A REVIEW OF DEEP SIMPLICITY
By John Gribbin

My real problem with popular science books of this kind is that (i) they state theories which lack (certainly) complete or (even) general acceptance as if they were facts, (ii) that they skate over difficult areas which would weaken their viewpoint and (iii) they ignore opposing work. I'm afraid that this book suffers from all the forgoing faults.

I have no real problem with the first 100 pages or so (indeed I agree with almost all the material) except that he blithely makes assumptions about the formation of the solar system without mentioning that there are other theories – but this isn't material to his argument (or my objections) – so let's pass on.

My real objections start to arise in the "Edge of Chaos" chapter. On page 113 he starts to develop his incorrect and oversimplified argument that natural forces can produce order of a kind that could enable the formation of life from non-life in a planetary environment – say on earth.

He is of course, completely incorrect. I shall return to this a little later below.

On page 132 he makes the completely unjustified statement "The essence of Darwin's theory remains at the core of our understanding of evolution." Clearly he is not familiar with the punctuated equilibrium models of Stephen J Gould (Professor of Zoology at Harvard and one of America's 83 "living legends") in his seminal "The Structure of Evolutionary Theory" (where he demolishes classical Darwinism) or Steven M Stanley (Professor of Paleobiology at Johns Hopkins) in "Macroevolution: Pattern and Process" (where he also refutes Darwinism) or the works of Ernst Mayr or Niles Eldredge and many others. Or more likely he chooses to ignore this work. This is not to say that there is no such thing as evolution, but it certainly is to say that classical Darwinism is not the only or even the leading mechanism for evolution.

It is misleading to the general public to tell them that Darwinism is correct and "all there is".

It is also well worth noting that these other evolutionary mechanisms do not proceed on the basis of "the survival of the fittest" (which Gribbin proceeds to assume on the following pages).

At this point I have to say that I find Gribbin's method of proceeding from well documented (and largely correct) mathematical arguments to other areas disagreeably misleading. It gives the general reader the strong impression that his biological arguments are founded on mathematical laws which is far from being the case.

I agree with the basic idea of the next chapter on the importance of extinctive events – although exactly how much importance should be given to the Yucatan impact in the extinction of the dinosaurs is unclear. They had already experienced a number of evolutionary ups and downs.

On page 169 Gribbin starts to go much too far. Let's look at the emergence of proteins in a more realistic way than Gribbin does here – see Appendix I – The Origin of Proteins. You'll

see that the only reasonable conclusion is that the improbability is so great that even if this were happening throughout the universe it would be very unlikely for even a single usable protein to arise. This is in complete contrast to what Gribbin has to say – he's glossing over the truth.

Nor is it realistic to say that life could have originated in an RNA world as Gribbin starts to imply on page 169. Some scientists have tried to argue that life began in an RNA world rather than a DNA world, but that is not helpful to their case here as the same kind of bonding rules apply to RNA molecules as well. Additionally no RNA molecule which is fully self replicating has yet been discovered or developed. Christian De Duve who is critical of the idea of an intelligent designer, says of an RNA world possibility "Hitching the components together in the right manner raises additional problems of such magnitude that no one has yet attempted to do so in a pre-biotic context."[1]

At the beginning of chapter 6 Gribbin goes way too far. He says: "Evolution is a fact, just as the elliptical shape of the orbit of a planet round the Sun is a fact. There is ample evidence of evolution at work, transforming one species into another, both in the fossil record and from studies of present-day life on earth." This is entirely misleading to the general reader who is not able to analyse his bringing the relative certainty of planetary orbits into the murky sphere of evolution. It's simply grossly misleading, especially as he goes on to relate that back to Darwinism as the "THE" theory of evolution which is simply not the case even amongst biologists who espouse evolution in general as a theory. We've already discussed this. I TAKE GREAT EXCEPTION TO THE GENERAL PUBLIC BEING MISLEAD IN THIS WAY.

Also the man completely misunderstand science. Later down the page he says "Newton's theory [of gravity] was improved on at the beginning of the twentieth century by Albert Einstein." This makes it sounds like an incremental development. Nothing could be further from the truth – the two theories are like chalk and cheese. Newton postulates forces between bodies, Einstein postulates that mass distorts space. General relativity completely replaces Newtonian mechanics – although we have absolutely no certainty that General Relativity is the last word (as he states later on the same page) and many very strong indications that it is not. General Relativity is completely incapable of dealing with extremely intense gravitational fields such as black holes or the first 10^{-43} seconds after the big bang. For these situations we almost certainly require a unification of quantum mechanics with General Relativity.

To present theories that are known not to be complete and consistent as the last word is again to wilfully mislead.

Returning to his arguments on Darwinian evolution misleadingly set out in the remainder of this chapter – he totally fails to deal with the difficult issues which I briefly summarise (both in relation to Darwinian Evolution and evolutionary theories generally) in Appendix II.

In his "Life Beyond" chapter Gribbin adopts the same misleading approach that has characterised the whole book – he starts with hard science and attempts to cloak his much more dubious theories with the respectability they attract. However, he totally fails to attack

[1] De Duve, *Vital Dust*, p23

the problem of the origin of DNA – probably the most difficult barrier to the origin of life without outside intervention. I summarise my view of the problems in Appendix III.

In summary then I find this a very disappointing and misleading book.

APPENDIX I
THE ORIGINS OF PROTEINS

The formation of life by random processes seems unlikely to the point of impossibility – especially within such a relatively short space of time. Even if earth's primitive seas were (somehow) full of all the right building blocks of life – the right amino acids – (and believe me that in itself is very unlikely – the current evidence from examination of pre-Cambrian rock strata is that they contain none of the residues we would expect to find if a pre-biotic soup had existed), the chances of even the simplest protein self-assembling are less than the chances of randomly selecting a designated atom from all the atoms in the solar system. Here I need to emphasise that proteins are absolutely essential to the existence of living cells. The origins of life's information library – DNA – are even more problematic.

Proteins are each made up of long strings of between 200 to more than 1,000 amino acids. Each amino acid has to be in exactly the right place in the string forming the protein, or the protein won't function – rather like computer code or putting together letters to form a (very long) word. And let me emphasise here that there is absolutely no significant chemical or other similar principle determining the ordering of amino acids in a protein. There are some minor affinities between amino acids, but actual functional proteins tend not to follow that ordering in any event. It is likely that the human body contains more than 1 million different proteins and the simplest functional cell of which we can conceive would contain at least 100 proteins.

Let's assume that earth's primitive ocean somehow had all the right amino acids existing in close proximity to each other within it. Even then the chances of making a complex protein such as collagen (which has 1,055 amino acids) would effectively be nil. The chances of 1,055 amino acids assembling themselves in the right order is 1 in 10^{260}. That's far less than the probability of selecting one particular atom at random from amongst all the atoms of the universe. Furthermore, it's unlikely that all the right amino acids could have been produced by chance from the inorganic chemicals which existed on the early earth, and as we saw the geological evidence is that such a pre-biotic soup never existed.

Haemoglobin is one of the simplest proteins, it contains just 146 amino acids, but even here the chance of it constructing itself by random combinations of amino acids is around 1 in 10^{190}. As Fred Hoyle said, the chances of even one protein being constructed by random combinations of amino acids is less than the chance of a whirlwind passing through a junkyard and leaving behind a fully assembled jumbo jet.

Also, let's not forget that we have been talking about just one protein. As we have already said, we need at least 100 proteins to make a very simple living cell.

And it only gets more complex and unlikely. A protein is not only distinguished by the exact sequence of amino acids which comprise it, but by its shape – the way it is folded. Even then a single protein, or even a million proteins, are of no use unless they are able to be replicated or to replicate themselves. No protein can do that by itself, DNA is required in addition.

Immediately we come to another paradox. Proteins can have no use (even if they somehow came into existence) without DNA – because without DNA they can't reproduce. But DNA has no function or purpose without proteins, so how could it ever arise? We shall be returning to the subject of DNA a little later.

Those who deny a creator God, argue that proteins somehow partially assembled in shorter chains and that such chains somehow developed increasing complexity. However, it is difficult if not impossible to see what functionality such short chains could have had to cause them to be created in the large numbers that would have been necessary for there to be any reasonable chance of further, more complex, development. I believe it is for those advancing such arguments to provide a convincing mechanism. For the moment a designer creator God is, in my view, the only reasonable hypothesis.

It is true that simpler proteins involving fewer amino acids can exist, but such simpler proteins lack the folding structure which is necessary to their function in living organisms until they have at least 75 amino acids. This is still far too many to permit any realistic possibility of a chance origin.

As I've already said I do not believe scientists can validly look towards evolution, Darwinian or otherwise, in seeking a suitable mechanism. Natural selection requires self-replication, but as mathematician Von Neumann has shown[2] any system capable of self replication would need to contain systems or sub-systems that were functionally equivalent to the systems we find in living cells. To put it another way natural selection cannot operate until the level of complexity we find in living cells has been reached, but that level of complexity cannot be arrived at by random fluctuations – chance – because the odds are so immensely against. Thus, pre-biological natural selection is a contradiction in terms. Hence, we can't invoke evolutionary type mechanisms to explain the origins of proteins and DNA.

Nevertheless, both Richard Dawkins and Bernd-Olaf Kuppers have attempted to revive the concept of pre-biotic natural selection. Both use a computer model to try and demonstrate the efficiency such selection could have. They select a target sequence of letters to represent a desired functional polymer. After creating a crop of randomly constructed sequences and generating variations amongst them at random, their computers select those sequences that match the target sequence most closely. The computers then amplify the production of these sequences (to simulate differential reproduction) and repeat the process. As Kuppers puts it "Every mutant sequence that agrees one bit better with the meaningful or reference sequence … will be allowed to reproduce more rapidly." After only 35 generations his computer model succeeded in spelling the target sequence "NATURAL SELECTION". However, there is an obvious flaw in this experiment. Chemical molecules in a pre-biotic ocean do not have a target compound "in mind". Their different arrangements will not differentially reproduce until they arrive at a functionally advantageous arrangement. The results of both Kuppers and Dawkins simulations show early generations full of non-functional gibberish, corresponding to useless chemical compounds in the real world. In Dawkins model, not a single functional word appears until after the tenth generation – and this is with the benefit of the foresight or foreknowledge built into the model. Where would this foreknowledge come from in an unaided material world.

It is precisely the difficulty in arriving at a naturalistic, non-deistic, mechanism that has led some scientists to assume that life developed away from earth, and that earth was later somehow seeded with life. But, of course, that just displaces the problem elsewhere, just pushes it back one stage. Given the extreme improbabilities involved the probabilistic resources of the entire universe are exceeded. To put it another way it's so unlikely that even

[2] J von Neumann, *Theory of Self-Reproducing Automata*, University of Illinois Press

if it were happening all over the universe there is no reasonable probability of its happening by chance. In any event, how could any life which was formed, reach us across thousands of millions or even billions of light years of distance. Thus, the approach of moving origins elsewhere solves nothing.

APPENDIX II
Difficulties with Theories of Evolution

As a first problem, the fossil record simply does not support Darwinism; we do not find evidence of the numerous intermediate forms of life predicted by Darwin. Instead, new species emerge in the twinkling of an eye, with no evidence of intermediate developmental forms. Darwin himself knew this problem was serious. In the *Origin* he said it was "probably the gravest and most obvious of all the many objections which may be urged against my views." The gaps still exist today – Stephen J Gould called it "the trade secret of palaeontology"[3].

The overall character of the fossil record as it stands today was superbly summarised in an article by G G Simpson – a leading palaeontologist who was invited to address the Darwin centenary symposium and whose testimony to the gaps in the fossil record has considerable force. As he points out it is one of the most striking features of the fossil record that most new kinds of organisms appear abruptly and not gradually as Darwin's theory would have predicted. He says:
"They [new organisms] are not as a rule, led up to by a sequence of almost imperceptibly changing forerunners such as Darwin believed should be usual in evolution. A great many sequences of two or a few temporally inter-grading species are known, but even at this level most species appear without known immediate ancestors, and really long, perfectly complete sequences of numerous species are exceedingly rare."

In effect, Simpson is admitting that the fossils provide none of the crucial transformational forms predicted by Darwin.

Basically, three explanations have been put forward to explain the gaps in the fossil record: (i) insufficient search, (ii) imperfection of the record, and (iii) punctuated evolution (i.e. that the gaps are real and evolution has proceeded in a series of jumps). The hope of uncovering missing links in unexplored rocks is not completely dead, but it has greatly diminished. As Norman Newell past curator of historical geology at the American Museum of Natural History puts it:
"… experience shows that the gaps which separate the highest categories may never be bridged in the fossil record. Many of the discontinuities tend to be more and more emphasised with increased collecting."

It is particularly difficult to accept insufficient search as an explanation for the gaps between the major invertebrate phyla. There is a mystifying almost total absence of transitional forms in the pre-Cambrian rocks.

Imperfection of the record has always been the most popular explanation for the gaps. It was Darwin's explanation. Certainly there is some imperfection, but G G Simpson recently estimated the percentage of living species recovered as fossils in one region of North America and concluded that at least for larger terrestrial forms, the record was almost complete[4]. According to an article by Wyatt Durham in the *Journal of Palaeontology* it is probable that as many as 2% of all marine invertebrate species with hard skeletal components which have ever lived are known as fossils. Most professional palaeontologists have always

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[3] Eldredge N and Gould S J, *Models in Paleobiology,* Schopf, Freeman, Cooper and Co p181
[4] Simpson G G, *The Evolution of Life*, University of Chicago Press, Table 8

been sceptical about imperfection as a means of explaining away the absence of transitional forms.

The fundamental problem in explaining the gaps in terms of insufficient search or in terms of imperfection of the record is the systematic character of the gaps – there are fewer known transitional species between the major divisions than between the minor. Thus, between Eohippus and the modern horse (a minor division) we have dozens of transitional species, while between early land mammals and whales (a major division) we have none. This rule applies fairly universally.

Punctuated evolution – the supposition that new types of organisms arise suddenly – partly solves the problem of the lack of transitional forms. Darwin was opposed to this idea because he was aware of the improbability of evolution by macromutation – an issue we shall deal with in a moment. In 1954 Ernst Mayr initially proposed [5] (at least in its modern form) an idea later elaborated by Niles Eldredge and Stephen Jay Gould [6] that the gaps in the fossil record should be viewed as real and propose a model of evolution as an episodic process occurring in fits and starts interspaced with long periods of stasis – the punctuated equilibrium. In their model new species arise rapidly in isolated populations. In an isolated population a new species emerges after which it spreads widely and afterwards undergoes little change. Clearly given the small numbers of individuals involved in the transition the chances of finding fossil evidence are remote.

There is considerable evidence from recent genetic studies of isolated populations that this is indeed how new species arise. However, whilst this model is a perfectly reasonable explanation of the gaps between closely related species it is doubtful if it can be extended to explain the larger systematic gaps such as the gap between primitive terrestrial mammals and whales for example. This would require hundreds, probably thousands, of transitional species. Unless we believe in miracles (I do but only when God intervenes), such gaps could not have been crossed in geologically short periods of time with all the transitional forms all contained in isolated areas. Many of the transitional species would surely have spread widely – but no evidence of their existence has been found. Furthermore, unless some of these transitional forms did spread, the chances of further mutation amongst a suitable sub-group would be negligible. Let's be clear on the magnitude of the problem being faced here. The fossil evidence shows that the move from a small land mammal to a whale, or from a small land mammal to a bat, occupied little more that 10 million years – a very short time indeed for the magnitude of change involved.

As a second problem with Darwin's theory, there are numbers of species, which have existed for millions of years with little or no evolutionary change – the so-called "living fossils". One example of these is bowfin fishes. No more than two species of bowfin fishes have existed at any one time. In their history of more than 100 million years, bowfin fishes have displayed virtually no evolution at all. Lungfishes are another example. They evolved quite rapidly at the beginning of their history some 300 million years ago, but since then have again hardly evolved at all for hundreds of millions of years. Other examples are sturgeon fishes, alligators, tapirs and aardvarks. These are difficult, if not impossible, to account for on a strict Darwinistic view. It is, of course, precisely what we would expect on the punctuated equilibrium model. This is one of the reasons why I think the punctuated

[5] Ernst Mayr, *Change of Genetic Environment and Evolution*, pp157-180
[6] Eldredge N and Gould S J, *Models in Paleobiology,* Schopf, Freeman, Cooper and Co pp82-115.

equilibrium model is probably correct, but we must remember that this does not in any way solve the problem of the larger systematic gaps we just discussed.

A third problem with Darwin's theory is the extremely rapid development of huge numbers of new species, indeed numbers of whole new phyla, during the early Cambrian period – the so called Cambrian Explosion. This explosive development cannot be accounted for by a gradualistic evolutionary model and indeed can only be accounted for with great difficulty (if at all) by the punctuated equilibrium model. Within less than 50 million years we see the sudden appearance of all the known animal phyla. A similar and parallel problem exists in the sudden appearance of flowering plants, which Darwin sought to explain away by proposing the existence of an unknown continent in the Southern Hemisphere.

A fourth problem with Darwin's theory is that neither this theory, nor other evolutionary models such as the punctuated equilibrium, have any answer for "irreducibly complex" biological systems (primarily the mechanisms within the cell). Whatever Dawkins says about transitional wing forms advantaging land based animals for example, there is no factual basis for his assertions and they do not satisfactorily address mechanisms like the bacterial flagellum the human immune system or the blood clotting mechanism. He makes an analogy with solving a combination lock which gradually gives out hints. But, like a well designed combination lock, the universe doesn't give out hints. Unless partial constructs are useful, there is no reason why they should be retained. And that's the whole point of irreducible complexity – it's very difficult to see how any intermediate forms could be useful. It's for proponents of evolution as a theory to come up with the answer to this problem. Dawkins doesn't deal with it except to baldly state that he is sure that there are gradualistic mechanisms which can develop these systems. That's not an answer unless you take evolution by natural selection as a given – which Dawkins obviously does. Irreducibly complex biological systems can have no function at all until they are complete and thus cannot have been produced by gradualistic means. Equally, to imagine they could be produced in a single bound of macromutation, strains our credulity given the enormous improbability involved.

Thus, I think you can see that the scientific evidence simply does not support Darwin's theory in its classic form of slow gradualistic change. I consider that this theory should be firmly rejected. If Darwinism were not so intellectually satisfying in philosophical terms to so many scientists (because it eliminates the need for God), it is doubtful if it would have survived to this day. Stanley M Stevens, professor of paleobiology at John Hopkins University, says "In fact, the fossil record does not convincingly document a single transition from one species to another"[7]. He also says " … gradual modification of existing species cannot even account for the origins of most new genera.[8]" And "What happens if we attempt, hypothetically, to form each new genus by gradual modification along one of the well recognised evolutionary pathways? What happens is that we are stymied![9]" Now I should emphasise that Stanley Stevens is no friend of Christians or creationists – he roundly attacks these groups later in the book from which I just quoted. So you see just how deficient classical Darwinian theory is.

Here, I should say that I do consider that the punctuated equilibrium model of evolution we discussed a few moments ago has limited validity and does explain some of the development of life as we know it. However, I do not believe it is a complete explanation for all such

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[7] Stanley M Stevens, *The New Evolutionary Timetable*, Harper & Row Ltd p95
[8] Ibid at p97
[9] Ibid at p99

development because of the problems of rapid major transitions we have looked at and the irreducibly complex systems issue. In my view, the Intelligent Design hypothesis is a better explanation of the evidence and this is even more strongly supported in the area of the origin of life, which is our next topic.

Whatever its merits in explaining the development of life, I contend that neither Darwinism nor the punctuated equilibrium theory can offer any explanation whatsoever for the *origin* of life. In brief summary my argument is that evolution can only take place by selection amongst naturally self-replicating entities. Until life exists, self-replicating entities do not exist and therefore evolution cannot occur.

It is true that in his book, Darwin himself made no claim that his model of evolution could be extended to explain the origin of life, but the implication was there and was soon taken up by his contemporaries like Thomas Huxley. Today the idea that selection amongst beneficial mutations was responsible for the origin of life is firmly held by most evolutionary biologists.

Now we used to think that life started about 700-800 million years ago, but recently an Australian group has discovered the remains of a simple algae in rocks at least 3,500 million years old. The earth's surface didn't even become solid until 3,900 million years ago, so that leaves at most 400 million years for inorganic compounds to somehow be transformed into living cells.

The formation of life by random processes seems unlikely to the point of impossibility – especially within such a relatively short space of time.

APPENDIX III
The Development of DNA

Most complex life is built up of cells which contain proteins (up to 20,000 different ones in a typical human cell) and many other things as well. For living things to function, the proteins within their cells must be able to reproduce. In order to do that they need both the apparatus of the whole cell and the information contained in a complex chemical compound called DNA. As Richard Lewontin writes "No living molecule is self reproducing. Only whole cells contain all the necessary machinery for self reproduction …… Not only is DNA incapable of making copies of itself aided or unaided, but it is incapable of 'making' anything else ……. The proteins of the cell are made from other proteins, and without that protein forming machinery nothing can be made." DNA is a pretty common term today and I'm sure you will all have heard of it – in fact it's an absolutely amazing substance.

DNA is life's computer programme – its Windows 7 as it were – but much better put together! DNA is the repository of a digital code, a library of information, telling the cell's machinery how to build specific proteins. This code is written in a four value code (rather than the two value binary code used by computers). These four values are represented by four chemical compounds called bases. These are A (adenine), T (thymine), C (cytosine) and G (guanine). Without this code, without DNA, proteins are unable to reproduce. Thus without DNA living cells cannot function at all. But, where did this digital code, this information contained in DNA, come from. I believe it is best explained on the basis of an intelligent designer and creator.

As I just said, DNA stores information in a four character digital code rather than the two character digital code that computers use. Properly arranged these four characters, or "bases" as they are usually called, instruct cells to build different sequences of amino acids which, as we've already seen, are the building blocks of proteins. To build even one protein the information expressed by between 1,200 and 2,000 bases, that's 1,200 to 2,000 letters in this code, is typically required. This means that there is rather a lot of DNA in the human body. You have more than 2 metres of it, if it were straightened out, squashed into every cell and this 2 metres of DNA contains over 3 billion letters of coding. Altogether within your body you may have as much as 20 million kilometres of DNA – enough to stretch to the moon 50 times over.

DNA is essential to life, but it is not itself alive, indeed it is particularly chemically inert. DNA is like a library of information which is absolutely necessary to the functioning and replication of a cell. But, without the cell, or at least without proteins, the information has no function or purpose – so how could it have originated? Information theorists hold that the creation of new information is generally associated with conscious activity by a thinking being.

Jay Roth, professor of cell and molecular biology at the University of Connecticut, said, "Even reduced to its barest essentials the original template for life must have been very complex indeed. For this template and this template alone, it appears reasonable at present to suggest the possibility of a creator."

Some scientists have advanced various hypotheses supposing that chemical attractions may have caused DNA's alphabet to self assemble or that natural affinities between amino acids

caused them to link up in a particular order. Given the failure of models involving pre-biotic natural selection this seemed to be the only explanation not involving the need for a creator designer. Rather than invoking chance, these theories invoked necessity. Scientists in the late 1960's suggested that the chemicals involved might possess self-ordering properties capable of organising the constituent parts of proteins, and also DNA and RNA into the specific arrangements they now possess[10]. Kenyon and Steinman developed the idea that affinities between different amino acids might account for the sequences of amino acids we find in proteins in a book called *Biochemical Predestination* in 1969. They argued that life might have been biochemically predestined by the properties of attraction that exist between different amino acids in proteins. This view has now largely been abandoned. Dean Kenyon has specifically repudiated the notion.

In 1977 Prigogine and Nicolis proposed another self organisational theory based on the idea that systems driven far away from equilibrium often display self-ordering tendencies. For example gravitational energy will produce highly ordered vortices in a draining bathtub or hot air above a radiator will generate distinctive convection currents. They suggested that something similar might apply to the biochemical building blocks of life.

For many current origin of life scientists, self-organisational models now seem to offer the best approach to explaining the origin of life. Nevertheless there are many critics and huge problems. For example, an early advocate of self-organisation, Dean Kenyon, has now explicitly repudiated such theories as both incompatible with empirical findings and incorrect. Firstly, empirical studies have shown that some differential affinities do exist between various amino acids – that is certain amino acids do form linkages more easily with some other specific amino acids rather than other amino acids. However, it has also been shown that these affinities do not correlate to the ordering of amino acids we find in actual proteins. In short, chemical affinities do not explain the sequential arrangement of amino acids in actual proteins.

In relation to DNA, the point can be made even more strongly. The structure of DNA does, of course, depend on chemical bonds. However, there are no chemical bonds between the bases arranged along the helix structure of the DNA molecule. These are attached to the helix but not to each other. Further, just as you could attach magnetic letters anywhere on your refrigerator, similarly each of the four bases of the digital code (A, T, G and C) can attach anywhere on the backbone of the DNA helix with equal facility. Thus all possible sequences of bases are equally probably (or improbable). Indeed there are no significant differential affinities between any of the four bases and the binding sites on the DNA helix – exactly the same kind of chemical bond attaches each of them. All four bases are acceptable; none is preferred. As Kuppers put it "the properties of nucleic acids indicate that all the combinatorially possible nucleotide patterns of DNA are from a chemical point of view equivalent."[11] Thus it is quite clear that self organising bonding affinities cannot explain the specific sequential arrangement of nucleotide bases in DNA because (i) there are no bonds between the bases themselves and (ii) there are no different kinds of bonds and no differential affinities between the backbone of the DNA helix and the bases which bond to it.

Some scientists have tried to argue that life began in an RNA world rather than a DNA world, but that is not helpful to their case here as the same kind of bonding rules apply to RNA

[10] H J Morowitz, *Energy Flow in Biology*, New York Academic Press, pp5-12
[11] B Kuppers, *The Prior Probability of the Existence of Life*, Cambridge MIT Press pp355-369

molecules as well. Additionally no RNA molecule which is fully self replicating has yet been discovered or developed. Christian De Duve who, as we've already seen, is critical of the idea of an intelligent designer says of an RNA world possibility "Hitching the components together in the right manner raises additional problems of such magnitude that no one has yet attempted to do so in a pre-biotic context."[12]

Some scientists are also unwilling to abandon 'inevitable ordering' arguments, in spite of the evidence against that we have just briefly summarised. De Duve says "the processes which generated life were highly deterministic, making life as we know it inevitable given the conditions that existed on the prebiotic earth." Yet if we imagine the most favourable conditions possible – a pool full of all four DNA bases and all the other components of the DNA molecule – it is clear that it is unlikely that any functional protein or gene would ever arise. To say otherwise is like claiming that the structure of Buckingham Palace is inevitable given the properties of the bricks and stones used to construct it. Bricks don't care how they are arranged and nor we have discovered do the information carrying bases in DNA.

In fact there is a good reason why this should be so. Information theorists have shown that chemically based ordering would not yield information of a sufficiently complex nature to enable the DNA code to contain the specifications for all the varied components of life. At a simple level this is easy to understand. Suppose there were bonds and affinities such that every time base A occurred it attracted T to follow it and that every time base C occurred, G would likely follow it. As a result, DNA would be full of repetitive sequences AT and CG – rather like the structure of a crystal. In a crystal chemical attractions do determine to a very large extent the arrangement of its molecules. Thus, a crystal is highly structured and regular – ordered and repetitive with little information content. The forces of chemical necessity reduce the capacity to convey novel information. As chemist Michael Polyani notes:
" … Whatever may be the origin of the DNA configuration, it can function as a code only if its order is not due to the forces of potential energy. It must be as physically indeterminate as the sequence of words on the printed page."[13]

Chemical affinities do not generate complex sequences. Information is both 'complex' and 'specific'. Thus, chemical affinities cannot be invoked to explain information content. As Yockey says, the accumulation of structural or chemical order does not explain the origin of biological complexity or genetic information[14]. He concedes that energy flowing through a system may produce highly ordered patterns, but the information content of DNA is not regularly ordered.

In the face of these difficulties, some, such as Manfred Eigen, have claimed that we must await the discovery of new natural laws to explain the origin of biological information. In my view, this displays confusion on two counts. Firstly, scientific laws do not generally cause or even explain natural phenomena – they describe them. For example, Newton's law of gravity described but did not explain the attraction between planetary bodies. Secondly, laws describe highly deterministic inherently predictable relationships. Laws describe patterns in which an event becomes inevitable given previous circumstances. Yet, information increases as improbability increases. Thus to say that a scientific law can provide complex information is effectively a contradiction in terms.

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[12] De Duve, *Vital Dust*, p23
[13] M Polyani, *Life's Irreducible Structure, Science 160*, pp1308-12
[14] H P Yockey, *Self Organisation, Origin of Life Scenarios and Information Theory*, Journal of Theoretical Biology 91

Let me just summarise in a couple of sentences what we've learnt about the structure of DNA. DNA provides the information that enables the replication of proteins within living cells. This information is represented by the bases attached to the DNA helix. These bases do not interact chemically with each other in DNA. Any base can attach at any point along the DNA helix backbone with equal facility – they are totally interchangeable. That means that chemical affinities could not possibly have produced the ordering we observe. Information requires irregularity of sequencing that bonding affinities between the bases in DNA (which are the information carriers) would not produce. Even if there were any relevant chemical affinities, to hold that they could have produced complex information of the kind we find in DNA is analogous to arguing that a pile of paper and a bottle of ink somehow organised themselves to generate this talk.

If neither chance nor the principles of physical-chemical necessity, nor the two acting in combination, can explain the origin of the information content of DNA, what does. Do we know of anything that has the causal powers to create large amounts of information content. We do. As Henry Quastler, an early pioneer in the application of information theory to molecular biology recognised, the "creation of new information is habitually associated with conscious activity"[15].

Everyday experience confirms that specified complexity or information content only arises from the activity of intelligent minds. Think of computer code or a newspaper article – these have a mental not a material cause. This holds for specified complexity not only in languages or codes, but other things as well. Think of the carvings of American presidents on Mount Rushmore in the USA – no one would think of suggesting that these had originated by weathering patterns or any activity other than that of an intelligent creator designer.

Indeed we normally hold to this principle so strongly that we make suitable inferences even when the causes themselves cannot be directly observed. Archaeologists assume a mind produced the carvings on the Rosetta stone. Anthropologists argue for the intelligence of early pre-human hominids on the basis of chipped flints which they discover. NASA searches for possible extra-terrestrial intelligence on the basis of searching for patterns (such as the prime number sequence) embedded on electromagnetic signals from space. In all these cases we are unable to observe an intelligent mind at work, but on the basis of what we do observe (or hope to observe) we do not hesitate to infer the existence and operation of such a mind.

We have now observed the information content of DNA. I contend that this information content is by itself an extremely strong argument for the existence of a creator designer God. We know of no other cause besides intelligence that produces complex information. Even the rabid atheist Professor Flew from Cambridge University (who had written more than 25 anti-Christian books) converted to Deism (although not Christianity) a few years ago on the basis of the DNA evidence.

This argument from evidence to design is not an argument from ignorance. Some scientists have said that because we do not yet know how specified complexity in physics and biology could have arisen we are invoking this mysterious and unscientific notion of intelligent design and this is not a scientific explanation but a kind of place holder for ignorance. Yet, as

[15] H Quastler, *The Emergence of Biological Organisation*, Yale University Press, p7

I've just argued, we often infer the activity of intelligent agents as the best explanation for certain events or phenomena. As Dembski has shown[16] we do so rationally according to clear theoretical criteria. Intelligent agents have unique causal powers that nature and natural forces do not. When we observe effects that we know from experience only intelligent agents can produce, we rightly infer the antecedent presence of a prior intelligence even if we did not observe the action of the particular intelligent agent responsible[17]. When these criteria are present, as they are in living systems, design constitutes a better explanation than either chance and/or deterministic natural processes.

Yet others have objected that we cannot infer the existence of an intelligent designer for life because we have no knowledge that such a being exists. However, well accepted design inferences elsewhere, do not depend on a prior knowledge of a designing intelligence. Take for example the SETI research by NASA already mentioned. We do not know that any extra terrestrial intelligence exists, but the researchers (in my view rightly) assume that the existence of large amounts of specified complexity in any radiation they might detect would establish the existence of such an intelligence. Closer to home anthropologists have, as we already noted, inferred the intelligence of proto-humans by examination of artefacts these beings produced.

Yes say the objectors but the examples you have given only require intelligence at the human level. The creation of life would require a much greater intelligence than any that we know exists – a superintellect to use Fred Hoyle's words. This is an attempted application of the *vera causa* principle which asserts that we should only postulate (or prefer in our considerations) causes which are sufficient to produce the effect in question and that are known to exist by their observation in the present[18]. Darwin himself marshalled this argument as a reason for preferring his theory of natural selection over special creation. Scientists, he argued, can observe natural selection whereas they cannot observe God creating new species. Even so, Darwin admitted that he could not observe natural selection creating the kind of large-scale change that his theory required. For this reason, he had to extrapolate beyond the known powers of natural selection to explain the large-scale change during the history of life. But, he knew that natural selection was capable of producing small-scale changes, so he reasoned that this could reasonably be extrapolated to explain large-scale changes over longer times. Historical scientists have long regarded such extrapolations as reasonable and fully in accord with the *vera causa* principle. Consequently the *vera causa* principle cannot reasonably be employed to exclude arguments from intelligent design – it is a reasonable extrapolation to the effect of a greater intellect – God – from the effects of lesser known intellects.

Further, it has been argued that the hypothesis of an intelligent designer is not scientific because it is not testable. However, this allegation is untrue. Advocates of intelligent design have made a number of predictions based on that hypothesis, for example that the long sequences within DNA which do not encode genes and which until recently had no known function, would in fact be shown to have a function. That prediction has recently proved to be correct. These long "junk" sequences within DNA which were until recently thought to be rubbish left over from mutation and undesigned evolutionary processes have been shown to

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[16] W Dembski, *The Design Inference: Eliminating Chance through Small Probabilities*, Cambridge University Press pp36-66

[17] Ibid, *pp1-35, 36-66*

[18] V Kavalovski, *The Vera Causa Principle: A Historico-Philosophical Study of a Meta theoretical Concept from Newton through Darwin*, University of Chicago p104

be a part of what might in computer terms be likened to the operating system. They control the application of the gene coding sequences, they turn genes on and off and control their interaction and application. This successful prediction shows that the intelligent design hypothesis is testable.

Finally, others have argued that the intelligent design hypothesis is not science – because it is not naturalistic. If by this, we mean that only materialistic causes can be considered then the intelligent design hypothesis is not scientific on that definition. But what is the rationale for this criteria of materialism? Surely, science should be considering whatever explanations are more probable, not artificially restricting the choices of the kinds of explanations which can be considered. We should be asking what is the most adequate explanation, not choosing from amongst a range of artificially restricted options.

In any event, mainstream physics has for many years accepted that we cannot restrict ourselves to the purely materialistic, mechanical view of nature. Quantum theory requires a mysterious interaction between the observer and the observed. This is an almost mystical phenomenon for which we have no material explanation – we just observe the reality. But, what would have happened before there was any life in the universe to constitute an observer? Perhaps the observer was God!

Of course, the argument to design we have reviewed does not constitute a proof – nothing based upon empirical observation can – but it most emphatically does not amount to an argument from ignorance. Rather it is an inference to best explanation. Causes that can produce the evidence in question are clearly better explanations than those that cannot. We have clearly shown that chance and the blind operation of natural law (or the two in combination) cannot produce life, but we know that an intelligent designer could.