Five-fold Symmetry in AI

By

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In four parts we examine artificial intelligence and biological life, their connection with one another and suggest this connection might have clues that can help us find the origin of life.

Part 1

To make artificial intelligence (AI) we need semiconductors, like diodes and transistors. To make semi conductors we need to dope Silicon Si 4- with a group 13 doping agent to have positive silicon such as with boron B 3- or with a group 15 doping agent like phosphorus P 5- to have negative type silicon. Or we can dope germanium Ge 4- with a group 13 doping agent like gallium Ga 3- for positive type germanium or with a group 15 doping agent like arsenic As 5- to have negative type silicon. We connect the negative with the positive to have a semiconductor, meaning a current can run through it in only one direction.

We pull these AI elements out of the periodic table of the elements to make an AI periodic table:

|	13	14	15
2	B		
3	Al	Si	P
4	Ga	Ge	As

We now notice we can make a 3 by 3 matrix of it, which lends itself to to the curl of a vector field, by including biological elements carbon C (above Si):

$$\begin{pmatrix} \vec{i} & \vec{j} & \vec{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ (C \cdot P)y & (Si \cdot Ga)z & (Ge \cdot As)y \end{pmatrix} =$$

$$(Ge \cdot As - Si \cdot Ga)\vec{i} + (C \cdot P)\vec{k} =$$

$$\left[(72.64)(74.92) - (28.09)(69.72)\right] \vec{i} + \left[(12.01)(30.97)\right] \vec{k} =$$

$$3{,}482\left(\frac{g}{mol}\right)^2 \vec{i} + 372\left(\frac{g}{mol}\right)^2 \vec{k}$$

Let us dot this with $\left(x\vec{i} + y\vec{k}\right) dxdy$ and take the double integral over Si to Ge over both variables:

$$\int_{Si}^{Ge}\int_{Si}^{Ge}\left(3{,}483\left(\frac{g}{mol}\right)^2+382\left(\frac{g}{mol}\right)^2\right)\cdot\left(x\vec{i}+y\vec{k}\right)dxdy=$$

$$\int_{Si}^{Ge}\int_{Si}^{Ge}\left(3{,}483\left(\frac{g}{mol}\right)^2\cdot x+382\left(\frac{g}{mol}\right)^2\cdot y\right)dxdy=$$

$$\int_{Si}^{Ge}3{,}483\left(\frac{(72.64-28.09)^2}{2}\right)dy+\int_{Si}^{Ge}372y\cdot(72.64-28.09)dy=$$

$$3456359\left(\frac{g}{mol}\right)^4(72.64-28.09)+16573\left(\frac{g}{mol}\right)^3\left(\frac{(72.64-28.09)^2}{2}\right)=$$

$$170427030.8\left(\frac{g}{mol}\right)^5$$

$$\sqrt[5]{170427030.8}=44.3g/mol$$

Now let us take the harmonic mean between Si and Ge. It is

$$\frac{2SiGe}{Si+Ge}=40.5g/mol$$

And the arithmetic mean between them:

$$\frac{Si+Ge}{2}=50.365g/mol$$

We see the value of 44.3 g/mol is somewhere between the harmonic and arithmetic mean. Perhaps it is the geometric mean…

$$\sqrt{SiGe}=45g/mol$$

Thus we can say…

$\overrightarrow{u} = (CP \cdot y, SiGa \cdot z, GaAs \cdot y)$

$$\sqrt[5]{\int_{Si}^{Ge}\int_{Si}^{Ge} \nabla \times \overrightarrow{u} \cdot d\,\overrightarrow{a}} = exp\left(\frac{1}{Ge - Si}\int_{Si}^{Ge} ln(x)dx\right)$$

Which like Stoke's Theorem in that it relates an integral of a flux over a surface to path integral. The expression on the right-hand side of the equation is the geometric mean between Si and Ge. This integral can better be represented with product calculus:

$$\sqrt[5]{\int_{Si}^{Ge}\int_{Si}^{Ge} \nabla \times \overrightarrow{u} \cdot d\,\overrightarrow{a}} = \sqrt[n]{\prod_{i=1}^{n} x_i}$$

Where $x_1 = Si$ and $x_2 = Ge$ and n=2. If we we say the arithmetic mean is A, and the harmonic mean is H, the geometric mean G…

$$\frac{A + H}{2} = 45.4325 \approx G$$

This is

$$\frac{Si^2 + 6SiGe + Ge^2}{4(Si + Ge)} \approx \sqrt{SiGe}$$

This is quite interesting because

$$H(a,b) = \frac{a}{b} = \frac{1}{\frac{1}{b-a}\int_b^a \frac{dx}{x}}$$

$$A(a,b) = \frac{1}{b-a}\int_b^a x dx$$

$$G(a,b) = exp\left(\frac{1}{Ge - Si}\int_b^a ln(x)dx\right)$$

I say interesting because we can write all three of these as one equation, the f-mean:

$$M_f(x_1, \ldots x_n) = f^{-1}\left(\frac{1}{n}\sum_{i=1}^{n} f(x_i)\right)$$

The harmonic mean and the arithmetic mean are special cases of the power-mean which is the case when $f(x) = x^p$, the harmonic mean when p=-1, and the arithmetic mean when p=1.

But what is interesting to me is that to get the geometric mean from the f-mean we have to change the function f(x) to f(x)=ln(x). This is when it becomes simpler to express the geometric mean in terms of product notation:

$$M_0(x_1, ..x_n) = \sqrt[n]{\prod_{i=1}^{n} x_i}$$

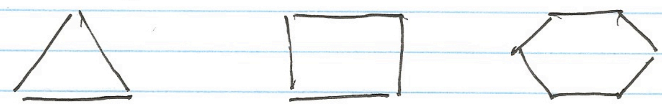
And this is precisely interesting to me because five-fold geometry does a similar thing. We have a five-fold expression in our AI equation we arrived at:

$$\sqrt[5]{\int_{Si}^{Ge}\int_{Si}^{Ge} \nabla \times \overrightarrow{u} \cdot d\overrightarrow{a}} = \sqrt[n]{\prod_{i=1}^{n} x_i}$$

In that we take the fifth root of the double integral on left. This makes me thing of how we can tile a surface with regular polygons 3-sided (triangle), 4 sided (square), and 6-sided (regular hexagon) but five pops out and the pentagon requires another shape added in to tile a surface without leaving gaps, as a so-called Archimedean tessellator, the equilateral triangle, square, and regular hexagon are the regular tessellators. However, if you are working with solids, there are five regular solids and they all tile to close off a space, using triangles, for example the tetrahedron, or squares (the cube), and yes the regular pentagon in the dodecahedron.

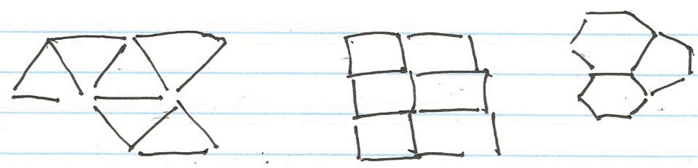
See illustration on next page…

THE REGULAR TESSEllATORS



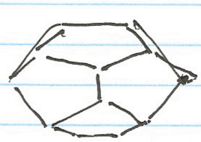
n=3 n=4 n=6

TiLE A SURFACE WIThout Gaps

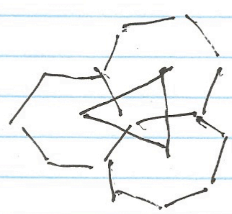


The Regular solids include n=3, n=4, and n=6 But As well have n=5:

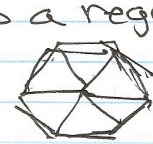
n=3 n=3 n=4



n=5



n=6 occurs in The 20-Faced solid because though it uses n=3 the dual of a regular hexagon is a regular triangle:



It was the Russian scientist Shubnikov who noticed that five-fold symmetry is more characteristic of life while six-fold symmetry is more characteristic of the physical. He wrote:

As to the alive organisms, we have not for them theory, which could answer the question what kinds of symmetry are compatible or incompatible to existence of living material. But we can note here that remarkable fact that among the representations of the alive nature the pentagonal symmetry meets more often.

I think from experience and observation you will find this as true if you pay close attention to Nature. You will find if you look at flowers every now and then you will find six petals around its center, or sometimes as with a rose perhaps near a hundred petals, but most often you will find there are five petals around the center of a flower. As well, even in the rose, with near a hundred petals, they spiral in as a golden spiral, which is built of ratios of the golden ratio (Φ) and use patterns of Fibonacci numbers. The successive ratios between terms in the Fibonacci sequence converge on Φ at infinity and the golden ratio is derived from pentagonal symmetry in that if you draw in the chord of a regular pentagon, the ratio of it to its side is Φ. And indeed the human has two legs, two arms and a head adding up to five, or two eyes, and a nose and a mouth adding up to five. Or, five fingers, or five toes on each hand or each foot. But for the physical like a snowflake, there are six points that form around it giving it hexagonal symmetry. The starfish has five arms.

In looking at life we notice it is based on carbon which is in group 14 of the periodic table of the elements just like semiconductor elements silicon and germanium. It is because of this that carbon works because it means has 4 valence electrons, meaning it can form long chains with hydrogen making organic matter the hydrocarbons, utilizing oxygen (O), nitrogen (N), phosphorus (P), and sulfur (S). Life does not seem to be based on silicon, though, even though it has 4 valence electrons as well because while carbon can combine with hydrogen to make hydrocarbons such as CH_4, or combine with O, N, H to make the most simple organic compound isocyanic acid HNCO which binds H-N=C=O, silicon in the presence of oxygen forms glass SiO_2 so easily that it can not combine with the H, N, C, O, P, and S readily with each equally so as to form functional hydrocarbons.

It is at this point that I would like to note that carbon is element six in the periodic table giving it 6 protons, and since its molar mass is 12.01, it has 6 neutrons. It so happens that closest packing of equal radius spheres in the plane like protons, and neutrons is six-around one or hexagonal symmetry. As Buckminster Fuller constructed his geometry in Synergetics, he outlined his discovery that equal-radius spheres pack in the form of what he called the vector equilibrium, which is the cuboctahedron, which he demonstrated was the most transformable construct and as such becomes pivotal to his Synergetics,

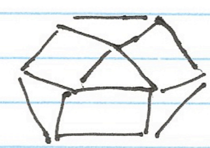
I would like to suggest in light of this that since carbon has six protons and six electrons, with the six protons determining its number of electrons (6 to be neutral) giving it four valence electrons in its outer shell for combining with other elements (the outer shell is four and wants four to complete an octet, such as four hydrogens each H^+, that though life more often meets with pentagonal symmetry, and here we see carbon meets with six-around-one in the plane, or twelve-around-one in space as the vector equilibrium, or six-fold symmetry, it is because life is built out of the physical, like carbon to make the biological, characteristic of pentagonal symmetry. And it is here I suggest that life animates out of a dynamic structuring of the physical (inanimate). See illustration on the next page…

C 6 (protons)

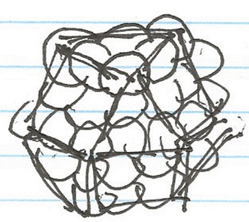
Closest Packing of equal radius spheres is six-around-one

C 6 (neutrons)

C 6 (protons + neutrons)



Omnidirectional Closesest Packing of the protons and neutrons in Carbon is characteristic of their sum, which is twelve. They form the vector equilibrium of Buckminster Fuller. It is his zero frequency.



Two-Frequency has 42 Additional spheres packed required. In general The number of spheres is $10F^2+2$ where F is frequency.

Indeed we see life could be the interplay between 3, 4, 5, 6 as structured in Buckminster Fuller's Synergetics. For instance the vector equilibrium (cuboctahedron) is made of equilateral triangles and squares, the regular tessellators. With eight triangles and six squares. All of this speaks respectively of NH_3 (ammonia, believed to have contributed to making the amino acids the building blocks of life) which is three hydrogens around a Nitrogen, CH_4 (methane, believed to have contributed to the formation of amino acids in primordial earth as well) the eight triangles in the cuboctahedron representing the combination of elements such that they complete an octet, and its six squares, the six protons, six neutrons, and six electrons of carbon.

With all said here so far, it might be said that understanding life and its origins can be understood by looking at artificial intelligence.

Part 2

Let us return to the geometric mean becoming a different function in the f-mean. We have:

$$M_f = f^{-1}\left(\frac{1}{n}\sum_{i=1}^{n} f(x_i)\right)$$

$$M_f(x_1, x_2) = f^{-1}\left(\frac{1}{n}\sum_{i=1}^{2} x_i^p\right)^p$$

p=1 yields:

$$M_f(x_1, x_2) = \left(\frac{1}{2}x_1 + \frac{1}{2}x_2\right) = \frac{x_1 + x_2}{2}$$

Is the arithmetic mean between x1 and x2. Now take p=-1:

$$M_f(x_1, x_2) = \left(\frac{1}{2}\sum_{i=1}^{2} x_i^{-1}\right)^{-1} =$$

$$\frac{2}{\frac{1}{x_1} + \frac{1}{x_2}} = \frac{2x_1x_2}{x_1 + x_2}$$

Is the harmonic mean between x1 and x2. Now we try p=0 hoping to get the geometric mean…

$$M_f(x_1, x_2) = \left(\frac{1}{2}\sum_{i=1}^{2} x_i{}^0\right)^{\frac{1}{0}} =$$

$$\left(\frac{1}{2}\sum_{i=1}^{2} 1\right)^{\frac{1}{0}} =$$

$$\left(\frac{1}{2}\right)^{\infty}$$

So for $f(x) = x^p$ we can't make sense and we have to search for a function that will produce the geometric mean in the f-mean. It is ln(x). This is interesting because the natural log of x was created to settle the following conundrum:

$$\int \frac{dx}{x} = \int x^{-1} dx = \frac{x^{-1+1}}{0} = \frac{x^0}{0}$$

This is where we ned to create the natural logarithm function so we can have a solution to such an integral and, we have

$$\int \frac{dx}{x} = ln(x) + C$$

Where

$$ln(x) = log_e(x)$$

$$e = 2.718\ldots$$

Let us return to our $\left(\frac{1}{2}\right)^{\infty}$. It is not a sum

$$\frac{1}{2}\sum_{i=1}^{\infty}\frac{i}{i} = \frac{1}{2}\left(\frac{1}{1} + \frac{2}{2} + \frac{3}{3} + \ldots\right)$$

But is a product

$$M_0(x_1, x_2, x_3\ldots x_n) = \frac{1}{2}\sqrt[\infty]{\prod_{i=1}^{n}\frac{i}{i}} =$$

$$\frac{1}{2}\left(\frac{1}{1}\cdot\frac{2}{2}\cdot\frac{3}{3}\cdot\ldots\right)$$

What this says is that what is important in not the values of data points in an experiment, not the x_i's but the i's themselves, then number of the data point. Like the one in measurement 1, the 2 in measurement 2. Never mind that measurement 1 might equal 2.3 grams, measurement 3 might equal 0.5 grams, the important thing is the 1/2 outside the parenthesis because we are taking, i/i which is $1/1$,$2/2$,$3/3$,...is always 1. This is how reality never has any meaning: we just change $f(x) = x^p$ to f(x)= ln(x), which is the equivalent of writing

$$G = \sqrt[n]{\prod_{i=1}^{n}x_i}$$

Thus it is the experience itself that counts, we find

$$\int \frac{dx}{x} = ln(x) + C$$

If we say

Part 3

As we can account for some of the amino acids, the building blocks of life, in that Miller and Urey showed eleven of the twenty amino acids in proteins can be made by mixing together the primordial earth substances CH4 (methane) NH3 (Ammonia) and H2O water with a few other gases that were present, and then applying electricity to simulate electrical storms, we need not just amino acids to have life but sugars for the DNA and RNA that encode life.

Sugars are carbohydrates with the formula:

$$C_n(H_2O)_n$$

Where n is 2 to 7. n=1 is not a sugar and is called formaldehyde which is:

$$CH_2O$$

Which has the same structure as a sugar, which is a monomer from which the sugars form; that is, sugars are polymers of formaldehyde. For DNA (deoxyribose nucleic acid) and RNA (ribose nucleic acid) that encode life we need deoxyribose:

$$C_5H_{10}O_4$$

And, ribose:

$$C_5H_{10}O_5$$

The sugar produced by plants through photosynthesis that serves for its food is glucose $C_6H_{12}O_6$ which is n=6 in $C_n(H_2O)_n$. To make these sugars formaldehyde first combines to make the sugar glyceraldehyde (n=3):

$$C_3H_6O_3$$

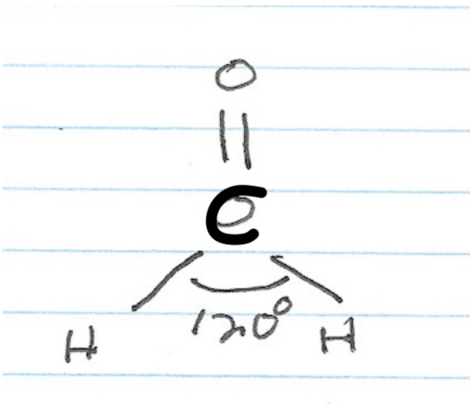
Then combines with this. But to explain the origins of life in terms of arising from a primordial substance, we need to explain how we make formaldehyde.

Formaldehyde is an intermediate in the combustion or oxidation of methane (one of the primordial gases that make some of the amino acids). It does not accumulate in the environment because it is broken down by sunlight or by bacteria in soil and water. It is produced by the action of sunlight and oxygen on atmospheric methane. In the lab it is stored as an aqueous solution (formalin) because it polymerizes spontaneously into paraformaldehyde. It exist in the interstellar medium (the empty space between stars) and is proposed to be formed there by the hydrogenation of carbon monoxide ice:

$$H + CO \longrightarrow HCO$$

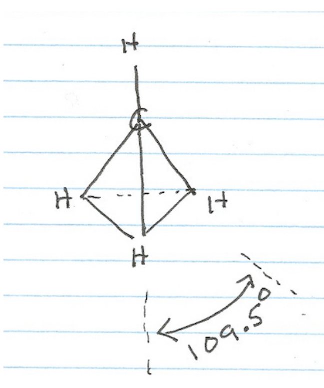
$$HCO + H \longrightarrow CH_2O$$

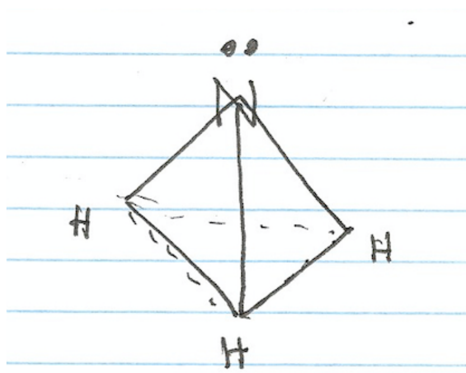
The molecular geometry of formaldehyde is trigonal planar :



And, has a bond angle of 120 degrees. More precisely of HCO=122 degrees, HCH=116 degrees.

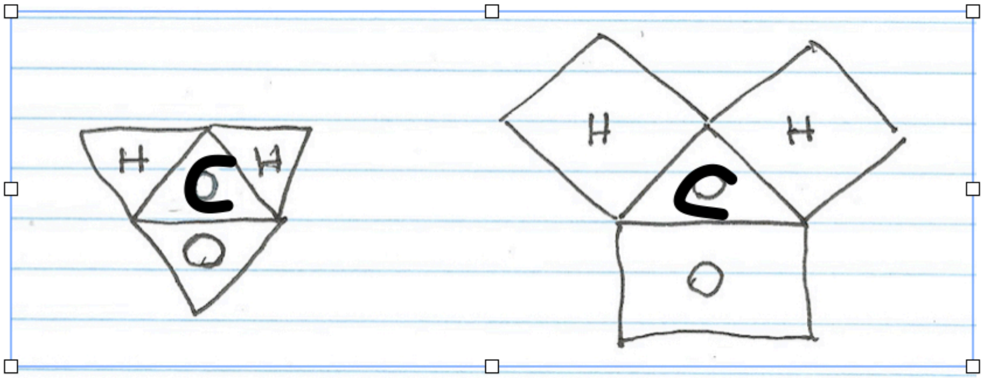
The molecular geometry of methane and ammonia from which have the amino acids are tetrahedral and pyramidal, respectively:



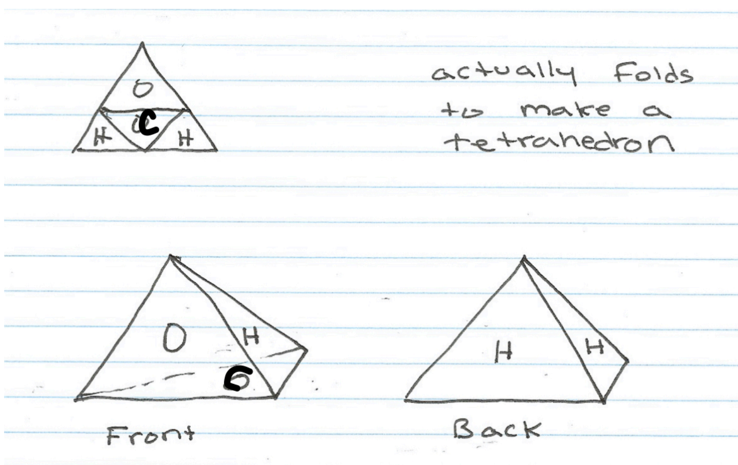


The methane has bond angles of HCH=109.5 degrees and the ammonia has bond angles of HNH=107.8 degrees with an unshared electron pair attached to the nitrogen.

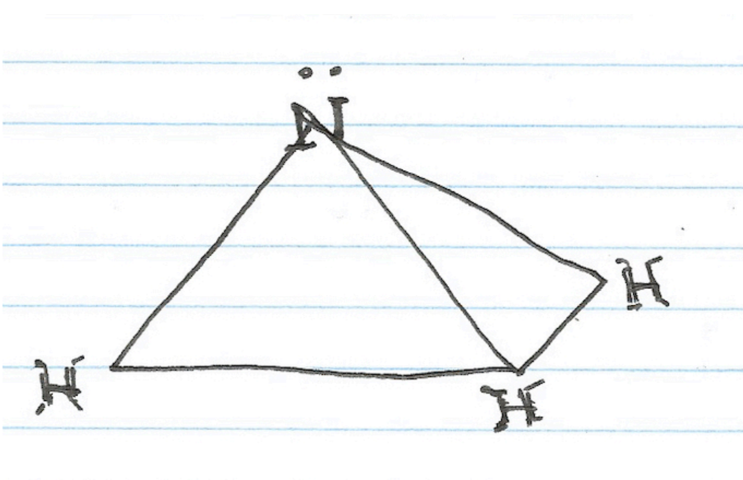
If we are to look at formaldehyde through the eyes of a caveman, so we may look at the primordial with a mind of primordial times we might imagine he would fit three around one by either considering triangles around a triangle or squares around a triangle…



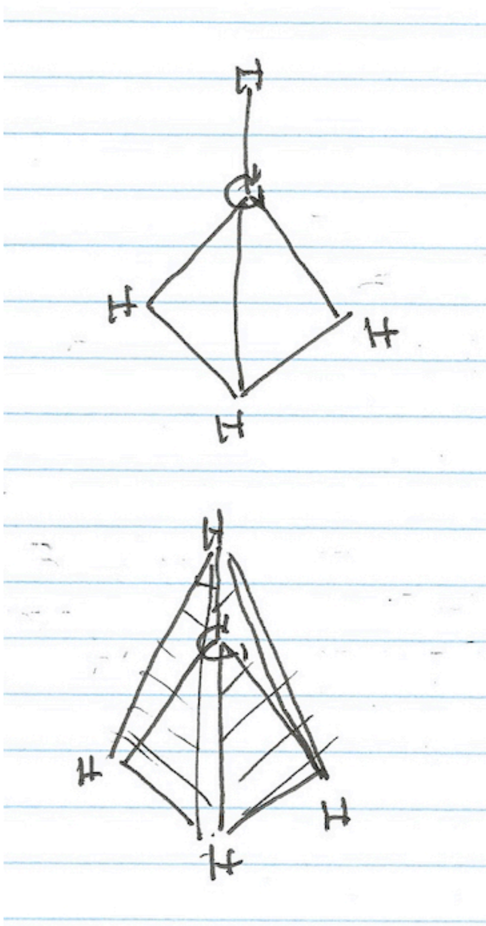
The arrangement actually folds to make a tetrahedron:



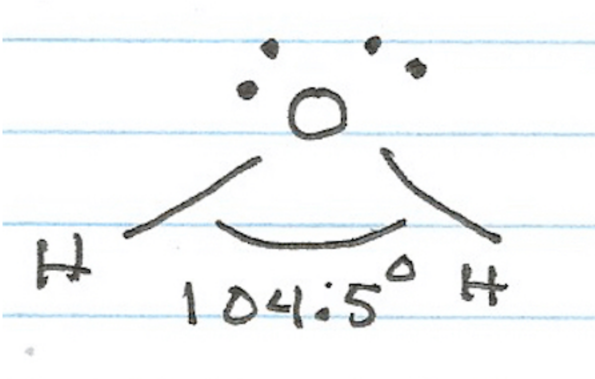
Which is the structure of ammonia used to make amino acids…



Ammonia in chemistry is called pyramidal because a tetrahedron is a kind of pyramid. However, methane, one of the other primordial gases that make amino acids is called tetrahedral because although its form is:



It can be thought of as a tetrahedron with carbon at its center. By connecting the base hydrogens with the top hydrogen. Thus we see that the primordial substance formaldehyde predicts through its geometric dynamics the methane and ammonia that are the primordial substances used to make the building blocks of life. But we need the formaldehyde to make the sugars for the DNA and RNA that encode for life. However, it predicts as well the other primordial substance water (H2O), because it is bent as it is called in chemistry which is a triangle, the unfolded geometry of the tetrahedron as seen through the eyes of a caveman:



H2O has the molecular geometry seen here. The two lone pairs of electrons on the oxygen push the hydrogens together creating a compressed angle of HOH=104.5 degrees that makes it less than the 120 degree bond angle one would think it would have from 360/3=120.

Thus, formaldehyde the primordial substance which is used to make the sugars that make DNA and RNA that encode life, predicts the primordial substances used to make the amino acids from which DNA and RNA synthesize the proteins of life.

Part 4

In order to determine whether life can arise spontaneously or not, a brief review of what we know suggests what I call an activation function.

Miller Urey Chemistry

Under Nobel prize winner in chemistry (1934) Harold Urey, Stanley Miller a graduate student set out to see if he mimicked the theoretical primordial Earth, he could produce the 20 amino acids that are the building block of life. He created the ocean by filling a closed glass container with water, and coming out of this was a tube that went to a second chamber that mimicked the primordial earth atmosphere which was methane, ammonia, and hydrogen. As the heated water vaporized it flowed out of the first chamber and into the second chamber. He passed electricity through the second chamber to mimic electrical storms or lightning. Between the first chamber and second he placed a condenser, so when the water vapor rose into it, some of it would condense into liquid to mimic rain. With this experiment he produced 10 of the 20 biological amino acids. We have yet to find a way to produce all 20 under theoretical primordial earth conditions.

Produced

Glycine, Alanine, Aspartate, Valine, Leucine, Glutamate, Isoleucine, Serine, Proline, Threonine

Not Produced

Phenyalanine, Tyrosine, Tryptophan, Histidine, Lysine, Arginine, Cysteine, Methionine, Asparagine, Glutamine

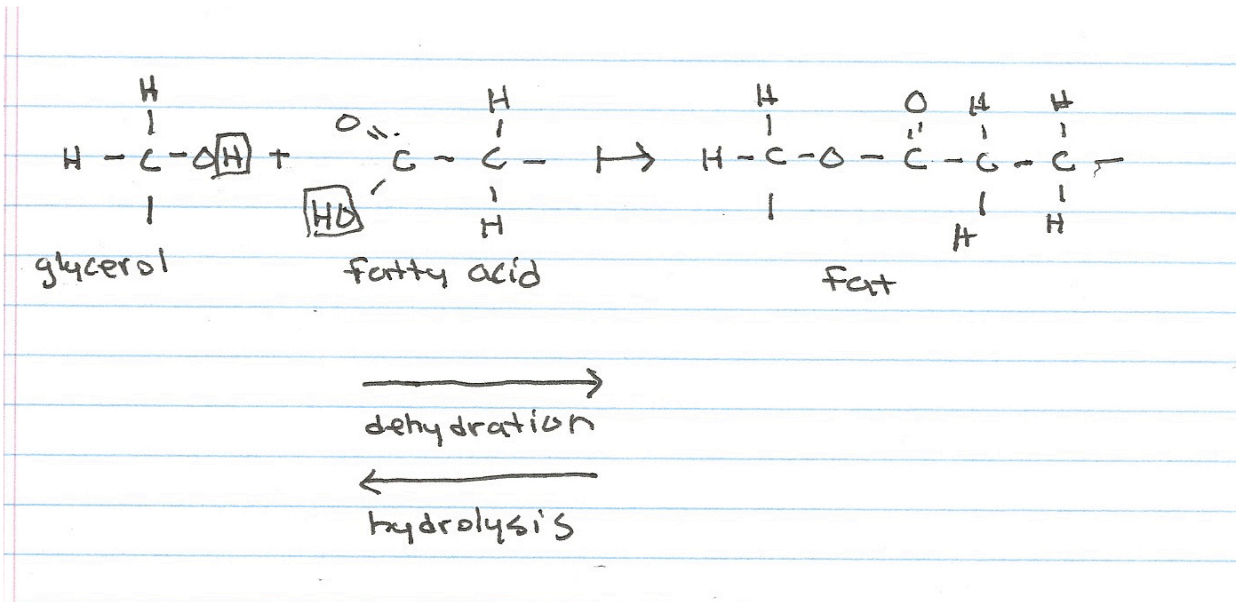
H2O

Water is an extraordinary substance and in order to have life you need it. The earth is not only the right distance from the sun for water to exist in three phases (ice, vapor, and liquid) but is also happens to be very plentiful here, it covers three quarters of the planet's surface and what is more there are great amounts of it under its surface. Let's look at some of the properties of water that it has that allows for life:

1. Water is solvent meaning it dissolves a great number of substances.
2. Water is cohesive and adhesive, cohesive because it flows freely, yet adhesive in that can also adhere to surfaces. Unicellular organisms rely on external water to transport nutrients and waste while multicellular organisms have internal vessels that use it to do the same. Because of adhesion and cohesion water can climb up from the roots of a tree to its top by tension created by water evaporating from its leaves.
3. Water has a high surface tension meaning plant debris can rest on its surface providing food and shelter for aquatic life.
4. Water in its solid phase (ice) is less dense than it is in its liquid phase because when it freezes it expands meaning it floats on the surface water. If it was not for this life could not exist on earth because if the ice sank the ponds, lakes, and perhaps even the oceans would freeze over solid.
5. Water has a high heat capacity. The specific heat of water is one calorie per gram degree centigrade which means it takes one calorie to raise the temperature of a gram of it by one degree centigrade. This keeps the earth relatively cool, and thus life thrives. A lot of the sunlight's energy goes into vaporizing it into clouds that would otherwise go into heating the planet.

Dehydration Synthesis and Hydrolysis

Let us look at how water synthesizes substances and breaks them down. Take making fat from glycerol and a fatty acid:

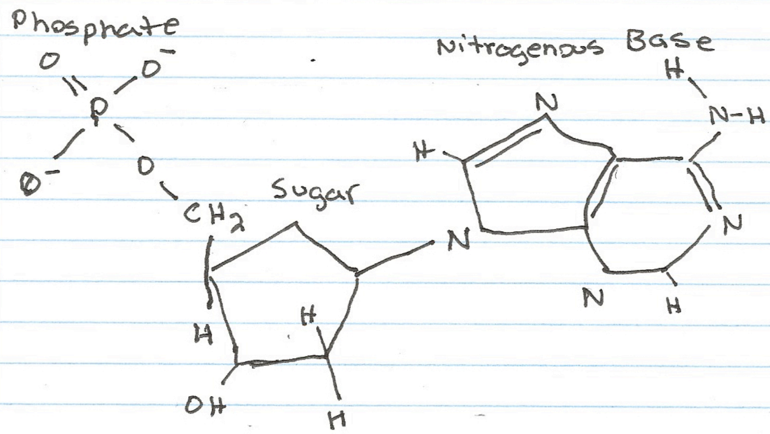


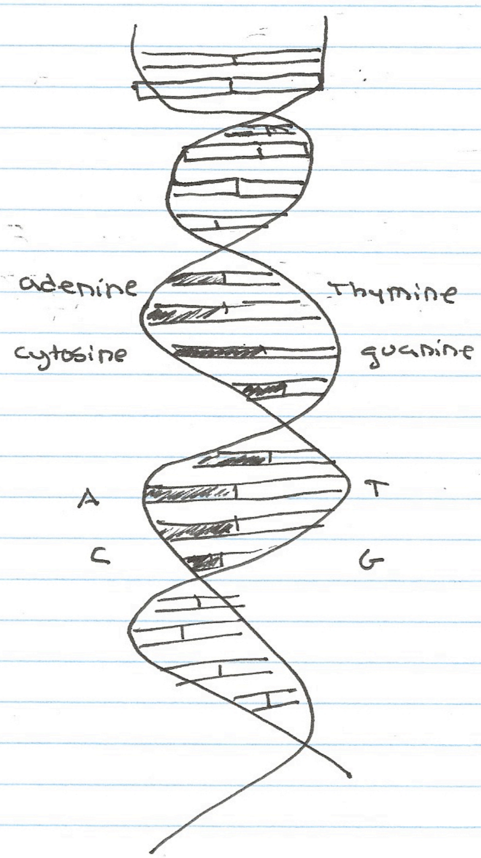
If you heat it you remove an H from the glycerol and an OH (hydroxide) from the fatty acid which is to remove a water molecule H2O leaving an O in the glycerol and a C in the fatty acid that joins the glycerol with the fatty acid to make the fat. For hydrolysis you add an OH to the fatty acid and and H to the glycerol by adding water (H2O) to the fat thus breaking down it down into a fatty acid and glycerol.

DNA and RNA

Life is encoded by DNA (deoxyribose nucleic acid) and RNA (ribonucleic acid) which make nucleic acids. Each nucleic acid is a monomer in a polymer called a nucleotide. The monomer consists of a phosphate, a 5 carbon sugar, and a nitrogen containing base. The phosphate is the phosphate ion PO_4^-. Deoxyribose is the sugar $C_5H_{10}O_4$ and is in DNA and ribose is the sugar $C_5H_{10}O_5$. The bases are guanine, cytosine, adenine, thymine in DNA and RNA uses uracil in place of thymine. The phosphate combined with the sugar is the backbone of DNA and RNA, and the bases are attached to the backbone. There are two back bones running parallel to one another and the bases of one attach to the bases of the other in a pairing that is always guanine (G) pairs with cytosine (C) and adenine (A) pairs with thymine (T). It is the sequencing of these pairings the encodes for life, and the parallel backbones are twisted so you have a twisted ladder where the base pairings are its rungs.

Guanine: $C_5H_5N_5O$
Cytosine: $C_4H_5N_3O$
Adenine: $C_5H_5N_5$
Thymine: $C_6H_6N_2O_2$, Uracil: $C_4H_4N_2O_2$


Phosphate
Sugar
Nitrogenous Base
CH_2
OH


adenine
Thymine
cytosine
guanine
A
T
C
G

The Problem

In order to have life we need to have the nucleic acids, which means we need to have the bases guanine, cytosine, adenine, thymine, and uracil. Can they arise spontaneously from the calculated conditions of the primordial earth?

John Oro in 1961 found amino acids and adenine could form from the mixture of hydrogen cyanide and ammonia in water. Later researchers found several of the bases needed were present if they allowed hydrogen cyanide to combine with the ammonia when heated in acid. The problem is hydrogen cyanide present in the laboratory experiment was hundreds of thousands of times more concentrated than is calculated to have existed on the primordial earth surface. Further, hydrogen cyanide cannot be concentrated by the evaporation of sea water in a tidal pool because it is more volatile than water,.

Later, Leslie Orgel found that freezing a hydrogen cyanide solution would allow it to form in the voids between ice crystals, which meant adenine could only form in the frozen polar regions. In 1975 Miller froze the stuff for 27 years, then analyzed it finding small amounts of several of the bases including the adenine.

We now know that four molecules of hydrogen cyanide can combine to form diaminomaleonitrile, then, under sunlight, if it reacts with another molecule of hydrogen cyanide it produces adenine in 7% yield. But if four molecules react with salt ammonium formate there is 90% yield of adenine. However, this requires dehydration, by removing two molecules of water, meaning we need to boil away the water of the solution to dryness.

The Solution

Substances and rapid temperature changes (cold for some reactions, warm for others like dehydration synthesis) that are not present today, nor that we calculate were present in the primordial earth (like sufficient quantities of hydrogen cyanide) that are needed to account for a prebiotic pathway to the nucleobases and their combination with phosphates and sugars, and all of the biological amino acids would suggest there was the presence of what I will call an *activation function.* Since these necessary substances are not present today, and cannot be calculated to have existed a long time ago, I suggest that the activation function was a limiting factor, that as it activated life from what was present, it depleted determining how much life was present in the beginning by its total depletion. Once life exists the production of the nucleic acids is possible because it can now be powered by life’s consumption of carbohydrates, which only can exist on the earth after the existence of life.

The Activation Function

I would like to suggest that the prebiotic chemistry might have been passed through an activation function that disappeared after life was on its way to evolving.

The problem, then, of answering the question of how life began is one of finding the activation function and its mechanism by which it takes prebiotic chemistry and activates it (makes it alive) so it can now self-replicate, and evolve. We assume that as this mechanism activates the molecules, its mechanism depletes as it activates from what is available. In this sense the mechanism is a limiting reactant, so it determines how much material is activated before it depletes completely.

Logically, the way to determine what this mechanism is, and how it serves as an activation function is to look for the by-products of the reaction that are left over, and from that, deduce its nature.

To do this, we have to look for that thing in our knowledge of the Earth's history that does not make sense. This would be in the faint young star paradox. We know that five billion years ago, when the Earth and Sun first formed, that the sun was 0.7 times its present output and so, the Earth should have been frozen over, yet, we know it was not. That it had water in its liquid phase. Thus something was there that is not present today. That something must have been the mechanism for the activation function that "turned on" prebiotic chemistry.

If $\sigma(x)$ is the activation function, where x is the prebiotic material, and we say r is residue of the reaction, and l is the activated substance (life) then,

$$l + r = \sigma(x)$$

We know l. If we can find r in nature, we can deduce $\sigma(x)$.

I have presented it like this because 1) Life has not been created in the laboratory from scratch 2) New life does not seem to be originating on earth in present times. Therefore, the activation function is probably not present on Earth today and more than likely disappeared, or depleted after activating prebiotic chemistry. Life exists, yet we do not know how prebiotic substances organize into self-replicating systems that evolve. Therefore, we must look for something concerning the Earth that does not make sense. I suggest that would be the young star paradox. If the Earth had water in its liquid phase when it should have been frozen over, then something could have existed then that was a limiting reactant, or something like it, that activated prebiotic substances, in that it was responsible for warming the earth (perhaps a heat retaining substance).

I use the term *limiting reactant* loosely as well as *prebiotic chemistry* because one, the reactant was not necessarily a substance alone, but a manifestation of energy not just necessarily sunlight incident upon the earth and, the prebiotic chemistry was not necessarily just substances that existed then from what we have theoretically calculated.

The Author