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The Solari Report

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



Introduction:

Welcome to a new *Solari Future Science Report*. My name is Ulrike Granögger, and we will be talking about nanotechnology –medical nanotechnology or medical nanobots, to be precise. The questions are: How real are they, and is it all science fiction? How ‘nanoliterate’ do we need to become in this new age that has come upon us? (To see the visualizations that are mentioned in this report, please watch the video of this presentation on *The Solari Report*)

For many of you, what I will be presenting may not be new because you follow many commentaries of Catherine (*The Solari Report*), as well as other researchers, journalists, doctors, and scientists who are speaking about the reality of something happening behind the scenes, and on the back of this global crisis that we are going through, namely a transhumanist trend, if not agenda, that is being manifested in our lives.

For many of us, we get the feeling that something is happening, but perhaps, we don't quite know where and what exactly is happening. That's no wonder because it is happening on a very, very tiny or invisible scale. It is literally happening on the nanolevel.

What I would like to give you is a bit of a notion or appreciation, an understanding that this nanoscale of reality that we are entering with new technologies, especially medical technologies, is more than simply a tiny, miniature form of material engineering. It is in fact, a *phase transition*. It is a literal *threshold* between matter and energy, between the particulate and the waveform that we are entering as we go to the domain of sizes and of objects on the micro- and nanoscale reality.

One of the most important understandings that we need to take away is that when we look and work and manipulate on this level of the nanoscale, it is not only 'tinkering' with matter, it is also not only tinkering with biology. What emerges – and maybe at the end of this report will be more apparent – is that we are taking a step into the *immaterial*. The immaterial has always been there. Simply science, our current human science, is not dealing with it. But now as science has opened that door, it will discover the immaterial. And *we* must also be at least in phase or ahead of this development in science, for we must be able

to help shape the realities of the future.

At the end of this report, we will also look at the implications that the understanding of the Wave Genome gives us about nanotechnology, and it will be exactly this: On the nanolevel – which is the level of the molecules and of DNA and RNA, where the molecules assemble and organize and program themselves into living entities, into cells and cellular structures – *there* is located the phase transition between the particulate and the wave form.

And so, we have seen that the Wave Genome literally also behaves like a wave. Yes, we do see the molecule, and we can chemically tinker with it, but it is also a reality that is part of the immaterial, 'quantum foam' background field from which it phases in and out; everything that happens on the nanoscale does that.

It is important for us to always keep this in mind. When we are talking about many of the applications and technologies that are being developed or already have been and are being applied — especially now, they are applied wholesale, large scale, globally, and forced onto everybody. We need to realize that there is at least a threshold into an immaterial domain that is being mediated by working with this level or scale of reality.

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### **What we will discuss in this Report:**

Let me give you a short overview of what we will discuss: First, we will look at how small *nano* is: 'Nano' in Greek means 'dwarf'. It is really, really small, as its name says. It is helpful to bring this into correlation or relation with things that we know.

On the nanolevel, we cannot see; not even an optical microscope can see. So how should we visualize it except by relation.

Then the questions are: If we cannot see the nano-level with our physical instruments or human nature, then how do we have access to these levels? How can we manipulate them, or perhaps even manufacture on the nanolevel as it is being done?

We have to understand the technological advances of advanced microscopes

and advanced lithography or forms of 3D printing that are being done on the micro and nanolevels. We will get an idea of this.

After that, we will go into molecular biology and into nano-computing: the two technologies on the nanolevel that are most important for our topic of the medical nano-engineering. From there, we will have the basis to appreciate a look at a selection of the applications and breakthroughs that have been made and that are already rolled out, and also get some future perspectives.

Finally, I would like us to begin to realize that this is so vast and so intense that we cannot escape, and that we all have to make up our minds as to how it will affect our futures, especially once we begin to see how ubiquitous the reality has already become and what the future trends are into networking on a nano scale all of matter into something that could be called 'a spatial web'- a bio-digital convergence. This is the bringing together of life or biology and the digital era or manipulation, digital control.

This is a future reality of "programmable matter", and this needs to be taken quite seriously as once all of the nano scale is networked and computerized and digitized, it can be taken up into one system of computing.

This is not the greater exchange and holistic field that people like Lynne McTaggart (author and alternative medicine activist) and others are talking about that permeates all of reality – of which we are also part – but this is a new type of field, an artificial, synthetic field that is being overlaid over reality if we allow that. Therefore, we will also look at epigenetics and how science is at this moment beginning to understand, as well as manipulate, not only DNA, but manipulate the energy field that rides upon it.

This is the door that is opening through the nano world, and we need to understand what is going on there.

Many people are now speaking about a spiritual war; an ancient 1,000-year-old war that is going on in terms of control over the human society.

The frontier of this war is not so much in human weaponry, but it is at the threshold between material and immaterial. At this threshold, we need to learn

to navigate, to understand, and to act.

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Nano Scale

This is a great website (<https://htwins.net/scale2/>) that allows us to look at and compare scales. We begin in the world that we know – the human scale/world, the meter scale. We see the human being and the giant earthworm. (I don't know if anybody has ever seen a giant earthworm...) We see objects that we know from daily life. We see a ruler, a measuring device, a basketball, and a teapot. As we zoom in, we see smaller animals and objects of our daily life – still very normal and visible. We see the matchstick that we can easily handle.

We see here on this level, the wavelengths of the microwave. We also see, as an example, the coffee bean. We go into the insect world, and we see various seeds down to the millimeter level that we all understand.

Zooming into the millimeter level, we see the grain of sand. Amoebas, for example, are about 350 micrometers, which means it's not quite half of a millimeter. One millimeter is 1,000 micrometers; one micrometer is 1,000 nanometers. So, one nanometer is the millionth part of a millimeter. So, we have to zoom in quite powerfully.

We see the thickness of paper. You should be able to see this quite well in the micrometer range. Here is the widths of the human hair. It's about 100 micrometers – between 50 and 100 micrometers. The human hair is always a good reference point.

This is the width of the human hair as we zoom in, and it is approximately the same as the width or size of the ovum, the human egg cell. This is already about the size of the smallest objects that are visible to the naked eye. From here on, we need a magnifying glass or need to put our glasses on, and we need microscopes to go even further.

For most people, they would not be able to make out the width of a silk fiber, and they will only be able to make out a droplet of mist with great difficulty. Certainly, they would not be able to see a white blood cell, so we need our optical instruments for that.

Here we see the red blood cell. Let's compare the white blood cell: It's about 10 micrometers. The nucleus of the cell and the red blood cell are approximately the same, namely about seven micrometers.

If we go further into the smaller scales, we come to the scale of the bacteria and mitochondria inside the cells, which are bacteria originally. They share a similar size.

The chromosomes, which is the winding up of the DNA, is on the micrometer scale – not yet the nanometer scale. The chromosome can be seen here as part of the micrometer scale. As we reach in, this is also the wavelength of violet light. Then we come into the domain of the viruses. We know how small the viruses are. Bacteria can be infected by viruses; that is how small they are. This is a virus – a bacteriophage – that infects bacteria.

Only from here on begins the nanometer level. This is below the micrometer level. The ultraviolet wavelength is here. Here are also the smallest objects that are visible to optical microscopes. After this, optical microscopes working with light do not help any longer; we have to work with protons and electrons. We have to work with electron scattering and other techniques of imaging and visualization at these lower levels.

This is why it is so hard to imagine them – because they are visually unimaginable. But we now have ways of looking at these scales and of working with these scales. That has brought the breakthroughs of reaching down to manipulating the very nano layer of reality.

Here we have the HIV virus and another virus. (This website was designed before coronavirus – before 2020. Otherwise, we would see a coronavirus here...)

Something very special: On the nanolevel we have the transistor gate. Namely, in the last decade the transistors have gone down into the nanometer range. This is the smallest transistor gate that was available in 2019. Now they are even smaller, going down to 10 nanometers.

This is quite remarkable because we will also be talking about nanocomputing. Already, in a sense, computer engineering has reached the nano layer.

Here we come to the level of 1 nanometer. This is DNA as seen as the whole double-helix. Here we have the size of membranes that make up the skin of a cell and the individual components for that. Here we have the wavelengths of x-rays, and we have here the so-called "carbon nanotubes". These are hollow tubes made up of a single layer of graphene, a carbon material that we will see play a very important role in the development of the nanotechnology.

So now, we are at the level of one nanometer, and what do we see? We see that this is the level of the threshold or the phase transition from molecular into atomic and subatomic realities. Here, on that 1 nm scale, we have a large atom – the cesium atom – but going in further, even the water molecule is smaller than this level. All of the important atoms of life are deep in the subnano layer.

This is the smallest thing that an electron microscope can see. Electron beams would not scatter off smaller items that we would have to look for on the subnanolevel, which goes down to pico and femto levels. However, we see that it is quite empty there – or there is plenty of room ‘down there’, as physicists would say. But we have not discovered what is happening there.

Our threshold at the moment is the nano threshold, and it is probably a very fundamental threshold. It is a time where there is more than simply another breakthrough; it is a fundamental shift of matter and consciousness that is upon us, and we should all understand it.

So, this gives us some idea. Once again, it is very important to understand that we are working on the level of biological molecules and cellular structures and cell organelles, even going into atomic interactions. We understand that we are approaching the quantum world where the macro behavior may not always be in place, but there may be the interference or the display of quantum behavior and quantum states. That may help us understand that we are here at a very, very important point in our evolutionary history.

Here is a final look at scales; this is on a logarithmic scale: We see from the nanometer, 10nm, 100nm, 1,000nm up to 1 millimeter. Of course, it would not

be possible to show all this on a linear scale. So, we see the DNA reaching from 1nm up to the micron scale in terms of its rolled-up manifestation of the chromosome; we see the viruses and the molecules; we see the genes, we see the cells, etc.

Below here, these are the living or the natural items that we would find on this level. Here we see the manufactured or engineered realities, for example, these are microsystems that can go to micrometer levels. Transistor gates are 100 or below 100 nanometers. Quantum dots are very, very tiny realities that are used in LED screens and lights. Here we have the carbon nanotubes that will play a role in our discussion.

We also see in this representation how we need different types of wavelengths for viewing, imaging, as well as handling or manipulating these layers, from light to the electron, and then to other nano imprint lithographies and to scanning probe lithographies. These are various types of 'printers' that we use to create nanomaterials and begin to handle nano realities.

Once again, I want to point out that on a logarithmic scale (based on the natural logarithm), all lengths in the universe – from the smallest (the Planck length) to the size of the observable universe itself – we find the dimension of DNA/RNA, the nucleus of the cell, the molecules of life at the very center and the exact point of intercommunication with all other scaling levels of the distribution of matter and energy in the universe.

This is based on the "interscalar" perspective of reality, the work of Hartmut Müller, who I will be introducing to you in future *Future Science* reports on *Solari*. He has much to share in that interscalar perspective of seeing the interrelationship between the large and the small, something that the ancients also knew.

It is quite remarkable that what we are going to talk about in this report – the molecules of life, the RNA reality, the DNA reality (think of the RNA vaccine that is on everybody's minds now) – is intercommunicating with everything else, and hold, therefore, a position of responsibility and a position of super-stability within the distribution of matter in the universe.

Also, we see a structural change of information that is going on at this very level of the DNA.

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## **Nano-Microscopy**

A quick look at nano microscopy, which is also a look at the way of how to manipulate or handle these layers. Each of these microscopes that were developed in succession earned a Nobel Prize because they opened so much of our understanding. Once the optical microscopes were no longer strong enough to go deeper, scientists realized that there is a deeper energetic level, and other microscopes had to be developed.

One of the first was the *transmission electron microscope*, which helped us see cellular structures. This was developed in 1931, and instead of beams of light, it uses beams of electrons. What we see here is a human leukocyte with cell organelles inside, like the Golgi apparatus. This cannot be imaged with an optical microscope but can only be scattered and reflected by electrons and other features. In the 1950's, it won a Nobel Prize in physics.

This is another Nobel Prize-winning microscope – the *scanning tunneling microscope*. It won the Nobel Prize in physics in 1981, and it is a way of imaging the surface on the atomic level. With this one, you can actually see individual atoms. You can not only see them, but with these devices, scientists or physicists are able to handle and manipulate individual atoms and molecules. So, this is a high-resolution imaging format for nanoparticle surfaces.

With the development of these very advanced microscopes, it is possible to *create* structures on very, very tiny levels. It is important for us to understand that it is not only seeing, but it is also doing things there. Once we realize that is possible, then much of what we are going to say later about the nanostructures that are being built and proposed makes more sense or is more plausible.

Thirty years ago, in 1989, IBM was able to move individual atoms and write the three letters 'IBM' with a scanning tunneling microscope. Each of these is an individual atom. Later, they even made a tiny film – a movie – made of atoms. So, you can write and draw and program with atoms if you are able to handle and maneuver the individual atoms.

Nowadays, scientists are using what is called *optical tweezers* to move atoms and single molecules, and nano-sized cells. Don't forget that we are not only interested in atoms and molecules, but proteins are molecules; RNA is molecules. How do we handle them? How do we put them into a lipid nanoparticle? How do we put them into an evacuated virus for delivery through a vaccine? How is all of this done? Certainly, not all of them are picked up by a microscope, but there are genetic engineering techniques and certain mixing techniques. However, it is important to understand there is the technology that allows us to manipulate these levels of reality.

This invention – the optical tweezers – won another Nobel Prize in physics in 2018. With this, you can optically – through what is almost 'optical levitation' – lift, position, and reposition an atom.

One more important microscope is the *super-resolution fluorescence microscopy*. It is an advanced form of optical scanners where light is coming from all sides that can now bring optical imaging to the nanoscale. This won the Nobel Prize in chemistry in 2014. So, a "direct observation of nanoparticles with high spatial resolution at subcellular levels", and that is of great importance to understand nano toxicology, etc. So, this would be conventional imaging, and this is a super-resolution fluorescence microscopy. The fluorescence is why you see many of the textbooks showing cells and their cellular structures in red and green; it is a green fluorescent light and the red fluorescence that is being imaged here.

Finally, we go from, not only imaging, but to manufacturing or printing or writing on these levels. To manufacture on the micro- and nano-levels, these forms of visualization become a form of lithography.

Here we have the *two-photon polymerization direct laser writing*, which is a very, very advanced machine where there is a type of etching or lithography or sculpting that is going on at the atomic scale level. It is where you build atom by atom or you sculpt from a larger domain.

This is also called direct laser writing on photosensitive material. I hope you can see this here: This is the eye of a needle... and this is not dirt, but here is an

actual sculpture. Here is the width of a human hair, and here we have a sculpture that is created by these very advanced instruments.

Another image, here in comparison with the scale of a human sperm and a very finely-sculptured object on such a small level.

## **Carbon Nanotubes**

On the nanoscale, there is printing and etching, and there is self-assembly going on. For example, biological molecules self-assemble, as well as crystals. Very special nanomaterials called *carbon nanotubes* also have self-assembly properties. We need to briefly look at them because they are playing a major role in all things 'nano'.

Carbon nanotubes are also called 'nanowires' or 'nanorods'. Here we see single-walled carbon nanotubes. Their diameter inside is down to one nanometer, and still there is space inside. They consist of a single layer or sheet of graphene, which is a form of carbon. It is a very special material. They were only discovered in 1991, and were credited to a Japanese physicist, Sumio Iijima, so it was very late even though it was claimed (and probably true) that by 1952, Russian scientists had already produced 50 nanometer-wide carbon tubes. But because of the Cold War and of their publications being in Russian, it was not recognized back then in the West.

These carbon nanotubes have very special properties; they are highly symmetrical materials. They are simply a sheet of graphene, almost the same as in a pencil but in a different configuration. Therefore, they are ultra-strong.

Some of the configurations have, as scientists believe, superconducting properties while most or all of them have semiconducting properties. Therefore, they are regarded as possible quantum wires for future production of field-effect transistors on a nanoscale.

Carbon nanotubes are 400 times stronger than steel and are lightweight. This is why today they are employed in producing metal alloys, mixing in the carbon nanotubes to make the metals much stronger and yet lighter. They also have very high thermal conductivity – higher than diamond; they can be extremely thin, they are highly chemically stable (resistant to corrosion), they are

semiconducting or superconducting, and they are hollow inside so they can even contain or transport something.

These are all carbon nanotube fibers that can be woven into a yarn. Because of their electrical conductivity, it is a type of electronic yarn. This means that we can have fibers or fabrics that are sensors and are electrically active or electrically transmitting.

Also, because of the strength they provide, they are woven into fabrics such as bullet-proof vests, and they actually make the fabric impermeable for bullets.

Where are they produced? They are produced mainly in combustion. To a large extent, they are also harvested from the air. New factories are opening to filter carbon nanotubes from the air from the CO<sub>2</sub>, which is producing global warming. So, global warming seems to be very good for the advancement of nanomaterials and nanotechnology.

Carbon nanotubes can also bundle up in agglomerates. Here they are a little larger, but this is not one tube; this is many tubes. It's found that, especially with the multi-walled carbon nanotubes, they can be toxic when they are inhaled. They can also assemble into long wires; they self-assemble into long wires. You should see this; it's quite interesting. There are targeted individuals who are saying that some of these materials are coming from their skin cells. It's a possibility that this has to do with nanomaterials.

I want to show you a video where these nanotubes under electrostatic fields begin to move on their own accord and begin to assemble and align. Therefore, under specific conditions, such a distribution of carbon nanotubes may lead to a whole net or web of wires.

Here I've switched off the sound. At Rice University, *Teslaphoresis* is applied; a Tesla coil is activated, and carbon nanotubes in the energy field of the Tesla coil begin to move on their own. Here they are even showing a certain traction.

The carbon nanotubes are self-assembling when an LED circuit is switched on. Between the energy poles, the carbon nanotubes assemble and align.

Here we see them mixed, and when the electric field is switched on, they begin to assemble, align, and connect into longer wires. Remember that they are highly electrically transmissive.

This leads us to the nanocomputing that we should look at. As carbon nanotubes may serve as future transistor gates that are on the nanolevel (we are already on the nanolevel, but much smaller than a one nanometer-wide transistor you cannot get), there is great prospect in having carbon nanotubes as candidates for miniature transistors and for a possibility of self-assembling computers in the future.

### **Transistor Sizes**

If we look at the sizes of transistors and gates in the past, the original transistors were, of course, huge. In 1974, it was the first time that six micrometer transistor gates were reached. The chip looked something like this in 1974. Today we are going into smaller and smaller scales. If we go through some of the steps, this is an 800-nanometer transistor gate. This would be the chip used in 1987. Here in 2005, manufacturing has reached 65 nanometers of transistor gates. Imagine how small that is! That is smaller than the HIV virus. This is incredibly small.

There is no more handling and welding occurring on these computer chips, but it is printed. It is sediment; it is lithography that is being used.

In 2009, they used 32 nanometers. In 2017, we have reached the 7-nanometer transistor. If we imagine that a DNA strand is two to three nanometers wide, that is 3 DNA strands next to each other to make one of these transistor gates. It's simply incredible. Until 2017, INTEL was able to pack 100 million transistors in each square millimeter. This is how far computing and integrated circuits have come.

Where is the next frontier? The next frontier is the interfacing of these tiny sizes with the tiny sizes of the genetic computer that is the human or the living cell.

Once again, these chips or integrated circuits or microchips are no longer built, but they are printed by lithography processes. They are kind of 'sculptured' or 'etched out' by light or by chemicals or by electrons or atomic beams. Here we

have several forms of nano lithography.

The very new carbon nanotubes, which were only discovered about 20 years ago, are opening new ways of printing the microchips. Here we have a video of Northeastern University where carbon nanotubes are being used to print computer chips in very cheap and very easy ways with a new type of format:

As consumer demand for smarter, bendable, even wearable electronics increases, companies everywhere are developing smaller, more flexible sensors and microchips to run them. So, if someone could figure out how to replace conventional chip materials with super-tiny nanomaterials, they would have a surefire winner.

This man believes he can do just that. He is Ahmed Busnaina, Director of Northeastern University's Center for High-rate Nanomanufacturing.

A traditional chip factory needs to be highly automated and cleaner than an operating room to prevent contamination. To make a chip, metals and other materials need to be deposited, etched away, redeposited, and re-etched to create the circuitry.

The process requires vast amounts of water, chemicals, and gases. The semiconducting wafers are all made of crystalline silicon.

At his Northeastern lab, Ahmed and his team developed a process for turning a typical silicon wafer into a printing plate or template. The template, with its etched circuitry, is dipped into a well containing nanotubes or other types of nanomaterials. When an electric current is applied to the well, the nanomaterials are drawn out of the water and adhere to the etched pattern like ink.

In an instant, the pattern that was inked on the template is printed onto the wafer. Like a printing press, the process can be repeated to make as many wafers as you want from the same template. And additional layers of circuitry can be added by inking a new template with a different pattern and pressing it against the existing wafers to make more complex electronics.

You can print circuits or sensors on cheap, flexible plastic wafers at the macro, micro, and nano scale quickly and accurately.

So, this is how you can get these tiny, tiny nanochips onto a chip wafer. I find it quite interesting that someone like Charles Lieber invested in the creation of carbon nano transistors and found a company by the name of Biosys, which is a quantum dot company that is producing the next generation of LED displays and, also what they call, a quantum dot TV.

I wonder why someone who is totally immersed in brain-machine interface research would be working with carbon nanotubes to produce displays and computer screens, and if there was a connection. Isn't there a patent that shows how to control a user's mind through a TV and computer screen? Is there perhaps a connection between the nano dots or the quantum dots, the carbon nanotubes, and brain-machine interfaces?

The future envisions carbon nanotube transistors that are the smallest and probably the best at conducting, and the most stable transistors that MIT engineers are looking forward to building.

## **Synthetic Biology**

Nanocomputing and nanobiology – synthetic biology – and nano gene editing is another area. We are not only looking at the technological part, but also the biological layer of the nano scale. Remember, this is where atoms and molecules become lifeforms and cellular forms and structures. Therefore, it is a very important consideration to look at the biological component.

"Biology", says researcher Andrew Hessel, who is part of the Programmable Matter Group, "is a self-assembling nanotechnology with a programmable language". Biology, therefore, by many of the scientists, is viewed as *the* nanotechnology. It is natural that the two would merge, because what is happening is already merged on these levels in the living cell.

So when we speak about nano, we are speaking about the molecular scale; the molecular size of the DNA, of the RNA, of the proteins, of the genes, and therefore, the deciphering of the DNA has opened the way to exploring and

discovering and manipulating much, much more of this nanoscale. This topic of medical nanotechnology is probably the most important that we can speak about at the moment.

After the sequencing of the human genome in 2003, the cost of sequencing dropped from \$100 million to only a few hundred dollars or euros nowadays. It is below \$1,000 that a full genome can be sequenced. Also, with the drop of the cost of the sequencing, the number of sequencing has increased and – as we all know – exploded in the last year with billions of PCR tests being carried out. Each one of these can, in principle, also be sequenced for more than just traces of possible virus in it.

Microsoft, it is said, is buying the DNA sequences of the samples of PCR tests for a DNA database.

It's also, not only cheap to do the sequencing, but even the cost of DNA samples and cellular cultures are now well within everybody's range. For example, on this online company, you can buy human cell cultures and put them into the shopping cart.

## **CRISPR**

The main breakthrough in genetic engineering and synthetic biology came with the advent of CRISPR technology. I think that most of us know what the CRISPR technology is. CRISPR stands for certain "repeating passages" that were discovered in bacterial and archaic genomes'. These repeating passages were found where the DNA strand of the bacterium is opened at certain places to insert memory passages of the encounter of a virus. So, it's a kind of immune memory of the bacterium that is stored in its genome. For that, it has to open the genome, write in this new sequence, and close it again.

The opening is done by an enzyme that is called Cas9 or CRISPR-associated enzyme, and the discovery is not that this is happening in the bacteria, but the same enzyme and the same process can be used for any genome to precisely open at a certain point, cut the helix open, and make changes along the double-helix.

Incidentally, in the same online shop, you can also buy a starter kit for CRISPR

genetic engineering, and that goes for less than \$50. So, everybody nowadays can become a genetic engineer and do some dabbling in gene manipulation.

The CRISPR mechanism is a gene-editing technique. In it is a synthetic 'guide RNA' that directs the molecule to a specific location within the genome, and then the Cas9 enzyme cuts the strand, and the editing is being done.

So, the guide RNA is the unique locator. The RNA sequence that is identified as the correct place (where the cut needs to be made) needs to be very precise. Then you can open the double-helix and even exchange only a single nucleobase or a whole section of a gene.

This is a very precise and apparently easy procedure. It is very exact, and it won the Nobel Prize in chemistry in the year of our Lord 2020, when this whole pandemic 'broke loose'. It was only discovered in 2012 by Emmanuelle Charpentier and Jennifer Doudna. Both speak out, but I especially hear Jennifer Doudna speaking out against the misuse of this technique.

Here is a section of a video of a science festival that you can find on YouTube where Jennifer Doudna explains the different methods of life, editing *in vivo* and editing *ex vivo*, or in the lab, of editing of genes:

Host: Say you've got a gene or you've got a patient population and you have a manipulation. How do we introduce that into human patients who we are trying to treat? What are the ways that we can go about doing that in terms of doing it *in vivo* and *ex vivo* and what that means?

Jennifer Doudna: There are really two ways. I think it's shown on this slide here where you can introduce the gene editing molecules in cells that are taken out of a patient, so it's done 'ex vivo' – outside the body – and the edited cells are then replaced. That would be, for example, to treat sickle cell disease. That's how it would be done. Or we can do it 'in vivo' where you use something like a virus to deliver the gene editors. Then the virus can hone into the tissue where the editing is needed.

It's very interesting how she says that you use a virus to edit the genome *in vivo*. You can also do it *ex vivo* – also with a virus or with other ways.

I think that we all know how things like that could be done if we think about vaccines that are either lipid particles (nanoparticles) or that are emptied viruses that are bringing in a certain RNA messenger.

CRISPR is on the rise everywhere. CRISPR is used by everybody – even by school children. It is a technique that is so potent that we all should be aware of how easy and how ubiquitous it has become to do gene editing and the opening of the DNA.

Here are two examples of the apparently successful use of CRISPR: This is a lady with sickle-cell anemia, and this was done *ex vivo*, which means that stem cells were removed from her body, and they have been reprogrammed in the lab. Then they were inserted back into her blood, and that has apparently helped her to get better in overcoming the disease.

Now in 2021, for the first time, it was approved to have an *in vivo* gene editing done on a human being. First, this was done in 2015 on a rat, namely on an eye condition. The *in vivo* CRISPR gene editing done to correct retinal dystrophy in a rat has helped to restore the proper functioning of the cells. Now in 2021, it is carried out and the first patient is to receive *in vivo*, *live* CRISPR editing in their eyes.

Because this is important, I think that we should see this short video segment that I have edited down for brevity:

Now let's take a look at a CRISPR Cas9 treatment in practice. To get the drug into the eye, the doctors perform a subretinal injection.

The surgeon makes three tiny incisions in the eye so that they can put instruments inside the eye to remove the vitreous gel, which is needed so that the very fine cannula that is used to make the subretinal injection can be passed across the eye and placed very delicately under the retina to inject this small amount of gene editing drug.

That drug contains an adeno-associated virus vector. The virus is the delivery system for CRISPR Cas9. The researchers put the sequence and

code in the Cas9 protein and two guide RNAs inside the virus, and the virus carries it like cargo to the cells. The target is a mutation in photoreceptor cells in the CEP290 gene.

We are finally at a point where the promise of CRISPR Cas9 is beginning to be tested out in the real world.

Once again, it is the virus that is bringing the gene-editing component into the body behind the eye and directly into the body that needs curing. So, there are companies now forming around this technology. It's a very young technology, a very promising technology, and very easy to use.

This company, CRISPR Therapeutics, is one such company. It is developing ex vivo and in vivo uses of CRISPR Cas9 genome editing. It is interesting to look a little at the connections of these companies and their owners and their investors, especially *Solari Report* subscribers will have an interest to know this. For example, it is "partnering with MIT for non-viral forms of gene editing" that work with lipid nanoparticles.

Now where have we heard that before? Lipid nanoparticles in connection with viruses and with RNA insertion...? Also "mRNA combinations" with CureVac – "controlled duration of expression, tissue specificity, and increased potency", etc. These are non-viral forms of administration.

Here we have viral forms: "Adeno-associated viruses as vectors" to bring the material into the cell *in vivo*.

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Applications of Nanotechnologies

Let us now look at some of the applications of these revolutionary nanotechnologies. Let us see what is already happening. Should we take it seriously after what we discussed before? Is it for real, or is it science fiction? Is it far away? Is it simply possible fantasies of scientists, or is it already applied?

I think that we know the answer by now with what has been said. If not, look at what they have created already.

First, we have something that we all know now, which is *drug delivery*. It's a widespread application, and it has been researched for a long time. Drug delivery goes into the body, and instead of going through the gastrointestinal tract where most of the pharmacological agent may be broken down or ending up in the liver, it would be ideal – according to the narrative – to be able to deliver the drug exactly in the cell where it is needed. For example, it would go directly to the cancer cells where certain chemotherapy is necessary.

All of us know now that such drug delivery mechanisms can be done through lipid nanoparticles, through hydrogels, through PEG polymers, or through liquid crystalline structures that are designed to hold a pharmaceutical agent inside of it and then release the drug when the right tissue is addressed.

These can be cell-targeted, they can be tissue-targeted, they can control the release of the agent, and they can combine therapeutics with diagnostics. There is something that is called "theranostics". That means that these lipid nanoparticles, or whatever the carrier is, may not simply be a neutral carrier, but it may be a sensor to do diagnosis and feedback into the real world. And they can cross the blood-brain barrier, especially if you coat them or camouflage them so that the human immune system will not fight them off.

That means that many of them are also sensors – *nano-bio-sensors*. These nanobiosensors have been described as "labs on a chip" or "labs in a drop". So, there is a direct analysis of the situation in the cell or in the tissue, and there are various sensors also working in the fluids. Most of them are 'hydrogel' liquid crystals, but they can also be the lipid nanoparticles. They can be connected wirelessly and they can also have miniaturization and integration as sensors in various areas of the body or outside the body.

They can also consist of tattoos or nano-ink printing sensors as we have seen printing on to the wafers. It is also possible to print on flexible material.

One famous company, because it's been mentioned by many commentators and even on American TV, is the company Profusa. This gives us an example of an optical-guided sensor. The company has been working with DARPA (Defense Advanced Research Projects Agency) to develop a very advanced biosensor and to create, as they call it, a 'platform' in the body that will be able to read and

emit the biosensor information. A gel-like polymer is the sensor, which is inserted under the skin. On top of the skin, you have the optical reader. It is supposedly measuring oxygen in the peripheral arteries of the body. Changes in the oxygen levels may indicate the onset of an infection or a biological attack.

It says, “The goal of the study is to develop an early identification system to detect, not only disease outbreaks, but biological attacks and pandemics up to three weeks earlier than current methods...”

In this article, we can see an infographic of how it would work. It is a wirelessly working hydrogel sensor that is inserted under the skin and will be read by a device on top of the skin. These sensors are called ‘smart gel’ or tunable photonic crystals or hydrogel polymers.

The sensor was featured recently in a *60 Minutes* TV report where, none other than the vaccine coordinator of Operation WARP Speed, Dr. Matt Hepburn, who formerly worked with DARPA, was interviewed. Here is a short excerpt:

David Martin: Dr. Hepburn showed us a few current projects. Some sound like they are from an episode of *Star Trek*.

Consider a ship, like the USS Theodore Roosevelt, hobbled last year when 1,271 crew members tested positive for the coronavirus. What if everyone on board had their health monitored with this subdermal implant, now in late-stage testing? It’s not some dreaded government microchip to track your every move, but a tissue-like gel engineered to continuously test your blood.

Dr. Matt Hepburn: It’s a sensor.

David Martin: That tiny green thing?

Dr. Matt Hepburn: That tiny green thing in there. You put it underneath your skin. What that tells you is that there are chemical reactions going on inside the body. That signal means that you are going to have symptoms tomorrow.

David Martin: There is an actual transmitter in that?

Dr. Matt Hepburn: Yes, it's like a 'check engine light'.

David Martin: "Check this sailor out before he infects other people."

Dr. Matt Hepburn: That's right.

Narrator: Sailors would get the signal, then self-administer a blood draw, and test themselves onsite.

Dr. Matt Hepburn: We can have that information in three to five minutes. As you truncate that time, as you diagnose and treat, what you do is stop the infection in its tracks.

The next step is to look at *nanorobots* (not nanosensors). Both are really connected because these sensors, as we've seen, can also go into nanoparticles and travel through the body. How far is that developed? Let us look at some examples of nanorobots and their progress in manufacturing and in application.

One very interesting one and some of the questions are, "How do these tiny, tiny objects or robots move, and how are they powered? How are they controlled or guided?"

Here is the work of the Max Planck Institute in Germany who, about six years ago, created nanopropellers that are imitating the corkscrew movement of the flagellum. Using this as an example, they are able to be magnetically guided through very viscous material such as the thick blood flow in the body.

Here is a film of how they can be steered. It is quite interesting. First, this shows how they are produced. They are produced by evaporating material onto a rotating wafer so that they form in the right helix shape. Then they are released from the base, and are steered by magnetic fields – quite precisely – on the micron level.

Here is another magnetically-controlled microrobot in blood vessels. These ones have self-motion and self-assembly, which is quite remarkable – self-assembly of

robotic micro and nano-swimmers using magnetic nano particles.

"The micro- and nano-swimmers fabricated use self-assembly of nanoparticles and control via magnetic fields. Nanoparticles self-align into parallel chains on the magnetization." The micro-swimmers are made up of tiny iron oxide beads, as small as 200 nanometers. They are joining naturally or self-assembling as a chain. These beads are composed of inorganic biocompatible materials that will not trigger immunological responses in the body.

To induce their movement through the bloodstream, the robot chain or the bead chain is exposed to a very finely-calibrated magnetic field from outside.

Another very fascinating form of robots are these cell-sized robots that were grown on a chip or a wafer, and the most difficult part here is the legs and how to make them move. It's called the 'actuators'. The legs of these tiny little robots (which can also carry microcomputers), are only 10 atoms thick and are able to move according to magnetic field and thermal influences.

Here we have another form of robot, the "theragrippers". They would function based on temperature, that is thermo-biochemically actuated. That means that the change of temperature would open and close them so that they can act as carriers of a cargo or they can take cargo and bring it to a certain location. These are in the micron range. We can also see them here. This is an article that many of you must have seen that was published last year in 2020 in the middle of the virus scare:

"Shape-changing microdevices for extended drug release in vivo." Therefore, they are drug carriers. Their size here is about 250 micrometers. What is amusing about the story is that in the article by Johns Hopkins University, they showed this picture of a swab with little dots of dust on the head, which are multiples of these tiny devices. So you can see how small they are.

Of course, in a time when everybody has to do swabs into their noses, this was not a very good marketing idea.

These microdevices are magnetically controlled, and the latest version is also from 2020. It's coming from Germany, and they are much, much smaller devices from the Max Planck Institute for Intelligent Systems. They are the size

of white blood cells. Therefore, they are under eight micrometers in diameter. They are microrobots that propel forward and can navigate inside blood vessels. They can do this at very high speeds because the speed of the blood flow can be quite high under magnetic guidance.

They can also flow against the bloodstream. They can be coated with antibodies on their surface so they would be active agent deliverers.

Here we see that when the magnetic field is on, they are flowing against the blood flow. This is the direction of blood flow, and the particle is moving against the stream. When the magnetic field is off, it will go with the blood flow.

It follows the direction of the magnetic field. Here it goes against blood flow, and it follows the various directions that are indicated by the magnetic field arrow.

Here we see that the top is the same in the blood vessel. The particles are the same untracked and in the lower image, the two tracked particles make the same movements under the same magnetic control.

What else can be controlled? Quite interestingly, there is a very recent development of the remote control of hormone release using *magnetic nanoparticles*. With them, the scientists are stimulating the adrenal gland to secrete hormones.

It says here, “In the new study, the research team wanted to explore the idea of treating disorders of the brain by manipulating organs that are outside of the central nervous system, but influence it through hormone release.”

So, the intention is to influence the brain, but you do this by backfeeding from the hormonal system. One well-known example is the hypothalamic-pituitary-adrenal (HPA) axis, which regulates stress response in mammals. So, the idea is that you can suppress stress response, or maybe even activate stress response. We should, however, note that this axis between the hypothalamus, the pituitary, and the adrenal glands, not only regulates stress, but many other body processes such as digestion, the immune system, the mood, the emotions, the sexuality, and the energy storage and expenditure. And there are other axes

between the center of the brain and certain glands in the body.

These particles have magnetite or iron oxide nanocrystals inside. This research is also funded by DARPA as well as by MIT and other institutes.

The same team is working on a similar project where there are magnetic nanoparticles inside of liposomes. So the liposomes – the lipid nanoparticles – can be filled with smaller magnetic nanoparticles that will guide the liposomes to their desired locations. This is a way of drug delivery.

Nowadays, drugs are not only chemotherapy or aspirin that you want to have in a certain area of the body, but these drugs are the new form of therapy to use gene editing.

Here we have a new development, namely *magnetogenetics*. So far, the guidance through the magnetic fields was done by the use of these magnetic crystals, but it can also be done by engineering magnetic protein where researchers create artificial protein that is magnetized by fusing it with the paramagnetic region of ferritin and adding a DNA sequence that will signal the cells to transport the protein to the nerve cells. So with adding the DNA sequence, the cells are tricked to bring it directly into the nervous system. The magnetized protein there will be deposited.

The combination of the magnetized protein and the DNA sequence was grown in human embryonic kidney cells. These cells synthesized the magnetic protein that is inserted into their membrane. This is then brought into the nervous system so that it can be visualized or can be controlled.

This is done to literally control the nervous system of a live animal. Look at the mouse. See how it behaves when there is no field. Suddenly, the field is on, and it begins to rotate around its own body axis. It begins to move much more. This is because it has these magneto proteins and magneto particles in its brain that were inserted there.

When there is no field, it calms down. Then the field is switched on, and it begins to rotate around its axis.

In this case, these nanoparticles are inserted or injected into the brain cells and into the nerve cells. However, if lipid nanoparticles or hydrogels are coated with neurotransmitters, the lipoids can be smuggled through the blood-brain barrier.

This takes us to a completely different level of nano- and micro-robotics, which is that of brain research and the influencing of nervous systems. This is especially the *brain-machine interface* studies by the Charles M. Lieber Group of Harvard and others.

What we are looking at here are neuron-like electronics – ‘mesh electronics’ – in a mouse brain. Charles Lieber has been working on nanowire transistors and mesh electronics in combination with brain-machine interfaces for over 20 years. He says here, “this ... literally blurs the ever-present and clear dissimilarities in properties between man-made and living systems.” In other words, between human and machine. This has been researched and experimented on for decades and is to be used now in a much broader sense just as the RNA, the lipid nanoparticles, and the various bio-sensors and bio-robotics have been waiting to be used.

Let us look at the Lieber research with a little more attention. They are speaking of syringe-injectable mesh electronics. So even though this is going to be quite gruesome, we should look at it and remember that once this is published, we do not see the next step that is already being worked on because the publications are usually years behind the actual interest of the working groups.

Here we see that it is possible to inject with a syringe "input/output connectivity" or electrodes into a brain that will then connect with the natural nerve fibers, axons and dendrites, and not be rejected by immune response. The tissue response shows that these mesh electronics are so similar to the natural behavior of the nervous system. They are not eliciting inflammation, for example, or scarring. Rather, the neurons will grow around the mesh wires, and the mesh wires were integrated into the brain circuitry. We will see a video on this.

Here we also see how the mesh electronics are not only inserted into the brain, but behind the eye into the retina for the recording of the signals of the optical nerves and the retina activity:

The main advantage of this technique is that mesh electronics do not elicit a chronic immune response and gliosis once implanted into the brain and allows for a seamless integration with the surrounding neural tissue.

So here we see the electronic fibers, which are taken up. These are very tiny fibers that are put into the syringe. Once this is done, it can be applied to the mouse brain, which is opened. Two incisions are being made. The syringe with the mesh inside is lowered down. The mesh is injected into the brain. In this case, an input/output connector is added before the mouse is woken up again. Connections are tested, and the mouse has these implants which can be read.

Unlike conventional rigid brain probes, mesh electronics can be left in the tissue during histology, making it possible to precisely correlate electrophysiology data with immuno-histochemical analysis.

This is the Lieber Research Group at Harvard University working with nanomaterials, nanobioelectronics, and brain science. The same Lieber Research Group has been working for decades on precision electronics in the brain or on "scalable ultrasmall three-dimensional nanowire transistor probes for intracellular recording" in the brain or in the nervous system. Interestingly, the same Charles Lieber was charged and arrested together with two Chinese nationals in January of 2020, just when a worldwide pandemic of a possibly engineered virus broke out.

There are two more steps to take to understand the future that is now in terms of programmable lifeforms, including the human. One is called 'smart dust' or *neural dust* or microelectromechanical systems, which are distributed nanomachines that can work under one arc of acoustic or optical or magnetic control, creating a weblike network of sensors and processors throughout an organism. The 'organism' can be an individual or an animal or can be a forest or a whole ecosystem.

This early development, as published in 2009 in the magazine, *Lab on a Chip* (quite an interesting journal) uses biosensors that are powered by biomolecular motors, literally powered from ATP, a similar form of energy that is powering living cells. It consists of dust-like biosensors that can be distributed

everywhere, and together they will create a web of feedback and surveillance.

These are attempts at digitizing and networking whole environments that are very close to being actuated if we can assume that there is something behind the rollout of military-grade technologies that are being injected into human beings.

Here we have another form of smart dust or neural dust — "Wireless recording in the peripheral nervous system with ultrasonic neural dust": This is where sound is used to both power and read and guide the microsensors. In this case, they are not so small and have to be implanted. But it is proof of concept, so to speak. The idea is that these microcomputers will see and hear and sense everything in their environment – either individually or as a collective network. Within these sensors, self-organization may be possible, but with the Internet of Things and with our understanding of mesh electronics, there may be this type of sheet over and above all bioelectrical signals.

Finally, we must bring the logic of nanocomputing and nanomolecular biology together. Earlier in 2013, scientists at Stanford created a *biological transistor*. They also devised a biological internet or mechanism to send genetic messages from cell to cell. The messaging platform uses a virus gene to automatically encode DNA messages of various lengths. This, of course, was before the discovery of CRISPR. So, what they have used is DNA as transistors – as logic gates.

It says here, "A transistor controls the flow of electricity through a device, acting like an on-off switch. Similarly, the biological transistor, called a 'transcriptor', controls the flow of an enzyme (RNA polymerase) as it travels along a strand of DNA."

So, the enzyme is now being regarded as a transistor – an 'on-off switch' – and you can use the same logic as in transistors and integrated circuits also along DNA. In 2019, this has come to an even more powerful manifestation based on CRISPR technologies: "Central processing unit to program complex logic computation in human cells" being demonstrated by researchers around Martin Fussenegger from ETH Zurich where they combined CRISPR technology with biodigital logic so that cells can be made into computers.

This means that there is now a threshold with CRISPR to bring together computing and the human genome. They were working with human cells.

Fussenegger says, “Imagine a microtissue with billions of cells, each equipped with its own dual-core processor,” or with its own ‘on-off switch’ by means of an RNA-guided enzyme. “Such ‘computational organs’ could theoretically attain computing power that far outstrips that of a digital supercomputer – and using just a fraction of the energy,” because living systems need only nutrients in order to do their processing. One can envision artificial lifeforms and biological machines doing the data processing as well as the data storage of supercomputers as is described here.

These artificial lifeforms – this type of *biodigital convergence* is on the rise. These artificial lifeforms are being devised, and there is only one step away from utilizing your own body as a biodigitally-converged computer. This is where I think we are already, reaching into the future where we should not leave the future to the scientists. But we should think ahead, and 'sense ahead' of where all this could lead.

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## **Continue in Part 2**

The combination of nanomaterial engineering and nanocomputing with genetic engineering and biological computing has brought us to a fundamental threshold of interaction or communication with larger parts of the universe.

Remember, DNA, RNA, and the molecules of life are situated at a unique position in the interscalar communication with the fractal resonance pattern of matter and energy in the observable universe. Not only are there new technologies and fascinating opportunities opening with nanotechnology, and the combination of computing with life in terms of supercomputing and DNA data storage and health improvements, but there are also critical dangers before us in terms of surveillance, digital body currency, blockchain DNA, etc.

The ability to work on the scale of the phased transition between matter and energy is also opening completely new realities of understanding the physics of life itself. The paradigm shift at which we find ourselves, and the window that has opened on the nanolevel between the material and the immaterial is of such

importance that we cannot quickly add it to this discussion, and I have decided to bring this into a 'Part II' continuation of the nanotechnology report.

We will look at life as computers, and space and time as an Internet of Things. We will look at the field structures of the genome, and the rise of the understanding and utilization of the *epigenome*. We will begin to realize that more than genetic engineering is taking place; there is a much larger manipulation possible of all the field lines of life on this planet. Therefore, let us take one more hour in Part II to look at these research areas.

### **MODIFICATION**

Transcripts are not always verbatim. Modifications are sometimes made to improve clarity, usefulness and readability, while staying true to the original intent.

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