Origin of life: instability of building blocks

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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:

> *Tor 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.[3-5] 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=0) 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 ($t_{½}$) 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]

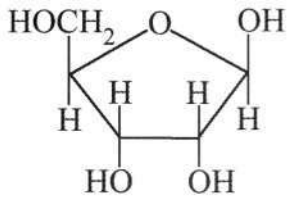
Much of the populist evolutionary propaganda resembles the following hypothetical theory for the origin of a car:

> *'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



ribose

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 CC N) and cyanoacetaldehyde (H_3CCOC 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_20 and hydrogen sulfide (H_2S) greatly hindered cyanoacetylene and cyanoacetaldehyde formation. However, most evolutionists now believe that the primitive atmosphere was 'probably dominated by $C0_2$ and N_2.'[20]

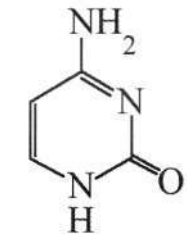
Furthermore, cyanoacetylene and cyanoacetaldehyde would undergo side reactions with other nucleophiles rather than produce cytosine. For example, cyanoacetylene and cyanoacetaldehyde both react with the amino group, which would destroy any prebiotic amino acids. And there is one destructive molecule 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.

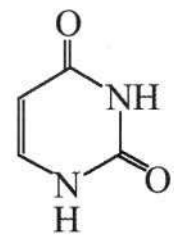
Instability of cytosine

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 — $1_{1/2}$ = 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.

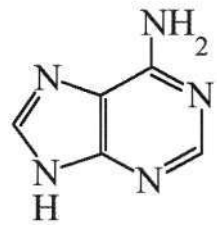
On single-stranded DNA in solution, $t_{1/2}$ of an individual cytosine residue = 200 years at 37 °C, while the double helix structure provides good protection — $t_{1/2}$ = 30,000 years.[22] Such C→U mutations would be a great genetic hazard, but cells have an ingenious repair system involving a number 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



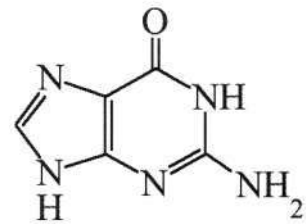
cytosine



uracil



adenine



guanine

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 $C0_2$ and NH_3. Instead, they heated 10^{-3} M cyanoacetaldehyde with various concentrations of urea ($(NH_2)_2CO$) in a sealed ampoule at 100 °C for five hours with 30-50 % yields of cytosine. Urea is produced in spark discharge experiments with N_2, CO and H_20.

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 90 °C 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 Wachterhauser's theory that life began on the surface of pyrite, which Stanley Miller calls *'paper chemistry'*.[21] *'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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27. Horgan, Ref. 26; Miller cited on p. 102.
28. Horgan, Ref. 26; Wächterhäuser cited on p. 106.
29. Sarfati, Ref. 8, extensively critiques one of Wächterhäuser's latest experiments that supposedly supports his theory.
30. Shapiro, R., *Origins: A Skeptic's Guide to the Creation of Life in the Universe*, Penguin, London, p. 130, 1986,1988. Shapiro then wishfully continues: *'We are far from that state now.'*

Jonathan Sarfati has a Ph.D. in chemistry from Victoria University of Wellington (New Zealand), and has published papers on high-temperature superconductors and selenium-containing ring and cage-shaped molecules. He now is on the staff at Answers in Genesis, has written articles for *Creation* magazine and *CEN Tech. J.*, and is the author of *Refuting Evolution.* He is also a former New Zealand national chess champion.

Erratum *CEN Tech. J.* 13(1)

Kui Shin Voo & Larry Hovee, The lamb of God hidden in the ancient Chinese characters, pp. 81–91.
1. Abstract: The 'wen' (𠂇) should be (文)
2. Results: first paragraph, fourth line, The left part '改' should be '示'
3. Figure 3 A: the character '羴' should be changed to '羴'
4. Figure 5: the footnote in the figure was left out. Dragon shaped sacrificial vessel for '....' family, should read, ... for '辞' family.
5. Figure 10: the ancient character '匽' should be replaced with '匽'. Also the reference number after An Ko Jun (40) should be (41).
6. Discussion section: page 89, line 11 from the bottom (a saint, 及) should be (a saint, 聖人)
7. Discussion last paragraph, Nelson and Broadbury should be Nelson and Broadberry.

Danny Faulkner, A biblically-based cratering theory, pp. 100–104.
1. Photographs: courtesy of NASA.

Jules Poirier, Monarch butterflies and navigation, pp. 105–114.
1. Title: Poirer should be Poirier.
2. References 1 to 3: Poirer should be Poirier.
3. p. 113 — Figure courtesy of Mountain High Maps.