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The Solari Report

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Future Science Series: Medical Nanobots – Implications of the Wave Genome, Part II with Ulrike Granögger

Ulrike Granögger: Welcome back to Part II of the *Solari Future Science Report* on nanotechnology. Now we will go a step further, and explore the field implications of bionanotechnology. (As in Part I, to see the visualizations that are mentioned in this report, please watch the video of this presentation on *The Solari Report*).

I know we are often influenced by images of little robots running through our veins, and there is somewhat of a thrilling shiver that runs down our spines. Now, however, I would like to take this to a subtler area, and one that we may overlook by focusing on the machine idea of nanobots.

The Wave Genome points us to the immaterial and interaction with information fields in space and time rather than a purely material reality. This has been the secret of life so far, and it was and is difficult to crack for the purely materialist scientist. However, due to the unique position of the nanoscale along the logarithmic line of universal lengths, scientists are bound to discover some of the information field design of life.

We, too, should know about this, for we all have a role to play in protecting the sanctity of life from its utilization of, what would be called, an Ahrimanic mechanistic power that tries to pull a veil of matter or a web of sensors over the mind and replace or curb our innate dynamic and co-creative interaction with the living.

Most of what we discussed in Part I, particularly regarding the applications of medical nanotechnology, concerned the interfacing of biology or living matter with microrobotics, computer engineering, and a resultant 'programmable matter'. Remember that biology and bioengineering is essentially the same as nanotechnology – both happen on the same scale.

On this tiny nanoscale, a phase shift occurs – probably more profound than the one on the quantum scale. It is here that the transition between macro and micro reality, between particle and wave structure, is beginning to take hold and show effects. That is why this area of research is going to profoundly affect our lives.

It is the phase transition between matter and information. Therefore,

information technology and biotechnology or bioinformatics are converging on this level into an inevitable "biodigital convergence" that even governments are speaking about and projecting into the no-longer distant future. You will find a very good report by James Corbett on exactly this biodigital convergence, which I would recommend to each of you.

The fusion of our understanding of biology with nanotechnology is subsumed under the general term 'synthetic biology'. This comprises a mixture of technological engineering and genetic or biomolecular engineering.

Synthetic Organisms

In order to create enhanced or altogether new organisms, many different concepts and disciplines are subsumed under 'synthetic biology' such as digital biology, claytronics, programmable matter, xenobiology, etc. All of them are used for various applications resulting primarily in biological computing.

This biological computing has led to the creation of new and artificial lifeforms. The very first synthetic organism in the modern-day period is Craig Venter's Synthia 1 (JCVI-syn1.0), and the subsequent Synthia 3 (JCVI-syn3.0) – an artificial bacterial lifeform.

Mycoplasma genitalium, which is an infectious bacterium, was emptied of its chromosomes and was inserted with a new totally artificial genome that also contained four watermarks or owner's tags with the names of the scientists that created the genome, including that of Craig Venter. It also included a website address and three quotes from literature and human history that the authors chose to represent their mindset in making this synthetic biology.

So here we see the artificial genome, which was published in 2010. Here are the four watermarks or 'inserts' that look like this in genetic letters. These would correspond to the four inserts. These four inserts are not functional proteins, but are there as a code of human information in the bacterial lifeform.

When these four inserts are discovered and deciphered, they reveal three quotes that are demonstrating that this is genuinely an artificial lifeform – the world's first synthetic organism. These are the three quotes: "To live, to err, to fall, to triumph, to recreate life out of life," by James Joyce. The second quote is, "See

things not as they are, but as they might be," which is attributed to J. Robert Oppenheimer. The third quote is, "What I cannot build, I cannot understand," attributed to Richard Feynman. They are coded from a code of genetics into a bacteria. This creation of synthetic genomes is possible due to a digitalization of biology, and reversely, an emergent biology from digital data. Here, we see the convergence.

The scientists write the genome code on the computer, and then assemble the corresponding nucleotides – like letters – into a text. In the same way, the names of these authors and quotes were made into biological information.

In this case, they were not using CRISPR (clustered regularly interspaced short palindromic repeats) to add or remove genes, but they wrote an entire genome code from scratch. We see that DNA can be utilized to store information that is not necessarily biological information or a protein script, but any information such as a name or a text or, as we will see, even a video can be stored in DNA.

DNA Data Storage

More and more DNA is used for such data storage. Harvard Medical School is among the key institutions pursuing this development. They are finding that DNA is highly dense; it is a million times denser than any other storage medium. So, one gram of DNA can store hundreds of petabytes of data. That is trillions of bytes of data. Also, one advantage of DNA storage and ultimately DNA computing, is that there is 'in-storage computing', meaning that you do not have two separate places – one for where you keep the data, and the other where the processing is going on; processing and data storage are on the same level.

Following is a short video excerpt from a talk by a Harvard Medical School professor who is working on DNA information storage:

> How we might use nucleic acids to store data. What is data, and what is the cloud? This is a photo of the Facebook data center. It's about a million square meters and about a billion dollars to construct, and it holds all of your data, and yet 90% of the data is never accessed. This is what we have learned from Facebook, from DropBox, and from a number of studies. Using storage at this rate, by 2025 we will run into at least two problems:

> There will be more data generated than the amount of the silicon that can be used for memory being mined. Secondly, data centers will take about 20% of the global world electricity production. Clearly, we need to do something else.
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> DNA is incredibly dense, it's easy to replicate, and it is something that we will read forever as long as we have access to a DNA sequencer. The world's largest, most advanced USB (thumb) drives store about one terabyte of storage.
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> If you take the calculation of how much DNA is in your biological thumb, you can get a hundred million times that storage – and that is something that we can read – at any point.

That is quite interesting – how much data can be stored in just a tiny bit of DNA. Here is the work of two European inventors who received this year's European Innovation Prize for making DNA storage stable. This is one of the questions of how to stabilize the storage into something that is as sensitive as DNA. Here are Robert Grass and Wendelin Stark from Austria and Switzerland. They are working with an advanced form of data storage in DNA that is permanently protected in the form of synthetic fossils. As we will see in the next video excerpt, the information from a book is converted into DNA letters, and then synthesized as DNA.

In order to make the storage long-lasting, the DNA is placed into tiny glass beads, much like an amber fossil encapsulating an ancient insect:

> So, the researchers take nature and combine it with technology. For example, every character in a book can be translated into digital code, and that – in turn – into a DNA code. A sequence of DNA letters is created. This construction plan then enables artificial DNA to be produced. The information inside an entire book can then become DNA. But protecting it effectively is a challenge.
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> The problem with all of the previous approaches was that the information wasn't stable enough if simply translated into DNA. The stability doesn't only depend on the DNA itself, but also on sealing the DNA inside

another material.

Finally, they try using tiny spheres of nonporous silicon dioxide, glass particles. These are only one ten-thousandth of a millimeter in size, so they are only visible under an electron microscope. The researchers seal the DNA inside these tiny spheres. There is enough DNA in each one to store two pages of a book.

The problem is that we can't read the DNA when it's inside the glass particles, so we have to remove it. With glass, we chose the most stable material in existence. But there are fluoride ions, and they react with glass. So, we can selectively dissolve the glass without destroying the DNA.

Using these biotechnological methods, the researchers succeed in retrieving the valuable data from the tiny glass beads. After three years of intensive research, it is now clear: The DNA data stored inside the synthetic glass fossils is undamaged; the DNA code can be read in its entirety again, and translated back into the original information. The researchers even use this technique to preserve a music album for eternity.

It is quite remarkable how precise DNA is in storing normal information once it is digitized. Not only human letters to DNA letter translations are possible; all digital data can be stored in DNA.

Here we see how scientists already in 2017 have stored a video in bacterial DNA and were able to recapture it. These are scientists at Harvard under George Church. They used CRISPR DNA editing technology to first record images of a human hand into the genome of a living E. coli bacteria. This was then read out with higher than 90% accuracy. The bacteria were able to pass this DNA information on to following generations.

Later, there was a full video with a horse movement, which employs a sequence – a time factor – of data. It was retrieved in the same way.

The method is termed 'molecular recording' and has far-reaching implications for the *recording of biological time*. We will see that this plays a role in our discussion. Here we see a short, edited video:

We are looking at an image of a human hand. We chose a human hand because it was one of the first images that people put on the natural world. Because we are encoding images here into the natural world in a different way, we decided to recapitulate one of those images. What you are seeing is the source image, which is what we started with. We then coded all of the pixel values into the nucleotides of the DNA, distributed them over a number of strands of DNA, and then put them into bacteria where the bacteria acquired those sequences and captured them into their own genome.

After the cells grew for a while, we then sequenced their genomes and were able to reconstruct the image based on the sequencing of the nucleotides that were inserted. So, then what you are looking at is also the reconstructed image from the bacteria after they were sequenced.

Here we are looking at a movie of a horse running. This was originally taken by Eadweard Muybridge. Again, it was one of the first moving images that was made, so we thought that was an appropriate thing to encode. What we did here was, again, for each frame, we broke down the pixel values and coded them in the nucleotides of DNA across many different strands – about 100 strands for each frame of the image. Then, in this case, we delivered those strands to living bacteria over time. So, each frame was delivered on a different day over the course of five days.

We let those cells grow for a little while, and then we sequenced their genomes and we were able to reconstruct, not only each of the frames, but the *order* of each of the frames because the molecular recording system that we are using captures the timing information of different molecular events.

The next step would be to hook it up to actual biology. Right now, we were supplying information in the form of synthesized DNA. In the future, we want that information to come from biological events that are happening within the cells. So that is the next step.

That is fairly interesting, which I hope you caught at the very end. The

molecular recording is able to capture the timing information of molecular events, and the scientists are looking, not just at recording timed sequences that are coming in from external information, but are ultimately interested in recording the time sequence of molecular events in the cell. This is the decoding of biological time, and it will take us to the larger umbrella of our talk on epigenetics. It is there that I feel that the biggest breakthroughs in nanotechnology are being made, which will concern us.

Molecular Recording

He said that in the future, we want this to record the events of the cell itself. It is therefore reading a time sequence that is of events going on inside.

The method of molecular recording is more than 'meets the eye' at first. In this article of 2019, it says – and this is all cutting edge and very, very recent research – that here "we present a flexible high-information multi-channel molecular recorder with a single cell readout and apply it as an evolving lineage tracer to assemble mouse cell fate maps from fertilization through gastrulation".

So, the cells of mouse tissue – their fates and their timeline and their life history – is mapped out over a stretch of time. This is done with an abundance of information, and multi-channel molecules are being read.

The article says, "Our approach enables massively parallel, high-resolution recording of lineage and other information in mammalian systems." So, what we are looking at is the recording of time in our cells. This refers to not only our own historical time, but even to lineage time – to predecessors that are going into our own genetic code.

DNA Computing

Also, DNA or biomolecules are more and more used for Biocomputing, which will then allow for massive parallel computing at a very low energy costs. Normal computers cannot do parallel functions at all.

It may seem that our PC or smartphone can perform several tasks at once, but really it can only do one logical step at a time. It does them, however, very, very quickly and modern CPUs can switch between different steps about 2.5 billion times per second.

As mentioned in Part I, there exist first bionanotransistors or similar 'on/off' switches using enzymes in cells and along the DNA. So, we are beginning to use DNA and cells as literally biological processors.

There are attempts at drawing whole integrated circuits with proteins and biomolecules that are leading us to entirely new forms of computation.

Here in this work, we see nanometer-sized biomolecular machines that can solve problems by moving through a nanofabricated network of channels designed to represent a mathematical problem. This is the network of channels that are designed, and the result as they move through will then be the solution to a mathematical problem. What is moving through are biomolecular machines, which are called myosin. Despite the fact that the biological proteins are moving rather slowly compared to current computer speeds, the advantage is that proteins and biomolecules are self-assembling. They can be used in large numbers and can quickly add their computing power into parallel computations.

It tells us: "A given combinatorial problem is encoded into a graphical modular network that is embedded in a nanofabricated planar device. Exploring the network in a parallel fashion using a large number of independent molecular motor-propelled agents solves the mathematical problem", and does this very quickly.

In 2016, this is the first viable biocomputer using this biomolecule myosin for solving problems. Myosin are proteins that we all have in our bodies. They allow for muscle contraction; they transport a signal or a protein in the muscle fiber. These myosin motors move the filaments along certain paths. Paths can be designed artificially in order to produce this calculation network.

Let us look at a short video excerpt to explain this:

> Classical computers can't do such things very well. The closest thing that we've gotten to is that many classical computers are slapped together and given the title of a supercomputer. What we need is a computer that can actually solve many problems at the same time. What we need is something called a parallel computer. A brand-new feasible solution has

just been discovered at Lund University in Sweden. The results have been published in the proceedings of the *National Academy of Sciences*.

The biocomputing approach uses less than one percent of the energy used by current electronic transistors. As it turns out, the solution has been around for a very long time in the form of a protein called myosin, part of our muscle tissue.

You are actually using myosin right now in your eyes to watch this video. Myosin can be thought of as tiny molecular motors converting chemical energy into mechanical energy. The Swedish biocomputer uses the myosin to guide protein filaments along artificial paths. In simple terms, it involves building a network of nano-based channels that give specific traffic regulations for protein filaments.

The solution in the network corresponds to the answer of a mathematical question, and many molecules can find their way through the network at the same time.

Let's quickly look at the system in action. You are looking at it right now. The numbers at the bottom represent solved solutions to an equation. As you can see, the system is finding many solutions at the same time.

So, you will soon have bacteria or bioproteins in your smartphone and tablet, and you will have live molecules – DNA and RNA – harnessed into computer operations. Simple lifeforms such as bacteria and cells at large are being employed as logical gates and calculators, or even as power generators for cryptocurrency mining and for the blockchain, such as in this institute in the Netherlands where organisms (in this case, human organisms) are utilized for energy production.

All of this is part of the biodigital convergence and synthetic biology as a consequence of the interfacing of life and machine.

Electrical Biofield

However, the biorobots that I consider as much more ground-breaking, and the knowledge of which is much more impactful than what we have seen so far, in

my opinion, are those that are created by the manipulation of nothing less than the electric energy information field of the living species. Harvard now knows the biofield.

The same institutions that study how to interweave brains with computers now know how to control the morphogenetic field of a species. They have solved one of the longstanding unanswered questions of biology and genetics, namely: What is the guiding force behind cell differentiation?

If all cells basically have the same chromosomal library, how and when do they decide to differentiate into very differently structured and functional cells from the same stem cell blastula? Where is the information stored if not in the genes alone?

The Harvard scientists were, of course, not the first or the only ones to discover this guiding electric field that steers cell differentiation at the anatomical-spatial order of the organism, but most of the former discoveries were regarded as 'fringe' or, more or less, unscientific. However, once a university like Harvard and Tufts are working with the energy field of living creatures, the results take on a new direction and potential.

As you've seen in the recommended TED (Technology, Entertainment, Design) Talk by the distinguished professor of biology at Tufts University, Dr. Michael Levin, who works on the electrical voltage differences across the cells in a developing animal to influence gene expression or to correct birth defects or to regenerate whole limbs, or even to grow additional limbs… he does this all without making any changes to the DNA molecule – only by controlling the electrical field that surrounds cells.

DNA is not the only aspect to build and regulate an organism. The effects of the electrical direct current potential covering the organism are what define the function and location in space and time for the lifeform. It is now possible to intervene in this bioelectrical code without the need to intervene with DNA.

Here is an excerpt of the TED Talk by Michael Levin. He explains this electromagnetic or electric field around the cells and how this is the guiding force for cell differentiation:

> Cells certainly do communicate biochemically and via physical forces, but there is something else that is going on that is extremely interesting, and that is basically called bioelectricity – non-neural bioelectricity. It turns out that all cells in your body, not just nerves, communicate with each other using electrical signals. What you are seeing here is a time lapse video. For the first time, we are now able to eavesdrop on all of the electrical conversations that the cells are having with each other.
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> Think about this: This is an early frog embryo. This is about 8-10 hours of development. The colors are showing you actual electrical states that allow you to see all of the electrical software that is running on the genome-defined cellular hardware.
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> These cells are basically communicating with each other – who is going to be head, who is going to be tail, who is going to be left, and who is going to be right. They communicate who is going to be eyes and brain and so on. It is this software that allows these living systems to achieve specific goals – goals such as building an embryo or regenerating a limb for animals that do this. The ability to see these electrical conversations gives us some really remarkable opportunities to target or rewrite the goals towards which these living systems are operating.

This is groundbreaking research, but they are not the first. In the 1960's and 1970's, earlier work by Robert O. Becker, author of the well-known book, *The Body Electric*, showed already that by applying an electrical potential to the location of a severed limb in animals, certain species could regrow a full limb. Others, especially mammals, were at least able to regrow a partial limb.

It is now understood that there is a direct current associated with the central nervous system. More precisely, it was the glial cells covering the nerves as a sheath. In these cells, it seems that a direct current potential is flowing or is situated.

This is the research of Robert O. Becker: You must understand that salamanders have the natural ability of limb regeneration while other animals, such as frogs, for example, do not have this. When a salamander's leg is severed,

it can regrow the leg completely. However, when a frog's leg is cut off, or a mammal like a mouse or a rat has a limb cut off, and a direct current field is applied, the rat or frog will grow its limb again.

We see the different stages. Here is the severing, and then here is the regrowing of the limb. This is in the case of the salamander – the natural regeneration. Here we see the rat having its limb severed, and then the direct current is being applied. After seven days, there will be the beginning of the growing of new muscle, new nerves, and even new bone structures.

Interestingly, most organisms have the same direct current or electric field polarization along the nervous system. We also remember from the *Wave Genome,* the unique results of Guido Ebner and Heinz Schürch of Novartis in Switzerland. They treated the spawn of trout and the spores of ferns and other plants in an electrostatic field to discover that antecedent phenotypes and morphologies emerged from these eggs or these spores, even though the genome had not been touched.

We also remember the work of Tsian Kanchzhen, who was able to electromagnetically create hybrid features between a chicken and a duck, as well as between cucumbers and melons and other species. There was no gene splicing and no CRISPR technology. All that is done is radiation of the field.

The work done in Michael Levin's group is a revival and a profound expansion upon these earlier findings. Once again, since this is now done at a major university interested in the interface between human and machine and that is interested in biorobotics, and is interested in bionanotechnology, there is something special happening in the knowledge field of academia.

Michael Levin has found that each organ and each organism has an electrical pattern that can be controlled by switching voltage-gated ion channels in the cells on or off. It's almost like transistors. In this case, they are not applying electricity per se; they are switching the ion channels between the cells. This electrical map that runs upon all the cells – by switching on and off – can be manipulated to build different structures than the cells would normally build.

The quote is, "We are now beginning to crack that morphogenetic code and

rewrite that map to new outcomes."

These planaria worms, as you have seen the TED Talk, have the ability to regenerate themselves almost from any section cut off. It's similar to the salamander, but even more powerful; they will always build a full planaria.

The Levin lab has changed the electrical field by switching the ion channel transistors and has been able to generate planaria with two heads or with two tails. Similarly, they are able to regenerate limbs in other animals or to even grow extra limbs. They can grow extra organs or extra eyes simply by manipulating the field.

This is groundbreaking as there is no CRISPR editing of the genome required. The DNA remains the same, and yet unheard of changes are made.

Remember also in the concept of the Wave Genome, the DNA-RNA double helix is primarily acting as an antenna that captures and transmits the yet-to-be discovered informational fields, which hold the key to the morphological maps, including the neurological electrical maps.

In further research, the Levin lab is also looking at the cognitive or consciousness aspect of morphogenesis. The questions are: Does shape have something to do with cognition, with brain functions, or with consciousness? How does shape emerge? How does consciousness emerge? Is there information in the voltage patterns along the nervous system? Can we simply manipulate the cell or the body without impacting on its inherent and emergent consciousness?

Levin's work was also able to restore brain function simply by the manipulation of the voltage field of the cells.

It is possible to repair damaged brains during embryogenesis, and in later stages, by guiding or controlling the bioelectric circuits. In this case, nicotine was used to disrupt the normal electrical patterns in the brain of the growing embryo. What emerged was a misguided or misformed brain. This is a normal brain of the frog embryo, and here we have a brain under the influence of nicotine during embryogenesis.

Nicotine reduces the strengths of the voltage map; it's no longer clearly defined. This leads to malformations and malfunctioning of the nervous system.

The author then activated the ion channels and returned the functionality of the brain even when the ion channels were not activated in the region of the central system. Let us remember how close Tufts is to Harvard and to the Lieber Research on brain-machine interfaces. Will these interfaces be possible eventually by altering and controlling the ion channel gates of the cells to stimulate new electrical patterns over and across the neurological network?

Robotic Lifeforms

Their most recent work applies this understanding to create robotic lifeforms. They call them xenobots. They are made by designing a computer platform to select the appropriate shape and function. Xenobots have emergent consciousness; they represent a form of synthetic morphogenesis. They can be called 'living machines' because they are not a lifeform, but they still have a type of will of their own, and they can be programmed to perform certain functions.

For the production of these xenobots, the researchers selected skin cells and heart cells from the African frog and combined them in a particular way in order to produce an entity that can walk.

Here we have the skin cells in green and the heart cells in red. The heart cells were placed in particular locations because they would enable the organism to move – to propel itself forward – through the contraction motion of the heart cells. They are displaying almost willed behavior, or they seem to at least, having a will and a social life and certain interaction activity.

Here (video) we have a description of how this has been done. Stem cells were opened, and the tissue is harvested. Then it forms into a sphere. This tissue – this sphere – closes in upon itself and becomes mobile. It moves by tiny cilia (small hair) that it developed on its surface without the researchers telling it to do so. It also seems to be able to move on its own.

They also have a rudimentary type of memory, and it can be programmed to make signals under certain environmental conditions.

Researchers believe that they will be able to use them as robots to clean up areas; they heal when injured.

Epigenetics

The important insight in all of this work is that it is not primarily the molecular chemical genome that is involved in the pattern formation, in the pattern memory, and in the morphogenesis. Genetically, no change has been made, but proteins, enzymes, and processes were either expressed or switched off through other factors that demonstrates the superior information field on the epigenetic level.

Epigenetics is the study of the causes for the different phenotypes without changing the genotype, or how non-gene factors can influence the traits and functions of an organism. How and why is a gene expressed or not? What factors from the environment – and the environment in the wider sense, including the electromagnetic field environment and information environment – may impact gene expression, the turning on and off of certain genes, acting as a switch for different genomic sequences?

The genome is the instructions and the epigenome is how they are read. We can see this very markedly in the example of the honeybee. Each of these manifestations of the bee have almost the same genome – the worker bee, the drone, and the queen – and yet they form completely different functions and phenotypes. These factors that decide the epigenetic expression are, for example, the food that the queen bee receives, or a certain electromagnetic communication that is going on to determine what function the entity will take on in the swarm organism.

Epigenetics is explaining a wide variety of factors in the expression of life. Think of twins who have the same genome but who lead very different lives. They may have very different reactions to the environment.

A wide variety of illnesses, behaviors, and other health indicators have already been linked with epigenetic mechanisms. For example, all types of cancers and also, cognitive dysfunctions such as schizophrenia have been connected with epigenetic markers. Other mental or neurological diseases have been connected

with epigenetic markers, as well as respiratory, cardiovascular, reproductive, and autoimmune diseases.

The known or suspected drivers behind epigenetic processes are manifold, including poisoning through heavy metals, pesticides, diesel exhaust, and other exhaust particles, tobacco smoke, and hormones, radioactivity, microwave radiation, and also viruses and bacteria, as well as mentality, habit, medical procedures, stress, family situation, and the emotional environment. All of this is part of the epigenetic coding of the organism.

In this sense, we can imagine how the modern RNA and DNA vaccines will be epigenetic interventions. They will have, not only a genetic effect, but an epigenetic effect. They will have an impact on the way genes are expressed and proteins are synthesized.

Epigenetic factors can be found or are visible along the DNA in the form of mainly two aspects: *DNA methylation* – that is the addition or the removal of a methyl group which acts as a marker. Each of these methyl groups, as it is added to the chromosome or to the DNA helix at a certain point, correspond with an event that left an epigenetic trace in the life of the organism.

Usually, methyl markers along the DNA helix mean that the particular region in the DNA is no longer going to be expressed or is expressed in a faulty manner.

Another form of epigenomic changes are *chromatin modifications*. Chromatin is the winding up of the double helix to ultimately form the chromosome. In order to do this winding up, the double helix winds or folds around proteins that are called histones. If there are epigenetic markers on the histone tails – epigenetic factors – the folding and winding as well as unwinding will be hampered and no longer smooth.

What is most interesting is that these methyl groups and epigenetic factors on the histones function like a *timeline* of environmental and inner-environmental events. So, these also show *when* the events occurred in the lifetime of an organism.

What we are seeing through the work of Becker or Gariaev, or modern

researchers such as Bruce Lipton, and now in particular through the work of Michael Levin and his laboratory, is that epigenetics relates to the informational field that plays a role in the expression or manifestation of the organism. The epigenetic literally is interconnected with the electromagnetic and informational field.

There seems to be an epigenetic information flow within the voltage gradients across the organism that Michael Levin discovered. If that is altered, it will result in, more or less, dramatic changes of the space and the morphology that is incorporated by the lifeform.

This leads us to the questions: Is there a deeper significance in the actual shape or space of an organism? Is there meaning in the harmonics and proportions, in the geometry of the body, and the result and communication and memory flows between the cells so positioned?

We should think about this: Where does the spatial and temporal structure of the human body – its manifestation in space and time – result from? It is obviously not the DNA alone. The question is: With these breakthroughs now made in the last couple of years, is science at the brink of understanding and addressing the geometry of shape in living bodies?

Michael Levin can create different shapes. What is the feedback to the intelligence of the organism? What is the feedback between space and time and the life force in the body?

Spatial Computing

Here we see how close through advances in genetic engineering we have come to cross the threshold between the material and the immaterial. If we understand that there is a meaning in the shape and the geometry and the spatial manifestation of an organism, what does this mean for the building of an internet of bodies and the new development of spatial computing?

Spatial computing is one of the developments riding upon the nanotechnological and biodigital convergence. Spatial computing is the use of three-dimensional physical space to interface with a computer and to receive a computers output. So, it is no longer a flat computer or a keyboard and a flat

screen – a device – but it is literally the digitalization of the environment and of the space around us. I would argue that it is not only the surface space around us, but the actual nature of space.

Spatial computing is the human interaction with machines, such as computers, robots, or sensors that can save and manipulate data and relations of data on real objects and 3D spaces. The new web or internet – the spatial web – will give us 3D input and three-dimensional output. For that, one needs a special internet protocol on which different companies and players are working. Normal HTTP will not power the full spatial web; the web will need to be reinvisioned into a spatial web. So far, the World Wide Web is still a flat interconnection of different computers, different servers, and nodes.

The spatial web will take this into three-dimensional protocols. We will take this into the interaction and interrelationship of spaces and computers and people.

The following company has developed what they are calling a "hyperspace transfer protocol" to be able to calculate the spatial web. Here is a short film excerpt. (All of the videos are edited. You will find the linkage in the bibliography):

> There is a new world emerging right before our very eyes – a world where we seamlessly and naturally interact with augmented and virtual reality, opening endless possibilities to learn, collaborate, create, and explore. Spaces and cities become smart, physical and digital goods are tracked, and people's identity, security, and finances are protected. This enables citizens, big data, artificial intelligence, and the Internet of Things to finally work together for the benefit of humanity and the planet.
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> But have you ever stopped and wondered how we actually get from here to there? The last few years have shown enormous advances in augmented and virtual reality devices – computer vision, location tracking, edge computing, blockchain, and 5G. But these applications and the devices and operating systems that they utilize are not connected; they are siloed experiences. There is no common standard for all these technologies and applications to work together. For that, you need a common protocol – a way to communicate between each of these technologies. For that, you

need VERSES. VERSES has developed an HSTP (Hyper Space Transfer Protocol) allowing parties to agree on who, what, and where everything is in the physical and virtual world.

Join us and our many forward-thinking partners and industry leaders as we drive the next generation of innovation and lay down the digital infrastructure to support a better future and a new web for people, businesses, our environment, and humanity. Let's build the spatial web.

Now put this together with the hacking of the energy field, the spatial field, or the space geometry of organisms. After 5G, and the Internet of Things, we will have 6G already announced as the Internet of Bodies where each one will wear or have implanted sensors and computers that link us to each other and to the cloud.

With the new breakthrough, will we have a 7G, an "Internet of Energy Bodies" that is an internet that controls and programs the shaping electrical fields of our life? Maybe this sounds far-fetched, but I believe that we should think ahead to possible developments.

It is not only space that is being hacked or that is now in the reach of science. More importantly, when we look at the epigenetic markers along the line of the double helix, such as the methyl groups and the histone tails, they virtually construct a timeline of epigenetic molecular events, and thus a timeline of the environmental impacts and changes that can act as identifiers for the marked events in the life of an organism.

ECHO

Remember the molecular recorder that is intended to read the time of events in the cell. It would utilize epigenetic time markers. The markers along the epigenome can be thought of as entries in the diary of life. Wouldn't it be interesting and provide insight and intelligence if one could look into somebody's book of life?

The military is doing just that. DARPA's (Defense Advanced Research Projects Agency) ECHO program stands for Epigenetic CHaracterization and Observation. "ECHO aims to develop technologies that enable the use of an

individual's epigenome to reveal their history of exposure to weapons of mass destruction and their precursors."

Now, of course, in a military context, you have to give it a military function or some war scenario function, but it reveals an individual's "history of exposure". Weapons of mass destruction sounds very specialized, but the exposure can be equally to any other agent of life and any other impact or influence that would register in the epigenome.

We have already seen that all kinds of impacts, even emotional impacts and consciousness impacts, and diseases and nicotine and alcohol and food… all leave their epigenetic markers. So, what lies before the researchers is an actual timeline of events of an organism's life history. This could include the time of drug use or the times of exposure to viruses or the time of exposure to radiation, or even the time or moments of psychological trauma, or the time of conception and pregnancy. This could even show the epigenetic marker of when you met your spouse or how you were treated by your father.

It says, "ECHO is a technology that quickly reads someone's epigenome and identifies signatures that indicate whether that person has ever in his or her lifetime been exposed to…" – whatever is defined or looked for. So, this program by DARPA is combined with other programs such as the PREPARE (Preemptive Expression of Protective Alleles and Response Elements) program and others, to work in the current pandemic. It is designed to diagnose or sense or discover exposure to chemical weapons and biological/viral weapons — or any other event.

Interestingly, in the brochure that DARPA published on preventing pandemics where ECHO is being referenced, other programs are referenced, showing how the company Moderna was asked by DARPA in 2017 to work on mRNA vaccines in partnership with prevention diagnosis as a critical aspect of a pandemic response. "Rapid discovery, validation, and manufacture of diagnostic tools for the public health community that they can use to detect any disease threat anytime, anywhere," is listed on there for two DARPA programs: The Detect It with Gene Editing Technologies (DIGET) program and the Epigenetic CHaracterization and Observation (ECHO) program.

These programs are utilized in global situations, but they build on an understanding of the epigenetic field that travels with the genetic code; it travels with the electromagnetic biofield. This biofield can now be manipulated.

If we substitute the word 'experience' instead of 'exposure to weapons of mass destruction or viruses', then we can read an individual's characteristic life experiences, even from a sample of their saliva or their blood. The head of the DARPA ECHO program, Dr. Eric Van Gieson, says: "The epigenome is biology's record keeper. We are just beginning to understand this rich biographical record that we carry around with us."

The same technology is also aiming to *predict* outcomes from exposure or experience. So, you are looking at a full timeline of past, present, and future of an organism's critical life events. This not only gives access to an individual's lifetime, but ultimately, can serve as bodies or organisms being used as sensors over time recording and predicting certain environmental factors.

Eric Van Gieson says, "It turns out that our bodies, [or any biological organism,] are better sensors than anything we can build synthetically to date. For example, we have realized that our body's reaction to an infection happens two or three days before one can even detect the pathogen. So why not use our own body for early detection?" — based on the reading of the epigenome.

This has been applied during the current pandemic, and they found that their diagnosis and sensing device based on saliva and blood tests – reading the epigenetic information – is more sensitive and more precise than the PCR tests that are taken everywhere. (Of course, we know that the PCR tests are not precise for detecting a virus.)

Listen here to an excerpt of an interview with Dr. Eric Van Gieson where he shows you the extent to which this program has progressed, and draw your own conclusions:

> So that led me to the formation of two programs in my portfolio. One is the Epigenetic CHaracterization and Observation program (ECHO). In ECHO, what we are doing is actually exploiting an entirely new landscape. It's a landscape that people have shied away from. We've known about the

landscape, and that is the epigenome. What is crazy about the epigenome is that it's kind of like a black box; it records what has happened in your life from day zero. It even has little hints of recordings of what happened in your ancestors' lives because you can actually pass along the epigenome.

Think about it like this: It's a labelling system on your genome. Think of your genome as your ACTG's, but it's about two meters long in every single cell, and it is also identical in every single cell, but it is used differently by every single cell.

The epigenome is really a way that each cell is able to know what parts of the genome to use, to live and to function. All of the cells in our body function differently. The point here is that it's a pretty permanent mark, and it responds to the environment. When you go outside on a hot day, your epigenome is changing. When you go into an indoor pool and you breathe in a lot of chlorine, that is changing your epigenome, too. When you get a viral infection, that definitely is changing your epigenome because your body is trying to respond to that virus by making antibodies. Guess how it makes those antibodies? It rewrites its own epigenome to make the antibodies that are very specific for that virus.

What we can do is exploit that and say, "Oh, let's just look at the epigenome," because that response actually happens within an hour or so of exposure to a virus. It's a quick response, and it's happening in millions of cells in your body. So, there are plenty of cells to sample. Therefore, there is plenty of signal to read.

Going back to my quest of reading what is going on in cells and in your body, this epigenome is a really ripe target for doing that in the context of viral infections, and it opens up a whole new landscape and way to diagnose infection that no one has been using ever. We are really the first ones doing it.

When we started this program two years ago, no one thought we could do it. Now we are able to distinguish people who have infections better than the current state of the art. We are beating PCR (polymerase chain reaction) which is the current state of the art. But what is also cool is we

> are doing things that our current diagnostics can't do. For example, we are now in human samples distinguishing people who have drug-resistant infections from the same species of bacteria versus a non-drug-resistant strain of that bacteria. So, this is antibiotic resistance that we are diagnosing just from your own cells – your own epigenome – rather than taking a blood sample and having to culture that bacteria and figure out if it is responsive or nonresponsive to antibiotics.
>
> We are able to show now from your own host response to those bacteria that we can tell you if you have a drug-resistant infection or not. That can guide treatment, and that can make a big difference. And we can detect it very early in the infection – much sooner than conventional methods.
>
> That is the ECHO program in a nutshell, and we think that we can actually change the game in COVID-19 response as well because we think that we are going to get responses days before the current technology for diagnosing and testing for that viral infection. That is something that is very exciting for me, but hopefully, it makes a difference in the world.

I hope that you are connecting the dots. Imagine what is possible now: Not only the history, the life timeline of an organism can be read – and *all* organisms have these epigenetic markers that are based on environmental events, experiences, and intra-environmental events, such as experiences of your emotions, your thoughts, and your energy exchange – not only can the life timeline of an organism be read, but also predictions can be made into the future, into the behavior and into the impacts that will come towards this organism or this collection of organisms.

Image and Similitude

Despite the gruesomeness of the idea of little robots crawling through our blood vessels and tissues, I believe that the last two developments, namely the discovery of the spatial epigenomic electrical pattern that determines shape, and secondly, the ability to read and predict the temporal epigenetic signatures that code an organism's history and memory, are much more significant to understand in terms of our progress in nanotechnology. They go far deeper than technology has taken us before. They actually touch upon who we are as spatio-temporal beings. They even touch upon who we are as created beings – created

in the Image and Similitude of the Divine.

If that image, shape, and that energy field can be changed now by science, we have an obligation and a responsibility to take notice. Perhaps now we understand why in the Scripture it says that we were created in both an Image (*tselem*) and a Likeness, or similitude (*demut*). They are not only two different words denoting the same idea; the image is the blueprint of life; it's the code for the body information. The similitude, on the other hand, is the field that is needed to enact or express this code. Without access to the right field, the body cannot be sustained in a higher function, or the DNA antenna cannot couple to the holographic memory to deliver more than just the most basic molecular motions of life, to bring through that higher image component.

We cannot allow this energy and information field needed for a higher evolutionary life to be overlaid or suffocated by a web of sensors, transmitters, motes, and bots that seek to integrate all of life into the machine, that seek to subsume 'the biosphere into the technosphere', to use the terminology of Vladimir Vernadsky.

Instead, we must remain true to sensitivity, to beauty, to honesty, and to true scientific inspiration and open up a new layer of the Noosphere to advance into that which is not of matter, but of light and spirit.

So what can we do? What can we learn from this decoding of the epigenetic field right at the moment of the biodigital convergence? First, we must treasure our own life for we can write our own epigenome. We cannot hand it over to the machine or to some university programming their minds into us.

We can decide to stay in a higher energy field. That also may include the necessity to remove interfering electromagnetic fields such as Wi-Fi and cell phones as much as possible. And we must actively seek exposure to "weapons of mass upliftment", namely to that which is positive and benign. We must actively seek to bring kindness and peace and music and culture and real interaction with people of like minds.

We must seek exposure to the higher life, to what is eternal, true, and ultimately powerful.

Romans 8:5-6

For those who live according to the flesh set their minds on the things of the flesh, but those who live according to the Spirit set their minds on the things of the Spirit. For to set the mind on the flesh is death, but to set the mind on the Spirit is life and peace.