

## SPRING 2012

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# Into the FUTURE

By: Maissa Azab

Growing up in the 1980s, I was not a huge fan of Sci-Fi movies such as *E.T. the Extraterrestrial*, the most popular of the decade in this genre. However, the *Back to the Future* trilogy was and still is, more than a quarter of a century later, one of my favorite movies of all time.

The way the movie creators visualized the future has always fascinated me; I must say I am quite disappointed that we do not have flying cars yet, now that we are only three years away from 2015, which was the far future for the movie characters. Not having to drive through the heavily packed Egyptian streets of today is definitely a recurring dream, I am guessing for millions!

But, seriously, Sci-Fi literary works and movies have dazzled us for centuries with vivid and fascinating visions of the future, many of which, though once seemed so unbelievably unrealistic, have amazingly come true and have actually shaped the life we live today. Leafing through this issue you get a glimpse of some futuristic reads from the past that have been realized years, sometimes centuries, later.

However, that is just one aspect of our theme, "The Future"; our real aim here is to try to envision and share with our readers our actual possible future based on actual science that is currently in the works.

In this issue, we tackle questions such as: will we one day find a habitable planet where we could live, and actually be able to travel there and inhabit it? Will we be able to stay within safe planetary boundaries, avoiding irreversible global catastrophes we are currently hurling towards with our incessant greed? Is there hope for a sustainable future without giving up the comforts of our modern life? Can we live forever? Well, not forever, but longer? Can we achieve the dream of perpetual youth? And, how would the social network change our lives even further than it already has?

But that is not all. *Back to the Future* was not just a Sci-Fi movie about future life; the trilogy was a series of Sci-Fi movies about time travel. You would not think that we would not jump at the chance of tackling this wasps nest, would you? Well, we did, and it has been quite the mindboggling whirlwind!



## PUBLIC EVENTS WORLDWIDE

Landmark UK conference, Planet Under Pressure (PuP), has taken place on 26-29 March, teaming up with science center and museum networks to foster collective understanding of the critical state of Earth's system and solutions for more sustainable pathways through concurrent public events around the globe.

While 2,500 specialists gathered in London to present the latest scientific knowledge on the state of the planet and potential solutions for a sustainable world, science centers and museums worldwide held 150 public events relating to the PuP conference and the Rio+20 Summit in June.

Events took place in North and South America, Asia, Australia, Africa, and Europe, giving the public a snapshot of the state of the planet and scientific concern in advance of the UN Rio+20 Summit. Via live web streaming, email and twitter, participants were able to follow the conference live from all over the world and interacted with the speakers in London in real time.

PuP organizers are DIVERSITAS, the International Geosphere-Biosphere Program, the International Human Dimensions Program, the World Climate Research Program, and their Earth System Science Partnership, which is an integrated study of the Earth System, the ways that it is changing, and the implications for global and regional sustainability. The organizers joined forces with worldwide science center and museum networks, which are global non-profit organizations that foster public engagement with science, through science centers and museums that are experts in bringing science and the public together, offering a platform for people of all ages and backgrounds to explore, understand and relate to recent scientific findings.

"The high public interest in the events at the science centers and museums worldwide encourages us as scientists in our daily work. It underlines that our research is relevant and that we have a lot to contribute to finding viable solutions. On behalf of the conference organizers, I would like to thank the science center networks for taking strong collective action to making Planet under Pressure accessible to so many local and national audiences." added Dr Mark Stafford-Smith, Co-Chair, PuP Conference.

The scientific sponsor of this conference is the International Council for Science ([www.icsu.org](http://www.icsu.org)).

**For an overview of all 150 events, visit:**  
[www.planetunderpressure2012.net/scitech.asp](http://www.planetunderpressure2012.net/scitech.asp)

**W**ith the explosive growth of population on Earth, humanity is demanding more and more from the planet. The quandary is not made any easier by the human rate of consumption; we are practically consuming resources that could be sufficient for two Earths not just the one.

Not only are we depleting the planet, but we are also abusing its nature; air, water, land, flora and fauna. As a result, our Earth is facing drastic environmental challenges; global warming, climate change, water scarcity, drought, famine, among many other imminent predicaments. Not to mention a myriad of natural disasters, which are out of our hands and threaten lives in all parts of the world.

Because of these challenges and disasters, a huge number of people have been and will most probably be displaced; but will there still be room for them to move to? As a solution to this problem, some have started dreaming of moving to another planet!

Habitability of worlds other than Earth has always been a mystery. For centuries, philosophers and scientists supposed that habitable Earth-like planets existed.

Our galaxy, the Milky Way, contains at least 100 billion stars; powerful telescope observations suggest many of the stars in the night sky have planets orbiting them. The discovery of extra-solar planets or exoplanets has intensified interest in the possibility of extraterrestrial life or finding inhabited planets.

## Planets for Rent

Not all planets are capable of sustaining life; a planet has to meet certain conditions to be able to support life. Habitability depends on many factors; having liquid water and an atmosphere are among the most important.

By: Sara Khattab

# A New Earth



In order for life to evolve on a planet, it has to lie in the habitable zone, also called the "Goldilocks" zone<sup>(1)</sup>, which is the region around a star where a planet can sustain life. The host star has to serve as a long-lived, stable source of energy just as the Sun does; the planet has to be at the right distance to be warm enough to contain at least liquid water, but not so hot that all the water turns into vapor. The existence of a moon with sufficient mass is also essential as it stabilizes the rotation of the planet to control water on its surface.

The size of the planet is important as well; it cannot be too large because it would have a massive suffocating atmosphere, and it cannot be too small because it would have no atmosphere to protect life on its surface.

A habitable planet must have an oxygen-rich atmosphere because it has an important role in metabolic processes. In addition to oxygen, other elements that are essential for the existence of life include carbon, hydrogen, nitrogen, phosphorous and sulfur; 95% of life on Earth is built upon these six essential elements.

Moreover, the solar system must be at the right place in the galaxy; not too near to dangerous radiation, but close enough to other stars to be able to absorb heavy elements after neighboring stars die. As a matter of fact, radiation from stars is a free source of energy in the universe, but it has drawbacks. Although life needs

energy, some parts of the radiation spectrum—X-rays, Gamma rays, and ultraviolet radiation—are simply too energetic for life; in fact, they produce photochemical reactions that are lethal for life systems.

Furthermore, the orbits of all planets around a star should have low eccentricities and big gaps between them; this is essential for the long-term stability of a system.

## Neighbor-O-Neighbor

Claims of habitable planets detection have been made since the 19<sup>th</sup> century. Many bodies in our own solar system have been suggested as being capable of containing extraterrestrial life; Mars, Venus, and other celestial bodies were thought to be within the habitable zone due to the varying atmospheric pressures of these bodies, which determine their potential for surface water.

In the past, liquid water was widely thought to have existed on Mars, either on or under the surface when snow and rain fell on the planet and created lakes and possible oceans. However, according to the current conditions on the planet, it does not support the long-term existence of liquid water. The average atmospheric pressure and temperature are far too low, leading to immediate freezing.

On the other hand, even though Venus had habitable conditions, astronomers discovered that its atmospheric pressure is far too high, making it so enormously hot due to the greenhouse effects.

## Hunting Exoplanets

Throughout years of detection, many exoplanets were detected, most of which are believed to resemble Jupiter or Neptune as massive planets are easier to observe; however, these giant planets are unlikely to harbor life. Some exoplanets have been directly imaged by telescopes; thanks to improved observational techniques, the rate of detections has increased rapidly.

In 2007, planet Gliese 581c was announced as a potentially habitable planet; but later found too close to the star Gliese 581, making the planet too hot for life. Gliese 581, located 20 light years away from Earth in the constellation Libra, has about 30% the mass of our Sun, and the outermost planet is closer to its star than we are to the Sun.

Excitement spiked again in September 2010 with the claimed discovery of Gliese 581g, which attracted attention because it was near the middle of the habitable zone of its parent star, which consequently meant that it could sustain water on its surface and could potentially host life similar to that on Earth. This discovery was the result of more than a decade of observations using the W.M. Keck Observatory in Hawaii.

Gliese 581g has a mass three to four times that of Earth; its mass indicates that it is probably a rocky planet with a definite surface and enough gravity to hold on to an atmosphere. It takes just 37 days to orbit its Sun.



The planet is tidally locked to its star, which means that during its orbit, it always shows the same face to the star so that one hemisphere is always in daylight while the other is in permanent nighttime.

### Kepler Quest

In 2009, NASA launched the Kepler spacecraft, designed to survey the Milky Way for Earth-like planets orbiting other stars similar to our Sun in or near the habitable zone. Kepler locates new worlds by simultaneously monitoring 150,000 stars for dips in brightness, which are indicative of planets passing in front of, or transiting, their stars. It requires at least three transits to verify a signal as planet.

Based on the Kepler data, an estimate of around 100 million habitable planets in our galaxy may be realistic. It has detected more than 2,000 possible planets observed, 207 of which are similar in size to Earth.

In February 2011, Kepler found six confirmed planets orbiting a Sun-like star, Kepler-11; the largest group of transiting planets orbiting a single star discovered outside our solar system. All discovered planets are larger than Earth, with the larger, known as Kepler 11b to 11g, being about Neptune's size.

### Earth Twin

As Kepler continued, a possible Earth twin was confirmed in December 2011. The new planet, Kepler-22b, was among the candidates in the habitable zone reported by the team, and the first to be formally confirmed using other telescopes.

Kepler-22b's discovery caps a half-decade of astronomers searching for a habitable planet, not too hot or too cold to harbor oceans on its surface, like Earth.

It is the nearest to Earth's size; 2.4 times the size of Earth, which makes it the smallest planet ever found in the lukewarm zone<sup>(2)</sup> around another sun.

Located some 600 light-years away, Kepler-22b is a little bit closer to its star than Earth is to the Sun, almost 15% closer. The star, Kepler 22, is a little bit dimmer, cooler and smaller than the Sun, which means that Kepler-22b has a rather similar temperature to that of Earth.

Additional observations are required to tell whether this planet is predominantly rocky, liquid or gaseous in composition, but findings confirm for the first time the long-held expectation that Earth-size planets do in fact orbit other stars in the habitable zones of their host stars. That, in return, improves the odds for the existence of life, as it is commonly defined, beyond Earth's Solar System.

### Latest Scoop

Early in February 2012, astronomers discovered the latest potentially habitable alien planet named GJ 667Cc; it is located in the habitable zone of its host star GJ 667C, which is nearly 22 light-years away from Earth. This dwarf star is a member of a triple-star system. The components of the entire star system are different from our Sun; the system has much lower abundances of heavy elements, such as iron, carbon and silicon.

According to researchers' estimations, the mass of the newly discovered planet is at least 4.5 times as that of Earth, giving it the name super-Earth. GJ 667Cc, with an orbital period of 28 days, is thought to absorb about the same amount of energy from its star that the Earth draws in from the Sun,



leading to the possibility of Earth-like temperature and, if conditions are right, the availability of liquid water. Preliminary observations suggest that more planets could exist in this system.

### Alas ...

The discovery of extra-solar planets has captured the imagination and interest of the public and scientific communities. Kepler's mission is getting closer and closer to what is truly Earth-like, and that progress is exciting to watch.

More "Earth 2.0" candidates are likely to be confirmed in the near future, although a redefinition of the habitable zone's boundaries has brought the 54 exoplanets down to 48 only. However, none of the candidates have thus far met all factors needed for the existence of life.

Moreover, the discovered extra-solar planets are so far away, spaceships travelling close to the speed of light would take 20 years to make the journey. If rockets were one day able to travel at a tenth of the speed of light, it would take 200 years to make the journey. Hopefully, by the time one of these planets is confirmed as a habitable planet, there will be a transportation means that can transfer us to that planet faster.

But let us be honest and face the bigger question: given the availability of all required elements of life, as well as a faster and cheap means of transportation, which science and technology may as well provide in due time, will we be willing to leave our Earth behind to establish a new life on another planet? Will it become as mundane as migrating from one country or one continent to another?

That is a question we will probably have to put out there for generations to come; the more current question would be:

Can we afford, under any circumstances, to let our Earth die of unnatural causes as a consequence of our today's actions?

### Glossary

1) **Goldilocks zone:** The name originates from the story of *Goldilocks and the Three Bears*, in which a little girl chooses from sets of three items, ignoring the ones that are too extreme (large or small, hot or cold, etc.), and settling on the one in the middle, which is "just right".

2) **Lukewarm zone:** A zone around the Sun-like star where the temperature is suitable; not so cold and not so hot.

### References

- [www.nasa.gov](http://www.nasa.gov)
- [www.bbc.co.uk](http://www.bbc.co.uk)
- [www.scientificamerican.com](http://www.scientificamerican.com)
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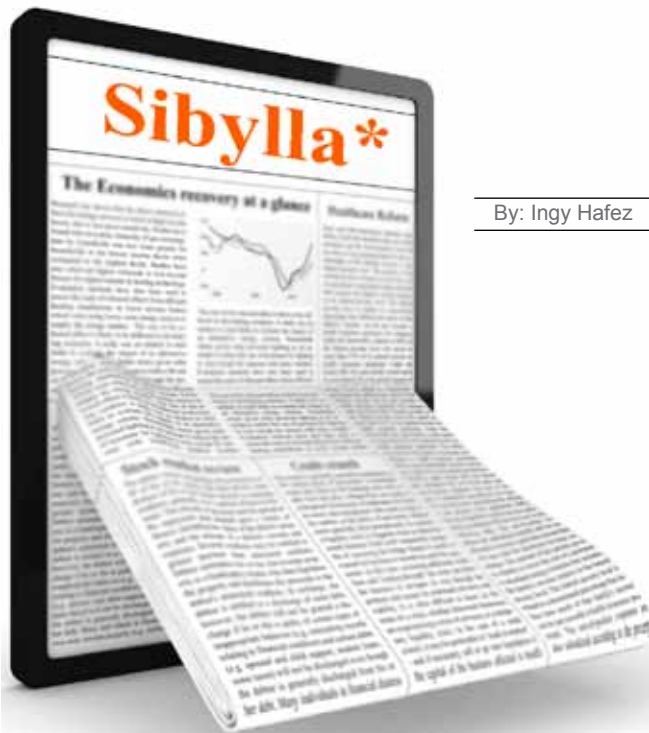


## AVAILABLE SHOWS

- The Zula Patrol**  
23 Min. Full-dome Show
- Stars of the Pharaohs**  
35 Min. Full-dome Show
- Seven Wonders**  
30 Min. Full-dome Show
- Oasis in Space**  
25 Min. Full-dome Show
- Mystery of the Nile**  
45 Min. IMAX Show
- Cosmic Voyage**  
35 Min. IMAX Show
- Stars Show**  
45 Min. Live Show by the PSC resident astronomer

## VISITORS INFO

- For the Planetarium daily schedule and fees, please consult the Center's official website: [www.bibalex.org/psc](http://www.bibalex.org/psc).
- Kindly note that, for technical reasons, the Planetarium maintains the right to cancel or change shows at any time without prior notification.



By: Ingy Hafez

Throughout history, Man has been making predictions of the future; some of them failed while others came true, but most of them have been recorded for future generations. This got me thinking about regular disaster forecasts that we see in the media every day. It occurred to me that throughout history, a lot of predictions of certainty and scientifically-based forecasts have not come true. We have seen that many experts got it wrong, regardless of how good their science was:

"Earth's crust does not move," accepted geological science from the 19<sup>th</sup> century to the early 20<sup>th</sup> century.

"Heavier-than-air flying machines are impossible," Lord Kelvin, British mathematician and physicist, and President of the British Royal Society, 1895.

"There is no likelihood Man can ever tap the power of the atom," Ernest Rutherford, shortly after splitting the atom for the first time, 1923.

"While theoretically and technically television may be feasible, commercially and financially it is an impossibility, a development of which we need waste little time dreaming," Robert Millikan, American physicist and Nobel Prize winner, 1926.

"There is not the slightest indication that nuclear energy will ever be obtainable. It would mean that the atom would have to be shattered at will," Albert Einstein, 1932.

"There will never be a bigger plane built," a Boeing engineer, after the first flight of the 247, a twin engine plane that held ten people, 1933.

"A rocket will never be able to leave the Earth's atmosphere," *New York Times*, 1936.

"The bomb will never go off. I speak as an expert in explosives," Admiral William Leahy, US Atomic Bomb Project, 1943.

"I think there is a world market for maybe five computers," Thomas Watson, Chairman of IBM, 1943.

"Space travel is bunk," Sir Harold Spencer Jones, Astronomer Royal of the UK, 1957. Two weeks later Sputnik orbited the Earth.

"There is practically no chance communications space-satellites will be used to provide better telephone, telegraph, television, or radio service inside the United States," T. Craven, FCC Commissioner, 1961. The first commercial communications satellite went into service in 1965.

"There is no reason anyone would want a computer in their

home," Ken Olson, founder of Digital Equipment Corp (DEC), maker of big business mainframe computers, arguing against the PC in 1977.

"That virus is a pussycat," Dr. Peter Duesberg, Molecular-biology Professor at U.C. Berkeley, on HIV, 1988.

## When Fantasy became Reality

The 21<sup>st</sup> century, once the far future of our childhood, is now reality. Of course, we may not have the flying cars we have always imagined and we still do not live on other planets, but many ideas scraped on paper in some science fiction stories are now alive. So today, it is not uncommon to go shopping and see items that could only be found in science fiction movies just a few years ago:

### CCTV: The Magic Box

George Orwell's haunting portrait of society in his epic novel, *1984*, was way ahead of its time. Written in 1949, the book envisions a future where the mythic and all-pervading, Big Brother, closely and secretly uses telescreens to monitor people. Twenty years later, the first Closed Circuit TV (CCTV) was installed in the UK.

### The World Wide Web

Almost a century before the Internet was introduced, Mark Twain predicted the future of a huge global information network. In *From the London Times of 1904*, published in 1898, Twain wrote about a 'telectroscope':

"The improved 'limitless-distance' telephone was presently introduced, and the daily doings of the globe made visible to everybody and audibly discussable too, by witnesses separated by any number of leagues."

### Online News

Some people prefer the smell and feel of reading a traditional newspaper, but many others do not. Today, most people are scanning headlines online and getting news through RSS feeds. This was accurately predicted by Arthur C. Clarke in 1968, in *2001: A Space Odyssey*, which described online papers:

"In a few milliseconds he could see the headlines of any newspaper he pleased... The text was updated

automatically on every hour; even if one read only the English versions, one could spend an entire lifetime doing nothing but absorbing the ever changing flow of information from the news satellites."

### Digital Books

Today, the iPhone, iPad and Kindle are conquering the world. However, back in 1961, they were only a prediction made by Stanislaw Lem in his novel *Return from the Stars*. The story refers to a touch-screen technology, where a book's content is recorded and perused, making the traditional form redundant. Ironically, you can now read Lem's work digitally.

### Credit Cards

In 1888, when Edward Bellamy published his utopian novel *Looking Backward*, there was no such thing as credit cards. In his book, Bellamy described credit card transactions that could be taking place today. The novel is about a man who falls asleep in 1888 to awaken in the year 2000 to a socialist society. More than a century later, Bellamy's words are a tangible reality.

### Genetic Engineering

With the mapping of the human genome, the genetics revolution is shaping our modern society. Much of this was foreseen by Aldous Huxley's 1932 novel *Brave New World*, where citizens are made to order and engineered into their role in society. It is interesting that Huxley wrote the novel before Watson and Crick's discovery of the DNA double helix a couple of decades later.

### Nanotechnology

The concept of nanotechnology was first explored in the late 1950s; however, it was *Engines of Creation: The Coming Era of Nanotechnology*, a 1986 book written by K. Eric Drexler, that popularized the term.

Drexler wrote about building machines on the scale of molecules, a few nanometers wide: motors, robot arms, and even whole computers, far smaller than a cell. The book contains descriptions of various exotic technologies and forecasts the use of technologies that are in development today; such as smart paper that can show personalized news headlines.

# Fantastic 5

ALEXploratorium

By: Shahenda Ayman

Drexler spent the next ten years describing and analyzing these incredible devices, and responding to accusations of science fiction. Meanwhile, mundane technology was developing the ability to build simple structures on a molecular scale. As nanotechnology became an accepted concept, the meaning of the word shifted to encompass the simpler kinds of nanometer-scale technology.

We live in a world where everything is possible, and where dreams and fantasies come true every day. What is considered fantasy today can very well become fact tomorrow; what is taken for fact today can be proven false tomorrow.

Prophecies and predictions never seize and it remains to be seen how many of them will eventually come true, and how many will not. The important thing to remember is to stay alert and curious, unleash our imagination, and keep an open mind and eye for new ideas than can one day rock our worlds.

\***Sibyl**, also called Sibylla, is a propheticess in Greek legend and literature. Tradition represented her as an old woman telling predictions.

## References

[www.britannica.com](http://www.britannica.com)  
[www.todaystent.com](http://www.todaystent.com)  
[www.cmano.org](http://www.cmano.org)  
<http://skeptoid.com/blog/201125/09/science-fiction-predictions-that-came-true/>  
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<http://listosaur.com/science-a-technology/10-science-fiction-predictions-that-came-true.html>

## VISITORS INFO

### Opening Hours

Saturday to Thursday  
[from 10:00 to 15:00]

### Guided Tours Schedule

Saturday to Thursday  
[10:30 + 11:30 + 12:30 + 13:30 + 14:30]

- Museum entry fees are included in all Planetarium show tickets.

- For non-audience of the Planetarium, Museum entry fees are 0.50 EGP.

- Museum Tours are free for ticket holders.

It would seem that we live in a cutting-edge high-tech age. Not really; not compared to what the world would be like if the technologies that today's scientists are currently working on see the light. Having already peeked at past futuristic predictions that have indeed come true, here, we take a look at just five inventions relevant to the current exhibits of the ALEXploratorium, and which are now in development and could very possibly come true in the near future.

### 1) A 6<sup>th</sup> Sense in the Making

At the Media Lab of Massachusetts Institute of Technology (MIT), using brain implants, Dr. Ed Boyden is heading up a revolutionary new branch of research known as "neurotechnology". Boyden is working on technologies designed to stimulate the brain from the inside; a technology similar to the cochlear implant device that is inserted into the ear to help restore hearing.

One method uses light to turn brain cells on and off, enabling doctors to correct diseases caused by poorly functioning neural pathways. Via a retrovirus<sup>(1)</sup>, photosensitive genes are implanted in brain cells to make them respond to signals sent by light-emitting brain implants.

### 2) Tailored Medicine

Can doctors one day use DNA to discover how we will age, or which medications will suit us best? Well, Bionanatrix<sup>(2)</sup> is working on creating a simple, reliable and fast test that can sequence a patient's DNA so that your doctor could treat you accurately.

In the Bionanatrix's device, a microchip acts as a sort of tollbooth for DNA strands, forcing them into an orderly line so that they can be analyzed as they pass the "gate". Bionanatrix hopes to have a finished product in the hands of doctors by 2014; each test will cost about USD 100.

### 3) The New Wireless Network

Military researchers are developing a decentralized "cognitive radio" system that would allow public safety officials and first responders set up their own wireless networks in times of crisis.

Cognitive radio will allow each "smart" handset picture a cross between a walkie-talkie and a Palm Pilot, and act as a base station, creating a local "mesh" wireless network independent of any fixed center. These "smart radios" can find each other when they are turned on, organize into networks, and then can relay information across groups.

"Imagine if you could have gone in after Hurricane Katrina and had 10,000 of these radios and you turned them on and they found each other," said Preston Marshall, Project Manager with the Pentagon's Defense Advanced Research Projects Agency.

### 4) A Super Battery

Professor Donald Sadoway, of MIT's Department of Materials and Engineering, is working now on developing a mega-battery that has the ability to store a lot of power. He hopes that someday he

would be able to wire battery packs together to create a system big enough to meet the demands of New York City.

His battery design consists of a layer of electrolytes, a salty liquid that is able to conduct electricity, sandwiched between two layers of metal. It is not like the typical battery, which has solid materials that eventually wear out.

For now, scientists are experimenting with an early-stage product, trying different combinations of metals and liquids to see which works best. Researchers believe they could have a battery on the market in five years.

### 5) Rollup TV

Today's PC, PDA and TV displays are made of glass, and can thus be easily destroyed. Flexible displays, on the other hand, bend upon impact and withstand abuse. One flexible display being worked on even rolls up into a tube the size of a finger.

Developed by Norwegian firm Polymer Vision, the Readius portable e-reader uses electronic ink like the Amazon Kindle, but the Kindle cannot be rolled up and put into your pocket. More rugged, less literary flex-screen devices are also underway.

For researchers and scientists, each of these inventions in the making, represent an inspiration to go above and beyond, stretching the limits of what is possible. For us, these future inventions, if and when they come to pass, will definitely pave the way for a healthier and happier life.

## Glossary

(1) **Retrovirus**: An RNA virus that is duplicated in a host cell using the reverse transcriptase enzyme to produce DNA from its RNA genome.

(2) **Bionanatrix**: A company developing and commercializing technologies for analysis of large biological molecules, such as nucleic acids, which are vital to life science research, clinical diagnostic applications and development of new therapeutics.

## Reference

<http://www.foxnews.com/story/0,2933,511181,00.html>

## Visitors INFO

### Discovery Zone

#### Opening Hours

Saturday, Sunday, Monday, Wednesday and Thursday:  
[From 09:30 to 15:30]  
Tuesday: [From 09:30 to 12:30]

#### Guided Tours Schedule

Saturday, Sunday, Monday, Wednesday and Thursday:  
[09:30 - 11:00 - 12:30 - 14:00]  
Tuesday: [09:30 - 11:00]

#### Entry Fees

Students	EGP 2	Non-students	EGP 4
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### Listen and Discover

- For the list of shows available at the "Listen and Discover" and the schedule, please consult the Centers official website: [www.bibalex.org/psc](http://www.bibalex.org/psc).
- For reservation, please contact the PSC Administrator at least one week before the desired date.

#### Show fees

DVD shows:			
Students	EGP 1	Non-students	EGP 2
3D shows:			
Students	EGP 2	Non-students	EGP 4





By: Sara Khattab

## Celebrating the Future

Science is all around; a part of each person's everyday life. But for most people, science is perceived as the tedious study of complicated facts, especially when it comes to science education in a formal setting.

In our educational system, and due to oversized curricula, information is delivered as is; teachers do not necessarily encourage students to think and be curious. Using scientific thinking, on the other hand, involves children in the process of finding out. To foster scientific thinking, educators need to view children as active learners and give them varied opportunities to explore and experiment.

Children are natural born scientists. They are curious by nature and have inquisitive minds; they want to know how things work and why the world functions as it does. Studies have shown that children think scientifically; making predictions, carrying out mini-experiments, reaching conclusions and revising their initial hypotheses in light of new evidence. Exposing children to the wonders of science from an early age will help develop their minds and increase their logic.

The future of humankind depends on knowledge; but our ability to generate new knowledge and use it innovatively depends on having a scientifically literate population. Approaching 9 billion people on a planet that is already being exploited beyond its limits, science and technology can help in addressing the challenges we face today; from finding a cure for fatal diseases, reducing hunger and poverty, to protecting the environment and the planet.

Learning science is indeed of a great importance in any educational system. This importance is even more significant in a country like Egypt, especially in such a

period of new hopes and increased general understanding. The role of science is now more evident than ever in building the economy, providing jobs, and narrowing the gap between Egypt and other developed and developing societies.

### The Advent of Science Communication

Science communication makes science accessible and exciting to young people and non-scientists. One of its main purposes is to engage children and youth in science so that it becomes part of their formation; they are thereby offered the opportunity to experience the joy and excitement of science.

Science centers are a major venue of science communication; they give science a presence in the community and offer people of all ages and backgrounds the opportunity to ask questions, discuss and explore.

"To promote science and technology among school students and the public at large, and to show their relevance to everyday life" is the mission of the Planetarium Science Center (PSC); a center that fosters the values of science through a variety of interactive exhibits and exhibitions, and a diversity of hands-on activities and other tools.

Generating a new generation of innovative thinkers and scientists is one of the main goals of the PSC. The Center thus organizes programs and events; such as the Intel Bibliotheca Alexandrina Science and Engineering Fair (Intel-BASEF), in collaboration with Intel Co, in March of every year. Intel-BASEF brings together students from Alexandria and neighboring governorates to train, research, innovate and compete. Winning projects get to participate in the annual International Science and Engineering Fair (ISEF) in the USA.

The PSC also collaborates with the National Authority for Remote Sensing and Space sciences (NARSS) to implement the Space Technology Program. The Program supports young people in pursuing studies and careers in the fields of science and technology in order to build Egypt's future generation of scientists and researchers. The Program will also support the development, construction, launch and operation of small educational satellites; such as the cube satellite called Alex-Edu.Sat1.

Moreover, to encourage young engineers to turn their ideas into feasible applications, the ALEXploratorium Project Support (APS) was initiated by the PSC three years ago. The Program aims to support projects that reflect a positive impact on the engineering field as BA experienced engineers provide participants with support, advice and guidance in developing their projects.

### Blossoming Young Scientists

Programs such as Intel-BASEF pave the way to students to participate in different science fairs and competitions that encourage participants to unleash their imagination and use scientific thinking in working on their projects.

### Nowhere to Go But Up

"Hitting the bottom is a good thing; it is when you realize that there is nowhere to go but up", said Azza Fayad, a promising young scientist. In 2010, Azza participated in Intel-BASEF without preparing a good project and the result was no awards. She was not disappointed, but insisted on participating in 2011 with a new project entitled "Ethanol Production by Cracking Polyethylene Plastic Wastes".

Her project, which won 1<sup>st</sup> place in the Environmental Management category, aims to present advantageous and environmental-friendly methods of managing plastic wastes, particularly polyethylene, which is the most commonly used synthetic plastic, by producing ethanol bio-fuel from polyethylene wastes. Ethanol is economically efficient, socially equitable, and a safe alternative source of energy to fossil fuels.

Azza did not stop at that point; she was awarded a special prize from EIROforum\*, competing with the best European students in the European Union Contest for Young Scientists, which was held in Helsinki, Finland in September 2011. After participating in science fairs, "Now I am a different person, someone who learned how to dream BIG, fight for what she believes in, and how to achieve her goals".



## Drawing the Future



"Do not hesitate to think and take up an idea; make it your life; dream of it; live on it; let your brain, muscles, nerves and every part of your body be full of that idea. This is the way to succeed; if you want to be a young scientist, keep your dreams alive, believe in yourself and believe that you are drawing the future of this world," said Mazen Alaa Eldin.

Mazen joined Intel-BASEF 2011 in a Team Project entitled "How to Increase Your Health Stock by Adjusting Your Biological Clock?" The project's purpose is to study the effect of the biological clock on the treatment of some diseases; such as cancer and hypertension.

As an experiment, the team compared between 8 mice; they adjusted the biological clock of 4 mice and disturbed the biological clock of the rest. From their observations, they concluded that any disturbance in the biological clock affects the general health of human beings and animals.

The project won the 1<sup>st</sup> place award in the Medicine and Health Sciences category, which qualified them to participate in the Intel Science Competition-Arab World at Sharjah University, UAE, and won the best presentation award.

"It was tremendous to meet other brilliant young Arab scientists and know their unique ideas, which might make us one day the leaders of the world. Being a BASEF participant gave me the chance to learn the true meaning of teamwork; we learned that all our dreams can come true with hard work, determination and dedication. So, young scientists: get ready; set your goals; and unleash your imagination", said Mazen.

## One Step at a Time



"A journey of a thousand miles begins with a single step;" Aya El-Saqa believed in this quote when she met a number of obstacles in her journey to become a scientist.

Aya started her journey by participating in different PSC activities; such as the Robotics Program. When she wanted to participate in the Alexandria Science and Engineering Fair (ASEF), she faced a problem; her age. She decided to practice and look for ideas to gain the appropriate experience to participate in the fair, which she did in 2009; she did not get any rewards though.

"I was not disappointed; I worked more on my project and participated again the year after. This time I won a special award from Yale Science and Engineering Association. Then I was determined to develop my project and participate in Intel BASEF 2011, in which I won the 1<sup>st</sup> place award in the Chemistry category.

This award nominated me to participate in Intel Science Competition-Arab World, where I won the 2<sup>nd</sup> Best in Category award in my category."

Aya's aim was to develop the heat pump in her project entitled "Using Chemical Reaction as an Energy Source for the Heat Pump". She had noticed how everybody was complaining of high bills; her aim was to solve this problem by reducing the internal work. She depended on chemical interactions in her approach.

"I took small steps towards success; together they added up to hundreds of small steps. I met many obstacles but with every small step I took, I was able to overcome all of them. It only takes one step to succeed; have you taken a step today?"

## Learning Never Stops

"My advice to young scientists is to enjoy the experience as much as possible. Do not let the competition take you from the most important thing, which is to learn, learn, and learn", this was what Ahmed Samir said.

Ahmed's journey started from Alexandria Science and Engineering Fair (ASEF) to Egypt Science and Engineering Fair (ESEF), ending up representing Egypt in Intel ISEF two years in a row; 2009 and 2010. He also participated in International Science Competition-Arab World, in which he won his first international award; 3<sup>rd</sup> Best in Category award in the Engineering category.

In 2009, he participated in Intel-ASEF with a project entitled "Show Me Your License", which aimed to implement a security system inside a car so that it would not start until the driver shows a registered driving license to help stop unauthorized people from driving.

In 2010, his project "Speed Limitation System" aimed to reduce the consequences of reckless driving and speeding, which causes a large number of accidents through implementing a control system that prevents the driver from going over the speed limit on the road.

## Life Changing Experience

"Learning scientific methods of thinking and how to write scientific research; learning how to solve problems using the proper scientific methods; developing presentation and communication skills; five local fairs; two international fairs; and two patents, all of this and

more is the harvest of two years in the life of Intel-BASEF", said Ahmed Tarek.

Ahmed Tarek won the 2<sup>nd</sup> place award in the International Environment Project Olympiad (INEPO) 2009, in Istanbul, Turkey. He participated in this event with a project about the communication of the deaf through a device that could translate sign language to written words so the process of communication would become easier.



He also won Best Young Inventor award in the World Intellectual Property Organization (WIPO) 2010. "Joining this experience will totally change your life; you will take your first steps towards a new life, full of achievements that will serve humanity in the future".

## A Future Out of this World

"After two years of preparation to become an engineer in the Space Technology Program, I had some thoughts that engineering is not my field of interest; until I took the NARSS training course, which changed everything", said Mahmoud Abo-Khedr.



Mahmoud, the winner of Famelab 2011, has won an undergraduate scholarship to study automotive engineering in City University in London. After participating in the Space Technology Program, he changed his career path and decided to continue his study in Aerodynamics science.

"The experience really influenced me and I am really happy because I was a part of this program. Maybe one day I will find myself an engineer in NARSS, working on our first Egyptian satellite".

## Teamwork Makes the Dream Work

Ali Wahba joined the ALEXploratorium Project Support in a team with a project entitled "Warehouse Management System using RFID", where they used Radio Frequency Identification (RFID) tags and readers for applying full digital control on the warehouse, to control and monitor the in and out operations of different goods using wireless techniques, which protect the goods from being stolen.

The team produced a full prototype that solves practical problems, and succeeded in having five sponsors to support their project. They also won the first place award at the Siemens Competition for Industry Automation and Drive Technologies.

All these talented young scientists and more are passionate about science contributing to a better new world. For science and young scientists to play the role required in the modern, technological and challenging world, support is essential. The public must be aware of the strategic importance of investment in science and technology. To that end, the PSC is committed to encouraging these talented young scientists actively and getting the public interacting with and supporting them.

## Glossary

\*EIROforum: an organization consisting of 8 European scientific research organizations devoted to promoting the conditions for efficient European Research Area.





# the Future

and underwater travel in a time when all of these worlds were completely obscure and unknown to man.

By the 20<sup>th</sup> century, however, fiction writers started to develop a sense of pessimism. Thus, dystopian literature became very popular at the time; writers did not stop using science as a main theme in their works, though. In fact, science became a means of destruction rather than a means of welfare and comfort as it used to be in previous works published in earlier eras. A case in point is *Brave New World* by Aldous Huxley, which was published in 1932.

Aldous Huxley, an English writer, was raised among a family of writers, scientists and teachers; he studied sciences and literature, which allowed him to use science as a main theme in his literary works. When Huxley published his book, the world was on the verge of conflict and disaster, which seemed to prophesize what he wrote in his novel, in which human life, with all of its emotions and feelings, was sacrificed for the sake of technological and scientific advances that were meant to create a so-called social stability.

In *Brave New World*, thousands of identical human embryos are produced but are classified into five categories: Alpha, Beta, Gamma, Delta or Epsilon. Alpha are conditioned and programmed to become leaders due to their high intellectual level, whereas Epsilon have the lowest IQs; thus, they are destined to perform hard labor that demands nothing but good physique.

Infants are not just preconditioned to perform at certain levels, but they are also taught the morals of their world, which is devoid of emotions, desires and human relationships. The novel also portrays the Savage Reservation, where real human beings reside; the Reservation represents a contrast to the World State. The conflict between both worlds is seen through the eyes of John, the hero, who belongs to the Savage Reservation but gets the chance to experience the lifestyle in the World State. The novel ends tragically when John hangs himself as he cannot accept the fact that he is submitted to the World State society, which he despises.

## Commonalities

Art is the mirror of reality. But what if an artist wants to create a whole new world that is set in the future; will s/he use reality as well?

Well, writers need a solid ground upon which to build their stories, and reality offers that. However, in futuristic literature, writers use certain motifs or phenomena from their own reality and develop them further to create their own futuristic reality. Whether you are reading a utopian or a dystopian novel, you will get to experience the writer's vision regarding a certain issue. Yet, no matter how different futuristic works are, most writers share common motifs and themes:

In our last issue, I wrote about "Science on the Big Screen", discussing science fiction (Sci-Fi) movies and some of the common trends and approaches that movie makers adopt when trying to involve science in their artistic works. This time, we turn our attention to the future in literary works.

Every now and then, we make speculations about what the future would be like. Some views are overly optimistic, while others tend to be too pessimistic to the extent that the future sometimes seems like a big black hole that will destroy or twist around any sign of goodness we have, or think we have.

Fiction writers are known for their creativity, ability to portray the past, capture the present and visualize the future in ways that get readers thinking more profoundly about themselves, their lives and certainly their future.

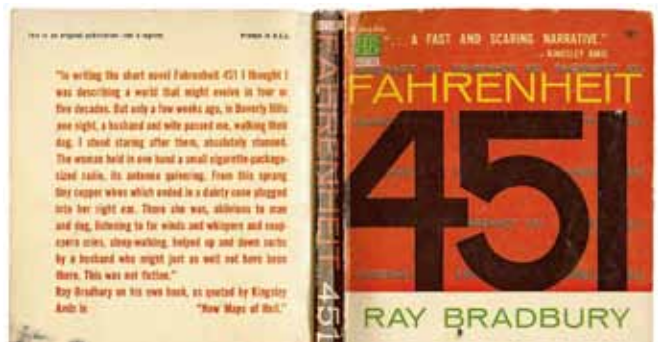
## The Back Story

Futuristic fiction gained popularity since ancient times, when Plato published his *Republic*, which was one of the earliest notions of a utopia, or an ideal society. Later on, precisely in 1516, during the European Renaissance, when there was a great revival movement of ancient arts, and endeavors to revisit ancient civilizations and cultures, such as the Ancient Greek civilization, Thomas More published his *Utopia*.

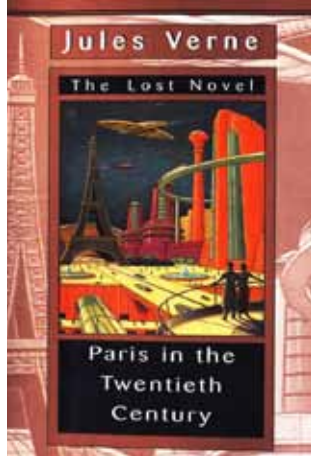
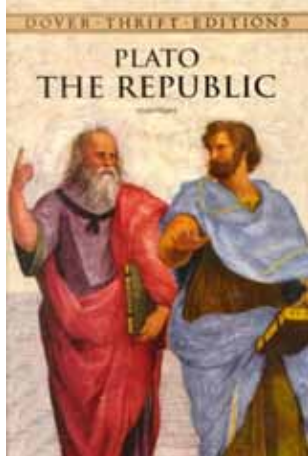
In *Utopia*, More puts forward his utopian beliefs in many topics; religious tolerance, equal education for men and women, sharing of power, and the evil of private property among others. Published in Latin, *Utopia* portrays Raphael Hythlodæus, a traveler who describes the political life on an imaginary island called Utopia; most scholars regard the book as a critique to Europe at the time.

A century later, Francis Bacon published *The New Atlantis*, in which he brought science and material progress along with a futuristic utopian vision. In that novel, Bacon created "Bensalem", meaning "land of peace", where values such as dignity and piety were highly cherished.

Many authors, later on, adopted Bacon's approach to viewing the future and combined it with science. This became even more evident with the advent of the Industrial Revolution in the 19<sup>th</sup> century. One such novelist influenced by Bacon's utopian vision was Jules Verne, a French author, who is referred to as the Father of Science Fiction. He published novels that are now considered classics of that genre, such as *A Journey to the Center of the Earth* and *Around the World in Eighty Days*. Verne extraordinarily wrote about volcanoes, space







### Socio-Political Life

As mentioned earlier, since ancient times when Plato published *The Republic*, writers have often offered their own vision; in Plato's case, of how a utopian society would be like in the future. *The Republic* is a Socratic dialogue, which means information is not given directly but presented instead, through posing a series of questions, where Plato puts forward his definitions of justice and portrays the dialectical forms of government.

Other modern novelists, like George Orwell, were concerned with sociopolitical life. They spotted things they regarded as threats in their present and visualized how such small problems would turn into serious disasters in the future. Usually, those small issues or symptoms were of sociopolitical nature. In that way, writers drew their readers' attention to those problems hoping that the latter would do something about it and change the current reality.

### Fear of the Unknown

Usually, most writers share their fear of the unknown, which is translated in works that show a dystopian vision of the future. Whether it is a totalitarian system where people are repressed and deprived of all forms of freedoms whatsoever, or a rigid society where everything is mechanized and there is no place for emotions or humanity, a dystopian dark vision prevailed in many futuristic novels.

Here are some futuristic novels that captured the attention and the admiration of many people from different ages, cultures and eras:

#### *Paris in the Twentieth Century*

*Paris in the Twentieth Century* was written by Jules Verne in 1863 depicting Paris in 1960, about 100 years in Verne's future. The novel was published for the first time in 1994, because Verne's publisher rejected the novel claiming that it was too unrealistic and pessimistic.

The novel portrays a young man who lives in a technologically advanced world that is short on culture and arts. Paris in the novel only celebrates technological advances: nothing but technology is available at bookstores; working in the "arts" field is considered as a disgrace; warfare has become so scientific that there is really no need for soldiers anymore; most women have become neurotic career women; food is synthetic made from coal; among other eerily familiar visions.

Verne creates a tragic end for that gloomy world where Paris faces massive famine due to the destruction of food supplies, and people experience climate change where temperature drops to thirty degrees below causing all rivers to freeze.

In that imaginary world Verne created, he succeeded in making several futuristic predictions of what we have actually witnessed hundreds of years after he wrote his novel. Some of those predictions include skyscrapers, calculators, telegraphic communications network, known nowadays as the Internet, electric chairs, and computers.

#### 1984

Written by George Orwell, one of the most acclaimed writers in English literature, *1984* is a critique of the socialist movement that was gaining a lot of propaganda and attention at the time. Orwell was a big supporter of socialism like millions of people worldwide. However, his fascination with such a political vogue turned into loathe and contempt after he witnessed the Spanish civil war in 1937, where socialist and Marxist parties were involved. That experience was life-altering for Orwell; right after his stay

in Spain, he denounced socialism and wondered how life would be like in the future, if socialism reigned.

In 1984, Orwell brought his fears and concerns to life by creating that imaginary futuristic totalitarian world, where nothing is private and there is no space for individual private life. Everything is monitored and watched by the imaginary "Big Brother" that was created by the ruling party.

The hero of 1984, Winston, succeeds in creating his own world away from the ruling party's eyes and away from Big Brother by starting a love affair with a girl, Julia, who shares his loathe for the system. However, at the very end, Julia and Winston discover that their private affair was not private at all when they get detained and tortured, till both of them give up their old rebellious ideas and succumb to that totalitarian system.

#### *I, Robot*

In the late 1940s and early 1950s, World War II had just ended and the world was obsessed with air combat and the role of technology in society. Isaac Asimov's stories reflected his concerns over the danger of technology, but they also humanized robots, indicating that it is not technology that is evil but the way it is sometimes abused. His stories were so successful that, in 1950, nine of his best short stories were selected for publication as the book *I, Robot*.

*I, Robot*, the first and most widely read book in Asimov's Robot series, forever changed the world's perception of artificial intelligence. Here are stories of sensitive robots, robots gone mad, mind-reading robots, prankster robots, and closeted robots that secretly dominate politics. Chronicling the robot's development from primitive prototype to ultimate perfection, *I, Robot* blends scientific fact with science fiction in Asimov's provocative style.

#### *Fahrenheit 451*

This 50-year old novel by Ray Bradbury is set in a grim alternate-future setting ruled by a tyrannical government in which firemen as we understand them no longer exist. Instead of dousing fires, they ignite them.

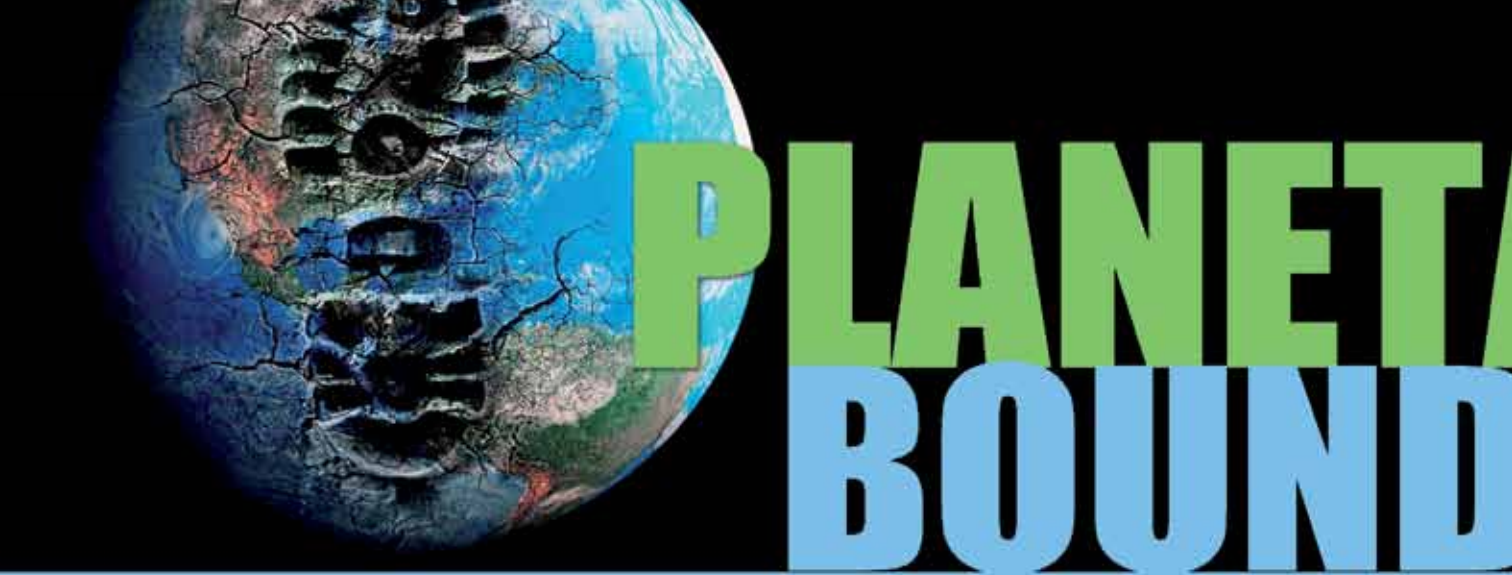
Books are illegal in Bradbury's world, but books are not what his fictional, yet extremely plausible, government fears. They fear the knowledge one pulls from books. Through the government's incessant preaching, the inhabitants of this place have come to loathe books and fear those who keep and attempt to read them. They see such people as eccentric, dangerous, and threatening.

One day, a fireman named Montag meets a young girl who demonstrates to him the beauty of books, of knowledge, of conceiving and sharing ideas. When Montag's previously held ideology comes crashing down around him, he is forced to reconsider the meaning of his existence and the part he plays. After Montag discovers that "all isn't well with the world," he sets out to make things right.

#### *Life As We Knew It*

*Life As We Knew It* is an award winning science fiction novel written by Susan Beth Pfeffer and published in 2006. The novel portrays life on Northeastern Pennsylvania when an asteroid hits the moon bringing it closer to Earth. Pfeffer was inspired by the Sci-Fi movie, "Meteor", which made her think about how life would be and how people would behave when faced by such a disaster as the one she proposes in her novel.

In *Life As We Knew It*, tsunamis wipe out the coasts, earthquakes rock the continents, and volcanic ash blocks out the Sun. Miranda, the heroine of the novel, succeeds in convincing her two brothers and her mother to retreat in their sunroom, where they subsist on stockpiled food and limited water in the warmth of a wood-burning stove. Miranda, in this way, retains her hope in that desperate post-apocalyptic world. The novel hits a nerve and relates to its readers not only through the highly appraised writing style, but also due to its topic, which discusses natural disasters that form real threats in our real world.



Since the beginning of time and for nearly 10,000 years, we humans have used and abused our planet and its vast resources to our hearts content, never assuming that this privilege could come to an end. Our ancestors invented agriculture and mining, built cities that grew into empires, all the while exploiting what seemed to be inexhaustible riches. Humans back then could pollute freely and with no regrets, avoiding any local repercussions by simply moving elsewhere, for the Earth seemed infinitely large.

Yet, the Earth remained relatively stable. The average global temperature only fluttered slightly, never lurching towards a greenhouse climate or chilling enough to enter a new Ice Age. The pH of the oceans stayed steady, the composition of the atmosphere remained stable, and the overall Earth's conditions kept relatively constant for nearly 10,000 years of the Holocene<sup>(1)</sup>, providing the right conditions for nature to flourish and to support the development of human civilization.

This period of overall stability and favorable conditions, along with the advances in public health and the rise of the Industrial Revolution, have all played a big part in humanity's explosion from about one billion in 1800 to nearly seven billion today; in the past 50 years alone, our numbers have more than doubled.

With surging human population, massive exploitation of Earth and environmental damage caused by them, the stability of Earth has come to an end.

### Entering the Anthropocene<sup>(2)</sup>

Over the past century, human activity has changed the global environment more than any natural process in Earth's recent history. As a result of our accelerated growth and our affluence, our use of resources has reached staggering levels; in 50 years, the global consumption of food and freshwater has more than tripled, and fossil-fuel use has risen fourfold.

This wanton growth has also expanded pollution from a local

problem to a full global assault. Consequently, our world has become a "full" world, with limited resources and limited capacity to absorb waste. Stratospheric ozone depletion and greenhouse gas concentrations are obvious complications, but many other human induced changes in the Earth's conditions are rising.

We humans have changed the chemistry of Earth's oceans, lowering their pH and causing ocean acidification. We are shifting the composition of the atmosphere, raising levels of carbon dioxide higher than they have been in at least the past 800,000 years. Ironically, our civilization has become so powerful that it has the ability to reshape the planet itself.

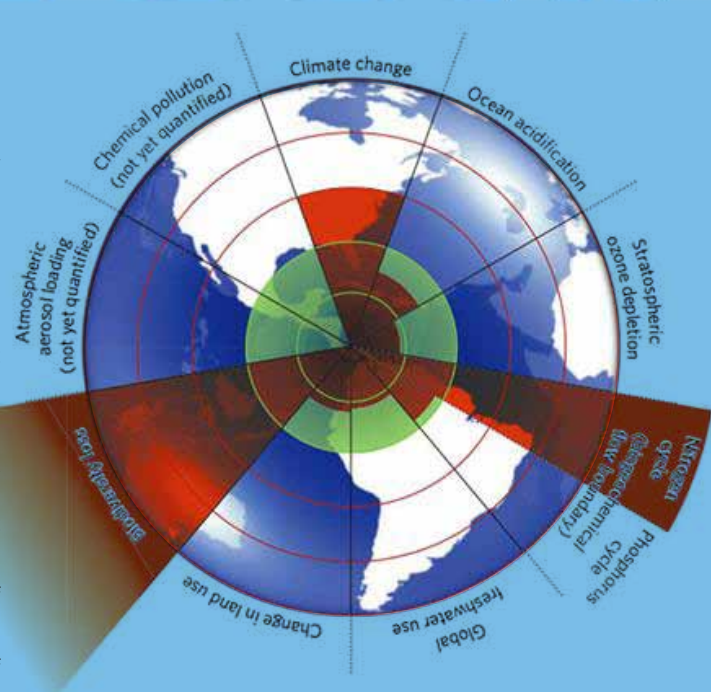
According to experts, Earth has now entered a new epoch, the Anthropocene, where humans constitute the dominant driver of change to Earth's System. They maintain that, ever since the Industrial Revolution, the advent of the Anthropocene, humans have been and still are effectively pushing the planet outside the Holocene range of variability for many key Earth System processes.

In recent years, many scientists have warned that if we keep pushing the planet this way, we will cause sudden, irreversible damage to the systems that made human civilization possible in the first place. They urged the need to revise our ways, and to take steps to ensure that we function within the "safe operating space" of our environmental systems. But what is this "safe operating space"? And where do its boundaries lie? And how can we avoid crossing them?

Twenty-eight scientists from around the world have recently come together to find the answer to these questions and to answer another graver one: are we nearing planetary "tipping points" that would push the global environment into dangerous new territory, outside anything seen during human history?

### Nine Planetary Boundaries

After examining numerous interdisciplinary studies of physical



and biological systems, the group of leading scientists led by Johan Rockström, Stockholm Resilience Center, and Will Steffen, Australian National University, determined the nine environmental processes that could disrupt the planet's ability to support human life. The scientists then set boundaries for these processes; limits within which humankind can operate safely, aka "Planetary Boundaries":

#### 1) Climate Change

The effects of climate change are already evident in the loss of summer sea ice in the Arctic Ocean, the melting of glaciers, the shrinking of the Greenland and West Antarctic ice sheets, and sea level rise.

Scientists measure climate change by the amount of CO<sub>2</sub> in the atmosphere and the level of radiative forcing, which is the change in the input or output of radiation to or from the atmosphere. Using pre-Industrial Revolution

measurements as a baseline, the background levels for CO<sub>2</sub> are 280 parts per million (ppm), and 0 watts/m<sup>2</sup> for radiative forcing; a positive number indicates warming.

The boundary is 350 ppm for CO<sub>2</sub> and 1 watts/m<sup>2</sup> above background levels; however, radiative forcing already measures 1.5 watts/m<sup>2</sup> and CO<sub>2</sub> levels reached 391.92 ppm in April 2011. Scientists believe crossing these boundaries can increase the risk of triggering irreversible changes.

#### 2) Ocean Acidification

The ongoing acidification of the seas is the lesser-known cousin of climate change. As atmospheric CO<sub>2</sub> concentration rises, so does the amount of CO<sub>2</sub> that dissolves in water as carbonic acid, which makes the surface ocean more acidic and less saturated with aragonite, a form of calcium carbonate used by marine organisms such as corals to make their shells.



# PLANETARY BOUNDARIES

By: Lamia Ghoneim

It is estimated that by 2050, only 15% of coral reefs will have enough aragonite for adequate growth. The background measurement of the saturation state of aragonite is 3.44, and the boundary is set at 2.74. Today, at a level of 2.90, ocean acidification is happening over 100 times faster than at any time in the last 20 million years. We are in danger of losing coral reefs and their ecosystems, as well as certain marine plankton that could affect the entire food chain.

### 3) Stratospheric Ozone Layer

The stratospheric ozone layer filters out the Sun's ultraviolet (UV) rays that can cause skin cancer in humans and damage plants and plankton. When chlorofluorocarbons and other halocarbon refrigerants rise into the stratosphere, they release chlorine and bromine atoms, which break down ozone molecules and deplete the ozone layer.

Ozone depletion is also exacerbated by the presence of polar stratospheric clouds over the Antarctic, which enhance the chemical reactions that destroy ozone. The 1989 Montreal Protocol banning ozone-depleting chemicals has helped shrink the hole in the ozone layer over the Antarctic and keep us within the planetary boundary of 276 Dobson Units, a measure of ozone density, against a background level of 290 Dobson Units.

### 4) Nitrogen and Phosphorus Cycles

Human activities convert around 120 million tons of naturally occurring nitrogen from the atmosphere into reactive nitrogen, mainly as fertilizer to help feed the world. But reactive nitrogen pollutes waterways and coasts, and in nitrous oxide form, exacerbates global warming.

Synthetic fertilizer, leguminous crops (soybeans, peanuts, alfalfa), many types of manufacturing, and fossil fuel burning industries and vehicles all produce reactive nitrogen. The planetary boundary for the nitrogen cycle is figured in millions of tons per year removed from the atmosphere; the

background level is 0, the boundary is set at 35; we are already at 121.

Phosphorus is a mineral that is mined for use in fertilizers, detergents, pesticides, steel production, and even toothpaste. It is measured in millions of tons per year entering the ocean. The background level is -1, the boundary is 11; currently 8.5 to 9.5 million tons end up each year in the ocean where it depletes oxygen levels, harming marine life.

### 5) Global Freshwater Use

Around the world, freshwater is becoming increasingly scarce because of human impacts on global resources. Humans have altered the flow of rivers so that 25% of the world's river basins run dry before reaching the ocean; they have also manipulated the water cycle through land use changes. Moreover, the freshwater cycle is greatly affected by climate change. Before the Industrial Revolution, humans consumed 415 km<sup>3</sup> of freshwater per year; the boundary of 4,000 km<sup>3</sup> allows for sufficient water in the system to regenerate precipitation and provide for ecosystems and aquatic habitats, and we now consume 2,600 km<sup>3</sup>.

### 6) Land System Change

The conversion of forests and other ecosystems, mainly for agriculture, has had significant impacts on biodiversity, water flow and CO<sub>2</sub> emissions. It is estimated that 12% of global land is currently being used as cropland.

A boundary of 15% is set because, beyond that, the most productive land on the planet will have been used up, which would necessitate clearing much more marginal land for incremental gains in agriculture.

To keep within the 15% boundary, scientists recommend that crops only be grown in the most productive areas, agriculture be based on natural processes, and the demand for food be better managed.

### 7) Rate of Biodiversity Loss

Changes in land use, the introduction of invasive species, and climate change are critical factors in

the rate of biodiversity loss, which today is 100 to 1,000 times more than the background extinction rate.

While extinction of particular species occur locally, it can leave large-scale land and marine systems more vulnerable to changes in climate and ocean acidification since biodiversity plays a key role in keeping ecosystems resilient.

With the global extinction rate expected to increase 10-fold this century, scientists concluded that humanity is already in the danger zone. Just recently, a study by UN University found that the strategy of creating land and marine preserves to protect vulnerable species is not preventing global biodiversity loss. The authors of the study stressed that approaches tackling the root causes of biodiversity loss—human population growth and resource conservation—are what is needed.

### 8) Aerosol Loading

Aerosol particles in the atmosphere influence global climate and impact human health. Some particles, like sulfur dioxide from coal-fired power plants and volcanoes, reflect the Sun and cool the Earth. Others, like soot or thin high clouds, behave like greenhouse gasses to warm the planet. Aerosol particles can also influence the hydrological cycle and monsoon circulation, cause forest degradation and acid rain, and are responsible for respiratory illnesses that result in 800,000 human deaths each year.

Scientists have not been able to define a boundary yet because of the variety of aerosol particles and their complex interplay. A new study by the National Oceanic and Atmospheric Administration found that aerosol particles slowed global warming, preventing 0.07°C of warming since 2000.

### 9) Chemical Pollution

Chemical pollution of the Earth from radioactive compounds, heavy metals and organic compounds produced by humans affect human health, ecosystems, biodiversity, and global warming. It can also cause reduced fertility and genetic damage, which can result in species loss. But as with aerosols, there are too many diverse chemicals in the environment and not yet enough understanding about their combined effects to establish a boundary.

### Living within the Boundaries

Scientists acknowledge that the nine planetary boundaries are rough estimates because many uncertainties and knowledge gaps remain. Moreover, the established boundaries are based on the assumption that no other boundaries are being transgressed. And, it is not known how much time

we have after crossing the boundaries before we reach tipping points that could produce irreversible changes.

But we do know that the nine boundaries are inextricably linked; breaching one makes it more likely that others will be breached. Land use changes in the Amazon rainforest can affect weather systems, and alter precipitation and freshwater resources. Exceeding the nitrogen and phosphorus boundary can damage the resilience of the ocean and reduce its ability to absorb CO<sub>2</sub>. Global climate change is hastening glacial melt, which will also affect freshwater supplies.

The nine planetary boundaries are meant to offer a new, albeit incomplete, global approach to sustainable development that can help guide future policy and governance. Within these boundaries, we still have options for our future development and well-being. We must find a way to live within these boundaries, as crossing them could be disastrous for humanity.

### Glossary

(1) **Holocene**: The geological epoch that began at the end of the last Ice Age about 12,000 years ago and is characterized by a relatively stable climate, favorable conditions, and the development of human civilizations.

(2) **Anthropocene**: A recent and informal geologic chronological term that serves to mark the evidence and extent of human activities, which have had a significant global impact on the Earth's ecosystems. The Anthropocene has no precise start date, but based on atmospheric evidence may be considered to start with the Industrial Revolution, late 18<sup>th</sup> century.

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# FUTURE = SUSTAINABLE ENERGY NOW

By: Shahenda Ayman



In school, we have learnt that there is energy in everything; in humans, animals, plants as well as non-living things; it has many forms: kinetic, potential, gravitational or nuclear, among many others. We have also learnt that any form of energy can be converted into another according to the law of conservation of energy, which states that energy may neither be created nor destroyed, making the sum of all the energies in the system a constant. More importantly, we learnt that there are two sources of energy: renewable and non-renewable; clean and unclean; sustainable and unsustainable.

Renewable energy is generated from natural sources; such as the Sun, wind, rain, and tides, among other sources. It can be generated again and again, as and when required, unlike non-renewable energy sources that are limited and bound to expire one day. Not only are they available in plenty, they are, by far, the cleanest sources of energy available on the planet; they produce little or no waste products such as carbon dioxide or other chemical pollutants, and thus have minimal impact on the environment in most cases.

Nevertheless, despite their numerous advantages, renewable sources of energy also have drawbacks. For one, it is not easy to set up a plant as the initial costs are quite steep. Besides, some sources can be unreliable; such as solar energy, which can be used during daytime but not during night or rainy seasons. Likewise, to use wind energy, strong winds are required; therefore, requiring a suitable site to operate.

Other sources can also have harmful side effects; such as geothermal energy, which can bring toxic chemicals beneath the Earth's surface onto the top, creating environmental changes. And, although hydroelectric provide a pure form of energy, building dams across a river, which is quite expensive, can affect the natural flow of water, and consequently wildlife.

Non-renewable sources on the other hand are attractive to consumers because they are cheap and easy to use. Yet, their impact on the environment when mined, processed and consumed is unequivocally disastrous. To name a few, coal processing plants leach toxic metals into ground water, producing tons upon tons of additional waste, while gasoline burned

in combustion engines emits carbon dioxide and other pollutants, majorly contributing to global climate change. Moreover, natural gas is mainly methane, which is twenty times more effective at trapping heat than carbon dioxide, making it twenty times more problematic as a greenhouse gas. Needless to say that all these "side effects" have devastating impacts on human health, as well as biodiversity, ecosystems, and consequently the balance and continuity of life as we know it on Earth.

Still, the fact is that more than 85% of the world's current energy needs are met through fossil fuels such as coal, oil and natural gas. Demand for energy is projected to increase; primarily in developing countries that are beginning to drive more cars and use more electricity. While there is enough fossil fuels supply for several more decades, what will happen when it starts running low?

Eventually, all non-renewable energy resources will be depleted; the name itself admits this inevitability. Because unsustainable energy reserves are limited, they will become more and more expensive. Consider the state of gas prices today, and imagine how these prices will continue to rise as oil becomes rare and gasoline is no longer an easily accessible resource. The technologies we use to make our lives easier will be rendered completely useless if the fuel used to power them ceases to exist, and yet, someday this is exactly what will happen. It would be better to stop needing fossil fuels before they have completely disappeared.

If alternatives are not sought out and perfected, such a shortage could result in chaos. We must turn to other forms of energy production that can be used indefinitely. With these alternatives, the process of technology conversion should begin sooner rather than later.

## Sustainability; Noah's Ark

There are ways to reduce waste and use existing technologies to keep the air cleaner by reducing fossil fuel emissions. Expansion of all economic energy sources will be required: coal, nuclear, biomass, other renewable resources, unconventional oil and natural gas; all of which are options that are part of a concept called energy sustainability.

Energy sustainability is about finding the balance between a growing economy, the need for environmental protection and social responsibility in order to provide an improved quality of life for current and future generations. In short, it is meeting the needs of the present without compromising the needs of the future.

Energy sustainability can inspire technical innovation with an environmentally conscious mindset. Renewable resources such as sunlight, wind and biomass provide a source of sustainable energy. This includes bio-fuels like ethanol, which is created from crops like corn or sugarcane.

Regulations designed to reduce air, water and waste emissions from energy-related activities, such as coal mining and electricity generation, also help with energy sustainability, as do people who conserve energy.

Meeting energy demand over the next century will not only require producing more, but also using what we do produce much more efficiently. But, how can we use less energy to power everything from our computers to cars for a rapidly increasing population? How can we produce more with less? How do we supply consumers with affordable energy to allow them to maintain a comfortable standard of living? The answer will require both new technologies and new cultural habits.

## Step One:

### Efficiency & Conservation

Electricity generated on the wind-swept prairies of Texas and sun-laden deserts of Arizona must be carried efficiently to houses and businesses in New York and Chicago. Doing so remains difficult, since a large portion of useable electricity is lost to heat as it travels long distances through wires and cables; tiny electrons lose some of their energy just trying to move forward against the wire's resistance. If the objective is to move electricity over long distances efficiently, this loss of energy is undesirable.

By improving the efficiency of this process, less total energy will be needed to power everything we use. Accordingly, scientists and engineers are working to streamline the electricity grid, modernizing transmission cables with new materials that allow electrons to move more easily, producing less waste.

Becoming more energy efficient will also require us to change how our buildings are made, how we heat our homes and how we light our classrooms. For example, when coal is burned in a power plant, the energy released is used to superheat water, just as you would boil a pot of water on your stove. The process creates very hot and high-pressure steam that then pushes a propeller. The spinning motion of this propeller turns a large magnet that generates an electrical current that is then transmitted to your home. But that steam at the power plant is still very hot after it has been used to create electricity.

Rather than letting this heat escape as wasted energy, it is possible to send the steam out to homes and buildings to provide warmth on cold winter days. This process, called "combined heat and power", will require us to rethink the ways in which we live and work, making our cities and buildings more connected.

Energy efficiency is also being explored in other areas as well. If you have ever been in a car on a sunny day without the air conditioning on, you



know it can become very hot and uncomfortable. By redesigning our homes and buildings, this energy from the Sun could be captured to heat rooms or the water we use in our showers and kitchens.

Another energy-saving efficiency can be found in hybrid cars. These cars capture a portion of the energy traditionally wasted as heat from friction between the tires and brakes. In hybrid cars, this contact recycles some of that wasted energy into electricity that can then offset some of the gasoline used in the car's engine.

As a matter of fact, we can use less energy by making even the simplest things more efficient—from our light bulbs to our cars, from our home air conditioners to our computers. Then, there is scientific innovation, which is the promise for a sustainable future.

For years scientists and engineers have advertized some fantastic schemes: satellites that beam solar power to receivers on land, wind machines that hover in the atmosphere, generating electricity and others. Down on Earth, however, researchers have recently received substantial government or private funding for a remarkable variety of long-shot technologies in a few key areas.

### Quantum Photovoltaics; the Promise of a Cleaner Tomorrow?

Capturing electricity from the Sun using nothing more than a few shiny panels seems magical. In reality, however, it is just a simple manipulation of atomic behavior; when photons from the Sun pass through the silicon wafers, their electrons are knocked loose. This eventually causes a current that flows from the panels into batteries or the grid.

This is not to say, of course, that there is no room for improvement. In fact, the efficiency of most solar panels is low, with most capturing between 5 and 19% of potential energy. Quantum photovoltaics, or quantum dot solar cells, offer one promising possibility for dramatically improving solar wafer efficiency.

Instead of using sheets of silicon pressed between glass panels, as is done in standard photovoltaic wafers, quantum dot panels use a matrix of finely-tuned crystals. The ability to tune the crystals to specific band-gaps, or segments of the light spectrum, means that cells can be constructed to capture more of the available light.

Furthermore, the unique mechanics of a quantum dot cell can potentially increase its efficiency. Unlike

standard silicone cells, which are capable of creating one excited electron from each passing photon, quantum dots can produce as many as seven.

Currently, the technology is still in pre-commercial stages of development. When it is finally scaled; however, quantum dot solar cells will be cheaper than today's cells and capable of reaching efficiencies as high as 65%—making solar power much more attractive on both macro and micro generation scales.

### Shock-Wave Auto Engine; Zero Carbon Dioxide Cars?

We have seen a number of innovations focused on improving the efficiency of hybrid cars. But, while most of these new ideas have focused on optimizing battery capacity, this is a new piece of technology that is about to revolutionize the engine itself. Straight from the engineers at Michigan State University, this new "wave disk engine" is 3.5 times more fuel efficient than a conventional combustion engine, can be run on almost any fuel, and emits 95% less carbon dioxide.

Wave disk engines are built to be small, light, clean, simple and cheap. The engine basically uses a disk that spins around super fast, and the disk is affixed with a number of channels that fill up with air and fuel as the rotor<sup>(1)</sup> spins. Pressure builds up as inlets<sup>(2)</sup> are blocked off, causing a shock wave within the chamber that ignites the compressed air and fuel. Essentially, as shock waves from the rotation compress and ignite fuel in the channels, the combustion causes the rotor to spin, generating electricity.

According to Michigan State University, the wave disk engine is about 20% lighter than a conventional engine and significantly cheaper to manufacture. But like all turbine-type engines, the wave disk engine is probably only able to provide high levels of efficiency when it is at its optimal speed, meaning that it will likely be most useful to apply the technology to charge the batteries of an electric vehicle, rather than to drive the car alone.

Michigan State's engineers have a prototype wave disk generator in action, and they hope to have a car-sized 25 kilowatt version running by the end of the year.

### Fusion-Triggered Fission; Nuclear Energy with a Twist!

According to Scientific American Magazine, physicists and engineers have been working for decades to harness nuclear fusion; the same process that happens in H-bombst<sup>(3)</sup> and the Sun. Researchers

can readily produce fusion reactions, which is slamming hydrogen nuclei together fiercely enough to merge, releasing neutrons and energy. The hard part is to do that with high efficiency and to release more energy than the energy used to start them, this process is called ignition, which could ultimately generate electricity.

Scientists at the National Ignition Facility in Livermore, California, have come up with a new twist: using fusion to drive fission; the atom splitting that powers conventional nuclear reactors. Director Edward Moses claims the process could lead to prototype power plants in 20 years. In the Livermore scheme, laser pulses produce fusion explosions at the center of a reaction chamber, emitting neutrons that split atoms in a thick blanket of uranium or other fuel lining the chamber's walls.

A fission reactor relies on a chain reaction in which neutrons from fissioning atoms trigger more atoms to split. Sustaining the chain reaction requires plutonium or enriched uranium fuel, both of which can be used in nuclear weapons. But, if most of the power comes from fission, why not stick with conventional nuclear power plants and avoid the hassle of developing the fusion trigger?

A conventional reactor splits only a few percent of its fuel's fissionable atoms before the fuel must be changed out. Moses says fusion-fission plants could achieve 90% burn, thus requiring perhaps only a 20<sup>th</sup> as much fuel as a typical fission reactor. An "incineration" phase in the final decade of the plant's roughly 50-year life span would reduce the long-lived waste from 2,500 kilograms or so to about 100, albeit with declining power generation in those years.

Fusion energy of any kind is a radical proposition. Even if Moses's facility demonstrated ignition, major technical obstacles would remain before a power plant could become reality. Tiny exquisitely engineered fusion pellet targets would have to be mass-produced inexpensively, and ignition would have to occur 10 times a second, which requires an array of unproved technology; the National Ignition Facility manages at best a few target shots a day.

Hybrid approaches also require technologies not needed in pure fusion—in particular, the fission blanket, including fission fuels that can withstand a much greater barrage of heat and neutrons than they encounter in a conventional reactor. Proposals range from solid, multilayered "pebbles" to liquids composed of uranium, thorium or plutonium dissolved in molten





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salts. The challenges are daunting, and Moses has mapped out an aggressive development path to achieve them.

The Sun gives Earth more energy in an hour than civilization uses in a year. If scientists could convert even a fraction of that surplus into a liquid fuel, our addiction to fossil fuels for transportation, and the problems they cause, could end. "Chemical fuels would be the game changer if you could directly make them efficiently and cheaply from sunlight," notes Nathan Lewis, Director of the Joint Center for Artificial Photosynthesis at the California Institute of Technology.

The plain truth is that if we do not take serious action now to conserve energy, use it more efficiently, seek and apply sustainable energy alternatives to regular energy sources used today, we will face serious and irreversible implications in the near future. With snowballing pollution literally choking life on Earth, and energy sources running out, if we are serious about the future of life on Earth as we know it for generations to come, we urgently need to figure out ways to save energy and make use of alternative and naturally clean resources NOW.

## Glossary

- (1) **Rotor**: the non-stationary part of an alternator or electric motor, operating with a stationary element called the stator.
- (2) **Inlet**: an opening providing a means of entrance or intake.
- (3) **The Hydrogen Bomb**, aka H-bomb, is a nuclear weapon that releases atomic energy by union of light (hydrogen) nuclei at high temperatures to form helium.

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# GREEN HOMES

By: Jailane Salem

being transported to the trash landfill. Not only that, the bricks used can also contain a high percentage of recycled materials, including glass.

## Bottled Buildings

Bricks are the building blocks usually used in construction, but does it necessarily have to be so? Monks in Thailand do not think so, and they proved it by building a temple using 1.5 million glass bottles. The entire structure is made of different sized bottles, creating a beautiful spiritual haven. The Wat Pa Maha Chedio Kaew temple sits in Thailand's Sisaket province, and is a standing example of the great feats that can be achieved through recycling.

But, is it only glass bottles that can be used in construction? Of course not! New projects are emerging where plastic bottles are also used. In the Philippines, Pepsi spear-headed a school building project; the method was as follows: collect used plastic bottles, fill them with adobe (a natural material made from a mixture of sand, clay, water and straw) and stack them up on top of each other to form walls within a steel frame.

This idea is brilliant on many levels, instead of leaving the bottles at large, they are being reused, the school costs less to be built and the design of the construction is eco-friendly. This idea has also travelled to Africa, and is a great way to create sturdy structures in a cost effective way.

A building is not just layers of bricks stacked up upon each other to create a sheltered space, buildings become homes and schools, where people learn and create memories. They become part of a person's identity, and therefore it is crucial that they be healthy, not just for us but the Earth as well. Who knows what ideas people will come up with in order to provide eco-friendly home solutions, but with the innovative and ingenious ways that are already around, the future is definitely looking greener.

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It seems that every other day a product, a place of business, or a service provider of some sort becomes greener; cars can run on electricity, electronics are more power efficient, factories are reducing their carbon footprint, and the list goes on. More and more people are turning to renewable energy for their supply of daily electricity; we now see houses that rely on solar panels and wind turbines for power in an effort to lead an eco-friendlier life.

People are not stopping at just trying to use greener methods of acquiring energy at home, it is becoming more popular to use recycled material to construct sustainable buildings. As places become more crowded and energy less available, we must all start to change our mindsets about what constitutes a home. Usually, we think of a traditional-looking house or building, made of concrete and bricks, but has it always been that way?

## Natural Buildings

Buildings in ancient times were made of simpler material; people used what was readily available to them from Mother Earth. Sand, clay, straw and water were combined to form a mixture that would then be used for building homes. This natural technique in buildings was sustainable as well as durable, and homes were harmonious with nature. This method of building fell out of favor due to industrialization and the modernization of construction; however, they are still in use in poor areas where natural resources are aplenty.

Not only is using natural materials cost effective and eco-friendly, they are also healthier for us. Natural materials are porous in nature; thus, they allow natural air circulation in the house, unlike other man-made materials, which create an unhealthy environment. Such houses exist here in Egypt, one example being the mud brick houses in Siwa built using a mixture of salt, water mixture and mud, which when shaped are left to dry in the Sun.

As a matter of fact, the largest earthen building in the world is the Great Mosque of Djenné in Mali, Africa. It was completed in 1907, and it is made from Sun-baked mud bricks coated with mud plaster to give a smooth finishing to the walls. The mosque is built on a platform measuring about 75x75m that is raised by 3m above the level of the marketplace. The people of Djenné take pride in their mosque; an annual festival is held to help maintain it, where festivities include food, music and competitions in repairing damage sustained by the mosque due to erosion.

## Green Buildings

From the moment of its inception, green construction should be environmentally friendly and responsible. Not only should the finished construction function in green mode, but during the process of its construction everything should be energy and resource efficient.

The main concept is that green buildings should be designed so as to reduce the overall impact of the construction itself on the environment as well as human health. This is done by adhering to an efficient use of energy, water and all resources; making sure the health of the builder and occupant will not be affected in any negative way; and, most importantly, reducing waste and pollution to the smallest percentage possible.

The masonry used in green buildings can be quite innovative and unusual. Everything used in construction has an impact on the environment; that is why it is a great idea to reuse materials instead of throwing them away and adding to the pollution. Some people have started using material that is left-over trash from other construction sites; old doors, windows and wood can find new homes instead of



# THE FOUNTAIN OF YOUTH

By: Lamia Ghoneim

Tales of a legendary fountain that restores the youth of anyone who drinks from it have been recounted for thousands of years. Most recently, in the latest *Pirates of the Caribbean* movie, the infamous Jack Sparrow and many others are on a quest to find that same mystical fountain. Only scientists may have found something better and much less far-fetched than magical waters.

In an amazing new medical breakthrough, scientists may have discovered a "Fountain of Youth" that can slow down aging and restore youth. It appears that contrary to popular myth, everlasting youth could possibly be granted by a single injection of "Stem cells".

Researchers at the University of Pittsburgh have developed a revolutionary stem cell treatment that has proven to significantly stall aging and increase life span; if you are a mouse, that is. Although the treatment was only tested on mice and is not yet ready for human use, we should not be discouraged for the study manages to shed light on many clues about the aging process, which is bound to help us with our own pursuit of health and longevity.

The researchers injected a combination of stem cells and a similar type of cells taken from the muscle of young healthy mice into mice that were bred with progeria, which is a rare genetic disease that causes advanced aging in children, making the mice bred with the disease old and frail; they were only expected to live for days. However, when they were injected with a single dose of stem cells, the result was miraculous; the aging process was reversed and the mice's life spans shot up.

The once rapidly aging mice lived up to three times longer, dying after 66 days, rather than 28 days. The cell injection also appeared to make the animals healthier, improving their muscle strength and brain blood flow.

According to co-author Dr. Laura Niedernhofer, Associate Professor of Microbiology and Molecular Genetics, University of Pittsburgh, the more

impressive results occurred when the stem cell mix was injected into mice with a milder form of the aging disease. Those mice typically would show signs of aging such as weak leg muscles, walking hunched over, and trembling. Following two injections of stem cells spaced several weeks apart, the mice saw relief in 75% of their symptoms, which suggests the stem cells delayed the effects of aging. "That, to me, is exciting," Niedernhofer said.

While aging is universal, some researchers believe it may also be reversible. Niedernhofer says their study suggests that stem cell dysfunction may be the cause behind some of the changes we see with aging. In recent years, scientists have agreed that aging in both animals and humans begins when stem cells lose their ability to rejuvenate the body's tissues.

"In order to stay healthy and functional, your stem cells are really important," Niedernhofer said, "we have got to find a way to replace them or improve their function. I think that will be a key goal for staving off a lot of aging-related diseases." She explained that, even though the injection of young cells did not necessarily rebuild the bodies of the mice, it did seem to improve their body health by rejuvenating the aging mice's cells, as opposed to replacing them.

"Young stem cells seem to secrete something that is quite beneficial," she said, "just what that is, we are not entirely sure". Discovering what that thing is will be crucial in determining if the technique can be used to extend lives and cure aging mice and, eventually, people.

Scientists are already studying how to treat humans with their own muscle cells. "The beauty of that is we can take them out of muscle and expand them so we have a useful therapeutic population of cells," Niedernhofer said; "if all of us could be treated with our own cells, we could eliminate problems with rejection and immunity."

But laboratory success with mice is a far cry from success with humans, which may be the reason why

more cautious scientists were less excited with the findings of the study."One must be very cautious in extending findings in mouse progeroid models to normal human aging," said Dr. Amy Wagers, Associate Professor of Stem Cell and Regenerative Biology, Harvard University. "These models are very different from physiological aging, and so it remains an open question whether such phenomenon may be relevant to natural aging symptoms as well."

The mice in the study were aging rapidly due to progeria, meaning they did not age normally, even by mouse standards; normal mice live for about 800 days. Though the mice in the study lived nearly three times as long as they would have, they lived for only 66 days. Dr. Curt Freed, Professor and Head of Clinical Pharmacology, University of Colorado, Denver, said he was unimpressed by the brief extension of life for the rapidly aging mice.

"Because the transplants have added only 30 days to these animals' short lives, the results are interesting but are hardly a turnaround in this devastating disease model. The transplants are not curing the disease," Freed said, "I cannot imagine that this strategy will be useful for modifying the aging process in humans".

While I agree that this current study does not yet provide an absolute cure for aging; it is, in my humble opinion, an amazing discovery and a turnaround in the study of aging and curing diseases that has in fact recently been successful on humans.

It has come to my attention that embryonic stem cells\* have just been used to treat human illness for the first time, improving the sight of two women with severe vision loss that was previously incurable. Although the women were not completely cured, their improvement, along with the findings of the mice study, proves that stem cell treatments are indeed the way to discover the fountain of youth.

While there may be obstacles with stem cells, they are much easier to overcome than acquiring the tears of a mermaid, which is apparently the only way to discover the mystical fountain, as Jack Sparrow in the latest *Pirates of the Caribbean* would have us believe.

## GLOSSARY

**\*Embryonic stem cells** are obtained from an embryo in the blastula phase, when they are still only a few days old. Because they have only begun to differentiate, these cells have the capability of developing into any cell in the human body; a fact that makes them important in medicine.

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By: Lamia Ghoneim

# GROWING NEW ORGANS: CAN WE LIVE FOREVER?

Have you ever wondered if a time would come when you could replace old worn body parts much like you would replace parts on your car?

Well, that time is nearly here. Using stem cells<sup>(1)</sup> organ regeneration technique, surgeons in Sweden have successfully transplanted a fully synthetic, tissue-engineered organ; a trachea, into a man with late-stage tracheal cancer.

The synthetic trachea was created entirely in the lab, using a scaffold<sup>(2)</sup> built out of a porous polymer, and tissue grown from the patient's own stem cells inside a bioreactor designed to protect the organ and promote cell growth.

Professor Paolo Macchiarini, an Italian expert in regenerative medicine who led the groundbreaking operation at Karolinska University hospital in Sweden, has successfully designed the Y-shaped synthetic trachea scaffold with Professor Alexander Seifalian, from University College London. The entire process took less than two weeks, and the patient has now made a remarkable full recovery.

## MILESTONE ATTAINED

The transplant success gives a whole new level of promise for regenerative medicine. This is not the first lab built organ; synthetic bladders have been successfully grown and transplanted for more than a decade now. It is not the first trachea either; Professor Macchiarini has successfully transplanted another stem cells seeded trachea more than three years ago. However, all previous transplants involved a donor organ that was stripped down to cartilage to serve as the scaffold for tissue growth. This new technique does away with the need for donors, relying instead on purely synthetic material for the scaffold; thus, providing a promising new advancement, particularly for patients on donor transplant lists.

More than 100,000 people are waiting for organ transplants in the USA alone; statistics show that every day, 18 of them die. With this new technique, all those lives could possibly be saved, no waiting is needed. Not only are healthy organs in short supply, but donor and patient also have to be closely matched, or the patient's immune system may reject the transplant. Using the stem cells regeneration technique, the organ is built from cells originating from the patient, meaning there is no risk of immune system rejection and no need for dangerous immunosuppressant drugs.

## STEM CELLS AND NANOTECHNOLOGY

The Y-shaped structure that served as the scaffold for the trachea was made from a novel plastic-like "nanocomposite" polymer that was developed by the team in University College London specifically for the transplant. This nanocomposite polymer material has a porous structure with a huge surface area that allows it to be readily seeded by a patient's tissue, rendering it a nanotechnology fabrication that can be expected to have many more exciting applications.

State of the art 3D scans of the patient's trachea were sent to the scientists whom, using these images and the newly developed polymer, were able to craft a perfect copy of the patient's trachea that is quite indistinguishable from his own.

This was then flown to Sweden and soaked in a solution of adult stem cells taken from the patient's bone marrow and incubated in a revolving bioreactor where the organ was grown, one cell at a time. The solution included chemicals meant to coax the cells to differentiate into the types of cells found in a trachea. Two days later, the millions of holes in the porous windpipe had been seeded with the patient's own tissue, and the first wholly tissue-engineered organ was complete.

## GROWING MORE ORGANS

No doubt the transplant marks a significant moment for regenerative medicine, but the real question is: can this technique be used for replacing more complex organs, such as a kidney or a heart?

Because the trachea is primarily a mechanical organ, a conduit for air, it is much easier to build than other more complex organs. While the procedure needed to build higher complex organs would be

much more challenging, experts maintain that we may just be years away from building such organs.

In an interview with Dr. Anthony Atala, a pioneer in the field who in 1999 transplanted the first of several synthetic bladders into young people with bladder disease, he described the growing of different organs as having "four levels of complexity:

On the first level are flat structures like skin; they are the easiest to make because they are flat. On the next level of complexity are tubular structures like the blood vessel and the windpipe. Next are hollow non-tubular organs like the bladder or stomach, because they have to act on demand; they have much more complex functionality. The most complex are solid organs like the heart; they require many different cell types.

At this point, we have been able to do all the first three: flat, tubular and hollow non-tubular; skin, urethra, windpipes and bladders. The fourth level is going to take time, but it may only be years away."

As technology continues to advance, it stands to revolutionize how science treats diseased and injured tissues and organs. Although we are not destined to live forever, this revolutionary technique may greatly lengthen human life to a level never achieved before, at the same time making life much easier for patients in need.

## GLOSSARY

1) **Stem Cells:** a class of undifferentiated cells that have the remarkable potential to develop into many different cell types. These stem cells are found in tissues such as the brain, bone marrow, blood, blood vessels, skeletal muscles, skin, and the liver. They serve as a sort of internal repair system, dividing essentially without limit to replenish other cells. Each new cell has the potential either to remain a stem cell or become another type of cell with a more specialized function. Under certain physiologic or experimental conditions, they can be induced to become tissue- or organ-specific cells with special functions.

2) **Scaffold:** a structure capable of supporting three-dimensional tissue formation where cells are often implanted or 'seeded'.

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# The Social Network



By: Maissa Azab and Ingy Hafez



# Network



# the Future

How often do you hear the expression "Google it"? How often do you "friend" people on Facebook or "Like" a post they have shared? How often have you "Tweeted" something you find really interesting? How many times do you go to YouTube to watch a video? If all of these things are familiar to you, then welcome to what has been called "The Social Network".

It is very surprising to realize how much social media has changed our world in a short period of time. About ten years ago, we used to go crazy about adding people to our cell phone's speed dial, composing ringtones, and having an email address. Today, one person may see you on Facebook, Twitter, Google+, LinkedIn, RSS feeds, and so much more.

### A Whole New World

As social media becomes increasingly present in our daily lives, a major cultural shift is underway. Through the power of relationships and sharing of experiences, previously ignored voices are becoming more and more heard like never before. These phenomena represent parts of a greater whole; a shift in power from specific individuals to whom they represent.

It is the evolution of democracy through technology, allowing individuals to become news generators by capturing events in images, text and video as they occur. However, to every action there is an equal opposite reaction, Newton said. Along with the wave of news, comes a mix of opinions that need to be rationalised and acted upon.

The use of this networking channel has been seen lately in social campaigns, news, business, as well as social demonstrations and public protest. In previous years, a revolution as large as the Egyptian one would have required a lot of planning, resources and communication to be able to lead such a large number of individuals to publicly demonstrate for a given cause. Nowadays, it has become much easier to influence people using such technology.

### When did it All Begin?

From a talk by Mark Suster at the Caltech / MIT Enterprise Forum on "the Future of Social Networking"

"Listening to young people talk about social networking as a new phenomenon is a bit like hearing people talk about a remake of a famous song from my youth as though it was the original version.

Yes, I was doing it when I was a teenager and yes, it was online, too. We were on services called CompuServe and Prodigy; other people were in the online community called "The Well", founded in 1985. We connected for the same reasons you do today; we were looking for what I call the 6 C's of Social Networking: communications, connectedness, common experiences, content, commerce & cool experiences (fun!). There were chat rooms, discussion groups, dating, classified ads—you name it. We had email, instant messaging, group calendars, discussion boards, etc. It is not new stuff; it just works better now and there are more people doing it.

Then there was AOL, which preceded the www. It was an online community like CompuServe and eventually started offering people dial-up access to the Internet for a monthly fee.

The funny thing about AOL is that while you dialed up to the Internet, the goal of AOL was to keep you locked into their proprietary content and thus earned the classification "walled garden". They had a proprietary browser, their own search engine, their own content, chat rooms, email system, etc.

AOL was controlled by one company, while the Internet was distributed. AOL controlled the services, taxed companies to access users and decided what was good or bad; it was closed, while the Internet was open. But AOL brought online services, email, chat and discussion boards to the masses and thus educated a generation that paved the way for others.

By the mid-1990s, we had the World Wide Web, which gave us a

standard way to publish web pages using HTML.

People still wanted to accomplish on the world wide web all of things that we did in the pre-Internet world; companies like GeoCities & Tripod built tools that let us publish web pages that could be discoverable by others.

Yes, social networks of today have much better usability, have better developed third-party platforms and many more people are connected. But let us be honest; they are mostly the same old stuff, reinvented, with more people online and trained."

### Down to Business

Hosting hundreds of millions of users worldwide, the web provides a space to share information, get questions answered and, most importantly, communicate. While social networking sites were originally developed for people to communicate with friends and make new ones, businesses have figured out how to jump into the game.

Given the great potential in this kind of networking, businesses are generating new contacts and channels of direct communication between themselves and the customer. Through these channels, they can have direct feedback and ideas, and let their customers know that they are genuinely interested in them, which is a key method for establishing strong customer relationships.

This is how the customer becomes engaged and connected to the business. Moreover, by establishing these connections with social networking users, businesses are able to connect with the users' connections, widening their circle of fans, which is called the ripple effect that spreads further and further as more users connect.

### So, What is the Future of The Social Network?

Naturally, to find the answer to this question, where else would we go but the World Wide Web? Browsing the

internet, we found some interesting forecasts.

Human relationships will no longer be physically dependent; we will befriend and hang out with people from all over the world and all walks of life, creating a worldwide melting pot.

Consumer brands can now build social commerce stores where Facebook users, all 700 Million of them, can purchase products on their favourite social network without needing to go to any destination site. Facebook will become one of the major channels of future online shopping.

Facebook, Twitter and other major social networks will become increasingly what Fred Wilson coins "Social Dashboards". In essence, Facebook and Twitter are social channels on which other companies can grow and develop their own technologies and businesses; both Facebook and Twitter have created economies far larger than many nations.





Social networking sites provide many opportunities for businesses to market their products. Companies can review people's likes, interests and needs. They can also use this information to determine how their fans fit into their marketing targets, making them able to determine interesting ways to advertise their products.

Soon in an age of Web 3.0, an age of Semantic Web\*, we will no longer need to search for information on the Web as information will find us based on the data companies are collecting. The right information will be served to the right people at the right time, saving us all a lot of time, effort and energy.

Whether it be the way that we get from point A to point B (Waze), the way that we find answers to our questions (Quora), the manner in which we test our Websites (uTest), the way that we get things done (Fiverr), or the way that we share information (Wikipedia); services will become increasingly crowd-sourced.

Crowd-sourcing starts with decentralization by sourcing tasks traditionally performed by specific individuals to a group of people or community (crowd) through an open call. In this way it is different from sites such as Twitter or Facebook, which do not have open call for contributions.

Jeff Howe established that the concept of crowd-sourcing depends essentially on the fact that because it is an open call to a group of people, it gathers those who are most fit to perform tasks, solve complex problems, and contribute with the most relevant and fresh ideas.

### The Experts Take

"The future of social media is moving from passively sitting back and watching what other people are doing to actively becoming more engaged and interesting through new social applications that encourage people to think bigger, then learn and act together."—Gina Bianchini, Founder & CEO of Mightybell, Co-Founder of Ning, the self-proclaimed World's Largest Platform for Creating Social Websites.

"Social media will be the main engine of discovery, giving us the ability to find the signal within the noise. As people's networks and interactions expand, massive data sets will generate predictive models that will know what you want before you look for it."—Chad Hurley, CEO of Delicious, co-founder of YouTube.

"The future of social media is far beyond a new Facebook layout or just wishing for more 'likes' on your Facebook page, it could be how business processes become more efficient, or how our regular devices are able to connect and interact meaningfully with each other.

For example, a refrigerator should be able to tweet to the manufacturer once a fault is detected while under warranty or automatically order new groceries. Based on the food in your fridge, your refrigerator should automatically 'like' the pages on your behalf and sign you up for free coupons on further purchases."—Jide Rotilu, Technology Strategist; Web Developer and Comedy Writer.

"The future of social media is already here. It is about sharing, curation, aggregation and finding new voices. Everyone wants to publish if they are given the right platform to create it. I believe that sharing horizontally might have peaked; Facebook and Twitter seem to be the 800 pound gorilla's, but the vertical social space is about to explode. That might not be as exciting for valuations in start-up land but it will mean better business models and a move on to other areas for swarming angel investors and venture capitalists. That would be a good thing."—Howard Lindzon, Startup Investor & Co-Founder of StockTwits.

"The future of social media is **ubiquitous**; it will be baked into everything we use, from desktop software, to mobile phones and the web, to the thermostat and phone in our hotel room.

It is **monolithic**; while the web and its low barrier to entry will continue to enable the creation of small diverse

communities, and while small teams will continue to create wonderful social niche products, eventually (and fairly soon) two or three services/brands will come out on top and will be the channels through which 90% of social commerce takes place. We can all guess which three services these will be—the pieces are already in motion—but it is still early enough that we might be surprised.

It is **smarter**, becoming more seamlessly integrated into traditionally 'private' activities, such as banking and shopping; but it is still new enough, poorly integrated enough, and riddled with sufficient usability problems to currently be a niche or vanguard activity (i.e. done by web and social media geeks, not the public at large). That will change; it will change faster if leading stores, banks, and so on work with real design and UX teams to integrate social experiences in ways that enhance the overall shopping/banking experience.

It is **invisible**; the phrase 'social media', already used only by a small subsection of the public (tech journalists, consultants, investors, unemployed designers) will fall into complete disuse as social media becomes smarter, monolithic, and ubiquitous—the background noise of all our lives, as little noticed as the electrical hum in our homes."—Jeffrey Zeldman, Designer, Writer and Publisher

Regardless of how we choose to use social media, the simple fact of the matter is that it is a whole new language and form of communication that is becoming an essential and primary element in our lives.

Today's world is no longer a global village, the world is your room. Social media has helped in making the world turn into this imaginary room with more friends you would never remember.

However, its future lies not in the size of this room, but in how it can be coupled with emerging future technologies. Social media is fast becoming the de facto standard in which we relate with the world; everything needs to be more social or its future relevance comes into question.

### Glossary

**The Semantic Web** is a collaborative movement led by the World Wide Web Consortium (W3C) that promotes common formats for data on the World Wide Web. By encouraging the inclusion of semantic content in web pages, the Semantic Web aims at converting the current web of unstructured documents into a 'web of data'.

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Adapted from a feature by Paul Davies, Theoretical Physicist, Scientific American

By: Maissa Azab & Ingy Hafez

For decades, time travel has been beyond the border of respectable science; but it has been a popular science-fiction theme since the novel *The Time Machine* by H. G. Wells was published in 1895. In recent years, however, the topic has become appealing among theoretical physicists. With the motivation being partly recreational, time travel is truly interesting and fun to think about. However, this research has a serious side as well.

#### Does Time Really Flow?

Our senses tell us that time flows; that the past is fixed, the future undetermined, and reality lives in the present. Physical and philosophical arguments suggest otherwise. "The past, present and future are only illusions, even if stubborn ones," was Albert Einstein's startling conclusion that stems from his special theory of relativity, which denies any absolute, universal significance to the present moment.

According to the theory, simultaneity is relative. Two events that occur at the same moment if observed from one reference frame may occur at different moments if viewed from another. For example, Earth and Mars are up to about 20 light-minutes apart; because information cannot travel faster than light, an Earth-based observer is unable to know the situation on Mars at the same instant but after light has had a chance to pass between the planets.

The inferred past event will be different depending on the observer's velocity. For example, during a future manned expedition to Mars, mission controllers back on Earth might say "I wonder what Commander Jones is doing at Alpha Base now." Looking at their clock and seeing that it was 12:00 pm on Mars, their answer might be "eating lunch". But an astronaut zooming past Earth at near the speed of light at the same moment could, on looking at his clock, say that the time on Mars was earlier or later than 12:00, depending on his direction of motion.

Such mismatches make a mockery of any attempt to confer special status on the present moment, for whose "now" does that moment refer to? If you and I were in relative motion, an event that I might judge to be in the as yet undecided future might for you already exist in the fixed past.

The most straightforward conclusion is that both past and future are fixed. For this reason, physicists prefer to think of time as laid out in its entirety—a timescape, analogous to a landscape—with all past and future events located there together. Most physicists would put it this way: the flow of time is unreal, but time itself is as real as space.

However, to deny that time flows is not to claim that the designations "past" and "future" are without physical basis; events in the world undeniably form a unidirectional sequence. For instance, an egg dropped on the floor will smash into pieces, whereas the reverse process—a broken egg spontaneously assembling itself into an intact egg—is never witnessed. The labels "past" and "future" may legitimately be applied to temporal directions,

just as "up" and "down" may be applied to special directions, but talk of the past and the future is as meaningless as referring to the up or the down.

Given that most physical and philosophical analyses of time fail to uncover any sign of a temporal flow, we are left with something of a mystery. Some researchers have suggested that the subtle physics of irreversible processes make the flow of time an objective aspect of the world. Paul Davies and others argue that it is some sort of illusion.

#### Does This Mean Time Travel is Possible?

Understanding the relation between cause and effect may be the key to construct a unified theory of physics; but can this theory turn into reality? Is it really possible to build a machine that would show us the way forward or backward?

Building a time machine would likely be difficult, requiring technology that does not currently exist. But you can see the concept of time travel in Einstein's theory of relativity. Theoretically, traveling forward in time is easy enough. If you move close to the speed of light or sit in a strong gravitational field, you experience time more slowly than other people do; another way of saying that you travel into their future. On the other hand, traveling into the past is rather trickier.

#### Fast Forward

In his special theory of relativity, Einstein proposed that the measured interval between two events depends on how the observer is moving. Crucially, two observers who move differently will experience different durations between the same two events.

The effect is often described using the "twin paradox". Suppose that Sally and Sam are twins. Sally boards a spaceship and travels at a high speed to a nearby star, turns around and flies back to Earth, while Sam stays at home. For Sally, the duration of the journey might be one year; but, when she returns, she finds that ten years elapsed on Earth and her brother is now nine years older than she is despite the fact that they were born on the same day. This example illustrates a limited type of time travel; Sally has leaped nine years into the Earth's future.

In daily life, we do not notice weird time warps because the effect becomes dramatic only when the motion occurs at close to the speed of light. Even at aircraft speeds, the time dilation, aka jet lag, in a typical journey amounts to just a few nanoseconds. Nevertheless, atomic clocks<sup>(1)</sup> are accurate enough to record the shift and confirm that time really is stretched by motion. So travel into the future is a proved fact, even if it has so far been in rather unexciting amounts.

To observe really dramatic time warps, one has to look beyond the realm of ordinary experience. Subatomic particles can be propelled at nearly the speed of light in large accelerator machines. Some of these particles, such as muons<sup>(2)</sup>, have a built-in clock because they decay with a definite half-life<sup>(3)</sup>; in accordance with Einstein's theory, fast-moving muons inside accelerators are observed to decay in slow motion.

Some cosmic rays also experience spectacular time warps. These particles move so close to the speed of light that, from their point of view, they cross the galaxy in minutes, even though in Earth's frame of reference they seem to take tens of thousands of years. If time dilation did not occur, those particles would never make it here.

Speed is one way to jump ahead in time; gravity is another. Einstein's relativity theory showed that time can be influenced; not necessarily meaning it can make you travel through it, but rather predicts that time runs more slowly in strong gravity. Being closer to the ground, you are in stronger gravity, which means you grow old more slowly living in a bungalow than in a skyscraper. Interesting!

Similarly, clocks run faster in space than on the ground. Again, the effect is minuscule, but it has been measured using accurate clocks. Indeed, these time-warping effects have to be taken into account in the Global Positioning System. If they were not, sailors, taxi drivers and cruise missiles could find themselves many kilometers off course.

A black hole represents the ultimate time warp; at the surface of the hole, time stands still relative to Earth. This means that if you fell into a black hole from nearby, in the brief interval it took you to reach the surface, all of eternity would pass by in the wider space. The region within the black hole is therefore beyond the end of time as far as the outside universe is concerned.



### Backwards, Replay

Going backwards in time is problematic. In 1948, Kurt Gödel of the Institute of Advanced Study, Princeton, produced a solution for Einstein's gravitational field equations that described a rotating universe. In this universe, an astronaut could travel through space so as to reach his own past, which comes about because of the way gravity affects light. The rotation of the universe would drag light and thus the causal relations between objects around with it, enabling a material object to travel in a closed loop in space that is also a closed loop in time, without at any stage exceeding the speed of light.

This result served to demonstrate that going back in time was not forbidden by the theory of relativity. Other similar scenarios have been found to permit travel into the past. Indeed, Einstein confessed he was troubled by the thought that his theory might permit travel into the past under some circumstances.

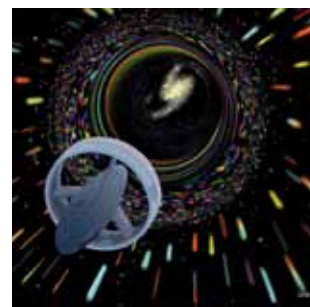
### The Time Machine

In the mid-1980s, the most realistic scenario for a time machine emerged based on the concept of a wormhole, which is a kind of a tunnel or a shortcut through space and time. It would resemble a black hole in being an object of fearsome gravity; but, unlike a black hole, which offers a one-way journey to nowhere, a wormhole would have an exit as well as an entrance. However, we cannot just build a wormhole wherever we want; we have to start with an existing one, which is not as easy as it sounds.

Large wormholes might exist naturally in deep space, a relic of the big bang<sup>(4)</sup>. Otherwise, we would have to make do with subatomic wormholes, whether natural, which are thought to be winking in and out of existence all around, or artificial, produced by accelerators. These smaller wormholes would have to be enlarged to useful size, perhaps using energy fields like those that caused space to inflate shortly after the big bang.

Should such a wormhole be created, it would have to be stabilized using an infusion of negative energy<sup>(5)</sup> to counteract the tendency of the wormhole to pinch off into a point of infinite or near-infinite density; that is, to prevent it from becoming a black hole.

Finally, if a stable wormhole could be created, a spaceship, presumably of highly advanced technology, would be required to separate the mouths of the wormhole, towing one mouth near the surface of a neutron star, an extremely dense star with a strong gravitational field. The intense gravity causes time to pass more slowly; because time passes more quickly at the other mouth, the two mouths become separated not only in space but also in time.



### To Time Travel, or Not

If time travelling is possible according to the relativity theory, and assuming that the engineering problems could be overcome, the time machine could open up a Pandora's box<sup>(6)</sup> of causal paradoxes; such paradoxes where there is no such thing as a logical explanation.

Let us assume that time travelling is possible. A time traveler goes back in time, at least one year before the birth of his parents. There, he kills his biological grandma, which means that he was never born and he could never return to kill his biological grandma. This is a paradox because the present is determined by the past; changing the past means you change the present.

But what if time travel does not change the past, but rather completes it. For example, a time traveler goes back and rescues a young girl from murder; this girl grows up to become his mother. The causal loop is now self-consistent and no longer paradoxical; it has created the right circumstances to produce the present, from which the time traveler came. The return in time has completed the past, and the present, the journey was already written in the past.

Nevertheless, even if time travel is not strictly paradoxical, it is certainly weird. Consider the time traveler who leaps ahead a year and reads about a new theorem; he returns to his time and teaches it to a student who then writes it up and it gets published. The article is the very one the time traveler had previously read; the question then would be: where did the information come from? Not from the time traveler, who only read it, and not from the student either, who learned it from the time traveler. The information seemingly came into existence from nowhere!

It seems that the relativity of time has helped us with certain problems; but on the other hand, created even more problems. Can time traveling be achieved in the future; and if so, how would it be regulated? Too many questions and dilemmas arise from the mere thought of it. However, we might find solace in what Stephen Hawking, British theoretical physicist and cosmologist, once said: "If time travelling will [one day] be possible, why haven't we seen a lot of tourists from the future yet?"

### Glossary

(1) **Atomic clocks** are the most accurate time and frequency standards known. The principle of operation of an atomic clock is based on atomic physics and using the microwave signal that electrons in atoms emit when they change energy levels.

(2) **Muons** are elementary particles similar to the electron, with a unitary negative electric charge; they are classified as leptons. As such, the muon is not believed to have any sub-structure at all; i.e. is not thought to be composed of any simpler particles.

(3) **Half-life**, abbreviated  $t_{1/2}$ , is the period of time it takes for the amount of a substance undergoing decay to decrease by half. The name was originally used to describe a characteristic of unstable atoms (radioactive decay), but it may apply to any quantity which follows a set-rate decay.

(4) **The Big Bang** theory is the prevailing cosmological model that explains the early development of the Universe. According to it, the Universe was once in an extremely hot and dense state, which expanded rapidly. This rapid expansion caused the young Universe to cool and resulted in its present continuously expanding state.

(5) **Negative energy/mass**, aka exotic matter, would possess some strange properties, such as accelerating in the direction opposite of applied force. For example, an object with negative inertial mass and positive electric charge would accelerate away from objects with negative charge, and towards objects with positive charge, the opposite of the normal rule that like charges repel and opposite charges attract. Despite being completely inconsistent with a common-sense approach and the expected behavior of "normal" matter, negative mass is completely mathematically consistent and introduces no violation of conservation of momentum or energy.

(6) **Pandora's Box** is an artifact in Greek mythology; the "box" was actually a large jar given to Pandora, whose name means "all-gifted", which contained all the evils of the world. The contents of the jar escaped when Pandora opened it, leaving behind hope. Today, to open Pandora's box means to create evil that cannot be undone.

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# BACK TO THE FUTURE

We are always fascinated by the future and how life would be like in 50, 70 or a 100 years; we have been haunted by the idea since childhood. When it comes to the future, we always think of robots and the possibility of traveling to space.

In this feature, I have browsed the Internet to find possible newspaper headlines of the future; which news would be on the front page?

## Another Great Year for Wind Power

18 December 2020 - This year shows strong growth for wind power when the total global installed capacity<sup>(1)</sup> added a record (62,000 MW), making the total capacity more than 680,000 MW. Wind power is by far the renewable source with the largest growth in worldwide capacity during the last decade.

The US was quite slow adopting wind power compared to many European countries; but, it passed Germany, which was the biggest producer of wind power in the world in 2008, then China passed the US in 2010. The US now has a capacity of 141,000 MW compared to 92,000 MW for Germany. China was the country with the strongest growth related to the total capacity, adding another 20% with 154,000 MW installed.

The US is behind Europe, though, when it comes to wind power as part of the total electricity demand, serving only 6%, compared to 12.7% for Europe. With 40%, Denmark is still the country with the highest share of wind energy, most likely reaching 50% within the next five years. Even though wind power as a renewable resource has its environmental advantages, the increasing demand for wind power is related to the low cost for the energy output, pressed down with more efficient and larger wind turbines, and the maturity of the market.

The trend of wind energy in the last decade has been towards more offshore sites. In Europe, offshore now counts for about 11% of all wind power capacity, compared to less than 2% fifteen years ago. The already projected wind farms give a forecast of about 50% of the total European capacity to be offshore by 2030.



## A Million Hydrogen-Fueled Cars in the Market Now



19 January 2035 - According to the latest statistics presented this week, 1 million hydrogen-fueled cars have now been sold. The figures for last year show an increase in sales by 50% from 2033.

The hydrogen fleet is still dominated by hydrogen-hybrids even though several fuel cell models have been introduced in the market during the last couple of years. The price for a

hydrogen-hybrid is still about 20% higher than it is for a regular gasoline-hybrid, which makes it more expensive to own and drive. The reason for the sale increase is more related to the hydrogen hype for environmental purposes, although mainly all hydrogen is produced from fossil fuels, like natural gas.

The latest environmental effort is the introduction of the Re-Hydro label last year to stimulate the production of hydrogen produced through electrolysis, based on a source of 100% renewable energy. The production is still quite limited and it is only available at selected stations. The current price is about 10% over the regular price for hydrogen, and will most likely not have a major impact until more producers switch from regular production to Re-Hydro.

The transition to hydrogen in the US is moving slowly compared to a country like Iceland where 80% of the car fleet already runs on hydrogen. They are planning to set a date for when to shut down the last gasoline pump in Iceland, and it looks like it will be around the year 2040. When that day arrives in the US, it will mean a lot to the global environment.

## Reality Check

Onshore wind power is in a good place, at least through the end of 2012. Wind power has made up 35% of all new generating capacity added to the US grid since 2007, which is twice what coal and nuclear resources combined have added in the last five years, according to the American Wind Energy Association (AWEA).

As US developers take advantage of federal tax credits for renewables through the end of 2012, it is possible that 2012 may result in the largest number of wind projects completed in one year.

As of the end of the third quarter of 2011, 8,440 megawatts (MW) of wind power capacity are under construction in the US and installed wind power capacity stands at 3,360 MW, which exceeds installations up to the same point in 2010 by 75%.

## Reality Check

The car of the future is here today. It does not use gasoline and it does not pollute the air; in fact, it produces steam instead of exhaust. What is its mystery fuel? Hydrogen: the simplest and most abundant element in the universe. Some people think that, in 20 to 30 years, we will all be driving these hydrogen-powered, fuel-efficient vehicles.

Actually, the technology for using hydrogen to generate power has been around since the early 19<sup>th</sup> century, which is longer than cars have been around. What is new is that you might actually see a hydrogen-powered car on the road, with steam coming out of its exhaust pipe instead of foul-smelling gases. Several hydrogen cars are now in existence, but most of them are concept cars. These eco-friendly driving machines include the Chevrolet Equinox, the BMW 745h and the one that is currently available for lease in California, the Honda FCX.



### Can the Paralyzed Walk?

5 September 2035 - More than 20,000 quadriplegics around the world have now got a BCI, a Brain Computer Interface. It gives them the ability to control their environment, from driving their own electric wheelchairs outside their house, to making their own dinner.

The BCI consists of an internal sensor to detect brain cell activity and external processors that convert these brain signals into a computer-mediated output under the person's own control. The sensor is implanted on the surface of the area of the brain responsible for movement, the motor cortex, and is then wirelessly connected to a computer. The first successful implanted BMI, Brain Machine Interface, was through BrainGate<sup>(2)</sup> more than 30 years ago, which then gave the patient the ability to move a cursor on a screen and play a simple computer game.

BCI is mainly for people with severe motor impairments from spinal cord injury, ALS (Amyotrophic Lateral Sclerosis), or other motor neuron diseases. Steve Nelson from Hoboken, New Jersey, has had his BCI for 3 years: "It definitely changed my life, after being completely stuck in my chair for years. We have connected everything in my apartment to the software that I control with my mind. I can even go out of my apartment, take the elevator down and go for a tour downtown, without anyone assisting me. With the robotic hand at my chair I can open the freezer, take out the food I want, and cook it myself." However, how well this works, of course, differs from one individual to another.

The development of BCI software and the experience of the increasing number of users now gives hope that legs and arms can be activated by thought only. Tests are currently made on people with BCI and, if the result is positive, a solution can be on the market in the near future.



### Reality Check

Scientists at Duke University are working on brain implants that could lead to a full body suit that would let the paralyzed walk again. Lead researcher Professor Miguel Nicolelis and his team showcased their work by demonstrating it with two rhesus monkeys that had electrodes implanted in their brains. The monkeys were able to manipulate an electric hand using brain power alone.

The team's objective is for paraplegics "not only to move their arms and hands and to walk again, but also to sense the texture of objects placed in their hands, or experience the nuances of the terrain on which they stroll with the help of a wearable robotic exoskeleton". The experiment showed that the team was able to provide the sensation of touch directly to the monkeys' brains. The monkeys were able to distinguish between different objects by sensing their different textures, but only through the sensations in their brains.

### First Tourist Heading for Mars

21 September 2050 - At a press conference today, it was announced that the first tourist heading for Mars will be the 38-year-old US businessman Patrick Clifford. He will leave Earth in the launching window<sup>(3)</sup> of June 2052, and set his foot on the surface of Mars in November, together with the other six astronauts assigned for the mission to further explore the planet.

Patrick has now two years of training ahead of him to get ready for the trip. Not only will he spend five months in getting to Mars, but another 600 days there before he can go back home. Patrick was, of course, very excited: "This has been my dream since I was four; seeing the first man on Mars 20 years ago made me realize it was possible".

To be able to pay the USD 1.3 billion for his ticket for the trip, Patrick sold his majority stake in the business empire his father had built. "I know that my father would have been proud of me if he had been alive today, he knew what this means to me", says Patrick. There is no risk, though, that you will find Patrick begging in your street corner when he comes back, rumors says that he was paid twice as much for his part of the company.

So, how is he going to spend his 600 days on the red planet? "Well, since I do not have a job when I get back after selling the company, I have plenty of time to come up with a new business idea," he says laughingly. If he brings a shovel, he can start building the first hotel there, but maybe he should not expect too many guests until someone can offer a lower transfer fare.

### Reality Check

Space Tourism took a few small steps forward with announcements that billionaire Richard Branson's company Virgin Galactic was set to launch well-heeled joy riders into space within 18 months, that a partnership between Boeing and Virginia-based Space Adventures plans to sell tickets on rocket rides to the International Space Station, and that a group of Russian companies wants to build the first orbiting hotel.

Since Branson created Virgin Galactic in 2005, the British entrepreneur has collected USD 45 million in deposits from more than 340 people who have reserved seats aboard a six-person, suborbital craft - at USD 200,000 apiece.

Space Adventures says it hopes to establish a space taxi system that would launch passengers into low Earth orbit by 2015. The company has already sent seven private space travelers to the space station on Russian Soyuz capsules, including Cirque du Soleil founder Guy Laliberté, who paid close to USD 40 million for an 8-day stay.

And while details and timing are sketchy, notes Tnooz.com, a commercial space station could offer short, hotel-style stays between three and fourteen days, with an opportunity for such "extra-vehicular activities" as space walks.



But what if you do not have a spare 200 grand, let alone USD 40 million, to blow on a trip to infinity and beyond? While making like Buzz Lightyear is not cheap, plenty of companies offer more down-to-earth options. This is just an imagination of how life will look like in the future. We may now think that this is only fiction and that we will never witness such things; but, we must remind ourselves that mobile phones and laptops were one day an imagination and fiction, and now they are essential items in our life. It is, therefore, not all that farfetched that, one day, these luxuries and advances would also become a reality; so let us dream big and work hard so that our dreams would one day come true.

### Glossary

- (1) **Global Installed Capacity:** the maximum capacity at which an Eligible Installation could be operated for a sustained period without causing damage to it, assuming the Eligible Low-carbon Energy Source was available to it without interruption.
- (2) **BrainGate:** a privately-held firm focused on the advancement of the BrainGate™ Neural Interface System. The goal of the Company is to create technology that will allow severely disabled individuals to communicate and control common every-day functions literally through thought.
- (3) **Launch window:** a term used in spaceflight to describe a time period in which a particular launch vehicle (rocket, Space Shuttle, etc.) must be launched.

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Hey girls,  
did you see my new smart  
glasses? I can browse the internet  
and read e-books when I turn  
them on :)

Really? Where did you get  
them? I would love to get one;  
but, I cannot get my car to fly  
these days so I cannot go  
anywhere until I get it fixed :(

Ohhh girls,  
forget it. Did you  
see this new stem-cell cream  
I had shipped from planet  
"Kepler 22b"? It regenerates the  
skin so that it stays  
young and firm :)

Maha!  
This cream is nothing, my  
doctor at the "Planet GJ 667Cc" clinic  
called me yesterday and told me that,  
according to my DNA records, I am about  
to fall ill if I did not take the medicine  
he had made especially for me.

How convenient? But, did  
you see my nanophone?!  
Guess you cannot; it is  
embedded in my earrings  
:)

Wow!!!  
I have not noticed it at all; it is  
so cool. Would you like some  
breakfast capsules? They are very  
delicious, you should try them; I have  
cereal, waffle and oatmeal  
flavors.

Sorry  
girls, I am late but the  
aero-taxi faced some storms in  
the way from London;  
it took one hour instead of  
30 minutes :(

Enough  
chatting girls; now  
that Ingy is here, we have to  
focus on our meeting. Today, we  
have a serious issue to discuss; we are  
invited to attend a training on Mars  
and we have to prepare for it  
:)



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Editorial Team:

Maissa Azab  
Head, Educational Publications Unit

Shahenda Ayman  
Sara Khattab  
Educational Publications Specialists

Ingy Hafez  
Lamia Ghoneim  
Noha Rahhal  
Jailane Salem

For more information and  
reservation, please contact:

PSC Administrator

psc@bibalex.org

TEL: +203 4839999

EXT: 2350, 2351

FAX: +203 4820464



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Illustrations: Maha Sherin