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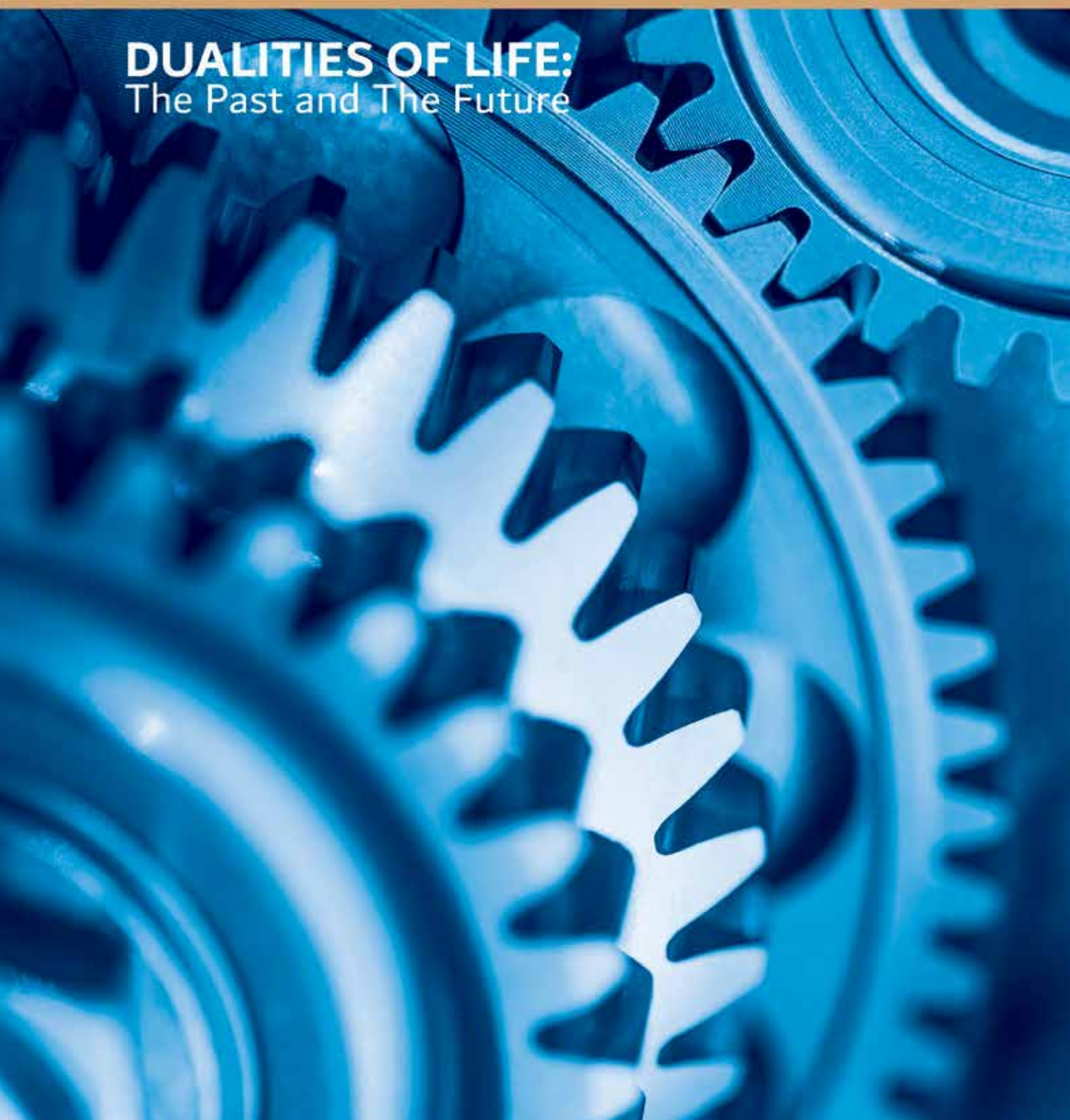
EYE ON SCIENCE

DUALITIES OF LIFE:
The Past and The Future



The Days of Future PAST

By: Maissa Azab

IN THIS ISSUE...

Happy New Year!

It is a New Year and not just any New Year; it is 2020! It does not seem that long ago we thought of 2020 as a far distant future; now that it is here, we find ourselves at an interesting juncture between the past and the future. Looking back, we realize how incredibly far we have come, and surrealistically fast within the past century, especially within the past couple of decades. Yet, the past is not just something to marvel at and feel nostalgic about; it is something to behold, study, and learn from. The future, on the other hand, is no longer something to fantasize about and long for; it is something to plan for very carefully, taking into account the lessons of the past.

Between the past and the future, by observing the starry skies, Man embarked on astronomy, and the desire to discover has taken us to the Moon and beyond; where to next? The pursuit of immortality paved the way to chemistry; the longing for a healthy and longer life developed into medicine; the yearning to understand and employ matter to improve our lifestyle led to physics; these are just the most fundamental sciences, which have sprung out of Man's basic needs to survive and progress. With Man's growing needs and desires, his pursuit of knowledge and prosperity has sprouted endless new branches of science and technology.

That thought-provoking duality of "Past and Future" is the first of our new year's series under the overarching theme "The Dualities of Life". Later this year, we will be tackling other fascinating dualities: "Earth and Sky", "Good and Evil", "Fact and Myth". It would be interesting to look at how Mankind has observed and dealt with nature, to live and develop; a noble quest that has led Mankind to much success populating the world and making it ours. It is also necessary to look at how Mankind can and has lost control, turning the quest into a conquest, and how this has often led to calamity.

Join us on this journey of probing into the dualities of life; let us observe, question, and try to find answers together. We hope to intrigue you in 2020, through both our printed issues, as well as our online articles; and do not forget to subscribe to our e-newsletter.

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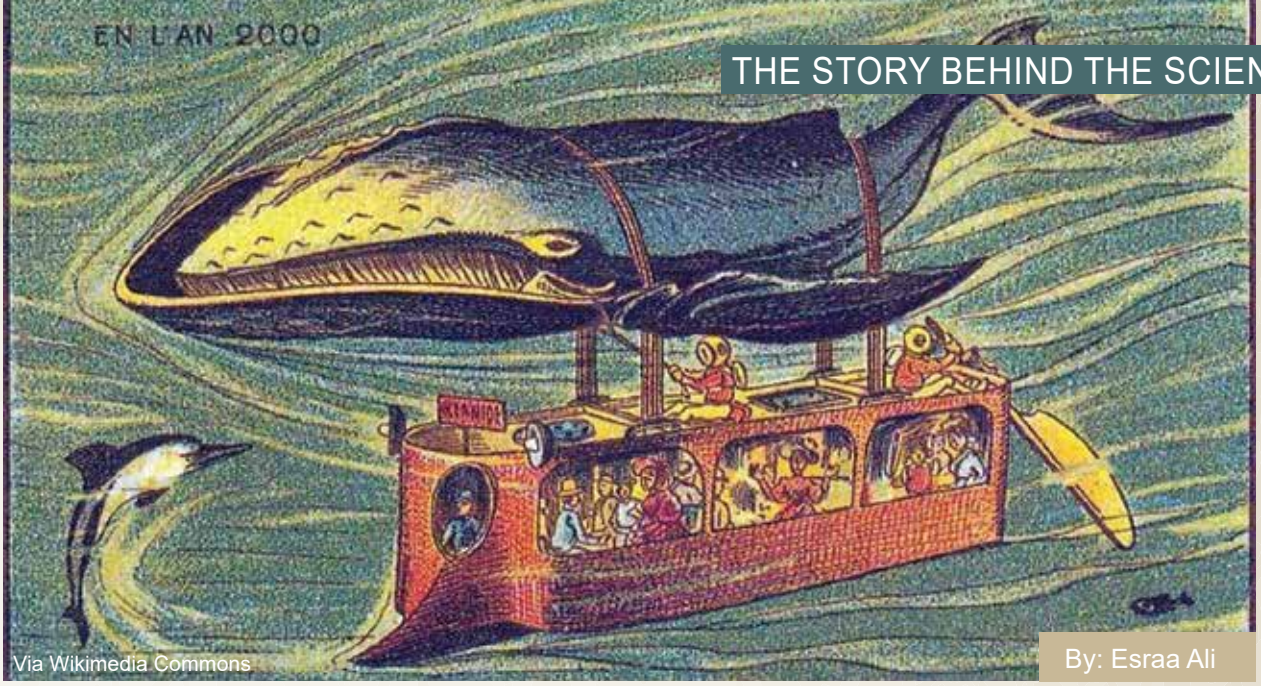

Via Wikimedia Commons

By: Esraa Ali

A History of the World's Future

Writers and artists often opt to dive into the distant past, and author fantasies about it and its inventions. They find comfort in describing a nostalgia; clichés of women dressed up like Disney princesses and dancing to music played on an antique gramophone, or elegant men talking over vintage rotary telephones. On the other hand, plenty of other writers and artists, and even ordinary people, prefer foreseeing over the horizon, and digging-deep into the future, because they find more comfort in thinking that great things await us.

With magic numbers such as 1900, 1919, 2000, 2020, 2222, etc., the years to come have always meant a fantastic world of potential great achievements. Yet, Danish atomic physicist Niels Bohr once said "prediction is very difficult, especially if it is about the future". That said, whether you are making weather predictions for tomorrow or predictions about how our lives would look like in one-hundred years, predicting the future is indeed a problematic task, albeit an interesting one.

While navigating the Internet for our ancestors' vision of the future, I have stumbled on a series of futuristic pictures—around 87 illustrations—depicting the world in the year 2000, entitled *En L'An 2000* (In the Year 2000). They were authored by various French artists 1899–1910, and were later printed as picture postcards. As you browse through the cards, you will see the future—or rather our past, 20 years ago—from our ancestors' point of view.

You will see, for example, predictions of magical video-call apparatuses, fabulous audiobook machines, wondrous housekeeping robots, flying taxies, and fancy underwater life with whale-drawn buses and water croquet. The illustrators' ideas were based on various imagined technologies changing people lives dramatically. Some of the predicted inventions came true, while others have not yet.

When the illustrators attempted to describe the world in one-hundred years they depicted what they believed was the peak of technology. However, that concept has totally changed. I remember by end-1999, people used to ask futuristic questions about the world in 2020, which was not such a distant future then! In such a short period, people foresaw radical change in all life forms. I recall predictions of world-end opposed to other life possibilities on different planets; that was based on the rapidly developing technology people witnessed at that time.

I recall my first mobile phone in 2000, with impressive features: a ringtone maker and a caller ID! Then, I could not think of any technology beyond, except maybe for playing an actual song instead of an irritating monophonic ringtone. Since then, however, technology has come such a long way; as someone calls you, your smartphone would vibrate, flash a photo of the caller, and play a song of your choice, all of which is now considered nothing special. Today, children at a very young age are capable of using smartphones and their impressive high-technology features of touchscreens and 3D facial recognition.

Today, a smartphone is equal to a long list of 19th and 20th centuries inventions; to name a few: the telephone, the camera, the recorder, the flashlight, the television, the radio, the phonograph, the typewriter, the video game console, the computer, and the list is definitely growing every day. In other words, you can see a group of the possible inventions predicted in *En L'An 2000* gathered in one device.

Now, you can simply connect your smartphone to your watch, your doorbell, and even your shoes; yet, people still expect a greater leap forward with smartphones. Some foresee smartphones embodied into our bodies using smart hearing aids and contact lenses, or screens in your skin. Though it might look like a frightening science fiction, it could be something very familiar later; or maybe smartphones would become obsolete with the popping-up of a better technology, who knows?

Today, look at the past's future and learn!

I write this article in November 2019 and expect a totally different life in 2020, which is only one month away! When you contemplate the future, you may think it does not carry much more for a certain technology, but you are definitely wrong. Innovation is a combination of the past and the future, and it never hurts to look back to the past to foresee your next leap forward. The future is almost here, and in the coming few years it will be just there; just keep your eyes on it, and dream of a better tomorrow.

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THE GREAT EPIDEMICS OF ALL TIME

By: Barbara Gallavotti

Have you ever wondered what in history has claimed the greatest number of human victims? Natural disasters? Famines? Wars? Well, as tragic as all these events have been, to figure out the enemy number one of Humankind, we need to focus on something invisible to the naked eye: pathogens (the microbes responsible for infectious diseases). Indeed, for millennia, epidemics have massacred unarmed people, leaving a long trail of mourning since the dawn of time.

In 430 BCE, Athens and its Empire challenged rival Sparta for supremacy over Hellas. The war plans of Athenian strategist Pericles failed significantly; the Spartan army devastated Attica and besieged Athens itself. The most terrible enemy, however, was not outside, but inside the walls: in the city where the germs of a terrible pestilence lurked; the historian Thucydides narrates what happened.

The raging of the disease is confirmed by the discovery of mass and hasty burials dating back to that time; yet, neither the Thucydides report, nor the human remains, allow us to identify without doubt the terrible biological murderer. Scholars have hypothesized that the epidemic could have been smallpox, typhoid, typhoid fever, plague, or even haemorrhagic fever, akin to today's Ebola. What we do know is that perhaps as many as 100,000 people lost their lives; that is, over one-third of the population of Athens. This is an impressive number, far superior to that of the deaths caused by the conflict. Over the centuries, bacteria, viruses, and other pathogens continue to kill more than the sword.

In the newly discovered Americas, natives were suddenly exposed to microbes brought by Europeans. The immune system of these populations had never come into contact with similar infections, so it was completely unprepared to fight the diseases they caused. Flu, measles, smallpox, typhus, and cholera exterminated the Amerindians; it is a destiny well represented by the Taìno people who lived in the Caribbean. Six years were enough to reduce them to less than 500 survivors.

Although Europeans gave free vent to extreme violence, such rapid extinction was largely due to new diseases; particularly smallpox, which is the same infectious agent that allowed few Spaniards to prevail over the powerful and well-organized Aztec Empire. However, when it comes to microbes, trips are almost never one way. The conquistadores may have brought to the Americas illnesses until then unknown, but all studies suggest they brought back to Europe syphilis, which exploded with particular virulence in the old continent. The first major epidemic occurred in Naples during 1495, just three years after the discovery of the New World; it then spread rapidly throughout Europe, where—according to some scholars—it exterminated about five million people immediately in the following years.

Over the centuries, things have not changed much; 2348 years after the plague of Athens, Major Powers in Europe confronted each other in the bloodiest conflict fought until then, World War I, where armies were equipped with repeating rifles, machine guns, and airplanes. The German

Imperial Army had the Paris-Geschütz (Paris Gun), capable of bombing the enemy capital from 130 kilometers away; but, all pales in comparison with what microscopic infectious agents can do.

After four years of conflict, on the armies on their last leg fell the most devastating epidemic of all time: the Spanish flu, fostered by poor hygienic conditions. It is estimated to have provoked 50–100 million deaths around the world between 1918 and 1919. During the 20th century, before being definitively defeated in 1980, smallpox again claimed 300–500 million victims; three times more than all the bloody conflicts of that century.

What should we expect in the future?

The case of hemorrhagic fevers, as well as HIV, plague, flu pandemics, leprosy, and many other diseases, shows that, in several cases, deadly infectious agents evolve inside animal organisms, up until some mutation emerges by chance, causing them to acquire, not only the ability to infect human beings, but also to spread from one person to another. How many of these "ticking bombs" exist on the planet? In other words, how many infectious agents could become new threats to humanity? Supposedly, at least thousands; although it is difficult to make a precise estimate. Most of these will probably never become a real danger, but just as likely one will.

The ideal, for us humans, would be to prepare in advance and hopefully be ready for the emergence of new infectious agents; ready to hit it with the right bullet just before it has time to take over. It sounds like science fiction, and in part it is; yet, there are those who work precisely in this direction. They are the researchers engaged in the very ambitious *PREDICT* project, supported by several US universities and institutions. *PREDICT* aims to classify the microbes in animals and to identify those that could become dangerous for our species, so as not to be caught unprepared. Seen in this way, it is a superhuman feat; something akin to the search for a needle in a haystack. Of course, it is inevitable to narrow down the field, focusing first and foremost on the species that have proven to be particularly suitable as incubators for pathogens transmissible to humans.

Kevin Olival, for example, is a virus hunter who participates in *PREDICT*; he talked about his work in an interview published in the magazine of the Smithsonian Institution, one of the entities

participating in *PREDICT*. Olival combs the forests located in the southern part of the Indonesian island of Sulawesi in search of bats and flying foxes from which he collects blood and tissue samples. These are then sent to specialized laboratories, where they are analyzed for traces of suspected viruses. At least one-thousand have already been identified, many of which could have the potential to evolve into enemies for our species.

This type of research is also used to make predictions about which places in the world are most likely to have a higher concentration of infectious agents that could give rise to a health emergency, and which species would host them. "We are trying to improve the crystal ball, which is very murky," as stated in the same article by Jonna Mazet, General Director of *PREDICT*, and Epidemiologist at the University of California at Davis.

In addition to the new infectious agents that animals could "package" for us, there are many that different species can transmit and that are already perfectly adapted to take control of our organism. Many of these are conveyed by mosquitoes; that is the reason they have been defined by the World Health Organization (WHO) as "one of the most lethal animals in the world". Not all mosquitoes actually; of the approximately 3000 existing species, "only" about one-hundred can transmit diseases to us. However, the damage done is enormous, for example, malaria still kills over 400,000 people a year, more than nine out of ten in Africa.

Then there is dengue fever, the cases of which—according to WHO—have increased thirty times in the past 30 years. It is not always correctly diagnosed, but it is estimated that it affects 96 million people per year; almost four billion distributed in 128 countries would be at risk of contracting the disease. It is estimated that half-a-million people per year develop the infection in such a severe form as to require hospital assistance, although targeted therapies do not exist. The victims are many thousands each year, especially children.

Then there are countless other mosquito-borne diseases, such as yellow fever, West Nile fever, and Zika, which—for now—is considered dangerous only if it affects pregnant women because it causes damage to the unborn child. The most diverse strategies have been devised to counter mosquito-borne diseases, the most drastic of which is to exterminate mosquito species capable of transmitting various diseases; at least where their presence causes more damage. To achieve this goal, one possibility would be to use genetic modifications to make them sterile, and therefore, unable to multiply.

Exterminating a species is an option that is rarely taken into consideration, because it means altering the ecosystem. Yet, the danger posed by some species of mosquitoes is so great that the hypothesis is being considered.

Extracted from Barbara Gallavotti (2019). *Le grandi epidemie, come difenderci,* "Tutto quello che dovreste sapere sui microbe" (*The great epidemics, how to defend ourselves*, "All what you should know about microbes"). Published by *Donzelli Editore.*

When we hear the word "epidemic", some known epidemic diseases that killed millions of people over time—such as cholera, typhoid, and Ebola—pop up in our minds. Yet, have you ever thought about epidemics that killed thousands of animals?

By: Dr. Mariam Elsayed

ANIMAL EPIDEMICS

Surprisingly, epidemics increase in number and frequency over time; some target rare and threatened animals, and may lead to their extinction. Due to the increase in trade and travel, new pathogens transfer to disease-free areas, leading to the emergence of new diseases and spread of old diseases among animals.

Sarcoptic mange

One of these epidemic diseases is *Sarcoptic mange*; a common parasitic disease that affects more than 100 species. It is caused by a parasite, *Sarcoptes scabiei*, which transmits rapidly among animals, just by skin contact! It burrows under animal skin, causing severe itching and scratching, which leads to the spread of infection. The number of susceptible species to the parasite increases by time.

Several researches studied this epidemic and declared it a serious threat to wildlife, with several new outbreaks of higher severity and expansion. Researchers are trying to find out the reason of variation in severity and duration among different species. It was believed that this epidemic was the main cause of red wolves extinction in Bornholm, Denmark, 1980. Nowadays, the treatment of domestic animals is easier using certain medicines and dips, but the danger keeps growing uncontrollably in the wild.

Ebola

Ebola is another well-known epidemic that is not restricted to humans. From birds to gorillas, the Ebola virus can be found in the animal kingdom as well; it killed over 10,000 humans and apes. Being a fatal disease, Ebola causes fever and severe bleeding.

Outbreaks were firstly reported in gorillas, where 95% of the infected animals were killed. The number of animals decreased in the past due to hunting, but now this disease increases the risk of their extinction. Thanks to scientists, a new safe vaccine was discovered in 2014 and was effective on chimpanzees.

Canine distemper

Canine distemper is a disease that affects domestic dogs reared at home and other carnivores in the wild; its outbreaks are markedly increasing in different areas. It killed many black-footed ferrets in Wyoming in 1985, and reappeared again in the 1990s killing many African dogs and over 1000 lions in the Serengeti.

As the population of domestic dogs increases, the disease spreads and its severity increases; the virus also develops itself to infect new carnivores. Dogs in houses are now vaccinated two to three times during their early lives, and the vaccine is repeated annually to ensure the safety of dogs.

Chlamydia

Likewise, an epidemic disease that affects domestic cats and other animals, such as the koala, is Chlamydia. It causes respiratory and urinary problems; animals become infertile and blind, ending up dead. It caused a dramatic drop in the koala population from 60,000 in the 1990s, to 10,000 in 2012.

The diagnosis of Chlamydia is now easier, using ultrasound scanning rather than taking a swab from the lesion and examining it. The bacteria have found a new way to enter the body with the help of a virus called Retrovirus, which causes a severe decrease in the host's immunity, making the path clear for Chlamydia to enter. A new vaccine is discovered for koala trying to save them from extinction; another vaccination program was established for domestic cats in the high-risk area.

Rift Valley Fever

We cannot ignore the epidemic of Rift Valley Fever (RVF), which is recently hitting Sudan. The virus was first discovered in Rift Valley, Kenya, in 1931, killing thousands of sheep; the infection spread with imported livestock to Egypt in 1977. In the 1990s, it reached Somalia and Tanzania, but it was confined to Africa; in 2000, however, it reached Saudi Arabia and Yemen, also with livestock trade.

The disease can be transmitted to humans by handling infected animals' entire organs or blood. It is still hard to be diagnosed in early stages, but its main sign is abortion in all pregnant animals. There are several vaccination programs that should be considered in epidemic areas and other procedures to control its spread.

Human and veterinary medicine have much more in common than they are different. Humans and animals face the same risk of smart minute microorganisms, which can surprisingly confuse the whole world's past and future!

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The 2019 NOBEL PRIZE in Medicine

By: Reem Abdel-Aziz

The 2019 Nobel Prize in Medicine was shared among three scientists, each had his own separate research; without any coordination, they worked in strange harmony, effectively completing each other's work. The three researches addressed the adaptation of cells to the level of oxygen in the blood from a distinctive aspect, until the three scientists were able to solve the puzzle.

Oxygen is the element of life for all living organisms; cells need it to convert food into energy. All body cells can adapt to hypoxia—deprivation of adequate oxygen supply at the tissue level—by releasing the erythropoietin promoting hormone, which increases the production of red blood cells in order to increase the amount of oxygen in the blood. The three researches studied the mechanism used by the cells to adapt to the oxygen level, and the mechanism of stimulating cells to release the erythropoietin. Knowing this mechanism helps in controlling the level of oxygen in certain diseases, such as anemia, heart attack, angina, and cancer.

Although the real winners are science and the society, here is a brief about the three scientists who won the Prize.

- Dr. William Kaelin's research focused on a rare type of cancer caused by the Von Hippel-Lindau (VHL) genetic disease, which increases the secretion of the erythropoietin hormone that stimulates the production of red blood cells and the formation of blood vessels. Dr. Kaelin wondered why cancer needs all this blood. The answer was oxygen; henceforth, the mystery started to unravel.
- Dr. Gregg Semenza wondered what cancer cells look for when they spread in the surrounding tissues and the blood vessels. Are they looking for nutrients? Yes, in fact, looking for oxygen. Is there a genetic factor that makes the cell feel hypoxia or hyperoxia? Which gene is responsible for the increase of the erythropoietin hormone? His study of this gene has led him to study related diseases, such as cancer.
- Sir Peter Ratcliffe majored in kidney diseases, and studied how organs regulate the production of erythropoietin based on the available oxygen.

Cells use oxygen to turn food into energy; this process takes place in the cell's mitochondria through enzyme control. This discovery was awarded the 1931 Nobel Prize. Corneille Heymans was awarded the 1938 Nobel Prize for discovering that the oxygen level in the carotid artery controls the respiration rate by sending signals to the brain directly. Also, there is the carotid body, which stimulates the production of erythropoietin in the case of hypoxia by producing more red blood cells. However, the mechanism of stimulating the erythropoietin hormone in case of lack of oxygen was still unidentified.

Sir Peter Ratcliffe discovered that the mechanism for making erythropioetin is found in all body cells; this discovery was the first step. Dr. Gregg Semenza studied the gene responsible for stimulating the erythopoietin hormone, and how it varies according to oxygen concentration in the blood. Using a genetically-modified rat, he attached a distinct DNA to the gene responsible for erythropoietin production to facilitate monitoring the effect of hypoxia on it. He discovered a protein complex (protein synthesis) connected to the distinct DNA in case of hypoxia or hyperoxia; he named it the Hypoxia-Inducible Factor (HIF). He found two types of this complex (synthesis), but he focused his studies on the first type, HIF-1.

He began to decipher the mechanism of stimulating the erythropoietin hormone as HIF-1 increases with hypoxia and vice versa, then rapidly decomposing in normal conditions or in the cases of hyperoxia. Yet, how can the body protect this factor from decomposition in case of hypoxia? Dr. William Kaelin answered this question during his study of the VHL genetic disease, which increases the probability of cancer.

He found out that cancer cells with a deficiency in the gene responsible for the VHL disease have high levels of the hormone controlling oxygen; when the deficient gene is returned, the oxygen levels become normal. As such, the gene responsible for the VHL disease controls the cell's response to hypoxia or hyperoxia. It became clear that gene linkage with the protein complex HIF-1 leads to its decomposition in normal conditions.

We now know how to regulate the different levels of oxygen, and how this adaptation allows the cells to perform its vital processes, even during hypoxia, such as what happens to the muscles while exercising. This happens through the production of more red blood cells and blood vessels. Now that these promising researches have come to light, it is up to pharmaceutical companies to develop a medicine that controls the mechanism of cells adaptation to oxygen levels, whether by inhibition or activation according to each disease and what suits it.

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By: Heba Hammam

ANESTHESIA
A GIANT LEAP FOR HUMANITY

In an operating room, an anesthesiologist injects a fluid in one of the patient's veins; within seconds, the latter loses consciousness and the operation commences. When the patient wakes up, all s/he can remember is the injection; it feels as if nothing else happened. Nevertheless, things were not always that easy. Surgical operations before anesthesia were a nightmare for patients and surgeons; a surgeon once compared the operating theater to an execution room.

In the old days, patients were struck on the head to lose conciousness, or alternatively held down by strong people until the surgeon completed the operation. Other surgeons resorted to cutting the blood supply to the organ, so that it would die out, making it easier to remove. Others would apply ice to the area to numb it before operating; medical plants and herbs were also used in anesthesia, but applying too much had a negative effect, making it dangerous. Alcohol was discovered by accident due to the fermentation of fruits; its vapors were used in anesthesia due to its pain-relieving effect.

Modern anesthesia emerged when the English scientist Joseph Priestley discovered Nitrogen dioxide (NO_2), known as laughing gas. Dentists were the first to use it as an anesthetic, to address the pressing daily problem they faced with their patients during teeth extraction. On 16 October 1846, a surgeon at Massachusetts General Hospital, Boston, managed to remove a tumor from a patient's neck using an ether gas discovered by the American dentist William Morton. Marking a huge milestone in the history of anesthesia, the International Day of Anesthesia is celebrated annually on that day. Prior to 16 October 1846, pain and surgery were two sides of the same coin.

After that, ether became a popular anesthetic; still, it had side effects, including nausea, vomiting, and inflammation of the lungs. It also took a long time to function before the surgeon could start operating; these drawbacks urged the search for better alternatives. Scottish obstetrician Sir James Simpson discovered chloroform and used it during a childbirth operation. Chloroform had advantages over ether; it was faster, stronger, and cheaper. The fact that it was used during the childbirth of Queen Victoria to Prince Leopold made it more popular among surgeons and patients. However, it lost its reputation after its side effects on the liver appeared and deaths associated to it increased.

Later, many types of general and local anesthetics emerged, allowing doctors to choose according to the status of the patient and the type of operation. Patients lose feeling and conciousness entirely in case of using general anesthetics, the most popular of which are:

- Thiopental: It was discovered in the 1930s and is injected in the veins. It is merited for its rapid effect; however, it is short-termed, so after it is injected, the patient still has to be anesthetized using another drug.
- Halothane: It was discovered in the 1950s; it works through inhalation and is amongst the most widely used anesthetic drugs until now.
- Isoflurane: It is similar to Halothane, yet with the added advantage of being suitable for patients who suffer from liver diseases.
- Propofol: Discovered in 1977, it is one of the newest anesthetics; it is injected in the veins.

As for local anesthetics, they make patients lose feeling in a specific area, keeping them concious and alert; major examples include:

- Cocaine: It is the oldest local anesthetic; extracted from the leaves of the coca plant, it is the only naturally-existing anesthetic. Cocaine was discovered in South America, and was widely used during the 17th century in dentistry and ophthalmology.
- Lidocaine: It is the most widely used local anaesthetic until today, and is a derivative of Cocaine.

Later, spinal anesthesia emerged; it works on the lower region of the body. A local anesthetic, such as Bupivacaine, is injected in the spinal cord fluid in the lower part of the body; the patient loses feeling in the lower region of the body, but remains alert. This type of anesthesia is widely used in Caesarean section surgeries.

As science develops, new drugs emerge. These have included muscle relaxants, which prevent spasms during surgeries; antiemetics, which prevent salivation to protect the patient from suffocation; and antibiotics, which the patient takes before or after surgery. All this has made surgery much easier, decreasing the complications that could occur during or after the operation.

In spite of all the breakthroughs in anesthesiology, thanks to which millions of surgeries are performed annually around the world, Mankind is in a continuous quest to find what is better and safer.

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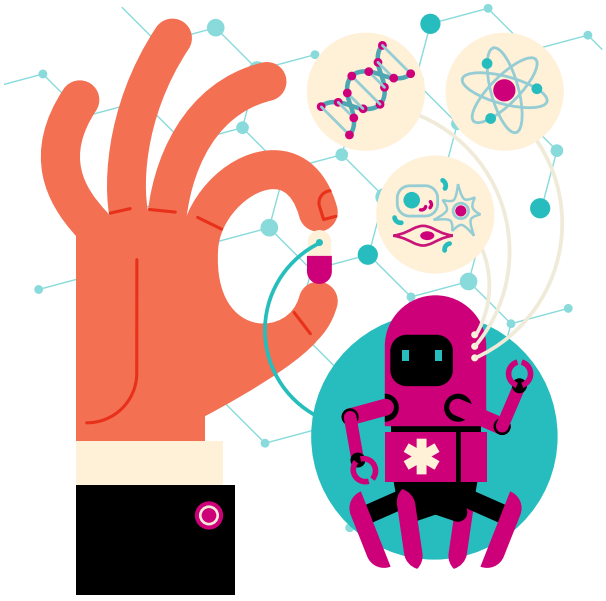

A Future Without Medication!

By: Reem Abdel-Aziz

He who has health has hope, and he who has hope has everything; hence, we all strive to stay healthy. Medications have a major role in fighting diseases and helping us restore our health after suffering from health problems. Between the past, the present, and the future, the pharmaceutical industry has witnessed and is still experiencing significant development. It is expected that more complex chemical compounds or antibiotics are still to be discovered with a better ability to fight bacteria. Yet, can we dispense with medications in the future?

Several techniques have recently emerged to treat diseases; they may determine our ability to dispense with medications in the future. Will these techniques fundamentally prevent some diseases from occurring? Let us postpone the answer to this question until we have reviewed some of the techniques and their development.

Gene Therapy

The idea of cultivating genes and using them to treat diseases began in the 1980s. The idea is to grow a specific gene to stimulate the formation of a specific protein, the absence of which was the cause of the disease; in other words, this gene regenerates the missing protein. One of the gene therapy applications is the treatment of cystic fibrosis—a genetic disease that causes an imbalance in all body systems as a result of increased mucous secretion. The disease is caused by the lack of the protein Cystic Fibrosis Transmembrane Conductance Regulator (CFTR). Scientists have successfully extracted the gene responsible for the production of this protein to inject patients with it, resulting in full recovery.

Unfortunately, in 1999, the unexpected death of the American patient Jesse Gelsinger as a result of gene therapy led to putting the research in this field on hold for years. In 2012, however, the European Medicines Agency certified the drug Glybera as a treatment for chronic pancreatitis; it is a gene therapy now available to patients. As a result, gene therapy researches have resumed.

Biotherapy

Most medications today are made from chemical compounds; can they be made from living organisms or biological materials in the future?

In the past, leeches were used to treat high blood pressure; they were placed on the patient's forehead to absorb blood and lower blood pressure. Now, scientists have discovered that leeches have the potential to maintain the blood's liquidity. They secrete an anti-clotting protein known as Hirudin while attaching to the human skin; thus, facilitating blood absorption. The treatment period ranges 20–45 minutes, during which 15 millimeters of blood can be absorbed; a very small amount compared to its benefits.

As a result, leeches are used in the treatment of clotting; they are also used to improve the blood circulation of diabetic patients who are subjected to leg amputation. They help keep the tissues alive by keeping the blood flowing through them. Leeches are also used in micro surgeries, plastic surgery, reconstruction, and restoration, to maintain the blood flow in the organ being rebuilt, such as in reconstructing the nose and fingers. They help the organ return to its natural state and in the body's acceptance of it, as well as speeding its healing.

On the other hand, scientists have discovered the ability of some worms to treat wounds because of their antibacterial effect. It is worth mentioning that the green fly larva is used in many medical fields, but the obstacle to its use is the excessive sensitivity of some patients to it. Some types of beneficial parasites are also used to strengthen the immune system and treat some diseases, such as asthma, allergies, and skin infections.

Biotherapy may be a strange field, but how many strange areas have evolved and are now normal. However, it still requires a great effort to study the active substances in these organisms, in order to make them easier to use and not to harm human health.

In reality, we do not know whether other drugs will be developed in the future or not. From the invention of penicillin by Alexander Fleming, to the discovery of the human genome, many years of work have passed during which the drug industry has developed extensively. What I know well is that science is limitless, and that it is the only way for nations to develop.

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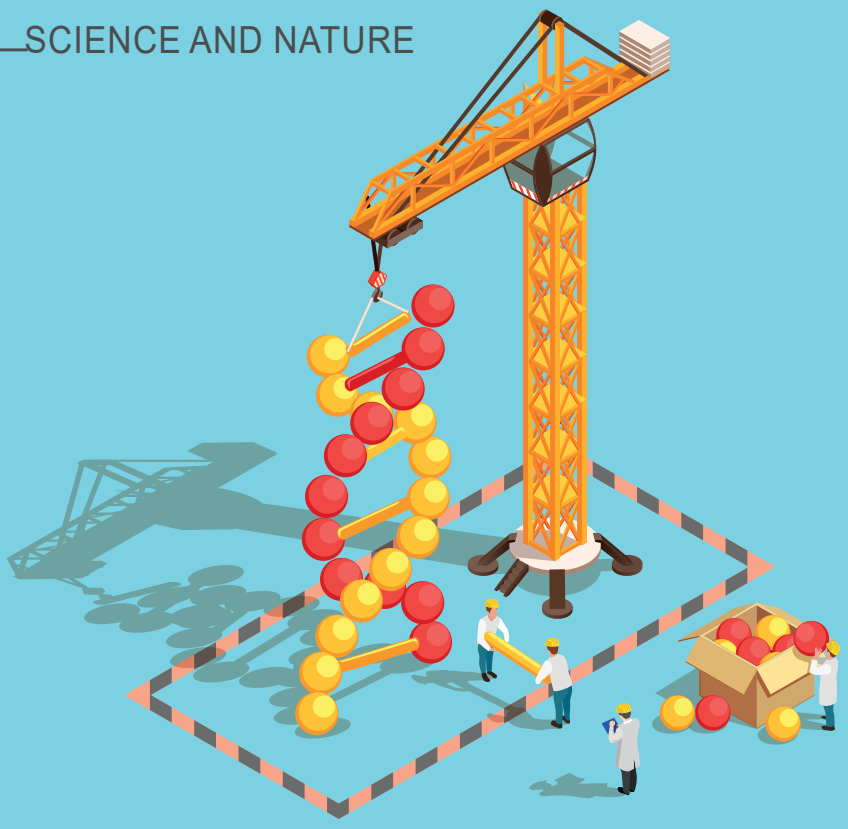

Better Genes for More Crops

By: Naglaa Hassan

Attempts to advance the quality and traits of living organisms, specifically plants, initiated thousands of years ago. They are not all human endeavors though; they also include natural evolution. This means that the characteristics of living organisms have changed over the ages. They have adapted to the surrounding environmental conditions and the selectivity features that work in favor of the individual, developing the most supreme and strongest characteristics to resist harsh environmental conditions.

Gene editing in plants aims to increase their nutritional value and fruit size, as well as enhance their ability to resist diseases and pests, prolonging their shelf life, and maximizing their adaptation potentials to the surrounding environment. Nutritionists and geneticists have agreed that, for each genetically modified plant, it must have three essential characteristics, which are to be genetically different from all other lineages, compatible with its species, stable and insusceptible to mutations.

Techniques

Using several methods, people have succeeded in improving plant's genetic characteristics; either by providing it with a new, good trait, or by removing a weak, harmful one. One of the most recent and well-known methods is "cross-breeding", which first appeared in 1700. The idea relies on pollinating two sexually compatible plant species to create a hybrid lineage, such as plum and apricot, lemon and grapefruit (tangelos), and radish and cabbage.

The researchers also derived the "mutagenesis" technique from nature, which is the alteration of plant genetic information. It is well known that genetic mutations may occur automatically when exposed to chemicals or radiations, and may result in lineages carrying genetic diseases or cancer. Mutations can also be processed in a laboratory by separating, altering, or adding genes or nucleotides. The first recorded mutation attempt was in the first half of the twentieth century; it resulted in a color change of the grapefruit.

One of the most important techniques of genetic modification is "protoplast fusion". It is a hybridisation-like process that takes place in the laboratory, not the farm, where scientists combine the contents of two genetically different plant cells, after removing their cell walls. Polyethylene is then added to help the two cells stick together. Scientists continue adding other supporting materials after the adhesion is complete, to complete the fusion process and the exchange of genetic information, resulting in a new hybrid. Plant hybridization experts use the "polyploidy" technique to control crop characteristics, such as the cultivation of seedless watermelon. Eukaryotes—organisms whose cells have a nucleus enclosed within membranes—have two paired sets of chromosomes, such as humans. Some plants, on the other hand, have more than two aired sets of chromosomes; known as polyploidy.

There is also the "genome editing" method, which is also known as genetic engineering. Scientists can add, cut, or replace genes within seed cells through the nucleus enzyme, which works as a scissor for molecules for its ability to edit, remove, and add nucleotides. It is totally created in the laboratory to be located exactly on the target gene or traits. One of the most prominent applications of this technology is the production of crops resistant to harmful herbicides.

In addition to the above-mentioned techniques, there is the "microinjection", where researchers inject DNA directly into plant cells. Many of the injected cells do not survive, but some would grow as a genetically modified plant incubating the new DNA. Likewise, in the "electroporation" technique, scientists apply a high electrical field to the cell plasma membrane to easily allow introducing DNA molecules that carry the needed traits to the cell. Subsequently, these cells recover and rebuild their walls, which were destroyed by the electrical field, to grow and multiply as a genetically modified plant. There are several methods and techniques that researchers are developing, such as transgenesis, microbial vectors, and cell selection.

These techniques share and intersect in many occasions, as one of them might suit a particular trait rather than the other; however, they all certainly develop the agricultural process, and produce crops with better traits. Scientists have proven that genetic modification is not science fiction, and that the idea of genetically modified foods and crops aims to serve humanity and eliminate nutritional problems around the world.

Controversy

The controversy is deepening and widening between the supporters of popularizing genetically modified food technology and their opponents. Each has a persuasive point of view supported by benefits and strengths. Scientists supporting the genetic modification theory, state several advantages of the technology, including the increase of the nutritional value of crops, such as Golden Rice. It is one of the first genetically modified crops, and was strengthened to treat vitamin A deficiency, which is common among developing countries and results in blindness and some infectious diseases, and can cause death among children. Other crops—such as maize, broom-corn, and bananas—were subjected to vital fortification with vitamins and minerals, to increase their nutritional value, in addition to having a better flavor.

The production of disease resistant lineages that are less demanding of pesticides, or requires less toxic and expensive species, is among the most important advantages of plant genetic modification. Pesticides cause undesirable effects to the environment, and to farmers' and consumers' health alike. Genetically modified plants produce toxic proteins that resist larvicides, and soothe viruses and plant fungi. Although these genetically modified seeds are more expensive than regular seeds, the total cultivation cost is overall reduced, as the cost of agricultural machinery, fuel, and chemical pesticides decrease; that is in addition to the resulting savings from crop yields. The pollution rate of water networks and drains in agricultural lands is greatly reduced, due to the lack of pesticides that previously spread widely over lands, and were mixed with irrigation and drainage water.

These crops are also characterized for being resistant to drought and water shortage, which makes them suitable for cultivation in several harsh places suffering from seasons of low supplies of water. They do not also require a lot of agricultural fertilizers, which reduces the total costs of the cultivation process. Moreover, they grow and ripe in a short period, and have long shelf life compared to regular crops that damage quickly. Genetically modified foods shine as well in the medical field; they can be used in the manufacture of immunizations, vaccines, and other several drugs. The characteristics of some of these crops, which could have caused serious diseases, such as cancer in the case of the potato plant, have become less cancerous when fried or exposed to extreme heat.

Genetically modified foods are, of course, subject to several accusations; some scientists have several concerns, and have attributed the emergence of some new diseases to genetically modified foods. Their concerns are represented in a number of points, such as the spread of allergies in a more exaggerated way than previously. The scientists' explanation of this phenomenon is that the planted genes in the modified crops may be from a plant or an allergen ingredient,

INTERNATIONAL YEAR OF PLANT HEALTH 2020

and their insertion in several other crops has led to the spread of an allergic reaction. World Health Organization (WHO) has asked genetic engineers not to use genes if they cannot prove that they are not allergens.

Modified crops are also accused of being one of the causes of the high prevalence of cancer rates, due to the occurrence of mutations in the DNA of the modified plant. However, the American Cancer Society denied these allegations, saying that it is inconclusive and needs further study. Physicians also attribute antibiotic-resistant bacteria that affect humans to eating modified foods. Their theory is based on the transfer of the gene responsible for disease resistance to human cells, then to the cells of intestinal bacteria, leading to the creation of new bacteria lineages that are antimicrobial resistant. WHO reports that there is little chance a gene transfers from food to human cells or bacteria.

Several groups in the society fear genetically modified foods, and have concerns over the creation of mutations, or novel, untreatable and uncontrollable diseases. Yet, the society accepts natural mutations, which may be caused by the exposure of living organisms to chemicals or radiations. There is no doubt that there are several flaws, as well as several advantages. It is, thus, necessary to compare the great benefits, the problems that can be eliminated, and the potential risks, and apply various experiments before generalizing or banning the idea of genetically modified plants.

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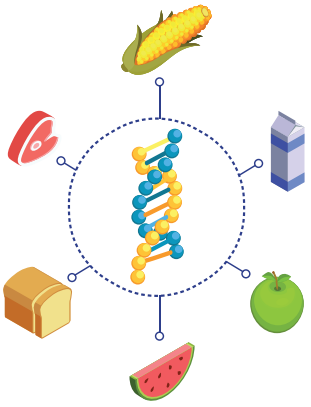

2020 A Make-or-Break Year For Climate Action

Humans are taking planet Earth for granted; they continue to deplete it thinking they will not be affected by the consequences. As a result, we are now facing the biggest environmental challenge our species has ever encountered; that is global warming. It is defined as the gradual heating of the Earth's surface, oceans, and atmosphere, as a result of burning fossil fuels, which release carbon dioxide, methane, and other gases into the Earth's atmosphere.

By: Shahenda Ayman

At the beginning of the 19th century, carbon dioxide was listed as a "greenhouse gas". In 1972, John Sawyer, Head of Research at the UK Meteorological Office, published a paper in *Nature* predicting a warming of about 0.6°C by the end of the 20th century. From 1906 to 2005, global temperature has actually increased by 0.74°C and global sea level has risen by 17 cm as a result of the ensuing snow melting from many mountains and in the Polar regions. More regional changes have also been observed, including changes in Arctic temperatures and ice, ocean salinity, wind patterns, droughts, precipitations, frequency of heat waves, and intensity of tropical cyclones.

Recent reports show that CO_2 concentration in the atmosphere as of 2018 has reached its highest records in 3 million years; 11% of greenhouse gas emissions are the result of deforestation caused by humans, and not by car and truck emissions. The last four years were the hottest on record, and winter temperatures in the Arctic have risen by 3°C since 1990. Sea levels are rising, coral reefs are dying, climate change has already begun to affect human health through air pollution, heatwaves, and risks to food security.

Higher CO_2 emissions are from the developed countries; the United States and China emit the highest levels of CO_2 emissions in the world. In 2015, China produced more than 900 million tons of carbon dioxide, while the United States has the second-highest of about 500 million tons. On the contrary, many of the poorest countries in Sub-Saharan Africa—such as the Central African Republic, Chad, and Niger—have the lowest levels of emissions; their average footprint is around 0.1 tons per year, and that is considered more than 160 times lower than Australia, Canada, and USA.

According to a recent report issued in October 2019 by the UN Intergovernmental Panel on Climate Change, we have to cut global carbon emissions by half in 2030 in order to avoid the worst impacts of global warming. The report indicated that, by limiting global warming to 1.5°C rather than 2°C—a goal set long ago—Earth will be much better; to achieve that goal, the world has to cut its greenhouse emissions by 45% by 2030.

In 2020, countries will meet to assess how they will save the planet from greenhouse gases threating life on Earth. Half as many people would face climate change-related water shortages, hundreds of millions would face extreme heatwaves. In order to save the people and the wildlife that depends on nature to thrive now and in the future, individuals, citizens, governments, businesses, and everybody have to step up together in 2020 and take urgent action to protect and restore nature for a more sustainable future.

There is no magic bullet to combat climate change, humans should change the way they produce and consume energy, such as shifting to wind and solar power, using biofuels produced from organic waste, and protecting the forests can reduce the amount of CO_2 and other gases that trap heat in the atmosphere.

Other solutions to reverse our current situation include building batteries to store renewable energy; engineering a smarter electric grid; and capturing carbon dioxide from power plants and other sources with the goal of storing it underground or turning it into valuable products, such as gasoline.

To achieve that goal, countries will come together in December 2020 at the 26th Conference of the Parties (COP 26) of the United Nations Framework Convention on Climate Change (UNFCCC) to enhance their action plans, to guarantee that the Paris Agreement goals set in 2015 are achieved. Accordingly, more ambitious plans need to be set to restore the natural systems and ensure their sustainability.

It is still our call; if we do not change the course by 2020, we risk disastrous consequences that will affect all life on Earth. Countries with the highest emissions must reduce theirs and must ask others to do the same. With everyone's help, 2020 will be the year that we can start restoring our planet, so let us make sure it is just that.

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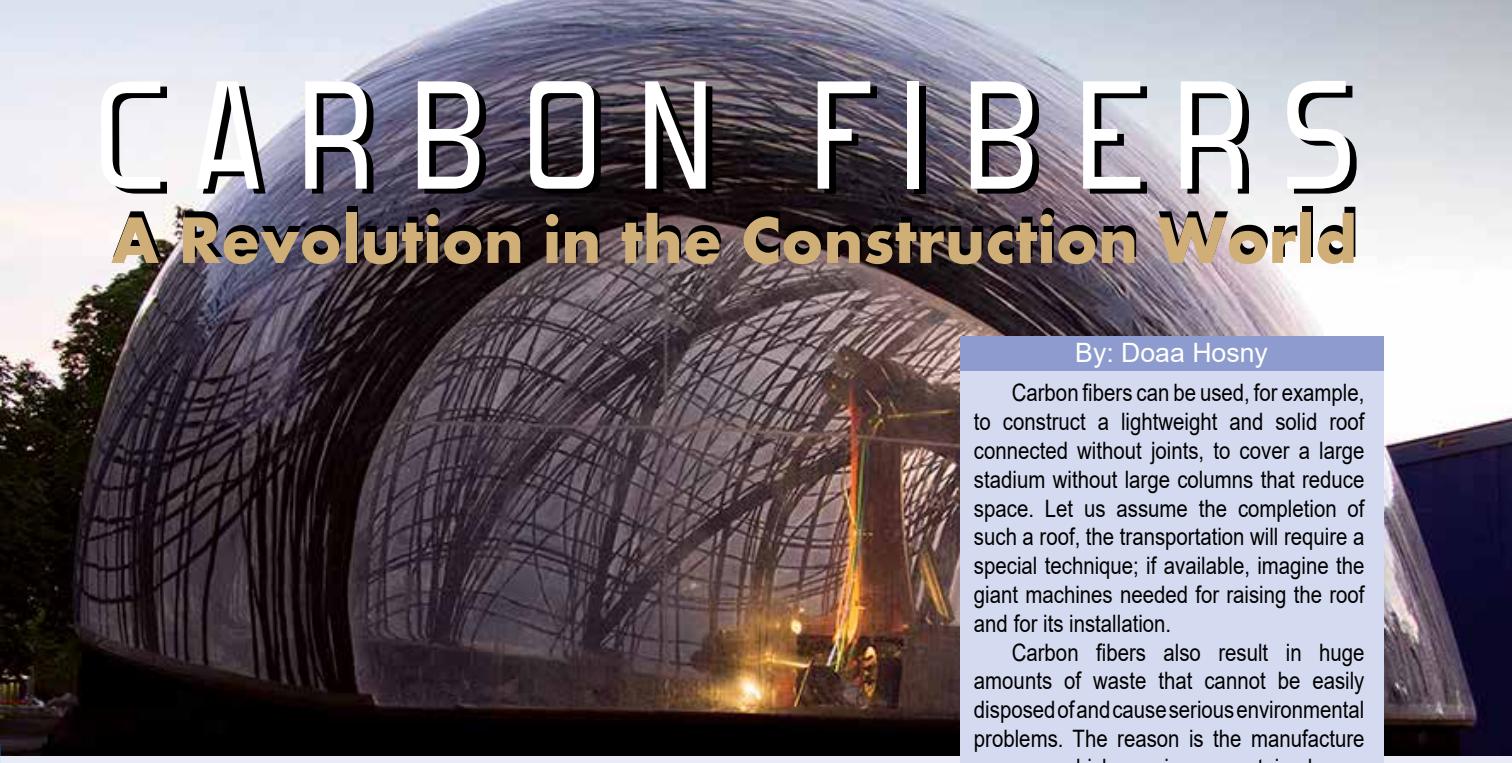
CARBON FIBERS

A Revolution in the Construction World



By: Doaa Hosny

Life is all about the evolution; all nations compete to invent what is new and useful for their survival, alas it crumbles underneath the speeding advancement of the day. Just like water and food, safe housing is a basic human need, and has been a main demand since life began on the planet. However, with the invention of carbon fibers, which are based on mixing carbon with other compounds, it has turned into a real revolution in the world of construction; but why? Here are interesting facts about carbon fibers to judge for yourself.

Carbon fibers are bundles of thread composed of carbon atoms that bind together and mix with other chemical compounds. Although the thickness of a single strand is thinner than a human hair, it is very tough and tensile. The real introduction of carbon fibers was in military industries, in the mid-1990s. The increasing rate of warfare and the doubled demand on weapons have led to a revival in its use in manufacturing light-steel weapons and other military equipment, such as aircraft, missiles, and helmets.

More recently, the United States National Academy of Engineering has voted carbon fibers as one of the top 20 achievements of the 20th century. Carbon fibers are a promising achievement for the building and construction sector because of their multiple advantages:

- It is five-times stronger than steel; making it an ideal and safe construction material.
- Its flexibility allows for the implementation of different, new and modern architectural designs; its strength helps in constructing earthquake-resistant buildings.
- It is easy to transport because of its light weight; it is stronger than steel and one-third of its weight.
- It reduces time and cost because a carbon fiber structure takes much less time than steel; it would take just weeks to build a structure out of carbon fiber, versus months to build the same structure with steel.
- It can withstand high temperatures. Its thermal expansion is low; meaning it enhances the buildings' ability to control temperature and isolates them from changing weather conditions, especially during current dramatic climate change.
- It has high chemical and corrosion resistance abilities.
- It is non-flammable and is used in fireproof cloth products, and it can be used in fireproof buildings too.
- It is a good conductor of electricity; however, this characteristic can be a serious defect when carbon fiber dust unintentionally accumulates in some places causing sparks and small circuits in electrical appliances.

Having said that, why is it construction professionals do not use carbon fiber extensively? In fact, like every new discovery, carbon fiber needs more time to be tested on a large scale, and to construct the needed plants to cover its demand. Overcrowded cities of solid concrete buildings impede carbon fiber extensive use in construction, and the replacement process requires time, effort, and a huge cost. The maximum benefit of carbon fibers will be achieved when used on a large-scale; however, tremendous equipment that do not exist now—but may be available in the near future—is needed.

Carbon fibers can be used, for example, to construct a lightweight and solid roof connected without joints, to cover a large stadium without large columns that reduce space. Let us assume the completion of such a roof, the transportation will require a special technique; if available, imagine the giant machines needed for raising the roof and for its installation.

Carbon fibers also result in huge amounts of waste that cannot be easily disposed of and cause serious environmental problems. The reason is the manufacture process, which requires a certain degree of pressure to grant carbon fiber strength and solubility resistance properties. For recycling and reclamation, carbon fibers must be incinerated or dissolved chemically as a whole. Accordingly, current studies address environmental concerns regarding carbon fiber recycling, as well as energy conservation in the production of new fibers.

The use of carbon fiber is not confined to the construction and building sector; its flexibility and strength widely increase its application. For example, it is used in manufacturing the bodies of race cars, aircraft wings, sailboat masts, bicycle tires, spacecrafts, telescopes, optical instruments, and mobile phone covers, which are shock absorbent and resistant to fracture and tear. In medicine, carbon fibers are used in the manufacture of prostheses; researchers currently study their usage in treating Anterior Cruciate Ligament (ACL) injuries.

Carbon fiber is indeed a promising material that would change the shape of several industries and fields, especially construction. Our world is in dire need of such breakthroughs, as well as accelerating their applications and overcoming any difficulties faced to achieve the development goals.

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By: Basma Fawzy

COMMUNICATION through the Ages

"Communication in the past was never easy; if you asked your parents or grandparents how they communicated with each other in the past, you will realize how difficult it was to call each other, or to send a letter to a relative living a bit far from them. Today, smartphones help us a lot to communicate easily with people around the globe, and access information whenever we need it.

An English novelist once wrote: "The past is a foreign country; they do things differently there". Let us see how communication methods of the present differ from those of the past, and try to figure out what the future holds for us.

Telephone (The Past)

It was a happy day for humanity when Alexander Graham Bell made the first phone call ever to his assistant, saying: "Mr. Watson, come here. I want you". This phone call transformed the way we communicate today. At the time, the telegraph was the available means of communication; it was a good system, but it was quite limited, as you could only send one message at a time. Bell's work to improve the telegraph system so that several messages could be sent at the same time led to the invention of the telephone.

He came up with the idea while trying to transfer speech through wires and experimented it with his assistant Thomas Watson. The idea of the telephone is based on a device to vary electric currents and a receiver to transform these currents into frequencies that could be heard. In other words, the telephone is a device that changes voice into electric currents that travel through the wire to reach its destination; those currents are transferred into speech. The birth of the telephone marked the end of the telegraph, as the telephone was more convenient.

Smartphone (The Present)

At the beginning, mobile phones were similar to landline telephones; the only difference is that mobile phones were wireless. The mobile phone concept is similar to that of a radio; first, the voice changes into electrical signals in your devices then is transformed into a radio wave. It reaches the cell tower then travels to reach another phone and changes back to sound.

With technology advances, the mobile phone has become a smartphone through which you can browse the Internet and look up information; ever since, life has tremendously differed. The revolution of smartphones has changed how people live. You do not have to send letters that take time to arrive; you can communicate easily and rapidly through E-mail, WhatsApp, or any other messaging applications. If you have a family member living abroad, you can communicate through video calls.

What is next? (The Future)

We do not know yet what will be next; it could be anything. There might be devices that allow us to communicate our thoughts without opening our mouths. If you think that this is too far-fetched, think again. Mark Zuckerberg, Facebook's CEO, has recently announced that he is interested in creating devices that can be controlled by our thoughts.

Brain–computer interfaces establish a connection between your brain and external devices; those interfaces are either invasive or non-invasive. Non-invasive are the devices that you can wear, while invasive devices are those inserted in the brain to measure signals. Invasive devices are used for medical purposes in neurosurgery and are quite limited because of the risks. More companies are interested in using brain–computer interfaces for various purposes and the future of wearable devices that can be controlled by your thoughts.

Bell's telephone has made communication and life so much easier, but smartphones have revolutionized the way we live. With every step we take toward the future, the past becomes more like a foreign country. The possibilities are limitless, we only have to wait and see.

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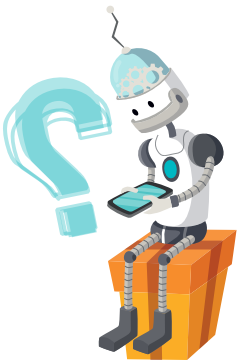
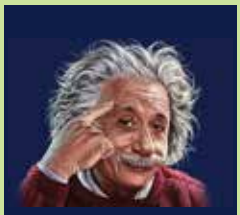


Needless to say, the aim of technology and discovery has always been to serve humanity and help people achieve more, through improving the quality of life and replacing difficulties with facilities. However, sometimes things head the other way round, and what was hoped to become a person's companion turns out to be a foe. In our digital age, technology has been pushing humans to the edge of anxiety, low productivity, and disconnection. Hence, there is a need to slow down and rethink of what is actually happening.

The Dark Side of Technology

Since human beings are social creatures by nature, finding new ways to connect with one another has been a core thing in their way of living. As a result, social media has emerged to shrink the

DIGITAL DETOX in the Digital Age



"I fear the day technology surpasses our human interaction; the world will have a generation of idiots"
Albert Einstein

By: Inas Essa

distance, and make it easy for people to connect with family and friends, or even get to know new people, and share moments and memories with them. However, that has come at a high price!

Although social media has succeeded in this mission, it has driven some people to stay in their bubble, isolated and disconnected from real life, which has affected social behaviors and mental health dramatically. Excessive usage of social media has pushed some people to unconsciously develop symptoms of addictions. This has shed light on an important question: Does the need to connect with others and stay sociable demand being mentally consumed by excess screen time?

Digital Detox

Studies conducted in this field indicate that social media appears to promote narcissism, smartphones may cause insomnia, and screens seem to make kids less empathetic and less focused. Thus, an immediate method was required to help stop that avalanche of disasters that is turning lives of millions upside down. A simple, yet effective, method is right there, namely digital detox!

A digital detox is a period during which a person voluntarily refrains from using digital devices, such as smartphones, computers, and social media platforms. It aims to reduce stress and anxiety associated with the overuse of technology, and to help one reconnect with nature and increase mindfulness. As such, a digital detox is a healthy way to set boundaries that keep you focused, relaxed, and able to discover new things far from your screen. It helps sustain a better and a healthier relationship with technology, and make connections in a more guanine and fruitful way.

This idea has been implemented on different levels; some implement it during their weekends, while others go the extra mile and seek refuge from technology in digital detox retreats. In a study conducted on 35 CEOs, entrepreneurs, and other influencers, on a trip to Morocco, neuroscientists observed every aspect of the participants' behavior, with and without technology. They studied participants' facial expressions and physical movements, and the results were remarkable after a few days without technology:

1. Participant postures noticeably changed; they began to adapt to primarily look forward into people's eyes, which also helped make better eye contact that encouraged people to connect more deeply.
2. They were more able to remember obscure details about one another. Neuroscientists believe that this happened because participants were more present in the conversation; thus, their brains were able to store new information more easily.
3. They could get more efficient sleep; as the blue light from screens makes us more alert, especially when we are exposed to it right before bedtime.

The study opened a new window for participants to make real change in their lives and view it from new perspectives. Some decided to make big changes in their careers or relationships, while others decided to recommit to health and fitness.

A Manifesto for a Digital Detox

It is easy to reach the best results from a digital detox; but first, you should believe in it as a real investment for your mental health and well-being. You can pursue that as a diet and take one step at a time to achieve the best result:

1. Delete accounts that you are no more interested in; you can also delete the application from your mobile phone, and log into your account from the computer.
2. Place limits on how much time you spend on social media or other applications.
3. When you feel stressed, go for a walk or practice one of your hobbies; you can also spend quality time with your friends or family, and thus feel connected to a real community.
4. Adapt healthy ways of distraction, such as reading, journaling, or learning a new hobby.
5. Set "no technology zones" and "no technology times" in your house.

We are not inviting you to go back in time to undo the impact of technology in the digital age. You only should use it wisely to achieve the most out of it without negatively affecting your social life and mental health.

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CYBER CRIMES:

The Price of Technology

By: Fatma Asiel

The technological revolution has had many positive effects on our lives; it has completely changed the shape of our daily lives and made a fundamental difference in it. Purchases, sales, and agreements are now easily carried out through computers or even mobile phones; cutting short the time, effort, and distance. Technology has even changed social life as we know it; gatherings and visits are done remotely through the Internet.

Nevertheless, our life is not free from problems due to technology. Perhaps technology itself is innocent, but misusing it has led to these problems; at the end, we have to face them whatever the cause is, and the most significant one is cyber crimes. Cyber crimes are crimes through the Internet, whether using computers, mobile phones, or tablets, with the assistance of certain programs and applications designed for the purpose of direct money theft, extortion, theft or destruction of important information, disruption of websites, in addition to other different forms of cyber crimes.

Forms of Cyber Crimes

- **Identity theft:** A serious crime, through stealing someone's data, and with the assistance of software, you can have that person's credit card number, bank account number, medical record, and other private information that can be used in illegal acts under the name of this person whose identity was stolen, who was impersonated, and whose documents had been falsified and used for illegal purposes.
- **Cyber bullying:** A form of crime against humanity that many people suffer from around the world, bullying usually starts at an early age in schools among students. Currently, bullying has evolved to take different forms; text or voice messages that contain humiliating phrases are considered an-all-too-familiar picture of bullying nowadays. It can evolve beyond that; to racism, mockery, offensive images, etc.
- **Extortion:** A very old concept, it is a threat using confidential information, pictures, or similar things, to drain someone's money or to force them to do something they do not want to do. The blackmailer has to burglar the victim or spy on him/her to get what s/he needs, then starts the extortion, which s/he may succeed in because the victim fears the leakage of the information. As technology has greatly facilitated the access to private information, pictures, and other personal material, it has become easier and quicker for criminals to extort people.
- **Money theft:** Stealing money has changed a lot than how it was done in the past; masked bank heists are no longer the usual form of money theft. Crimes and thefts have become much quieter, and the discovery of crime may take some time. Although banks and financial institutions impose strict protection systems on their programs and applications, hacking and manipulation still occurs, given the development of the programs that help hackers hack these systems and make transfers, sales, or purchases.

Cyber Security

With all these violations and cyber crimes, an effective solution had to be found; as a result, cyber security emerged. This specialty is responsible for protecting systems, networks, and softwares from cyber attacks; although it has evolved very rapidly, the task is becoming increasingly difficult. With the large number of devices allowed to access the Internet, and with the development of hacking programs, and devising new methods for cyber crimes, it has become difficult to completely prevent them. Yet, at least they can be minimized as much as possible.

The important rule that we should be aware of is that nothing is safe on the Internet; however, that does not mean that we are in major danger every minute. It is important to keep our personal information and photos away from our Internet-connected devices, and keep them on an off-line device or memory. Also, it is essential to install security softwares on our devices and update them on a regular basis to avoid cyber attacks.

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BLACK MIRROR

A Look at a Dystopian Future

By: Basma Fawzy

Black Mirror is a famous dystopian TV series about the potential horrors of technology in the future. Charlie Brooker, the creator of the show, reveals in his article published in *The Guardian* that *Black Mirror* refers to the mirror you find "on every desk, in the palm of every hand: the cold, shiny screen of a TV, a monitor, a smartphone". When your phone is switched off, all you can see is a black mirror staring at you. Technology in *Black Mirror* is more advanced, but the question the show raises is: "Does technology necessarily make our lives better?" *Black Mirror*, more or less, warns us that this might not always be the case.

In this article, I will focus on three episodes of the series entitled *The Entire History of You, White Christmas,* and *Playtest*, because they all revolve around the idea that the brain can act as a device that can either record, be manipulated, or accessed for data. In *The Entire History of You*, everybody is endowed with a "memory implant" that allows the brain to record every single event/situation that happens to a person in his/her life, so that one can always recall it as if watching a recorded video.

In *White Christmas*, the "cookie" is introduced; it is a digital copy of a person's brain. While in *Playtest*, the protagonist participates in testing a new game that uses virtual reality. The game provides a scary experience for the players, but it takes things further; it does not just show them some scary images, it also has access to their brains and what scares them most. The game adjusts the scary experience to a person's real fears; thus, it becomes too scary, as the brain cannot distinguish reality from the virtual reality experience.

In *Black Mirror*, data can be downloaded from the brain to use for different purposes; is this the future of mankind? Do we have the ability to uncover the mystery of the human brain? Nowadays, devices have been developed to record "the brain activity", not your thoughts; this technology promises the prospect of controlling seizures. Also, some technologies try to figure out what you are looking at by analyzing your brain activity. Scientists have also developed a brain-like device; a chip that has "artificial neurons" and is capable of mimicking "the behavior of neurons".

An understanding of how our brain creates and stores memories brings us closer to unveiling its mystery and one day maybe to read thoughts. A group of volunteers were asked, after wearing virtual reality headsets, to walk through a building. Their activity was monitored through an advanced brain scanning machine—functional Magnetic Resonance Imaging (fMRI)—the purpose of the research was to study patterns of the brain as it processes and saves data. If brain patterns are understood, they can lead to marvelous discoveries, making mind reading possible.

Virtual reality has also been applied in the episode *Playtest*, but what is virtual reality? It is a technology that includes most of your senses; your mind is tricked into believing you are somewhere else using special devices as goggles and sensory gloves to provide certain sensations. If you have seen anyone playing a virtual reality game, you will feel how much detached they look from their surroundings. The purpose of virtual reality is sometimes to place people in situations that might not be possible in realistic settings.

There are some useful applications to virtual reality today. For example, in the medical field, images of the brain areas where surgeons need to operate are taken and used to create a virtual reality experience for the doctors so they can practice, see, and feel the areas of the brain that need their attention, in addition to training new doctors. Of course, there are some benefits; but as with any technology, there are some cons; being totally detached from reality is one of them. Research is ongoing and the total effect of virtual reality on the brain is still unknown.

The technological breakthroughs that we observe daily in monitoring brain activities and trying to decode its signals make the predictions of the show not so far-fetched. Although a fictional series, *Black Mirror* raises concerns as to the dangers technology poses on our wellbeing; to name a few, the ethical dilemmas and the implications of accessing someone else's thoughts. Technology, in short, is a double-edged weapon that we need to know how to use wisely in order to survive.

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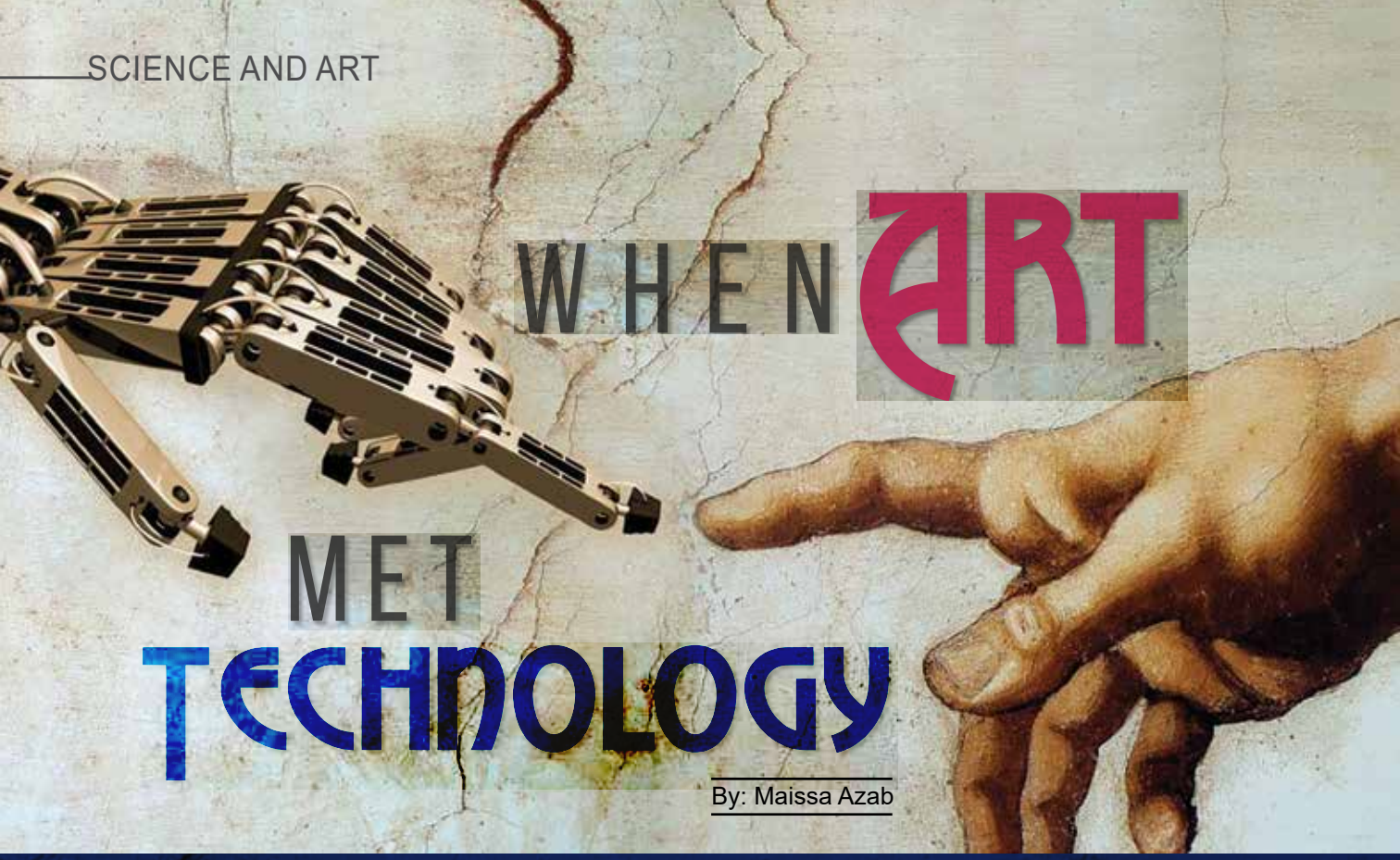


WHEN ART MET TECHNOLOGY

By: Maissa Azab

"The most beautiful experience we can have is the mysterious; the fundamental emotion that stands at the cradle of true art and true science." **(Albert Einstein)**

We have often discussed the elusive, but remarkably close, relationship between art and science; likewise, or even more so, the connection between art and technology may seem unlikely, but is indeed essential. If you think about it, you will realize that, without humanity's technological development since the dawn of time and throughout history, artistic expression would have remained locked away inside the thoughts and souls of humans.

Technological advancement has provided mankind with the materials and tools to use to create art in the form of writing, painting, sculpture, architecture, music, photography, cinema, and every other form of artistic expression. You may now think that it is a one-way relationship, but you would be wrong, because art is actually a vehicle for innovation and invention. Indeed, artists often develop new techniques, pushing the boundaries of imagination in ways that provoke new directions in technological development. From the preservation and restoration of ancient works, to the production of stunning visual graphics and immersive environments, the arts also generate substantial demand for innovation.

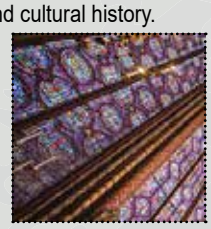
TALE AS OLD AS TIME

It is posited that drawing on cave walls improved early Man's skills of observation, as they were possibly used to conceptualize hunts, to evaluate the prey, to target vulnerable body areas, and to enhance group cohesion through spiritual ceremonies. The ability to produce art was an indication that humans had begun to think in more abstract terms. It is a thought process that enabled us to come up with the science and technology that enabled our species to become so successful.

Amongst the most ancient of civilizations, the Egyptians were a highly technological society; they brought to light a practice of art focused on producing technologically advanced forms: printing and carving texts, high-precision architectures, among others. In the intertwining of art and technology, ancient Egyptian artists designed technological changes that were developed by engineers and put in place by masses of workers.

The Greeks skillfully processed raw materials—stone, clay, and wood—and developed or improved tools, including pottery wheels and furnaces; thus, boosting production. Mining and metallurgic techniques contributed to a huge progress in engineering; technology was so significant to the Greeks, their mythology included a god of technology: Hephaestus.

The Romans, on the other hand, had access to a wider variety of materials, leading to improved production technologies that made the end products better, cheaper, and more available to people. By inventing concrete, introducing the arch and vault, and developing new techniques for construction, great public projects could be carried out. Roads, bridges, aqueducts, and amphitheaters left a deep impact on Roman social, economic, and cultural history.



Despite being known as the "Dark Ages", Medieval Times did not only provide mesmerizingly colorful stained-glass windows—such as in the Sainte Chapelle in Paris—but it also produced illuminated manuscripts intricately decorated with designs and miniaturized pictures in gold,

silver, and other brilliant colors. The fact that the manuscript was portable meant it was simple to transmit ideas from region to region, or even from period to period. Following the development of printing in Europe, in the second half of the 15th century, illumination was superseded by printed illustrations.

Brunelleschi was an Italian artist and architect famous for his technique for linear perspective and building the dome of Florence Cathedral. He is considered to be a founder of the Renaissance. His system of linear perspective was the principal influence on depicting space up to the late 19th century; he developed a mathematical system that enabled him to represent the three-dimensional world on a two-dimensional surface, via an experiment with a mirror and a hole.

Leonardo da Vinci is possibly the most well-known historical personification of the intertwining of technology and art. He was passionately curious, carefully observant, and playfully imaginative; he was always making plans and wanted to know more just for the sake of knowing. His studies of anatomy, birds, botany, the heart, fossils, geology, flying machines, and weaponry were innovative. With his explorations in optics and its mathematics, he demonstrated how light enters the cornea, among other in-depth knowledge of how the eye works, and was able to create the illusion of shifting perspectives in *The Last Supper*. Leonardo's ability to place himself at the meeting point of sciences and the humanities, as conveyed in his iconic drawing of *Vitruvian Man*, has bestowed on him the title of history's greatest creative genius.

Tune as old as song

Music appeared before agriculture or writing and has been present in every known society; technology has always played a major role in the development of music. From the monochord, which Pythagoras used to study musical intervals in relation to the ratios of the string lengths that produced them, to keyboard technology, instrument technology has also evolved with the music.

Organs from the Middle Ages combined exquisite craftsmanship with the knowledge of engineering to produce technological masterpieces that transformed air into breathtaking music. Four basic technological elements characterized this instrument: (1) a compressor to pressurize the air, in the form of a pump operated by levers or pulleys; (2) a vessel for storing air; (3) a mechanism for controlling air flow, usually in the form of a keyboard; (4) a progression of pipes of different sizes, which produced musical tones when air was directed across them.

Multiple keyboard innovations provided an outlet for the inventive genius of the mind throughout the history of music. Then, in 1837, Giuseppe Ravizza adapted the musical keyboard to mechanical writing; in 1870, the first commercially successful typewriter was patented.

Originally, listening to music required the presence of musicians; by the end of the 19th century, basic audio recording technologies became available, then Thomas Edison introduced the phonograph in 1877. Developing the technology of microphones and discovering electromagnetic waves led to the popularity of the radio as a system of broadcasting news and music in the 1920s. Anyone with a receiver at home could listen to radio; yet, it still relied on broadcasting real-time performances from the studio.

The first magnetic tape recorder was released in 1948, expanding the possibilities for broadcasting; live musicians were

Technology has always been and will always be a fundamental force in the evolution of art, facilitating easier creative processes, and enabling new types of artistic expression and revolutionary art forms.

no longer needed. Vinyl records soon reached the market, rapidly becoming the medium of choice for sound reproduction. They changed and evolved in line with technology and the demands of commerce; for example, vinyl grooves placed significant restrictions on the volume of bass frequencies, as high bass volume made the needle jump. These limitations were a strong influence on the very nature of pop and rock music as we know it.

Listening to music on records sprouted a new branch of the musical industry: the record company. Producers ingeniously overcame the limitations of the recording studio technology; by finding solutions for problems that occurred with each new project, they produced new techniques that broadened the scope of recorded music. The music industry could be the most tangible example of the art-technology intertwining and its influence on economy.

True as it can be

As a technology, photography was widely adopted by artists; by exploring it artistically, they developed photography and its range of applications. As a medium for artistic expression, it allowed for unprecedented forms of realism; techniques developed in relation to scale allowed us to see in completely new ways. Photography also liberated painting; painters were conditioned to make things look real, but with the arrival of photography, painters became free to explore new frontiers, and movements such as Impressionism and Expressionism were born.

The digital revolution has created a universal medium for creation and distribution. This has led to an increasingly integrated landscape of creative activity; ranging from digital photography, to product design and architecture, music production, games design, and visual effects in film. The growth of Virtual and Augmented Reality (VR and AR) is expanding the market and domains for artistic expression; 3D printing and scanning allow for rapid prototyping and the transmutation of objects between the physical and digital realms. This is an area that combines high-levels of artistic and technological skills; it is an area of economic importance, which in a world facing routine jobs automation and the growing pervasiveness of digital technology, is set to become more prominent.

Technology has always been and will always be a fundamental force in the evolution of art, facilitating easier creative processes, and enabling new types of artistic expression and revolutionary art forms. On the other hand, one of the most prominent artistic *Modus operandi* is connecting things that have not been connected before, or connecting them in unexpected ways, which results in the emergence of new things. Art and technology were born together and will always walk hand in hand propagating innovation as their domains connect to deliberately produce new ideas.

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HEDY LAMARR

By: Dr. Shaymaa Elsherif
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It may seem unreasonable to be a movie star and a scientist at the same time! This is practically impossible; one would be either engulfed by stardom and fame, or by science. To work and excel in both fields is an extraordinary feat that deserves spotlighting.

SCIENCE BEAUTY

Hedwig Eva Maria Kiesler was born in Vienna, Austria, in 1914. She was interested in science since childhood; her father helped her with research and reading. Later, she often credited her father for her love for science and scientific research. In parallel, she started her acting career in her twenties in Czechoslovakia. She then moved to Paris, from there to Berlin, then to London, where she met Louis B. Mayer, Head of Metro Goldwyn Mayer, who was stunned by her beauty and her English language (besides her native German language), and offered her a contract with the Company.

Hedy agreed immediately, so Louis B. Mayer changed her surname to "Lamarr" in memory of the silent movie star Barbara La Marr. Later on, Hedy Lamarr left Europe, all the way across the Atlantic Ocean to Hollywood, where she shot to fame thanks to her film *Algiers* in 1938. Lamarr reached the peak of her fame and glory with her historically immortal role in the film *Samson and Delilah* in 1949. One of the reasons this film was popular is that it was the first Technicolor film starring Lamarr. In the 1950s, Lamarr appeared on the cover of *TIME* magazine, where she was described as the most beautiful woman in the world. Lamarr ended her relationship with the cinema with her last film *The Female Animal* in 1958, and was honored with a star on the Hollywood Walk-of-Fame in 1960.

However, neither her successful career, her splendid divine beauty, nor her overwhelming presence on the screen stop her from being one of the most important scientists and inventors in history. Austria, Germany, and Switzerland celebrate her birthday on 9 November every year, dubbing it the "Inventor's Day" in honor of her scientific achievements.

When Hedy Lamarr was living in California, her neighbor was the famous composer George Antheil; during World War II, they worked together to create what they called "Secret Communication System". This was a way of changing the Radio Frequency (RF) to prevent enemies from decrypting messages. This system was designed primarily to face the Nazis; in that War, radio-controlled torpedoes were not successful in hitting targets, which was a major problem. Lamarr believed that the new communications system would make it difficult to detect the torpedo and uncover its signals; it later became an important element to maintain military communications security.

In 1942, both Antheil and Lamarr were granted a patent for their innovation, which was based on the idea of designing a wireless communications system that cannot be hacked or eavesdropped on. The idea is based on changing the radio frequency carrying the signal in a random manner, so that it would be difficult for any party other than the transmitter and receiver to follow it; they named this method "frequency hopping". However, the first version of this system was strongly opposed by the US Navy and was not used at the time. This situation lasted until 1962, when the US Navy finally decided to use the system in the siege of Cuba, after the expiry of the patent according to the American law.

However, Lamarr had to wait more than 30 years to be appropriately recognized for her scientific achievement. In 1977, she was honored by the Electronic Frontier Foundation for her contribution to this invention. Today, the system invented by Lamarr, in collaboration with Antheil, is considered the cornerstone of modern communications technology based on the "spread spectrum" technique, which is the same idea behind the invention of Bluetooth technology, Wi-Fi networks, and Code-Division Multiple Access (CDMA), which is used to turn your mobile phone into a radio, TV, computer, notebook, and data portfolio.

As such, Hedy Lamarr carved her name in two totally different worlds that could have an indirect connection. Science and technology may serve in artistic production; on the other hand, artistic production can promote science and its achievements, but combining them together as in the case of Hedy Lamarr is unique and non-recurring. No one has forgotten the glamorous actress Hedy Lamarr, nor the inventor Hedy Lamarr; she is an icon of beauty and science that inspires all generations. Nothing stands in the face of creativity; nothing is equivalent to being a multi-talented person, nor leaving behind a useful legacy to be invested by humanity for many years after one is long gone.

By: Dr. Omar Fikry
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BA Planetarium Science Center

URANUS AND HALLEY:
Two Coincidental Discoveries

The First Coincidence

William Herschel was one of ten siblings, four of whom died young. His father was a musician and conductor of a musical army troupe; his mother was an illiterate housewife. Since childhood, he showed signs of genius and excellence, especially in mathematics and linguistics. At the age of five, his father joined him in the musical troupe; he was released from the troupe when war broke out between France and Britain in 1753. The photograph of Herschel as a member of the musical troupe, as well as the certificate of discharge, are on display at the Herschel Museum of Astronomy in Bath, England.

He lived with his sister, who suffered financially, prompting him to play the keyboard to help him. He was a well-known musician until 1767, after which he devoted all his free time to astronomy and mathematics. It all started when, at the age of 35, he read an astronomy book, which he enjoyed a lot; he became so interested that he decided to start building his own telescope. After 200 failed trials, he succeeded to use his first telescope (5.5-inch diameter) to observe the Orion Constellation, where he detected a strange nebula, which was a turning point.

Herschel had a friend and neighbor named William Watson, who observed the strange object with him; he wrote a report about what they saw as a newly discovered comet, and submitted it to the Royal Society. Coincidence played a role in this discovery, as King George III was interested in science and equipment. The King read Watson's report about Herschel and his discovery; he invited the latter to the palace, provided him with the required funds to build a big telescope, and assigned him an annual salary. Herschel became devoted to astronomy and astronomical observation, paying special attention to the object he observed earlier. With continued observations using a bigger telescope, the object turned out to be a new planet, not a comet, The International Astronomical Union named it Uranus.

The Second Coincidence

Edmund Halley was born in 1656; his father was a soap maker and a real estate agent in London. Halley received his early education at home, before joining Saint Paul; he showed interest in mathematics and astronomy. At the age of seventeen, he joined Oxford University; his mother bought him astronomical equipment, and the renowned Astronomer Royal John Flamsteed was his supervisor. In 1673, Halley managed significant observations, including terrains of Mars and the Moon, and sunspots.

In 1676, he dropped his studies and started boxing; then he left London for Saint Helena Island, south of the Atlantic, where he regained interest in astronomical observation as a hobby. He catalogued 341 stars of the Earth's southern Hemisphere, and discovered a new star constellation. Halley also made the first observation of the transit of Mercury across the Sun. He wrote a research paper on how to use the transit of Venus across the Sun—like that of Mercury—to make astronomical calculations to measure the size of the Solar System.

In 1678, Halley became a famous astronomer. King Charles II issued a royal decree to return him to Oxford University and elect him member of the Royal Society. At the time, he was not twenty-two yet. After that, his observational achievements continued, all immediately published. His most important astronomical achievement was predicting the return of a comet, which he died before seeing.

The subject of the discovery and return of the comet started when Issac Newton published the *Principles of Natural Philosophy,* in which he said he suspected that the two comets that appeared in 1680 and 1681 are in fact one comet; yet, he could not prove it. However, when Edmund Halley published his book *A Synopsis of the Astronomy of Comets*, he used the laws of Newton to calculate the effect of Jupiter's and Saturn's gravity on the orbits of comets. He examined and traced the orbital elements of the two comets Newton mentioned; using theoretical calculation, he predicted the return of the comet the orbit of which around the Sun takes 76 years.

Halley passed away in 1742, at the age of 86, leaving three children: Margret, Rachel, and Edmund. He did not see the comet he discovered and predicted to return. The first to observe this comet was a German farmer interested in astronomy and astronomical observations, on 25 December 1758. Halley, the comet, appeared one month later than the actual prediction; scientists said this was due to Jupiter's gravity, just as Halley mentioned in his book. It is worth mentioning that the comet was named after Edmund Halley by French astronomer Nicolas-Louis de Lacaille, in 1759.

The Future of Aviation
Fantasy or Potential Reality?

By: Rania Farouk
Marketing Specialist,
BA Planetarium Science Center

Man has always challenged himself, seeking to gain new abilities and to reach places unreached before. The dreams of Mankind have urged him to explore the world and create numerous inventions throughout the ages. Flying was one of these dreams; as a result, many people attempted to imitate birds aiming to make this dream come true.

Arab Scientist Abbas ibn-Firnas was amongst those who tried to achieve this dream; he was followed by many. However, it was the Wright Brothers who managed to make the first auto-type of a plane that could actually fly, marking the beginning of an aviation revolution. Finally, Man could achieve the dream and travel all over the world; moreover, planes have been used in trade and even wars. Planes require much fuel to run; unfortunately, current fuel resources may deplete within years. How will the world be like when this happens? What are the alternatives that will enable us to move from one place to another?

The Future by Airbus planetarium show tackles these questions, featuring scenarios about the future of energy and aviation. Regardless of what would take place in the future, the show expects that aviation in the future would depend on creative solutions for the energy challenges. Engineers have already developed lighter and smoother planes that depend on smart materials. Some planes are increasingly using renewable energy sources, and fuels that are not oil-based. More solutions will definitely come up as research continues, including ones we cannot imagine today.

The show features some of these alternatives, their advantages and disadvantages. For example, the production of hydrogen fuel requires huge space, as it does not exist on Earth in pure form; we have to waste enormous amounts of energy to produce it. Fuel cells that generate electricity as a result of the interaction between hydrogen and oxygen in the air cannot be used in commercial aviation.

Solar energy is a classical example of renewable energy; however, no matter how big the production of solar cells is, they still cannot provide the needed power to make a plane take off. There is a more accurate method to use solar power, however. Providing algae sunlight, seawater, and carbon—which we need to get rid of—will grow and produce oils similar to the kerosene fuel used nowadays. Since algae does not require freshwater nor agricultural land to grow, the bio-fuel produced by algae could play an essential role in the future of aviation.

The show also tackles the issue of large numbers of planes crowding airports, and what can be done to reduce the safety distances between planes. Since planet Earth would not endure more wastes that cannot decay, the show also proposes solutions to make environmentally-friendly planes for the future.

We invite you to visit the Planetarium Theater, and enjoy this interesting show. It will take you on an imaginary journey to the future, and show you the dreams of the future of aviation.

PLANETARIUM SCIENCE CENTER

"Science for All"

History of Science Museum

Opening Hours
Sunday–Thursday: 9:30–16:00

Guided Tours Schedule
Sunday–Thursday:
10:30, 11:30, 12:30, 13:30, 14:30, 15:30

Fees: EGP 2.- for non-audience of the Planetarium

ALEXploratorium

Discovery Zone

Opening Hours
Sunday, Monday, Wednesday, Thursday: 9:30–16:00
Tuesday: 9:30–12:30
Saturday: 12:00–16:00

Guided Tours Schedule
Sunday, Monday, Wednesday, Thursday:
10:00, 11:00, 12:00, 13:00, 14:00, 15:00
Tuesday: 10:00, 11:00
Friday: 14:00, 15:00
Saturday: 12:00, 13:00, 14:00, 15:00

Fees: EGP 10.- (EGP 5.- for students)

Listen and Discover

Fees:
DVD shows: EGP 4.- (EGP 2.- for students)
3D shows: EGP 20.- (EGP 10.- for students)
12D shows: EGP 20.-

Available Planetarium Shows

The Great Barrier Reef; 42 min.

The Secrets of Gravity; 45 min.

Two Small Pieces of Glass; 22 min.

The Future by Airbus; 27 min.

Enlightened Mind; 19 min.

The Mission; 24 min.

Kaluoka'hina:
The Enchanted Reef; 33 min.

Stars of the Pharaohs; 35 min.

Seven Wonders; 30 min.

Oasis in Space; 25 min.

For schedule and fees, please visit the Planetarium Science Center's website: www.bibalex.org/psc

The Bibliotheca Alexandrina Planetarium Science Center (PSC) invites its visitors to spend a day of fun learning, where they can enjoy amazing scientific shows that cover a diverse variety of scientific fields and are suitable for a wide range of groups at the Planetarium Theater.

Visitors can also enjoy tours of the History of Science Museum, which highlights scientific discoveries throughout three eras: Pharaonic Egypt, Hellenistic Alexandria, and the Golden Age of Islam.

Moreover, visitors can enjoy a collection of interactive exhibits that targets children and adults, workshops, DVD and 3D shows at the ALEXploratorium as well as shows at the 12D Theater.

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NOW YOU DON'T SEE ME

To know why the family does not notice the thief, read the "Digital Detox in the Digital Age" article on page 15.
Illustrated by: Mohamed Khamis