Brian Davies OP (ed.), *Philosophy of Religion: A Guide to the Subject*, (Continuum, 2003), pp. 327 & 343.

[46] *ibid.*, p. 344.

[47] *ibid.*, p. 350.

[48] cf. Jack Collins, 'Miracles, Intelligent Design, and God-of-the-Gaps', *Perspectives on Science and Christian Faith*, Volume 55, Number 1, March 2003 @ [www.asa3.org/ASA/PSCF/2003/PSCF3-03Collins.pdf](http://www.asa3.org/ASA/PSCF/2003/PSCF3-03Collins.pdf); J.P. Moreland, 'Complementarity, Agency Theory, and the God-of-the-Gaps' @ <http://afterall.net/papers/490579>; David Snoke, 'In favour of God-of-the-gaps reasoning' @ [www.cityreformed.org/snoke/gaps.pdf](http://www.cityreformed.org/snoke/gaps.pdf).

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[53] Gregg Easterbrook, *Wired*, February 2007, p. 108.

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