ZULF'S MODEL OF EVOLUTION OF PRE-LIFE ON EARTH

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1. Motivation

I am extremely skeptical about reduction of life to chemistry. In fact, I am so skeptical that I will take any amount of resources I have and bet all of it against anyone ever demonstrating that life reduces to three-dimensional chemical processes.

Nevertheless, I am quite well aware that life does have some chemical aspects, DNA, proteins, and organic chemical interactions are part of life. My conviction is that they are only one part; another part is 4D electromagnetic. I won't go into that here.

In this note, I am going to address something far simpler than life. I am interested in a simple model of what I call *pre-life*.

I define *pre-life* as a situation where a large amount of organic inert non-living molecules exist, especially in the oceans of Earth.

I am interested in a very simple model of how there arose some substantial amount of inert, non-living, organic compounds in Earth's oceans in the first billion years of Earth's existence.

2. Assumptions about the Model

My model is for existence of some substantial amount of *organic molecules* in Earth's ocean without any life at all on Earth in the first billion years of Earth's existence.

I will describe the intuition behind the model thus. Earth cooled a bit, and had many oceans filled with water. Earth also had a substantial amount of carbons, oxygens, nitrogens etc.

The main process by which atoms of these basic elements became large organic molecules is not by any living process. Instead, the ingredients were:

- Sunlight day after day
- Waters of the oceans

The key ingredient is time, in the order of T=10^{11} days. Lets say the start time is $T_0 = 0$ and we have times $t = T_0, T_0 + 1, \ldots, T$.

Daily the sun pounded the oceans of the Earth with photons all day. Some of these photons led to formation of covalent bonds between carbon and other elements in the ocean. There was plenty of sunlight and plenty of ocean so that the probability of bond formation was non-zero. Once bonds formed, they stayed, so day after day, the molecules grew in complexity. At the end of our time period T we have some amount of organic compounds present in the ocean. None of this is *living material* but they are pre-life material. The much deeper scientific question of appearance of living organisms we put aside, because we believe this is quite

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delicate. The model we are interested in is for the existence of large number of organic non-living material which later can encourage formation of actual life.

There are subtleties of numerics in our model, and we hope the model will give us stronger understanding of the conditions that produced actual life. We do not believe seriously that life arose spontaneously just from sunlight and ocean although that is a possibility.

Note that if all the components of life form even once in the ocean then we have a phase transition because the behaviour of life molecules has the characteristic strange behaviour (from the inert non-living viewpoint)of growth and replication. Those things are too strange for our model. If we can assume that (a) life is chemical (b) once we have matched life chemical life is living, both of which are totally absurd to me, then our model can be considered as generation of life model. But we are honest scientists and do not want to fool the entire human race with absurd propaganda until they are willing to give us the keys to their ranches and buy Brooklyn Bridge from us. So we shy away from claiming our model is an account of spontaneous formation of life.

Without further ado, let's take a look at some simple numbers.

Sun provides $E = 3.85$ million exajoules per year to Earth. So that's quite a bit of energy. Let's see how much that is per square meter per day.

Oceans cover $A = 3.61 \times 10^9 m^2$.

3. Sun's Action On Ocean Per Day Per Meter-Squared

This is key to formation of pre-life.

$$e_{sun} = 2.922 \times 10^1 2 J/m^2$$

This is a good solid large figure. This is quite a bit of energy, ensuring that every meter-square of ocean is receiving enough energy so that there are plenty of high enough photons that will penetrate past all the ocean water and have a high probability of producing carbon covalent bonds.

4. Let Time Pass

The e_{Sun} the density of energy per square meter per day is so high that essentially the probability of producing covalent bonds for carbons especially without any life at all is quite good. And this is the key to the process that leads to a large number of organic compounds in the oceans in a billion years without any life.

5. Probability of Arbitrarily Complex Inert Organic Molecule Is High In First Billion Years of Earth

This is now fairly obvious. Once any organic compound forms, the probability of it growing larger is good, and probability of it breaking up is lower. Over a long enough period of time, large organic compounds will exist in good quantities.

6. Our Model Is Not Spontaneous Generation of Life

Spontaneous Generation of Life is a different sort of idea. We emphasize sunlight and oceans, not spontaneity. There is nothing spontaneous about our model. Sun pounds the ocean with $e_{sun} = 2.92 \times 10^{12} J/m^2$ every day for a billion years. This is regular, and every day, the molecules in the ocean form bonds, and the organic

molecules have no incentive to disintegrate. There then are a great variety of totally dead inert organic molecules in the ocean that are not the product of any life process.

This model then will tell us that a great amount of organic molecules in the oceans is expected. They might be used by life if it forms; but it did not need life to get there.

7. Conclusion

We can tell you with our model how every single organic compound needed for the operations of many living organisms can form with sunlight and ocean with sufficient time without telling you a single thing about why or how these organisms formed. It's something still, that all the parts of the organisms could be just floating around in the ocean, dead and inert, and nothing is alive that actually uses them.

8. Where Oparin-Haldane Hypothesis Will Fail

In 1920s Alexander Oparin and J. B. S. Haldane independently proposed that life arose from "gradual chemical evolution". In this note you can see simple ways in which part of their hypothesis can be justified. This is the part where many organic molecules arise naturally without presense of any life. This part of their hypothesis is most certainly true.

However, I strongly dispute the second part of their proposal, which is a wild and totally absurd proposal that *given that a large amount of organic molecules exist then anything like life will ever form.* Putting the right organic molecules together will no more make a living organism than your daughter's Barbie Doll will suddenly wake up one day and start complaining about sexual objectification of women in a patriarchal society. It's not that easy.

I am a devotee of Nature, and I know exactly how subtle Nature is. Here there is a glib sleight of hand that the entire scientific community has done for more than a century, and that is the assumption that life *reduces* to three-dimensional chemistry. It certainly does not. There is far more subtlety to life. Organic molecules are as dead as inorganic molecules. There is much more subtle structure to any living organism than a carefully placed set of organic molecules. This is not appreciated yet at all.