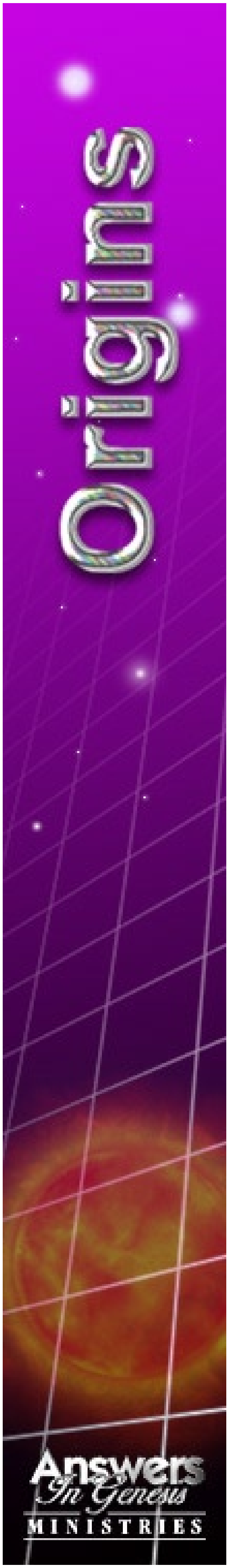

Can naturalistic evolution explain the appearance of life on Earth?

Loopholes in the evolutionary theory of the origin of life: Summary

by Jonathan Sarfati

First published in:
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1. There is almost universal agreement among specialists that Earth's primordial atmosphere contained no methane, ammonia or hydrogen —'reducing' gases. Rather, most evolutionists now believe it contained carbon dioxide and nitrogen. Miller-type sparking experiments will not work with those gases in the absence of reducing gases.

2. The atmosphere contained free oxygen, which would destroy organic compounds. Oxygen would be produced by photodissociation of water vapour. Oxidised minerals such as hematite are found as early as 3.8 billion years old, almost as old as the earliest rocks, and 300 million years older than the earliest life (these 'dates' are according to the evolutionary/uniformitarian framework, which I strongly reject on both Biblical and scientific grounds).

3. Catch-22: if there was no oxygen there would be no ozone, so ultraviolet light would destroy biochemicals.

4. All energy sources that produce the biochemicals destroy them even faster! The Miller/Urey experiments used strategically designed traps to isolate the biochemicals as soon as they were formed so the sparks/UV did not destroy them. Without the traps, even the tiny amounts obtained would not have been formed.

5. Biochemicals would react with each other or with inorganic chemicals. Sugars (and other carbonyl (>C=O) compounds) react destructively with amino acids (and other amino ($–NH_2$) compounds), but both must be present for a cell to form.

Without enzymes from a living cell, formaldehyde (HCHO) reactions with hydrogen cyanide (HCN) are necessary for the formation of DNA and RNA bases, condensing agents, etc. But HCHO and especially HCN are deadly poisons — HCN was used in the Nazi gas chambers! They destroy vital proteins.

Abundant Ca^{2+} ions would precipitate fatty acids (necessary for cell membranes) and phosphate (necessary for such vital compounds as DNA, RNA, ATP, etc.). Metal ions readily form complexes with amino acids, hindering them from more important reactions.

6. No geological evidence has been found anywhere on Earth for the alleged primordial soup.

7. Depolymerisation is much faster than polymerisation. Water is a poor medium for condensation polymerisation. Polymers will hydrolyse in water over geological time. Condensing agents (water absorbing chemicals) require acid conditions and they could not accumulate in water. Heating to evaporate water tends to destroy some vital amino acids, racemise all the amino acids, and requires geologically unrealistic conditions. Besides, heating amino acids with other gunk pro-

duced by Miller experiments would destroy them.

8. Polymerisation requires bifunctional molecules (can combine with two others), and is stopped by a small fraction of unifunctional molecules (can combine with only one other, thus blocking one end of the growing chain). Miller experiments produce **five times more** unifunctional molecules than bifunctional molecules.

9. Sugars are destroyed quickly after the reaction ('formose') which is supposed to have formed them. Also, the alkaline conditions needed to form sugars are incompatible with acid conditions required to form polypeptides with condensing agents.

10. Long time periods do not help the evolutionary theory if biochemicals are destroyed faster than they are formed (cf. points 4, 7, & 9).

11. Not all of the necessary 'building blocks' are formed; e.g. ribose and cytosine are hard to form and are very unstable.

12. Life requires homochiral polymers (all the same 'handedness') — proteins have only 'left-handed' amino acids, while DNA and RNA have only 'right-handed' sugars. Miller experiments produce *racemates* — equal mixtures of left and right handed molecules. A small fraction of wrong handed molecules terminates RNA replication, shortens polypeptides, and ruins enzymes.

13. Life requires catalysts which are specific for a single type of molecule. This requires *specific* amino acid sequences, which have extremely low probabilities ($\sim 10^{-650}$ for all the enzymes required). Prebiotic polymerisation simulations yield *random* sequences, not functional proteins or enzymes.

14. The origin of coding system of proteins on DNA is an enigma. So is the origin of the *message* encoded, which is extraneous to the chemistry, as a printed message is to ink molecules. Code translation apparatus and replicating machinery are *themselves* encoded — a *vicious circle*. A code cannot self-organize.

15. The origin of machines requires design, not random energy. E.g: the Nobel prize-winner Merrifield designed an automatic protein synthesiser. Each amino acid added to the polymer requires 90 steps. The amino acid sequence is determined by a program. A living cell is like a *self-replicating* Merrifield machine.

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Origin of life: Instability of building blocks

by Jonathan Sarfati

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1999

Evolutionary propaganda often understates the difficulty of a naturalistic origin of life. Production of traces of 'building blocks' is commonly equated with proving that they could have built up the required complicated molecules under natural conditions. The instability of 'building blocks' in non-biotic environments is usually glossed over.

The RNA/DNA base cytosine is not produced in spark discharge experiments. The proposed prebiotic productions are chemically unrealistic because the alleged precursors are unlikely to be concentrated enough, and they would undergo side reactions with other organic compounds, or hydrolyse. Cytosine itself is too unstable to accumulate over alleged geological 'deep time', as its half life for deamination is 340 years at 25°C.

Populist RNA-world propaganda

A pro-evolution booklet called *Science and Creationism*, recently released on the Internet by the National Academy of Sciences (NAS),[1] summarized the origin of life section as follows:

> 'For those who are studying the origin of life, the question is no longer whether life could have originated by chemical processes involving nonbiological components. The question instead has become which of many pathways might have been followed to produce the first cells.'[2]

No one disputes the existence of living organisms on Earth, and that cells indeed are capable of using simple building blocks to generate the required complex biochemicals at the necessary time, location and concentration. The question is whether the massive co-ordination of the metabolic processes which perform such feats could have arisen without intelligent guidance and driven by only statistical and thermodynamic constraints.

The NAS book glosses over the enormous chemical and informational hurdles which must be jumped to go from non-living matter to even the simplest living cells.[3,4,5] It's not too surprising, considering the heavy atheistic bias of the NAS, which was documented in the journal *Nature*[6] and which was probably partly responsible for their demonstrable scientific unreliability in the area of origins.[7] It is even less excusable to ignore the difficulties documented in their own journal — *Proceedings of the National Academy of Sciences* (PNAS), USA, as will be shown here.

Production of 'building blocks of life'

Science and Creationism argued:

> 'Experiments conducted under conditions intended to resemble those present on primitive

> Earth have resulted in the production of some of the chemical components of proteins, DNA, and RNA. Some of these molecules also have been detected in meteorites from outer space and in interstellar space by astronomers using radiotelescopes. Scientists have concluded that the "building blocks of life" could have been available early in Earth's history.'[2]

Even if we granted that the 'building blocks' were available, it does **not** follow that they could actually build anything. For example, under plausible prebiotic conditions, the tendency is for biological macromolecules to **break apart** into the 'building blocks', not the other way round.[8] Also, the 'building blocks' are likely to react in the wrong ways with other 'building blocks', for example, sugars and other carbonyl (>C=O) compounds react destructively with amino acids and other amino (–NH_2) compounds, to form imines (>C=N), a common cause of browning in foods.[9]

Furthermore, some of the building blocks are very unstable. A good example is ribose, which is obviously essential for RNA, and hence for the RNA-world hypothesis of the origin of life.[10] A team including the famous evolutionary origin-of-life pioneer Stanley Miller, in PNAS, found that the half life ($t_{1/2}$) of ribose is only 44 years at pH 7.0 (neutral) and 0°C. It's even worse at high temperatures — 73 minutes at pH 7.0 and 100°C.[11] This is a major hurdle for hydrothermal theories of the origin of life. Miller, in another PNAS paper, has also pointed out that the RNA bases are destroyed very quickly in water at 100°C — adenine and guanine have half lives of about a year, uracil about 12 years, and cytosine only 19 days.[12]

Most researchers avoid such hurdles with the following methodology: find a trace of compound X in a spark discharge experiment, claim 'see, X can be produced under realistic primitive-Earth conditions'. Then they obtain pure, homochiral, concentrated X from an industrial synthetic chemicals company, react it to form traces of the more complex compound Y. Typically, the process is repeated to form traces of Z from purified Y, and so on.[13] In short, the evolutionists' simulations have an unacceptable level of intelligent interference.[14]

Much of the populist evolutionary propaganda resembles the following hypothetical theory for the origin of a car:

> 'Design is an unscientific explanation, so we must find a naturalistic explanation instead. Now, experiments have shown that one of the important building blocks of the car — iron — can be produced by heating naturally occurring minerals like hematite to temperatures which are found in some locations on Earth. What's more, iron can be shown to form thin sheets under pressures which are known to occur in certain geological formations ….'

If this seems far-fetched, then note that even the simplest self-reproducing cell, which has 482 genes,[15] has a vastly higher information content than a car, yet self-reproduction is a pre-requisite for neo-Darwinian evolution.

Essential building block missing — cytosine

The evolutionary biochemist, Robert Shapiro, published a detailed study of the 'prebiotic' synthesis of cytosine in the *Proceedings of the NAS*.[16] Previous studies of his had noted that neither adenine[17] nor ribose[18] were plausible prebiotic components of any self-replicating molecule, but the problems with cytosine are even worse. Together, these studies raise serious doubts about whether a prebiotic replicator with any Watson-Crick base pairing could have arisen abiotically.

Shapiro noted that not the slightest trace of cytosine has been produced in gas discharge experiments, and nor has it been found in meteorites. Thus, he notes, either it is extremely hard to synthesise, or it breaks down before detection. So 'prebiotic' productions of cytosine have always been indirect, and involve the methodology alluded to above. That is, cyanoacetylene

($HC\equiv CC\equiv N$) and cyanoacetaldehyde ($H_3CCOC\equiv N$)have been found in some spark discharge experiments. Organic chemists have obtained pure and fairly strong solutions of each, and reacted each of them with solutions of other compounds which are allegedly likely to be found on a 'primitive' Earth. Some cytosine is produced. This then apparently justifies experiments trying to link up pure and dry cytosine and ribose to form the nucleoside *cytidine*. However, these experiments have been unsuccessful (although analogous experiments with purines have produced 2% yields of nucleosides),[19] despite a high level of investigator interference.

Unavailability of cytosine precursors

Shapiro also critiqued some of the 'prebiotic' cytosine productions. He pointed out that both cyanoacetylene and cyanoacetaldehyde are produced in spark discharge experiments with an unlikely methane/nitrogen (CH_4/N_2) mixture. The classical Miller experiment used ammonia (NH_3), but NH_3, H_2O and hydrogen sulfide (H_2S) greatly hindered cyanoacetylene and cyanoacetaldehyde formation. However, most evolutionists now believe that the primitive atmosphere was 'probably dominated by CO_2 and N_2.'[20]

Furthermore, cyanoacetylene and cyanoacetaldehyde would undergo side reactions with other nucleophiles rather than produce cytosine. For example, cyanoacetylene and cyanoacetaldehyde both react with the amino group, which would destroy any prebiotic amino acids. And there is one destructive molecule which is unavoidably present: water. Cyanoacetylene readily hydrolyzes to form cyanoacetaldehyde ($t_{1/2}$ = 11 days at pH 9, 30°C),[20] although one should not count on this as a reliable source of cyanoacetaldehyde because cyanoacetylene would more likely be destroyed by other reactions.[20] And cyanoacetaldehyde, while more stable than cyanoacetylene, is still quite quickly hydrolyzed ($t_{1/2}$= 31 years at pH 9, 30°C).[21]

The implausible production scenarios and likely rapid destruction means it is unrealistic to assume that the concentration of cyanoacetylene and cyanoacetaldehyde could remotely approach that needed to produce cytosine.

Instability of cytosine

As pointed out above, cytosine is deaminated/hydrolyzed (to uracil) far too rapidly for any 'hot' origin-of-life scenario. But it is still very unstable at moderate temperatures — $t_{1/2}$= 340 years at 25°C. This shows that a cold Earth origin-of-life scenario would merely alleviate, but not overcome, the decomposition problem. And a low temperature also retards synthetic reactions as well as destructive ones.

On single-stranded DNA in solution, $t_{1/2}$ of an individual cytosine residue = 200 years at 37°C, while the double helix structure provides good protection — $t_{1/2}$= 30,000 years.[22] Such C→U mutations would be a great genetic hazard, but cells have an ingenious repair system involving a number of enzymes. It first detects the mutant U (now mismatched with G) and removes it from the DNA strand, opens the strand, inserts the correct C, and closes the strand.[22] It seems that such a repair system would be necessary from the beginning, because a hypothetical primitive cell lacking this would mutate so badly that error catastrophe would result. And the far greater instability of cytosine on single-stranded nucleic acid is yet another problem that proponents of the RNA-world must account for.

Also, cytosine is readily decomposed under solar UV radiation, which requires that prebiotic synthesis should be carried out in the dark.[21]

An efficient prebiotic synthesis of cytosine?

This was claimed by Robertson and Miller.[23] They rightly disagreed with a previous suggested synthesis of cytosine from cyanoacetylene and cyanate (OCN^-) because cyanate is rapidly hydrolyzed to CO_2 and NH_3. Instead, they heated 10^{-3} M cyanoacetaldehyde with various concentrations of urea ($(NH_2)_2CO$) in a sealed ampoule at 100ºC for five hours with 30-50% yields of cytosine. Urea is produced in spark discharge experiments with N^2, CO and H^2O.

However, Shapiro criticised this experiment on the grounds of the unavailability of cyanoacetaldehyde and instability of cytosine, as above. Robertson and Miller avoided the latter problem by stopping the reaction after five hours. But in a real prebiotic world, such a reaction would most likely continue with hydrolysis of cytosine.

Shapiro also shows that urea is too unstable to reach the concentrations required (>0.1 M). Urea exists in equilibrium with small amounts of its isomer, ammonium cyanate, and since cyanate is hydrolysed readily, more urea must convert to maintain the equilibrium ratio ($K = 1.04 \times 10^{-4}$ at 60°C).[21] Robertson and Miller's sealed tube thus provided a further example of unacceptable investigator interference, because this prevented escape of NH_3, thus unrealistically retarding cyanate and urea decomposition. In an open system, 'half of the urea was destroyed after 5 hr at 90ºC and pH 7',[21] and $t_{1/2}$ is estimated at 25 years at 25°C.[21]

The usual cross-reaction problem would intervene in the real world. For example, urea can react with glycine to form N-carbamoyl glycine,[21] which would remove both urea and amino acids from a primordial soup.

Also, the primordial soup would be far too dilute, so Robertson and Miller propose that seawater was concentrated by evaporation in lagoons. But this would require isolation of the lagoon from fresh seawater which would dilute the lagoon, evaporation to about 10^{-5} of its original volume, then cytosine synthesis. However, such conditions are geologically 'rare or non-existent' today.[24] Concentrating mechanisms would also concentrate destructive chemicals.

The conditions required for cytosine production are incompatible with those of purine production. Therefore this scenario must also include a well-timed rupture of the lagoon, releasing the contents into the sea, so both pyrimidines and purines can be incorporated into a replicator.

Shapiro's materialistic faith

Shapiro concluded:

> 'the evidence that is available at the present time does not support the idea that RNA, or an alternative replicator that uses the current set of RNA bases, was present at the start of life.'[25]

But unwilling to abandon evolution, he suggests two alternative theories:

1. Cairns-Smith's clay mineral idea,[13] which seems to be driven more by dissatisfaction with other theories than evidence for his own.

> 'Cairns-Smith cheerfully admits the failings of his pet hypothesis: no-one has been able to coax clay into something resembling evolution in the laboratory; nor has anyone found anything resembling a clay-based organism in nature.'[26]

2. Life began as a cyclic chemical reaction, e.g. Günter Wächterhäuser's theory that life began on the surface of pyrite, which Stanley Miller calls 'paper chemistry'.[27]

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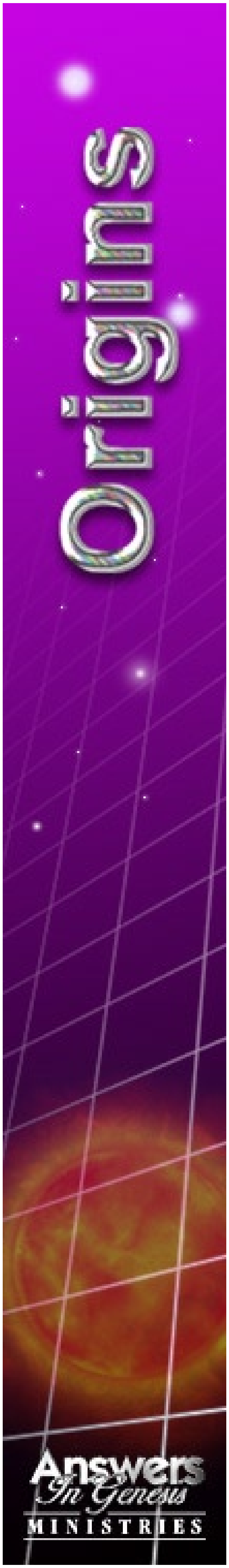

> ‘Wächterhäuser himself admits that his theory is for the most part “pure speculation”.’[28,29]

Shapiro’s dogmatism is illustrated in his interesting popular-level book *Origins: A Skeptic’s Guide to the Creation of Life in the Universe*, where he effectively critiques many origin-of-life scenarios. But he says, in a striking admission that no amount of evidence would upset his faith:

> ‘some future day may yet arrive when all reasonable chemical experiments run to discover a probable origin of life have failed unequivocally. Further, new geological evidence may yet indicate a sudden appearance of life on the Earth. Finally, we may have explored the universe and found no trace of life, or processes leading to life, elsewhere. Some scientists might choose to turn to religion for an answer. Others, however, myself included, would attempt to sort out the surviving less probable scientific explanations in the hope of selecting one that was still more likely than the remainder.’[30]

Conclusion

- No plausible prebiotic synthesis of cytosine yet exists.

- Vital ‘building blocks’ including cytosine and ribose are too unstable to have existed on a hypothetical prebiotic Earth for long.

- Even if cytosine and ribose could have existed, there is no known prebiotic way to combine them to form the nucleoside cytidine, even if we granted unacceptably high levels of investigator interference.

- Building blocks would be too dilute to actually build anything, and would be subject to cross-reactions.

- Even if the building blocks could have formed polymers, the polymers would readily hydrolyse.

- There is no tendency to form the high-information polymers required for life as opposed to random ones.

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Origin of life: the polymerization problem

by Jonathan Sarfati

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A well-publicised paper by Claudia Huber and Günter Wächterhäuser in *Science* proposed a scenario for a materialistic origin of life from non-living matter.[1] They correctly state:

> 'The activation of amino acids and the formation of peptides under primordial conditions is one of the great riddles of the origin of life.'

Indeed it is. The reaction to form a peptide bond between two amino acids to form a dipeptide is:

Amino acid 1 + amino acid 2 → dipeptide + water

$H_2NCHRCOOH + H_2NCHR'COOH \rightarrow H_2NCHRCONHCHR'COOH + H_2O$ (1)

The free energy change (ΔG_1) is about 20–33 kJ/mol, depending on the amino acids. The equilibrium constant for any reaction (K) is the equilibrium ratio of the concentration of products to reactants. The relationship between these quantities at any Kelvin temperature (T) is given by the standard equation:

$K = \exp\left({}^{-\Delta G}/_{RT}\right)$

where R is the universal gas constant (= Avogadro's number x Boltzmann's constant k) = 8.314 J/K.mol

For reaction (1),

$K_1 = [H_2NCHRCONHCHR'COOH][H_2O]/[H_2NCHRCOOH][H_2NCHR'COOH]$

= 0.007 at 298 K

where a compound in square brackets symbolises the concentration of that compound.

This means that if we start with a concentrated solution of 1 M (mol/l) of each amino acid, the equilibrium dipeptide concentration would be only 0.007 M. Since tripeptides have two peptide bonds, the equilibrium tripeptide concentration would be 0.007^2 M or 5×10^{-5} M. For a non-specific polypeptide with 100 peptide bonds (101 amino acids), the equilibrium concentration would be 3.2×10^{-216} M. NB: the problem for evolutionists is even worse, because life requires not just any polymers, but highly specified ones.

Since the equilibrium concentration of polymers is so low, their thermodynamic tendency is to **break down** in water, not to be built up. The long ages postulated by evolutionists simply make the problem worse, because there is more time for water's destructive effects to occur. High temperatures, as many researchers advocate, would accelerate the breakdown. The famous pioneer of

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evolutionary origin-of-life experiments, Stanley Miller, points out that polymers are ‘too unstable to exist in a hot prebiotic environment’.[2,3] A recent article in *New Scientist* also described the instability of polymers in water as a ‘headache’ for researchers working on evolutionary ideas on the origin of life.[4] It also showed its materialistic bias by saying this was not ‘good news’. But the real bad news is the faith in evolution which overrides objective science.

Some evolutionary scenarios

The analysis above doesn’t mean it’s impossible to make polypeptides. Consider the expression for the equilibrium constant K: if $[H_2O]$ is lowered, then [polypeptide] must increase. One approach is to drive off the water with heat, as proposed by Sydney Fox.[5] However, his experiments required a large excess of the trifunctional amino acids (i.e. they can combine with three other molecules), but these are produced very sparingly in typical simulation experiments.[6] The heat also destroys some vital amino acids and results in highly randomized polymers. Another problem is that all the chiral amino acids are racemized, that is, a 50/50 mixture of left and right handed molecules is produced, which is unsuitable for life.[7] The large excess of trifunctional amino acids results in extensive branching, unlike biological polymers. The required heating and cooling conditions are geologically unrealistic — there is no known place on Earth where amino acids could be dumped and polypeptides would result. Finally, Fox’s experiments required very concentrated and pure amino acids, while any hypothetical primordial soup would be impure and grossly contaminated with other organic chemicals that would destroy them.[8]

Another way to remove water is with certain high-energy chemicals that absorb water, called condensing agents. If the reaction between condensing agent C and water is:

$C + H_2O \rightarrow D$ (2)

and if ΔG_2 of reaction (2) is negative and large enough, it can couple with reaction (1):

$H_2NCHRCOOH + H_2NCHR'COOH + C \rightarrow H_2NCHRCONHCHR'COOH + D$ (3)

$\Delta G_3 = \Delta G_1 + \Delta G_2$. If ΔG_3 is large and negative, the equilibrium constant for reaction 3, K_3, will be large, and this could conceivably produce reasonable quantities of polymers.

Some researchers used the condensing agent dicyanamide ($N\equiv CNHC\equiv N$) to produce some peptides from glycine, even claiming, ‘dicyanamide mediated polypeptide synthesis may have been a key process by which polypeptides were produced in the primitive hydrosphere.’[9]

However, the biggest problem is that condensing agents would readily react with any water available. Therefore it is a chemical impossibility for the primordial soup to accumulate large quantities of condensing agents, especially if there were millions of years for water to react with them. Yet the above experiment used a 30-fold excess of dicyanamide. And even with these unrealistic conditions, 95% of the glycine remained unreacted, and the highest polymer formed was a tetrapeptide.[10]

Organic chemists can certainly make polypeptides, using intelligent planning of a complex multistage synthesis, designed to prevent wrong reactions occurring.[11] Living cells also use an elegant process to make polypeptides. This involves the use of enzymes to activate amino acids (and nucleotides) by combining them with the high-energy compound ATP (**a**denosine **trip**hosphate), to overcome the energy barrier. Such high-energy compounds are not formed in prebiotic simulation experiments, and are very unstable.

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Chain termination

To form a chain, it is necessary to react *bifunctional monomers*, that is, molecules with two functional groups so they combine with two others. If a unifunctional monomer (with only one functional group) reacts with the end of the chain, the chain can grow no further at this end.[12] If only a small fraction of unifunctional molecules were present, long polymers could not form. But all 'prebiotic simulation' experiments produce **at least three times more** unifunctional molecules than bifunctional molecules.[13] Formic acid (HCOOH) is by far the commonest organic product of Miller-type simulations. Indeed, if it weren't for evolutionary bias, the abstracts of the experimental reports would probably state nothing more than: 'An inefficient method for production of formic acid is here described …' Formic acid has little biological significance except that it is a major component of ant (Latin *formica*) stings.

A realistic prebiotic polymerisation simulation experiment should begin with the organic compounds produced by Miller-type experiments, but the reported ones always exclude unifunctional contaminants.

Wächterhäuser's theory

Günter Wächterhäuser is a German patent attorney with a doctorate in organic chemistry. He is highly critical of the usual primordial soup ideas of the origin of life. As the quote at the beginning of this article shows, he recognises that polymerization is a big problem. However, not willing to abandon his evolutionary faith, he proposes that life began as a cyclic chemical reaction on the surface of pyrite (FeS_2). The energy to drive this cycle is said to come from the continued production of pyrite from iron and sulfur. However, he admits that this proposal is is for the most part, 'pure speculation'.[14] Fellow origin-of-life researcher Gerald Joyce claims that the acceptance of Wächterhäuser's theory owes more to his legal skills than to its merit.[14] Stanley Miller calls it 'paper chemistry'.[15]

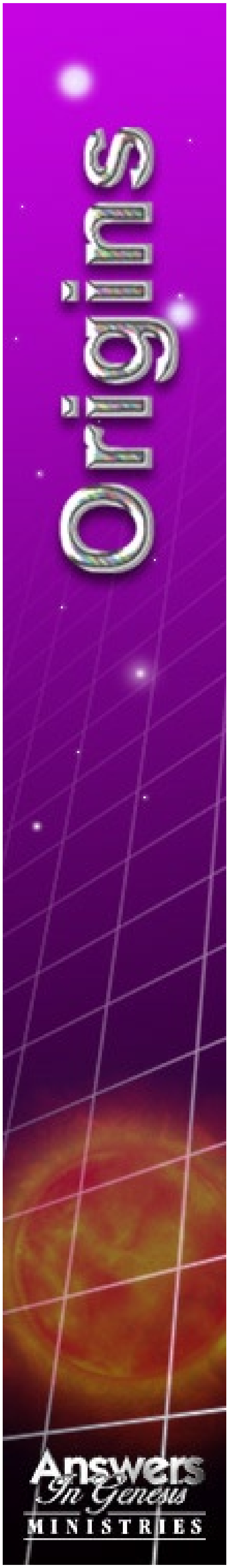
In their latest well-publicised experiment, Huber and Wächterhäuser activated amino acids with carbon monoxide (CO) and reacted them in an aqueous slurry of co-precipitated (Ni,Fe)S using either hydrogen sulfide (H_2S) or methanethiol (CH_3SH) at 100°C at a pH of 7–10.

We should also note that Huber and Wächterhäuser started off with very favourable conditions for chemical evolution. Although 'the researchers have not yet shown that this recipe can produce amino acids',[16] they used a strong solution (0.05 M) of left-handed amino acids (or the achiral glycine), with no other organic material. Of course, any 'primordial soup' would have been dilute, impure and racemic. It would have contained many unifunctional molecules and other organic compounds that would have destroyed amino acids. Stanley Miller also points out that Huber and Wächterhäuser used concentrations of CO far higher than are realistic in nature.[16]

Even under their favourable conditions (due to intelligent design!), all they produced was a small percentage of dipeptides (0.4–12.4%) and an even tinier amount of tripeptides (0.003 %) — calculated from reported quantities. Huber and Wächterhäuser also reported that 'under these same conditions dipeptides hydrolysed rapidly'!

The exclusive 'left-handedness' required for life[7] was destroyed in the process. They excuse this by pointing out that some cell wall peptides have right-handed amino acids. But this misses the point — enzymes that break down cell walls are designed for exclusively left-handed amino acids, so an occasional right-handed amino acid is the perfect defence in a left-handed world.

A final irony is that one of their previous experiments converted CO into acetic acid (CH_3COOH) under similar conditions with CH_3SH and a (Ni,Fe)S slurry.[17] Since acetic acid is unifunctional, this would **prevent** long polymers from forming under the conditions Huber and Wächterhäuser



propose!

Did scientists create life, or did the media create hype?

Newspapers around the world reported this experiment. Some went as far as claiming: 'German chemists have produced living cells from a combination of amino acids …'[18]

If true, then this would be remarkable. Even the simplest decoded free-living organism, *Mycoplasma genitalium*, has 482 genes coding for all the necessary proteins, including enzymes. These proteins are composed of about 400 amino acids each on average, in precise sequences, and all in the 'left-handed' form.[19] Of course, these genes are only functional with pre-existing translational and replicating machinery, a cell membrane, etc. But *Mycoplasma* can only survive by parasitizing more complex organisms, which provide many of the nutrients it cannot manufacture for itself. So evolutionists must postulate an even more complex first living organism with even more genes.

However, as shown above, all Huber and Wächterhäuser produced were a few dipeptides and even fewer tripeptides. While they didn't make the deceitful claim quoted above, their evolutionary faith means that they see far more significance in their experiment than it deserves.

The next day, the same newspaper wrote 'WA Museum evolutionary biologist Ken McNamara said if life could be created artificially, it could emerge naturally given the right conditions.'[20] How absurd — does this mean that because we can create cars artificially (with loads of intelligent input), it proves they could emerge naturally (without intelligence!)?

People should not be surprised by such biased reporting. We should compare the hype about 'Martian life' with the near silence about the fact that this claim has been thoroughly discredited, even according to most secular scientists.[21,22,23,24]

The cynical media disdain for truth was well illustrated at a symposium sponsored by the Smithsonian Institution. Ben Bradlee, editor of *The Washington Post*, said:

> 'To hell with the news! I'm no longer interested in news. I'm interested in causes. We don't print the truth. We don't pretend to print the truth. We print what people tell us. It's up to the public to decide what's true.'[25]

A detailed survey of the political and social beliefs of producers, editors, writers, and staff in the television industry[26] shows that they are biased against Christian morality. Two-thirds of them believe the structure of American society is faulty and must be changed. 97% say women should have the right to decide whether they want to have an abortion, 80% believe there's nothing wrong with homosexual relations, and 51% see nothing wrong with adultery. And they openly admit that they push their ideas into the programs they create for their audiences. The media's willingness to push evolutionary hype is consistent with their anti-Christian stance.

Conclusion

Despite over-optimistic science reports and very biased and hyped-up media reports, scientists have not even come close to 'creating life in the test-tube'. Even if they do manage this feat, it will be the result of intelligent design. Ordinary undirected chemistry moves in the wrong direction — for example, as shown in this article, biological polymers tend to break apart, not form.

Can naturalistic evolution explain the appearance of life on Earth? • Are there any 'transitional forms'? • If humans descended from monkeys (apes), why are there still monkeys (apes) around? • Is the 'big bang' a good scientific theory? •
Could life have originated in outer space?

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Origin of life: the chirality problem

by Jonathan Sarfati

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Many important molecules required for life exist in two forms. These two forms are non-superimposable mirror images of each other, i.e.: they are related like our left and right hands. Hence this property is called **chirality**, from the Greek word for hand. The two forms are called **enantiomers** (from the Greek word for opposite) or **optical isomers**, because they rotate plane-polarised light either to the right or to the left.

Whether or not a molecule or crystal is chiral is determined by its *symmetry*. A molecule is *achiral* (non-chiral) if and only if it has an *axis of improper rotation*, that is, an n-fold rotation (rotation by 360°/n) followed by a reflection in the plane perpendicular to this axis maps the molecule on to itself. Thus a molecule is chiral if and only if it lacks such an axis. Because chiral molecules lack this type of symmetry, they are called **dissymmetric**. They are not necessarily **asymmetric** (i.e. without symmetry), because they can have other types of symmetry.[1] However, all amino acids (except glycine) and many sugars are indeed asymmetric as well as dissymmetric.

Chirality and life

Nearly all biological polymers must be homochiral (all its component monomers having the same handedness. Another term used is optically pure or 100 % optically active) to function. All amino acids in proteins are 'left-handed', while all sugars in DNA and RNA, and in the metabolic pathways, are 'right-handed'.

A 50/50 mixture of left- and right-handed forms is called a **racemate** or **racemic mixture**. Racemic polypeptides could not form the specific shapes required for enzymes, because they would have the side chains sticking out randomly. Also, a wrong-handed amino acid disrupts the stabilizing α-helix in proteins. DNA could not be stabilised in a helix if even a single wrong-handed monomer were present, so it could not form long chains. This means it could not store much information, so it could not support life.[2]

Ordinary chemistry produces racemates

A well-regarded organic chemistry textbook states a universal chemical rule in bold type:

> 'Synthesis of chiral compounds from achiral reagents always yields the racemic modification.'and 'Optically inactive reagents yield optically inactive products.'[3]

This is a consequence of the Laws of Thermodynamics. The left and right handed forms have identical free energy (G), so the free energy difference (ΔG) is zero. The equilibrium constant for any reaction (K) is the equilibrium ratio of the concentration of products to reactants. The relationship between these quantities at any Kelvin temperature (T) is given by the standard equation:

$K = \exp(^{-\Delta G}/_{RT})$

where R is the universal gas constant (= Avogadro's number x Boltzmann's constant k) = 8.314 J/K.mol.

For the reaction of changing left-handed to right-handed amino acids (L→R), or the reverse (R→ L), $\Delta G = 0$, so $K = 1$. That is, the reaction reaches equilibrium when the concentrations of R and L are equal; that is, a racemate is produced. This explains the textbook rule above.

Separating the left hand from the right

To resolve a racemate (i.e. separate the two enantiomers), another homochiral substance must be introduced. The procedure is explained in any organic chemistry textbook. The idea is that right-handed and left-handed substances have identical properties, *except when interacting with other chiral phenomena*. The analogy is that our left and right hands grip an achiral (non-chiral) object like a baseball bat equally, but they fit differently into a chiral object like a left-handed glove. Thus to resolve a racemate, an organic chemist will usually use a ready-made homochiral substance from a living organism. The reaction products of the R and L enantiomers with an exclusively right handed substance R´ , that is R-R´ and L-R´ (called **diastereomers**), are not mirror images. So they have different physical properties, e.g. solubility in water, thus they can be separated.

However, this does not solve the mystery of where the optical activity in living organisms came from in the first place. A recent world conference on 'The Origin of Homochirality and Life' made it clear that the origin of this handedness is a complete mystery to evolutionists.[4] The probability of forming one homochiral polymer of N monomers by chance = 2^{-N}. For a small protein of 100 amino acids, this probability = $2^{-100} = 10^{-30}$. Note, this is the probability of *any* homochiral polypeptide. The probability of forming a *functional* homochiral polymer is much lower, since a precise amino acid sequence is required in many places. Of course, many homochiral polymers are required for life, so the probabilities must be compounded. Chance is thus not an option.

A further problem is that homochiral biological substances racemize in time. This is the basis of the amino acid racemization dating method. Its main proponent is Jeffrey Bada of the Scripps Institution of Oceanography in La Jolla, California.[5] As a dating method, it is not very reliable, since the racemization rate is strongly dependent on temperature and pH, and depends on the particular amino acid.[6] Racemization is also a big problem during peptide synthesis and hydrolysis.[7] It shows that the tendency of undirected chemistry is towards death, not life.

A tragic reminder of the importance of chirality is thalidomide. In the early 1960s, this drug was prescribed to pregnant women suffering from morning sickness. However, while the left-handed form is a powerful tranquilliser, the right handed form can disrupt fetal development, resulting in severe birth defects. Unfortunately, the synthesis of the drug produced a racemate, as would be expected, and the wrong enantiomer was not removed before the drug was marketed.[8]

In my own undergraduate chemistry education, one of the required experiments demonstrated these concepts. We synthesized the dissymmetric complex ion, $[Co(H_2NC_2H_4NH_2)_3]^{3+}$,[9] from achiral reagents, so a racemate was produced. We resolved it by reacting it with a homochiral acid from a plant source, forming diastereomers that could be resolved by fractional crystallisation. When the resultant homochiral crystals were dissolved, and activated charcoal (a catalyst) added, the substance quickly racemized, because a catalyst accelerates approach to equilibrium.

Origin-of-life researchers have tried to think of other means of producing the required homochirality. There have been unsuccessful attempts to resolve racemates by other means.

Circularly polarized ultraviolet light

With circularly polarized light, the electric field direction rotates along the beam, so it is a chiral phenomenon. Homochiral substances have different absorption intensities for left and right CP light — this is called **circular dichroism** (CD).[10] Similarly, CP light is absorbed differently by left and right enantiomers. Since photolysis (destruction by light) occurs only when light photons are absorbed, CP light destroys one enantiomer more readily than the other. However, because CP light also destroys the 'correct' form to some extent, this method would not produce the necessary 100 % homochirality required for life. One of the best results has been 20 % optically pure camphor, but this occurred after 99 % of the starting material had been destroyed. 35.5 % optical purity would have resulted after 99.99 % destruction.[11] 'A practically optically pure compound (99.99 per cent) … is obtained at an asymptotic point where absolutely no material remains.'[12]

Another problem is that magnitude and sign (i.e. right-favouring or left-favouring) of CD depends on the frequency of the CP light.[10] This means that resolution can occur only with CP light over a narrow frequency band. Over a broad band, enantioselective effects would cancel.

Circularly polarised light has recently been revived as a solution in a paper by the Australian astronomer Jeremy Bailey in *Science*,[13] and widely reported in the media. His team has discovered circularly polarised infrared radiation in a nebula. They admit in the paper that they have not discovered the required circularly polarised *ultraviolet* light nor any evidence that amino acids are produced in nebulae. They are also aware of the very limited enantioselectivity of CP light, and the fact that the effect averages to zero over a whole spectrum (the Kuhn-Condon rule). However, their faith in chemical evolution colours the way they interpret the evidence.

Not all evolutionists are convinced by the proposal of Bailey's team. For example, Jeffrey Bada said, 'It's just a series of maybe steps. To me, that makes the whole thing a big maybe.'[14]

Another proposed source of circularly polarised light is synchrotron radiation from a neutron star,[15] but this is speculative and doesn't solve the chemical problems.

Beta decay and the weak force

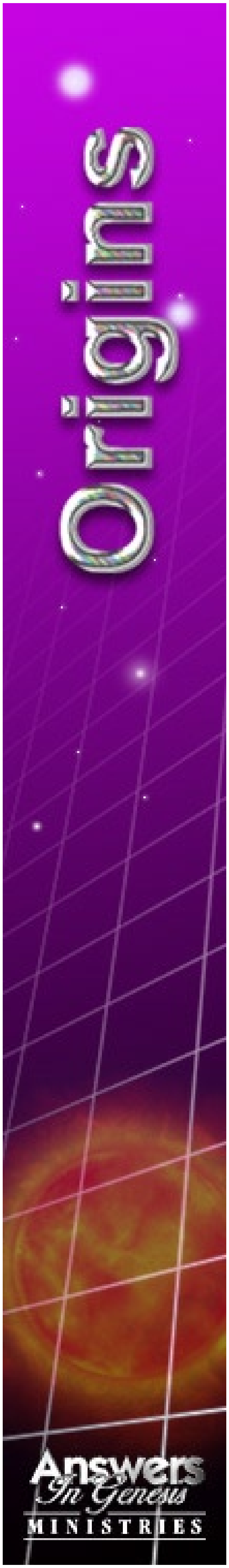
ß-decay is one form of radioactive decay, and it is governed by one of the four fundamental forces of nature, the *weak force*. This force has a slight handedness, called *parity violation*, so some theorists thought ß-decay could account for the chirality in living organisms.[16] However, the weak force is aptly named — the effect is minuscule — a long way from producing the required 100% homochirality. One specialist in the chirality problem, organic chemist William Bonner, professor emeritus at Stanford University, said, 'none of this work has yielded convincing conclusions'.[17] Another researcher concluded:

> 'the exceptional prebiotic conditions required do not favour asymmetric ß-radiolysis as the selector of the exclusive signature of optical activity in living nature.'[18]

Another aspect of parity violation is that the L-amino acids and D-sugars have a theoretically slightly lower energy than their enantiomers so are slightly more stable. But the energy difference is immeasurable — only about 10^{-17} kT, meaning that there would be only one excess L-enantiomer for every $6x10^{17}$ molecules of a racemic mixture of amino acids![19]

Optically active quartz powders

Quartz is a widespread mineral — the commonest form of silica (SiO_2) on Earth. Its crystals are hexagonal and dissymmetric.[20] So some investigators tried to use optically active quartz powders to adsorb one enantiomer more than the other. But they had no success. Besides, there are equal



amounts of left and right-handed quartz crystals on Earth.[21]

Clay minerals

Some investigators have reported a very small chiral selection effect by clay minerals, but the effects may have been an artefact of the technique used. Selective adsorption and binding have now been rejected.[22] Even if modern clays did have a chiral bias, this could be due to previous absorption of optically active biomolecules (which are, of course produced by living things). Prebiotic clays would then have had no chiral bias.

Self-selection

A small minority of chiral substances crystallize into homochiral crystals. Louis Pasteur was not only the founder of the germ theory of disease, the destroyer of 'spontaneous generation' ideas, and a creationist, he was also the first person in history to resolve a racemate. He used tweezers to separate the left and right-handed crystals of such a substance, sodium ammonium tartrate.[23]

This separation only happened because of outside interference by an intelligent investigator, who could recognise the different patterns. On the supposed primitive Earth, there was no such investigator. Therefore the two forms, even if they could be separated by chance, would have re-dissolved together and re-formed a racemic solution.

Also, Pasteur was fortunate to choose one of the few substances that self-resolve in crystalline form. And even this substance has this property only below 23°C, so it's perhaps fortunate that 19th century laboratories were not well heated!

Fluke seeding

Some theorists have proposed that a fluke seeding of a supersaturated solution with a homochiral crystal would crystallise out the same enantiomer. However, the primordial soup, if it existed,[24] would have been extremely dilute and grossly contaminated, as shown by many writers.[25] Also, nothing could be done with the growing homochiral crystal, because it would be immersed in a solution of the remaining wrong enantiomer. Concentrating the solution would crystallise out this wrong enantiomer. Diluting the solution would dissolve the crystal, so the alleged process would have to keep starting from scratch.

Homochiral template

Some have proposed that a homochiral polymer arose by chance and acted as a template. However, this ran into severe problems. A template of 100 % right-handed poly-C (RNA containing only cytosine monomers) was made (by intelligent chemists!). This could direct the oligomerisation (formation of small chains) of (activated) G (guanine) nucleotides. Indeed, pure right-handed G was oligomerised much more efficiently than pure left-handed G. But racemic G did not oligomerise, because:

> 'monomers of opposite handedness to the template are incorporated as chain terminators … This inhibition raises an important problem for many theories of the origin of life.'[26]

Transfer RNAs selected the right enantiomer

One attempt to solve the chirality problem was proposed by Russell Doolittle, a professor of biochemistry at the University of California at San Diego, and an atheist. He claimed: 'From the

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start of their [Transfer RNA synthetases'] existence, they probably bound only L-amino acids.'[27] He never explains how such complicated enzymes could have functioned unless they were themselves homochiral, or how they would operate before RNA was composed of homochiral ribose. Doolittle's 'solution' is mere hand-waving. It is hardly worth refuting except that it appeared in a well-known anti-creationist book, which says something about the quality of its editing, or the quality of anti-creationist arguments.

It seems like Doolittle was trying to explain away his prior televised evolution/creation debate with biochemist Duane Gish held before 5,000 people at Liberty University on 13 Oct 1981. The pro-evolution journal *Science* described the debate as a 'rout' in favour of Gish.[28] The next day, the debate was reported by the pro-evolution *Washington Post* under the headline 'Science Loses One to Creationism'. The sub-headline cited Doolittle's anguished remark: 'How am I going to face my wife?' showing that Doolittle himself knew he was defeated.

Magnetic fields

Some German chemists, led by Eberhard Breitmaier of the Institute for Organic Chemistry and Biochemistry at the University Gerhard-Domagk-Strasse in Bonn, announced that a very strong magnetic field (1.2–2.1 T) produced 98 % homochiral products from achiral reagents.[29] So organic chemists like Philip Kocienski, of the University of Southampton, speculated that the Earth's magnetic field could have caused life's homochirality. Although the Earth's magnetic field is about 10,000 times weaker than that of the experiment, Kocienski thought that vast time spans would result in the homochirality we see today.[29] He may have forgotten about palaeogeomagnetic field reversals!

Yet other chemists like Tony Barrett, of London's Imperial College, thought that the German experiment 'seems just too good to be true.'[29] This caution was vindicated about six weeks later. No-one else could reproduce the German team's results. It turned out that one of the team, Guido Zadel, the post-doctoral fellow on whose thesis the original work was based, had adulterated the reagents with a homochiral additive.[30]

Conclusion

The textbook cited earlier states:

> 'We eat optically active bread & meat, live in houses, wear clothes, and read books made of optically active cellulose. The proteins that make up our muscles, the glycogen in our liver and blood, the enzymes and hormones … are all optically active. Naturally occurring substances are optically active because the enzymes which bring about their formation … are optically active. As to the origin of the optically active enzymes, we can only speculate'[31]

If we can only 'speculate' on the origin of life, why do so many people state that evolution is a 'fact'? Repeat a rumour often enough and people will swallow it.

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31. Morrison and Boyd, Ref. 3, p.157.

Can naturalistic evolution explain the appearance of life on Earth? • Are there any 'transitional forms'? • If humans descended from monkeys (apes), why are there still monkeys (apes) around? • Is the 'big bang' a good scientific theory? • Could life have originated in outer space?