The genesis and development of life

LUCA

The earliest evidence of living organisms on Earth, which was discovered in Greenland, goes back 3.7 billion years which means that life probably started about 4 billion years ago, almost immediately after the Earth's temperature was low enough to sustain life. According to the present scientific understanding the earliest precursor to life is called LUCA - Last Universal Common Ancestor. There are several hypothesis about the LUCA structure and some evolutionists proclaim that it was a very simple organism.

I feel that a realistic and safe approach is to assume that LUCA was very similar to the structure of today's simplest bacteria which has hardly changed for the last 3 billion years. Therefore we can assume that it stayed unchanged right from the beginning of life on Earth.

The first living organisms were not just bags of DNA with randomly diffused proteins and enzymes, but included sophisticated and complex molecular machinery. There must be a lower limit of the organism's complexity below which biological life is not possible. Genetically modified organisms are now a reality and completely new sets of genes have been implanted in cells. Such work was performed in the J. Craig Venter Institute where a synthetic genome in *Mycoplasma mycoides*, a parasitic bacterium, was reduced to 473 genes. After the modifications these bacteria reproduced in perfect laboratory conditions at a reduced rate of 3 hours[1]. However the synthetic genome was introduced to living bacteria, therefore the whole supporting cell structure already existed. During this experiment many genes may have been removed which would have affected the long term survival of the bacteria therefore 473 genes might not represent the minimum genome. Since the functions of many genes have not been identified it is difficult to estimate what genome is needed for life.

What should the basic structure of LUCA be which could perform everything necessary for living tasks? It must fulfill several fundamental functions: it must

[1] Hutchinson, C.A., et al. 2016. Design and synthesis of a minimal bacterial genome. *Science*. 351: 25 March.

produce and utilize energy, it must store and make use of information on how to build cell structures, it must be able to make all cell components from the available raw materials, and it must reproduce or make copies of itself using the stored information and production facilities.

LUCA, which must have employed photosynthesis to generate energy, should be similar to present cyanobacteria which have about 3,000 genes. Therefore it is most likely that the first organisms, which would have had to survive in a difficult environment and adapt to varying conditions, would have needed at least 2,000 genes. Some researchers have proposed that LUCA could have had as few as six hundred or a thousand genes but they are not able to provide any substantiation for this hypothesis.

LUCAs from the beginning were very complex biochemical factories employing several thousand proteins involved in thousands of chemical reactions. Processes such as photosynthesis and respiration, which existed right at the beginning of life on Earth, employ, even by present-day scientific knowledge, mind boggling complexities.

Since it would be impossible for such complex life to evolve from inorganic matter the only plausible solution is that it was implanted on Earth. Life was designed and cells were made by extraterrestrial engineers and delivered when Earth became habitable. The cells could have been delivered in special containers which were sent to our planet. The containers landed in oceans where the content was released.

The first organisms which arrived on Earth were cells similar to present day bacteria and included cyanobacteria which were responsible for the generation of oxygen. Further development of these organisms was driven by several mechanisms. The most important were bacteriophages or viruses which replicated in bacteria and could modify bacterial DNA. Improved genes in some bacteria could be transferred to other bacteria using horizontal gene transfer mechanism.

This mechanism makes the direct transfer of genes from one individual to another possible, as well as picking up DNA material from outside of the cell. These mechanisms enable bacteria to adjust very quickly to different environmental conditions and fill any niches which become available. Now we find bacteria living in all conditions on Earth. From alkaline to acid lakes, from the Arctic to underwater volcanic vents. Bacteria are able to colonize all living organisms where they play an important part in their metabolism. We do not know how many species of bacteria exist, but some estimates are in the range of a billion.

After about 2 billion years, when oxygen in the atmosphere increased to sufficiently high levels, Earth was ready to accept more advanced life. Next the eukaryotic cell appeared; a new building block that eventually enabled the construction of multicellular organisms. It is most likely that progenitors of the eukaryotic cell were also delivered to Earth in containers.

Eukaryotic cells have far more complex genetic modification mechanisms than bacteria. These mechanisms, which include transposons and introns, allowed organisms to modify their genes and adjust to different environments. Eukaryotic cells were also subjected to attacks by viruses which changed their genes by injecting new DNA materials.

For the next 1.5 billion years life in the oceans was dominated by single eukaryotic cell organisms belonging to the kingdom Protista. Some protists such as algae perform photosynthesis, others are predatory eating other protists and bacteria and some scavenge for dead organisms. It is estimated that at present about 250,000 species belong to this kingdom. It is interesting to note that although eukaryotic cells had all the capabilities of becoming multicellular organisms, they waited so long for the next development phase. This delay was caused by Earth's climatic instabilities. Earth, between 750 and 550 million years ago, passed through several glaciation stages, some being so severe they caused all the oceans to freeze. Only when the Earth's temperature returned to normal could further development of life proceed.

This next phase was the Cambrian explosion which started about 541 million years ago. During this 25 million year period all the body plans which currently exist in all animals appeared. Some of the animal body plans were very complex such as the phylum Chordata to which all vertebrates, including *Homo sapiens,* belong. Such body plans could not have been developed from single eukaryotic cells by applying gene modification mechanisms because of the immense increase in complexity (discussed in my book The New Genesis). These bodies had to be designed from scratch and delivered to Earth in well advanced forms. The practical solution was to send to Earth frozen embryos of all phyla in special containers. Since all life was water based, such embryos placed in water would be in a benign environment. Water would also protect embryos against space radiation during the journey to Earth. One could envisage that the ocean's fauna were prepared in such a way that the simplest animals were sent first followed by more advanced. The Cambrian animals were well designed because they were fully adapted to the existing conditions on Earth.

The cells of animal embryos which were sent in containers had a very important feature. They had a large pool of genes, of which some were not needed and were switched off. Practically all phyla had about 20,000 genes. Several of these genes were prepared for future development and could stay dormant for millions of years. Only when the environment or living conditions changed were these genes switched on by epigenetic means. They could also be switched on using specially designed viruses.

Introns, which were introduced early on to eukaryotic cells, played an important role in the development of life. Introns enable one gene to code for several different proteins. This feature greatly enabled the production of various new proteins without the need for making new genes.

A very important event which took place more than 450 million years ago was vertebrate gene duplication[2]. This means that additional copies of the whole genome were made. Such an event could be triggered by implanting a suitable virus in the genome. That way vertebrates obtained a large amount of spare DNA material which could be modified and changed into new genes in the future. This event enabled the further development of vertebrates, leading to mammals and finally to man.

Once all phyla were well established in the seas, about 420 million years ago, some animals began to prepare to leave water. The first animals to venture onto land were the arthropods such as spiders and centipedes. Before animals moved onto land they had to be adapted to the new environment. The development of these animals took place whilst still living in water. For example, the earliest four legged vertebrates, known as tetrapods, which emerged from the water about 385 million

[2] Dehal, P., Boore, J.L. 2005. Two Rounds of Whole Genome Duplication in the Ancestral Vertebrate. *PLoS Biol* 3(10): e314.

years ago, looked like fish but already had lungs and sturdy shoulders and hips capable of supporting the body's weight on land.

Further development of land based animals would have to have taken place via the genetic modification of germ cells. The most important mechanism driving the development of new classes of animals such as amphibians, reptiles, birds and mammals were the genetic modifications of DNA caused by the incorporation of viruses entering the germ cells. The incorporation of virus DNA changed the operation of organisms bringing new functions and enhancing old ones. Its effectiveness in the modification of organisms could be several orders of magnitude higher than that of mutations. Viruses are therefore the most important mechanisms for driving the development of life. Such viruses were specially engineered for specific modifications and sent to Earth at the appropriate times.

Other internal genetic variability mechanisms could have played a significant role in the development process such as transposons and the epigenetic switching of genes.

About 75 million years after the first amphibians moved from sea to land, reptiles appeared. The next leap was the development of mammals which arrived on the scene about 200 million years ago. Being warm blooded, mammals had significant changes to their body plans such as more efficient metabolism, a four chamber heart and giving birth to live young. Again these changes were driven by viruses as has been shown, for example, where the genes involved in the development of mammal’s placentas originated from viruses.

The role of viruses in the shaping of mammals’ bodies can be confirmed by research which has shown that adaptations in mammals have occurred three times as frequently in virus-interacting proteins compared with other proteins.