Hi Frank,

Here’s a better explanation – I think – of the relationship between chaos and evolution. I’ve got to dash. See you on the Shabbat.

Roy

Because we are considering front-loading of the genome we need to consider how chaos may affect the genome from the point of view of the genome itself. Every genome is a high information system that can potentially behave in a chaotic manner. Cancer is descent of the genome by progressive stages into chaos. Mutation and loss of stability are the hallmarks of cancer. A single cell loses its stability by progressive mutation such that genes guarding against chaos are silenced and genes that are otherwise dormant become activated to produce a chaotic, speeded up version of evolutionary change at the genetic level.

The offspring of some cancerous cells die because their genome is no longer compatible with life. Other cancerous cells throw off the built-in restraints on the number of times the cells can divide and then divide continuously as ‘immortal’ cell lines. These cell lines exist today in laboratories around the world as sources for experiments. HeLa cells are one example.

The chromosomes of all eukaryotic cells end in what are called telomeres. These are sequences that act like a roll of tickets. After each cell division one of these ‘tickets’ is removed from the telomere. After the roll of ‘tickets’ to life runs out the cell dies. In this manner Yah limited the life spans of every animal including man. Some cancerous cells or cells infected with some viruses escape this fate by inhibiting the enzyme telomerase which removes the ‘tickets’. (Trying to avoid death by inhibiting telomerase actually increases the likelihood of malignant change and thus doesn’t prevent the outcome you are trying to avoid).

The normal genome can be considered an island of stability within chaos. It is a high information system with built-in protective mechanisms to prevent mutation and descent into chaos. However, preventing all mutations is impossible due to entropy so there are repair facilities built into the genome.

The idea of an island of stability within chaos may seem like a strange notion. Yet it occurs everywhere around us. The example of an island of calm within turbulent water is one example. Another is an experiment done with a fluid trapped between two co-axial cylinders, the outer cylinder being made of glass so that the fluid could be seen. The outer cylinder is held still while the inner is rotated. At first the fluid adopts a stream-line flow between the cylinders, then as the speed is increased there is a sudden change from stream-lined to turbulent flow. This behavior is seen with a thin stream of water dropping from a tap. As the water falls under gravity its speed increases until a point is reached when it breaks up into turbulent (chaotic) flow. (This transition occurs at Reynold’s number, an empirically derived value for every type of fluid)

A curious event occurs, however, when the speed in the above experiment is increased further. The flow may become streamlined again or a pattern appears within the turbulence. A further increase in speed and that streamline flow/pattern disappears again. In chaos these are called bifurcation points. It is not possible to solve the equations that govern this behavior but it is possible to simplify the equations by removing, e.g. a term related to viscosity, to get an approximation to what is seen in, for example, fluid flows in nature.

The planet Jupiter has a large red spot that has been present and stable for many centuries. It is a huge cyclone – an area of structure within chaos that surrounds it. It is important to note that the structure is not an area of total calm. High velocity winds are present within it but in a semi-ordered fashion. Chaotic material from the clouds that surround it, move into the cyclone, into an island of stability and then move out again into the surrounding chaos.

Now we can extend these ideas into the concept of islands of stability in the genome.

An island of stability is a structure – whatever form it may take – that remains constant over time within a chaotic system and which suddenly may suddenly disappear with a change in the parameters. Just as an island of calm will suddenly and unpredictably appear in roiling water, so the genome is an island of stability within potential chaos. Cancer is an example of a genome leaving stability and becoming completely chaotic as described above. Genomic stability is dynamic in that the genome is constantly undergoing mutation with point deletions, translocations, larger deletions and insertions. Repair mechanisms built into the genome tend to repair some of these changes so that a relatively stable genome and hence phenotype (what the organism looks like) results. This unpredictability is typical of non-linear systems such as we find in our universe.

There is some evidence of chaotic changes within biology at least at the level of physiology (how an organism works) implying a genetic basis for these changes. For example:

[*“The non-linear dynamics of biochemical, cellular, physiological, neuronal and ecological systems can limit or enlarge the range of phenotypes reachable by selection. Small changes in parameters governing the system can cause it to qualitatively change its dynamics, that is, to ‘bifurcate’, say, from a steady state to a stable limit cycle.*

Bifurcations occur in physiologically plausible models of the cell cycle, ventilation rate and many other physiological processes. In the cell cycle model, changing a rate parameter can cause the system to move between normal and arrhythmic breathing. There is some empirical evidence that these bifurcations also occur in real physiological systems. Bifurcations also occur in models of population dynamics: an ongoing series of experiments with Tribolium beetles has shown that a biologically based model of population dynamics can predict bifurcation that can be induced in the laboratory. ***Thus, bifurcations may be built-in to some basic physiological and demographic processes****.” Chaos and Evolution Regis Ferriere et al*]

Sandford has shown in his book Genetic Entropy that deleterious mutations progressively degrade the genome despite the presence of repair mechanisms. However, for most of this time the genotype (the genetic structure) and the phenotype remain relatively constant.

Eventually a point is reached where the mutational load becomes too much, the genome becomes unstable and the species population reaches an existential crisis. At this point the species will die out.

If, on the other hand, the primordial genome is front-loaded(as postulated by Mike Gene in his book *The Design matrix*) to account for these regular extinction events then as the extinction event approaches, the genomes of some individuals within the population, perhaps due to the increasing mutational load and loss of fitness, will undergo a pre-programmed change. This is a bifurcation point in evolution. The change would not be just a few point mutations but a wholesale re-ordering of the genome itself. The way this change could be achieved I have detailed below. The result is a new species, perhaps similar to the previous species or radically different. Which individuals would be involved would be unpredictable in number, timing and location. [*"…major trends in evolving traits are deterministic. These trends are determined by 'singular phenotypes' which move and change their nature (bifurcate) as the environment changes."* Chaos and Evolution Regis Ferriere et al]

There is some support for chaotic changes at the genomic level in the scientific literature but no firm experimental evidence as yet. Work is being done on short lived species such as bacteria which have a high mutation rate and fruit flies to confirm the hypothesis.

What we would see in the fossil record would be a decrease in the numbers of the previous population until full extinction occurred, then a period in which no fossils would be found then a gradual increase in the fossil numbers of a new species. Except for catastrophic extinction events not related to genetic changes this is what we see in the rocks. Prior to the final Cretaceous extinction event at the KT boundary we see most of the dinosaurs and related sea creatures going into decline.

Thermodynamics was originally formulated as a system of rules governing energy transactions but entropy or the second law relates to information and order, tying order, information and energy together. Thus high information states are also high energy states. Just as energy needs to flow 'downhill' from a 'hot' reservoir to a 'cold' reservoir to allow useful work to be done so high information states naturally tend to lower information states.

The classic evolutionary model of the genome is an upward progression of order and information within the genome from primitive organisms to more complex higher organisms. Clearly this is against the laws of thermodynamics. As Sandford illustrates, thermodynamics as applied to the genome results in a progressive loss of order and information in the genome. The end result <u>without some external input</u> would be complete degeneration of the genome, loss of order and information and thermodynamic equilibrium in which the genome would devolve to the level of the surrounding environment. Simply, entropy is everywhere globally increasing.

However, entropy can be locally reduced. As an aid to understanding consider air conditioning. Air conditioning <u>locally</u> reduces entropy. Coal is burned in large quantities at the power station to produce steam to turn the turbines to make electricity which is then transmitted along power lines to the consumer. In every step there is energy loss due to inefficiencies in the network as well as the theoretical efficiency limit on heat engines. The net result is for a small <u>local</u> decrease in entropy (increase in order) with air conditioning there is a huge <u>global</u> increase in entropy.

So it can be seen that entropy can locally be reduced provided there is an intelligent input and sufficient free energy to do so. Free energy is high quality energy that can be employed to go from a 'hot' reservoir to a 'cold' reservoir, doing work as it does so but being degraded and 'lost' to us as a result.

Sudden and unpredictable jumps between states are a known consequence of chaos as shown above even though we don't necessarily know what may cause these jumps to occur. The ability to jump from one ordered (stable) state (e.g. a worm) to a higher ordered state (e.g. a trilobite) can be exploited by Yah as the frontloading designer provided there is sufficient free energy available to do so even though the designer may not know when such a transition will occur. All He needs to know is that it will. Clearly the sun provides more than enough energy to bring about biological changes that degrade energy but in the process increase order and information. The only other requirement is intelligent input.

Such intelligent input was provided by Yah who front-loaded the first genome to adapt to changes in the environment.

So how could Yah build front-loading into this system?

Sexual reproduction produces gene shuffling of existing genes so that combinations more fitted to survive will occur.

Gene duplication is a brilliant method of keeping the genome intact while experimenting with it at the same time. In the human genome there are what are called 'pseudogenes'. These are non-functional genes that seem to have no purpose in the life of the individual and may be the end product of gene duplication that is either now redundant or a failed experiment. With gene duplication it is possible to mutate one of the identical genes to produce the rare beneficial mutation while not endangering the life of the individual by having a fully functional 'normal' gene. It should also be noted that gene duplication is a way of increasing the size of the genome but curiously there is no correlation between the size of a species genome and the number of functional genes it contains. For example a single celled species of amoeba has about 100 times the number of base pairs than humans but fewer functional genes. Nevertheless, gene duplication does increase the probability of increasing the number of different functional genes and hence the information content of the genome.

The presence of sequences or even genes hidden within the genome that could be activated by environmental pressures on the organism. Mike Gene has given examples of proteins needed only for multi-cellular organisms found in single celled bacteria.

The use of viruses to transfer genetic material between cells. This is a well-known fact whereby a virus may acquire from one individual – perhaps from another species – one or more genes or genetic material that is passed on when the virus infects another individual. Mitochondria are able to convert energy from glucose and the degradation of proteins into the energy currency of eukaryotic cells – ATP - such as ours. Mitochondria have their own genome and are thought to have been primitive bacteria captured by eukaryotic cells to enable an evolutionary advance.

Viral transfection is used in medicine to help cure genetic disease such as mucovicidosis (cystic fibrosis) but so far with limited success. Infection of somatic cells doesn't usually help transmission. When the stem cells that are in the testes and ovaries are involved the result is longitudinal transmission. It works in reverse as well – the virus is 'enriched' by genetic material from other sources including bacteria. This 'reverse engineering' may be what causes new viruses such as AIDS or Ebola to acquire their lethality.

The choice of amino acids which make up our proteins. Mike Gene has shown how mutations can have the statistical effect of changing hydrophilic amino acids to hydrophobic amino acids, thereby increasing the likelihood of a functional tertiary structure. The description is found in his book: The Design Matrix.

The DNA code itself. The code is optimized and is the same throughout all life on earth. This permits the exchange of genetic information over a wide range of species. Since the expression of genes is through control by master genes of other genes, whichever is effected may have little or a profound effect. In addition the 'junk' DNA by being the target of mutation, deletions or insertions may subtly modify the temporal and spatial expression of genes.

These described changes can singly or in combination result in a sudden shift in the expression of the genome in a chaotic non-linear system. Simple linear equations that model idealized or 'simple' systems such as the trajectory of a planet orbiting the sun are easy to solve. Equations that model reality more closely such as the Navier-Stokes equations are non-linear and are either very difficult to solve of can't be solved at all in closed form. These equations are associated in one way or another with chaos and its handmaiden quantum mechanics.

So we are left with the fact that front loading is nonlinear and hence its outcome cannot be predicted temporarily or spatially from the beginning.

A linear system might be Darwinian evolution where there is a constant background frequency of mutation leading (supposedly) to ever more complex and beneficial uplands of genetic diversity.

In non-linear systems we can expect a jump from one state to another without such a jump being predictable in both time and degree of change.

This whole hypothesis may seem counter-intuitive. However, it does explain much. It explains that an increase in order is possible without contradicting the laws of the thermodynamics.

It accounts for the progressive deterioration of species genomes without the entire genome becoming extinct.

It accounts for the paleontological record in the rocks in that evolution has proceeded in jumps and that evolution has progressed from the simple to the complex in a non-deterministic way.

It accounts for Yah's character in that He must create a non-deterministic universe to allow free will and to be continually hands-on would at least in part contradict that requirement.

Finally it must mean that Adam was created uniquely from the dust of the ground. His genome was perfect at the time of the garden. Humanoids outside the garden had genomes that were far from perfect and it seems very unlikely to me that a creator god would use something so genetically flawed when He could create a new being that was perfect in every way from scratch. Of all the people who have ever lived, Adam and Chavvah were the only ones to have lived in an island of stability in the midst of surrounding chaos. So why bring the chaos into the garden?

The other alternative to this hypothesis is that Yah is a hands-on creator. He could certainly do that and even in a non-deterministic universe He may have done so to ensure the appearance of man when He needed it.

The bottom line is that Yah is present in both hypotheses as the primal and only cause of life. The difference is merely the manner in which life was brought about.

I think the two hypotheses are equally valid or both may be working together. I can go no further in establishing what actually happened and - who knows – that may have been intentional.

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