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# AURORA

THE SCI-TECH NEWSLETTER OF BITS-PILANI

Volume 11

Issue 2

## Elon Musk: The New Ideas

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***"What change do I want to bring to the world? What will be my impact? How do I want to be remembered?"*** A budding engineer often wonders. There comes a plethora of philosophical wanderings over chai at redis, but they are lost somewhere as far-fetched dreams. A few years down the line, some reminisce them after a day at an unsatisfying, yet 'secure' job, as something that could have been done, while some others work super hard to bring the change.

Back in 1995, 20-year-old Elon Musk asked himself what things are most likely to affect the future of humanity in a positive way. He came up with five things, the internet, sustainable energy- both production and consumption, space exploration- extension of life beyond earth, artificial intelligence and rewriting human genetics. Fast forward to the present day, the whole world can't stop talking about the success stories of PayPal, Tesla, and SpaceX, the first three things on Musk's list. Now, let's talk about some of his lesser known projects.

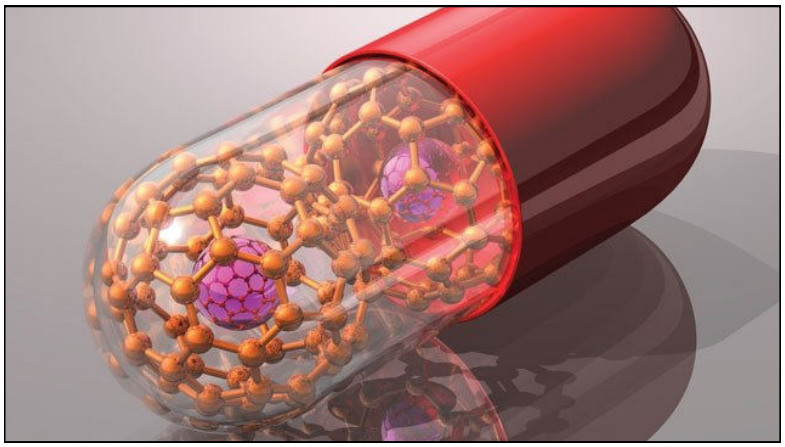
Fusing Human and Machine intelligence does sound stranger than fiction, but **Neuralink**, a start-up acquired by Musk in March 2017, aims to do just that with future plans of human enhancement by helping people with neurodegenerative disorders. It's something Musk thinks is necessary to counter the risk of AI apocalypse. The original founders – Mohseni and Nudo began their research on treating traumatic brain injury in 2011 and were successful in demonstrating a prototype in 2013 that helped brain-damaged rats to re-establish damaged connections by recording neurons in one part of the brain and then transferring the signals to another. The company and research are still in a very nascent stage and it doesn't seem possible for it to become a success in the near future due to the various hurdles in making such devices work with molecular accuracy and implanting in the brain. With advanced medical research, surgery techniques and pioneering work in understanding neurons and data transmission, the brain-computer interface would perhaps become a reality in the next decade. (*Ref. MIT Technology Review)*

**SolarCity**, a project acquired by Musk in November 2016 , aims to provide energy to power your home and your Tesla with the noble concept of using solar energy from glass solar tiles up on your rooftop. The glass solar tiles are aesthetically classy, are tougher and provide great insulation. SolarCity looks forward to integrate solar power, electric cars and stationary battery storage. With solar power, people would have to pay a lot less over the long run and also be eco-friendly. Cars could be charged with the power and with power storage units called Powerwall, we can use the energy even at night. The battery rated at 14kWh can run a four bedroom house for a whole day. Thus, with ideal conditions, we can power our homes indefinitely. (*Ref. YouTube Tesla: Tesla unveils Powerwall 2 & solar roof*)

If you have reached the end of this article, I have a good hunch of what you might be thinking. Here's what Musk has to say over that, as taken from an interview, "Even if you don't have a revolutionary idea, but you are doing something that has a small amount of good for a large number of people, I think that's fine. Stuff doesn't need to change the world just to be good." Now, that's all the motivation you need for your future endeavour!

# *Nanomedicine: Breakthroughs in medicine using Nanotechnoogy*

*-Sukrut Waghmare*



Curiosity, one of the basic instincts of man has led him to make astounding progress in the many fields of work at an amazing rate. What if we could control particles that can explore the very own cells that we are made of? This very question is at the core of a wonderful field called Nanomedicine.

Nanomedicine is basically the use of nanotechnology in different medical procedures. Looking at the field of medicine through a nano perspective has opened a new dimension of research. The scientists in the field of regenerative medicine and tissue engineering are continually looking for new ways to apply the principles of cell transplantation, material science, and bioengineering to construct biological substitutes that will restore and maintain normal function in diseased and injured tissue. Nanomedicine can be a potential solution for these. It could increase the efficiency and reliability of the diagnostics of human fluids or tissues samples by using selective nanodevices, to make multiple analyses at subcellular scale, etc. In in vivo diagnostics, nanomedicine could develop devices able to work inside the human body in order to identify the early presence of a disease, to quantify toxic molecules, tumor cells, etc.

One of the fascinating horizons explored is that of Nanorobotic Biovores: Artificial phagocytes called microbivores could patrol the bloodstream, seeking out and digesting unwanted pathogens including bacteria, viruses, or fungi. Microbivores would achieve complete clearance of even the most severe septicemic infections in 10-15 hours or less. The nanorobots do not increase the risk of sepsis or septic shock because the pathogens are completely digested into harmless sugars, amino acids, and the like, which are the only effluents from the nanorobot.

Another elusive problem: cancer treatment can be potentially solved with this technology. Researchers have demonstrated a method to generate sound waves that are powerful, but also tightly focused, that may eventually be used for noninvasive surgery. They use a lens coated with carbon nanotubes to convert light from a laser to focused sound waves. The intent is to develop a method that could blast tumors or other diseased areas without damaging healthy tissue. Researchers are investigating the use of bismuth nanoparticles to concentrate radiation used in radiation therapy to treat cancer tumors. Initial results indicate that the bismuth nanoparticles would increase the radiation dose to the tumor by 90 percent.

Researchers at MIT have developed a sensor using carbon nanotubes embedded in a gel, that can be injected under the skin to monitor the level of nitric oxide in the bloodstream. The level of nitric oxide is important as it indicates inflammation, allowing easy monitoring of inflammatory diseases. A test for early detection of kidney damage is also being developed. The method uses gold nanorods functionalized to attach to the type of protein generated by damaged kidneys. When protein accumulates on the nanorod, the color of the nanorod shifts. Yet another team of researchers at the University of Colorado Boulder are investigating the use of quantum dots to treat antibiotic resistant infections.

Thus nanotech has the potential to shoulder humongous research in the field of medicine. The sheer view of the diverse and colorful spectrum of applications of nanotech in medicine is interesting enough to induce a desire to know more about it. Nanotech inspires research right from the bottom-most layer of matter.

As Mr. Feynman has rightly said, **"There indeed is plenty of room at the bottom!!"**

*References: understandingnano.com/medicine, NCBI: J Indian Soc Periodontal PMC2813556*

# Resurrection Biology

-Pranshu Agarwal

Although once considered a fanciful notion, the possibility of bringing extinct species back to life has been raised by advances in selective breeding, genetics, and reproductive cloning technologies.

The possibility was first explored in the 1920s and '30s by German zoologists Lutz and Heinz Heck. They crossbred different types of cattle in an attempt to back breed for an animal that resembled the aurochs, an extinct species of European wild ox ancestral to modern cattle, based on historical descriptions and bone specimens that provided morphological information about the aurochs but had no insight into the animal's genetic relatedness. In the latter part of the 20th century, tools emerged that enabled scientists to isolate and analyze DNA from the bones, hair, and other tissues of dead animals. Coupled with advances in reproductive technologies such as in vitro fertilization, researchers were able to identify cattle that are close genetic relatives of the aurochs and combine their sperm and eggs to produce an animal (the so-called tauros) that is morphologically and genetically similar to the aurochs.

A key among the more recent advances was the development of a technique well-known as somatic cell nuclear transfer (SCNT), which was used to produce the first mammalian clone, Dolly the sheep in 1996. In 2009, using SCNT, scientists very nearly achieved de-extinction for the first time, attempting to bring back the extinct Pyrenean ibex! (*Ref. www.britannica.com/science/de-extinction*)

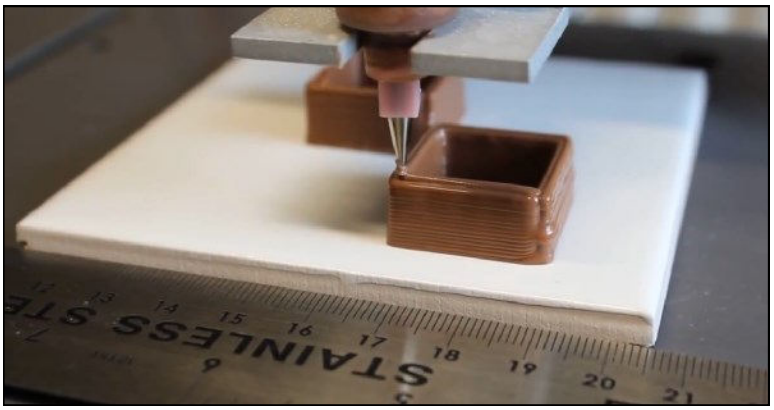
Other advances in genetic technologies have raised the possibility of inferring and reconstructing the genetic sequences of extinct species from even poorly preserved or cryo-preserved specimens. Reconstructed sequences could be compared against the sequences of extinct species, also allowing for the identification of genes that would be candidates for editing in living species. **Genome editing**, a technique of synthetic biology, involves adding or removing specific pieces of DNA in a specie's genome. This was greatly facilitated by the discovery of CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats), a naturally occurring enzyme system that edits DNA in certain microorganisms.

Some other high-profile examples of attempted de-extinction include the woolly mammoth, the passenger pigeon, the thylacine, and the gastric-brooding frog. De-extinction does not extend to dinosaurs (too bad for the Jurassic Park fans, huh?), partly because of the extreme old age of specimens and the severe degradation of DNA over time. While it might be a good idea to start thinking about these possibilities also, we are years or even decades away from being able to actually pull this off with most long dead animals. The problem isn't reading the DNA or even making the DNA, although it does take a lot of time, money and effort. The real problem is getting a cell to read any DNA we make in the lab. DNA has to be folded perfectly just so to fit inside the cell such that the right genes are in the right place to be turned on properly. Right now, only a cell can pull this off and until we figure out how to get lots of man-made DNA into a cell to have the cell fold it for us, we are stuck cloning with living or properly frozen cells. (*Ref. www.kqed.org/quest*)

The tricky part is re-configuring the adult DNA into embryonic DNA. If this isn't done just right, the embryo won't develop correctly. The right conditions are found by trial and error and are different for different animals. What this means experimentally is a lot of failed pregnancies and a lot of sick and dead babies. Considering the ethical aspects, some researchers believe it may be best to wait until we can invent some sort of artificial womb. In this context, the words of the ecologist Ben Novak, the lead researcher on the passenger pigeon project at Revive & Restore indeed ring true- "If this is always going to be a zoo animal, then stop, the goals have to be about ecological restoration and function."

# Artificial food: Fiction to Reality

-Jayesh Narayan




Would world hunger ever end? Imagine a day when there'd be food for every living creature under the sun and you'd be able to 3D print a fresh Pizza.

Winston Churchill couldn't have been more correct when he suggested in 1931: "We shall escape the absurdity of growing a whole chicken in order to eat the breast or wing, by growing these parts separately under a suitable medium." There has been promising research in the field of Artificial Foods and the fruits have been, well – 'Textured'.

In vitro cultivation of muscular fibers was performed as early as 1971 by Russell Ross but it wasn't until in 2013 under Sergey Brin that we made the first public trial of an artificial burger. It received rave reviews with some people calling it an 'Animal Protein Cake' but the feel and texture have been improved since.

Cultured meat preparation takes three essential steps :

- Starter Cells – Rapidly growing cells like stem cells.
- Growth medium - Treatment of these cells with a tissue growth promoting protein and placing them in a culture medium which supplies the energy requirements.
- Scaffold – For three-dimensional meat, a scaffold stretches and provides the right developing environment.

This process can theoretically produce unlimited meat. It's estimated that from just 10 cells we can have 50000 tons of meat over a period of just two months and it's cheaper to produce and eco-friendly which is the reason why it's expected to end world hunger and propel us to use alternative sources for edible products and put an end to animal cruelty and slaughter. We could soon be downloading and printing food, all thanks to 3D printers like 'Foodini' which utilizes a process called 'Additive manufacturing' to make edibles. It's believed that food printing would prevent food wastage by using hydrocolloid cartridges which form gel with water. There are various startups which have taken innovation to a new level, some like Beyond Meat and Impossible Foods have made "wheat meat" which tastes and chews the same like the real thing. Clara Foods have planned on making egg whites without the chickens by adding one part yeast, some DNA and leaving it for a few generations. Muufri aims to give cows some relief by making milk in Labs by using genetically modified yeast. Plant based scrambled eggs anyone? Hampton Creek is asking the same question. We would say that if you're planning to have a startup, do give synthetic foods a thought.

With not enough arable land to produce sufficient food for the ballooning population, few engineers envision machines making food with capsules of powders and oil having shelf life of over 30 years. We would be able to include all nutrients required in the right amount and engineer new edibles as we speak, moving towards a more sustainable planet.

There have been numerous references in fiction and pop culture about artificial food. But, it's not fiction anymore, is it? So, ten years down the line when you'd be eating your favorite muffin, you know who to thank.


*References: www.sciencemag.org, techcrunch.com/foodini, www.bbc.com/future*

# *Li-Fi and the future of Internet*

*-Prajjwal Khandelwal*

Light-fidelity, or Li-Fi, is a way for data transfer using household LED. It's a visual light communication system (VLC) running wireless to a speed of 224 GB per second. The term Li-Fi was coined by Professor Harald Hass during a TED talk in 2011, in which he envisioned light bulb as wireless routers.

Back in 2003, Professor Hass felt a spectrum crunch as he could visualize the lack of radio frequency spectrum, on which the Wi-Fi works, for mobile devices. At that time also it was difficult to get proper Wi-Fi connection in an urban area. Around the same time, new LED technology hit the market, Hass saw an opportunity to combine both and create a high speed network without disturbing the present radio waves infrastructure.

Scientist have taken li-fi outside the lab and found its speed to be 100 times more than the average speed of Wi-Fi. It will be the future of 5G visual light communication system by providing high speed wireless internet access. The idea was further commercialized in 2012. It was tested in a business firm and the results were brilliant. It was then decided to launch it in the market soon. The basic setup required for it is an LED light bulb, a solar cell and a laptop.

The advantage of Li-Fi over Wi-Fi is that it can be used in airlines, undersea explorations since it works on visible light concept while Wi-Fi requires hotspot or Wi-Fi kiosks. Wi-Fi can't be used in denser environments due to interference related issues, whereas Li-Fi can be used at such places. Also, as light cannot travel through a wall, Li-Fi is very secure for organizations since it will avoid hacking.

Moreover, Li-Fi consumes lesser energy as compared to Wi-Fi. In fact, Dubai has plans to be world`s first city to implement Li-Fi. The detriment to the system is that it can be transmitted over a distance of only 10 meters from the transmitter. If there is a major power cut in a city they would be left with nothing. So, Li-Fi has its own disadvantages. In conclusion, Li-Fi will not necessarily come to replace Wi-Fi, but to complement it. The VLC technology will be adopted by those who need higher data transfer speeds and securer networks.

*References: http://www.wipro.com/blogs/light-fidelity-the-bright-future-of-5g-visible-light-communication-systems/, http://www.sciencealert.com/li-fi-tested-in-the-real-world-for-the-first-time-is-100-times-faster-than-wi-fi, https://sites.google.com/a/ewg.k12.ri.us/li-fi/future-of-li-f , https://www.sitepoint.com/li-fi-lighting-the-future-of-wireless-networks/*

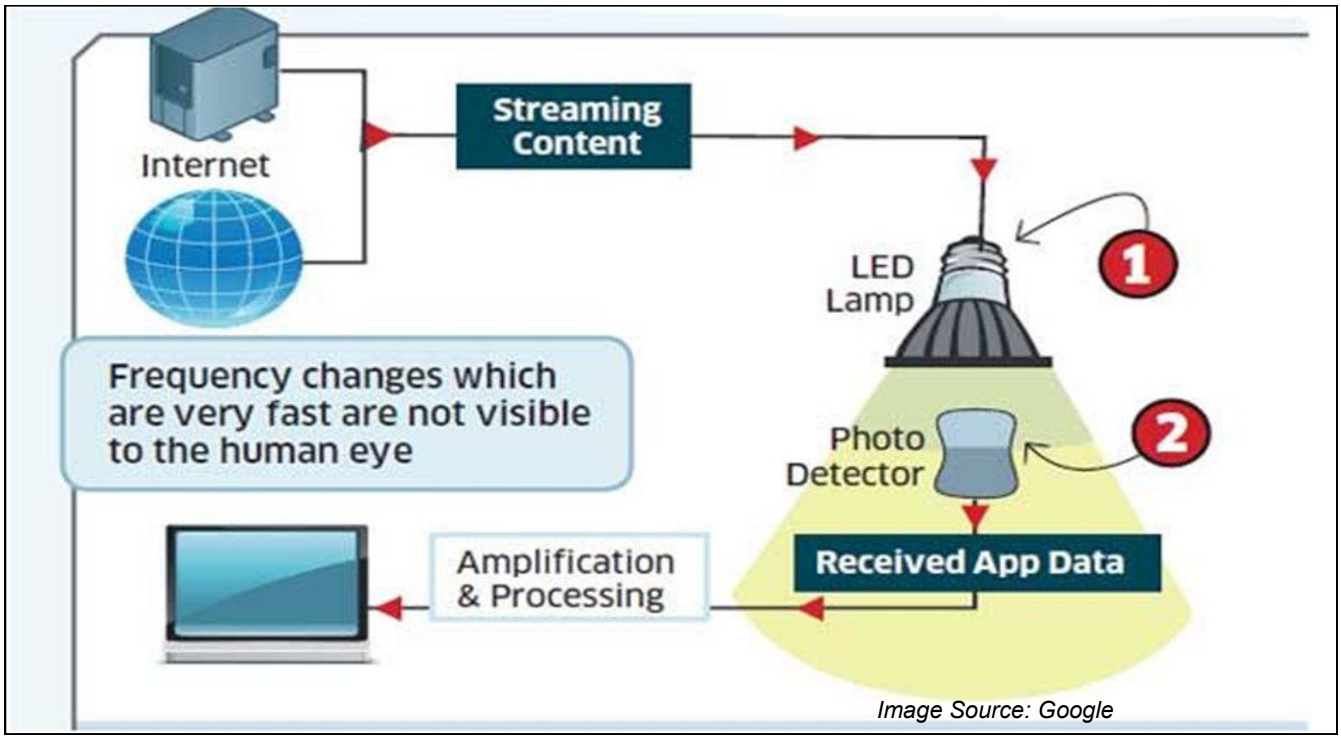



*Image Source: Google*

# *Feeds in the Science world to keep tabs on*

*-Pranshu Agarwal*

1. **Retraction Watch | Blog**

When a journal pulls a paper for being wrong or fake or plagiarized, Ivan Oransky's crew is there to make sure science does better next time.

2. **Last Word on Nothing | Blog**

This crowd of amazing science journalists got together to write stories and they ended up generating a beautiful website. From "How to Write a Science Feature" to imploring the National Institutes of Health to fund research on orphan diseases, they publish essay after essay, all lovely, about the culture of science itself.

3. **The Story Collider | Podcast**

Riveting tales about how we actually produce knowledge and how we understand our understanding of the world around us. Meta, man. Really meta.

4. **60-Second Science | Podcast**

These one-minute windows from the *scientificamerican* into the latest discoveries range from dark matter to the downside of high-intensity exercise (it can poison your blood).

5. **Symmetry | Magazine**

Symmetry is your view into the world of particle physics. Hear the latest news, meet the people behind the science, and get the background information you need to gain fluency in the language of particle physics. It receives funding through the US Department of Energy.

6. **PLOS | Blog**

The Public Library of Science is a non-profit publisher and advocacy organization on a mission to lead a transformation in research communication. It would like to explain things to you. Important things, like the science behind the squid's stomach. OK, and really important things like potential problems with meta-analysis.

7. **New York Times Science News**

The New York Times has a special Science page that covers current scientific events about the environment and space and the cosmos.

8. **HowStuffWorks**

HowStuffWorks provides explanations for thousands of topics, allowing you to explore how the natural world works, as well as topics in engineering, space, military tech, and physics, among others. You can get daily notifications about the newest articles through their RSS feed, as well as finding out about articles on specific topics.

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