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In this edition...

POWER: The Gift and the Crisis

By: Maissa Azab

You might be reading this editorial in October 2013 or later; it is in fact being written in August 2013, near the end of the holy month of Ramadan. A few days ago, I had my friends over for breaking the fast; less than an hour before Maghreb, a few minutes before the guests started to arrive the power went out in my building.

Ironically, having breakfast on the dim torchlight, it was one of the best gatherings I have had with friends in quite some time! Why? Because there was no TV, Wi-Fi, or enough mobile batteries to distract us from enjoying each other's company! This experience got me thinking about this issue we are working on; here, I would like to invite you to read Jailane Salem's feature "Off the Grid", page 14.

In today's world, especially in our country, in this day and time, we are bombarded by a fast-growing technology that is both bliss and burden. All these technologies rely primarily on one brilliant, world-changing discovery: electricity.

Electricity is now part of a series of challenging global crisis; the struggle to find alternative, renewable energy sources, the environmental and climatic predicaments of fossil fuel usage, as well as the production and use of modern-day technologies.

In this issue, we discuss different aspects of power: cosmic powers, the discovery and harnessing of electricity, a variety of potential alternative energy sources, the dam dilemma of electricity versus water, as well as a variety of small-scale power production solutions. We also branch out to discuss the power of the human body and the human mind.

As usual, we wish you a joyful reading experience and look forward to your comments and suggestions on our email: PSCeditors@bibalex.org.

FUTURE OF ENERGY IN EGYPT AND THE WORLD

By: Dr. Eng. Hani El Nokraschy

If the world—Egypt being part of it—maintains its current methods for producing electricity through burning fossil fuels and nuclear fission, it will run out of both within sixty years and deteriorate back to the Stone Age. Would this be the end of Egyptians, the makers of history?

Energy production comes second in priority to securing water and food for humans, as it is the primary engine of development. What is the use of development if it is only temporary, after which we would fall into an abyss?

Waiting until fossil and fission fuels are mostly depleted will lead to fierce conflict over getting them, and they will not be feasibly affordable; thus, hindering development. Thus, it is wise to immediately start planning for the post-oil-age, noting that our plans should be sustainable so as to allow for counting on them as long as Man lives on Earth. This is only achievable through relying on renewable energy resources.

If we look at the renewable energy sources available in Egypt, we will find that solar power—especially in Upper Egypt—is so abundant that it can meet the needs of not only Egypt, but the whole world as well, now and in the future.

The success of such plans primarily depends on adopting the proper technology to achieve them. There are two technologies to utilize solar power in generating electricity; the first is using solar cells that directly convert sunlight to electricity. However, this technology does not allow for storing the electricity produced during daytime for use at night.

The second technology is using mirrors to focus solar rays in order to reach high temperatures that allow evaporation. This technology fulfills the purpose of most power generation stations that use boilers around the world. The other advantage of this technology is that it allows for thermal storage at a cost 100 times cheaper than electricity storage. Egypt's qualitative trait is the feasibility of focusing direct solar rays it receives to apply this technology.

Thermal storage solar power stations would allow Egypt to stop importing fuels for electricity production, and will obviate the need for nuclear power stations as they are as efficient, yet are faster to build and operate. Moreover, these stations do not leave hazardous pollutants behind, their costs decreases as production increases, and their parts are manufactured locally, hence creating job opportunities.

Building small typical stations makes it easier to raise funds and increase their numbers. Moreover, building these stations near communities and along power lines decreases electricity loads and the transport loss, especially that it does not necessitate a near watercourse for cooling as a typical station is cooled using air. If the station is built near the sea, the thermal wastes could be utilized in water desalination.

If we adopt this policy, not only will Egypt move to the top solar electricity exporting countries, but it will also be an exporter of expertise and equipment needed for these power plants, mainly because it owns the needed tools for development; smart, hardworking people, and a non-depleting energy source.

It is also unquestionable that desalination of sea water is our sole way to secure water and food. The decreasing Nile water is forcing us to decrease the amounts used in irrigation. Consequently, agricultural drainage decreases leading to increasing soil salinity; hence ruining it for the generations to come, as already happened in other places.

In conclusion, looking back at the Egyptian history dating 7000 years back, and at the oldest 5000-years nation on Earth that kept giving generously all over these years, we should wonder whether we have the right to ruin this giving land we inherited sound enough to lead a decent life.

For all these reasons, it is inevitable that we include an article about sustainability in the Egyptian Constitution stating: "Maintaining the resources of the State through applying sustainability in agriculture, energy production, and other societal necessities in order to secure the environment for future generations".

Dear Reader, I am going to let you in on a science communicator's secret. Although we often start writing with a specific topic or angle in our head and then try to find a suitable title for what we write, sometimes, it is the title from which we begin.

This is usually the case when the overarching theme the Editorial Team is tackling seems at first sight to be distant from the section we are writing for. This here would be a case in point; I mean, who would think that, other than what we already know about solar power, space could be connected to power, or energy, on Earth?

My first instinct was thus to look into the subject of "Cosmic Powers" or "Cosmic Energy" in a more generalized sense, which is not as easy as you might think. To begin with, the first thing that pops up when you search for these terms is a myriad of articles on a variety of issues that range from religion and philosophy to literature, music, and more importantly, game applications!

Nevertheless, where there is a will, there is a way. I eventually succeeded in finding out that, in scientific reality, there are several forms of cosmic energy; most prominently, cosmic radiation, or cosmic rays for short (for more on that, check out the ASTRO-GEEK column). There is also the Sun's light at various wavelengths—optical, infrared, UV, gamma rays—as well as star light.

Moreover, there are energetic, electrically charged particles from many sources including the Sun, other stars and stellar explosions, the solar wind that fills the space between the planets, and the interaction of the wind with the interstellar material.

If we add all the energetic charged particles originating at the Sun and stellar explosions, we find that the energy striking the Earth is about 5 joules/sec/km^2 (where 1 joule/sec = 1 watt). That means that if you collect all the energy of cosmic rays over 12 km^2, you would have enough energy to power a 60 watt light bulb! When a strong solar eruption occurs, this number can increase by about 20% for perhaps as long as 10 hours, but this burst of activity is short lived.

There are other sources of energy input, but they are all small: stellar light, the solar wind plasma, gamma rays from astrophysical objects, etc.

This means that sunlight is still our best chance for getting energy from space. The solar constant is 135.3 mwatts/cm^2, which corresponds to a radiant energy input of 1.4 gigawatts/km^2; that is, 1,400,000,000 watts/km^2 at noon near the Equator. Now this is enough energy to power a small city if we could convert it to something usable like electricity in an efficient manner!

That just about sums it up! Well, not really; space does in fact have so much more to offer us when it comes to energy and powering Earth.

People have been searching for clean alternative energy sources for decades. However, as soon as one source emerges, someone uncovers its fatal flaw. The Sun does not always penetrate the clouds; hydropower dams disrupt natural environments; winds are not consistent; and traditional nuclear fission is too risky.

Some researchers think the answer to our energy needs is in the stars. From wind turbines on Mars to helium-3 fusion, people are increasingly looking to extraterrestrial sources for the Earth's energy needs.

Can the Moon Light Up the Earth?

One of the sources being looked into is helium-3 to use in nuclear fusion reactions. As opposed to nuclear fission, which splits an atom's nucleus in half, nuclear fusion combines nuclei to produce energy. While nuclear fusion has already been tested with the hydrogen isotopes deuterium and tritium, those reactions give off the majority of their energy as radioactive neutrons, raising both safety and production concerns. Helium-3, on the other hand, is perfectly safe; it does not give off any pollution or radioactive waste and poses no danger to surrounding areas.

An isotope of the element helium, helium-3 has two protons but only one neutron. When it is heated to very high temperatures and combined with deuterium, the reaction releases incredible amounts of energy; just one kilogram of helium-3 combined with 0.67 kilograms of deuterium produces 19 megawatt-years of energy. Roughly 25 tons of the stuff could power the United States for an entire year.

The only problem is we do not have 25 tons of helium-3 just lying around. Conveniently though, the Moon does; in fact, scientists estimate our lunar rock contains more than one million tons of the element. The energy stored in that much helium is 10 times the amount of energy you would find in all the fossil fuels on Earth. If you put a cash value on it, helium-3 would be worth USD 4 billion per ton in terms of its energy equivalent in oil.

The only issues that remain are the practicalities of extracting the helium and fine-tuning the fusion process. Current fusion reactors have yet to achieve the sustained high temperatures needed to produce electricity, and helium-3 extracted from the lunar surface would require lots of refining since it exists in such low concentrations in the soil.

What about Solar Wind?

The solar wind streams off the Sun in all directions at speeds of about 400 km/s. The source of the solar wind is the Sun's hot corona, the temperature of which is so high that the Sun's gravity cannot hold on to it. Although we understand why this happens, we do not understand the details about how and where the coronal gases are accelerated to these high velocities.

The solar wind is not uniform. Although it is always directed away from the Sun, it changes speed and carries with it magnetic clouds, interacting regions where high speed wind catches up with slow speed wind, and composition variations.

The solar wind speed is high (800 km/s) over coronal holes and low (300 km/s) over streamers. These high and low speed streams interact with each other and alternately pass by the Earth as the Sun rotates. These wind speed variations strike the Earth's magnetic field and can produce storms in the Earth's magnetosphere.

Using data from an aging NASA spacecraft, researchers have recently found signs of an energy source in the solar wind that has caught the attention of fusion researchers. NASA will be able to test the theory later this decade when it sends a new probe into the Sun for a closer look. The discovery was made by a group of astronomers trying to solve a decades-old mystery: What heats and accelerates the solar wind?

Adam Szabo of the NASA Goddard Space Flight Center says that "As solar wind leaves the Sun, it accelerates, tripling in speed as it passes through the corona. Furthermore, something inside the solar wind continues to add heat even as it blows into the cold of space".

Finding that "something" has been a goal of researchers for decades. In the 1970s and 1980s, observations by two German/US Helios spacecraft set the stage for early theories; narrowing down the possibilities was a challenge. The answer, it turns out, has been hiding in a dataset from one of NASA's oldest active spacecraft, a solar probe named "Wind".

Launched in 1994, Wind is so old that it uses magnetic tapes similar to old-fashioned 8-track tapes to record and play back its data. Equipped with heavy shielding and double-redundant systems to safeguard against failure, the spacecraft was built to last.

Wind has survived almost two complete solar cycles and innumerable solar flares. "After all these years, Wind is still sending us excellent data," says Szabo, the mission's project scientist, "and it still has 60 years' worth of fuel left in its tanks".

Using Wind to unravel the mystery, Justin Kasper of the Harvard-Smithsonian Center for Astrophysics and his team processed the spacecraft's entire 19-year record of solar wind temperatures, magnetic field, and energy readings.

"I think we found it. The source of the heating in the solar wind is ion cyclotron waves," says Kasper. Ion cyclotron waves are made of protons that circle in wavelike-rhythms around the Sun's magnetic field. According to a theory developed by Phil Isenberg, University of New Hampshire, and expanded by Vitaly Galinsky and Valentin Shevchenko, UC San Diego, ion cyclotron waves emanate from the Sun; coursing through the solar wind, they heat the gas to millions of degrees and accelerate its flow to millions of miles per hour.

Kasper's findings confirm that ion cyclotron waves are indeed active, at least in the vicinity of Earth where the Wind probe operates. Ion cyclotron waves can do much more than heat and accelerate the solar wind, notes Kasper; "They also account for some of the wind's very strange properties."

Here on Earth, atmospheric winds carry nitrogen, oxygen, and water vapor along together; all species move with the same speed and they have the same temperature. The solar wind, however, is much stranger. Chemical elements of the solar wind such as hydrogen, helium, and heavier ions, blow at different speeds; they have different temperatures; and strangest of all, the temperatures change with direction.

"We have long wondered why heavier elements in the solar wind move faster and have higher temperatures than the lighter elements," says Kasper; "this is completely counterintuitive". The ion cyclotron theory explains it: Heavy ions resonate well with ion cyclotron waves. Compared to their lighter counterparts, they gain more energy and heat as they surf.

"When you look at fusion reactors on Earth, one of the big challenges is contamination," Kasper explains. "Heavy ions that sputter off the metal walls of the fusion chamber get into the plasma where the fusion takes place; the heavy ions radiate heat, which can cool the plasma so much that it shuts down the fusion reaction". Ion cyclotron waves of the type Kasper has found in the solar wind might provide a way to reverse this process.

Theoretically, ion cyclotron waves could be used to heat and/or remove the heavy ions, restoring thermal balance to the fusing plasma. The next step, agree Kasper and Szabo, is to find out if ion cyclotron waves work the same way deep inside the Sun's atmosphere where the solar wind begins its journey.

Solar Probe Plus, scheduled for launch in 2018, will plunge so far into the Sun's atmosphere that the Sun will appear as much as 23 times wider than it does in the skies of Earth. At closest approach, about 7 million km from the Sun's surface, Solar Probe Plus must withstand temperatures greater than 1400°C and survive blasts of radiation at levels not experienced by any previous spacecraft. The mission's goal is to sample the Sun's plasma and magnetic field at the very source of the solar wind.

"With Solar Probe Plus, we will be able to conduct specific tests of the ion cyclotron theory using sensors far more advanced than the ones on Wind," says Kasper; "this should give us a deeper understanding of the solar wind's energy".

Space Solar Power: The Ultimate Power!

Solar energy available in space is literally billions of times greater than we use today. As Earth receives only one part in 2.3 billion of the Sun's output, space solar power is by far the largest potential energy source available, dwarfing all others combined.

Solar energy is routinely used on nearly all spacecraft today; this technology on a larger scale, combined with already demonstrated wireless power transmission, can supply nearly all the electrical needs of our planet.

Although solar power is at our fingertips, there are benefits to outsourcing it beyond the stratosphere. Aside from the more obvious reason of avoiding the large land-use footprint presented by collections of solar panels, there is the fact that the Sun actually does shine brighter on the other side of the fence; in this case, eight times brighter.

Without obstacles such as rain, clouds, and nighttime, solar arrays based in space would receive more concentrated solar rays than they would on Earth. The panels also would not be subject to the seasonal fluctuations that are unavoidable on Earth.

Space Solar Power (SSP) would basically work the same way that regular solar power works. The only difference is that the solar panels would either be attached to orbiting satellites or stationed on the Moon, in which case it would be called Lunar Solar Power (LSP). The electricity created would be converted into microwaves and beamed down to Earth. Rectifying antennas, or rectennas, on the ground would collect the microwaves and convert them back into electricity.

If the concept seems like a stretch, consider that communications satellites already do something very similar when they transmit your cell phone conversations. In fact, one of the reasons space-based solar power has gotten so much attention is that all of the necessary equipment and technology is already developed and understood.

Some initial proposals in the 1970s envisioned gigantic 5-by-10-kilometer solar panel arrays transmitting microwaves to rectifying antennas of a similar size. These geostationary satellites, 36,000 kilometers high, would stay in the same place in relation to Earth at all times. While just one of these satellites would produce enormous amounts of energy—twice the energy output of the Hoover Dam—launching such a big project proved to be economically impossible.

Recent proposals to have smaller satellites circle Earth continuously would be more manageable and still produce considerable energy output. A satellite less than 300 meters across orbiting 540 kilometers above Earth could potentially power 1000 homes.

The major obstacle right now, as with any new technology, is cost. Launching, setting up, and maintaining a solar farm on the Moon would require vast amounts of human resources and money. As it is now, launching an object into space costs 1000 times more than transporting that object across the country on a plane—even though they use the same amount of energy.

Cheaper, cleaner launch vehicles are needed. Moreover, to gather massive quantities of energy, solar power satellites must be large, far larger than the International Space Station (ISS), the largest spacecraft built to date. Fortunately, solar power satellites will be simpler than the ISS as they will consist of many identical parts. A relatively small effort is also necessary to assess how to best transmit power from satellites to the Earth's surface with minimal environmental impact.

All of these technologies are reasonably near-term and have multiple attractive approaches. However, a great deal of work is needed to bring them to practical fruition.

In the longer term, with sufficient investments in space infrastructure, space solar power can be built from materials from space. The full environmental benefits of space solar power derive from doing most of the work outside of Earth's biosphere. With materials extraction from the Moon or near-Earth asteroids, and space-based manufacture of components, space solar power would have essentially zero terrestrial environmental impact. Only the energy receivers need be built on Earth.

Space solar power can solve our energy problems long term. The sooner we start and the harder we work, the shorter "long term" will be.

It is a universal reality that the Universe never ceases to amaze and surprise us by offering alternatives that have the potential of solving some of our major terrestrial conundrums. No matter how distant a global problem might appear, space is not really that distant. We are an inherent part of space and it will continue to shelter and nurture us with its incredible cosmic powers, and we must continue to search for answers within its realms.

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COSMIC PARTICLE ACCELERATORS

During a chance encounter with what appears to be an unusually strong blast of solar wind at Saturn, NASA's Cassini spacecraft detected particles being accelerated to ultra-high energies. This is similar to the acceleration that takes place around distant supernovas.

Since we cannot travel out to the far-off stellar explosions right now, the shockwave that forms from the flow of solar wind around Saturn's magnetic field provides a rare laboratory for scientists with the Cassini mission to observe this phenomenon up-close. The findings confirm that certain kinds of shocks can become considerably more effective electron accelerators than previously thought.

Shock waves are commonplace in the Universe; for example, in the aftermath of a stellar explosion as debris accelerate outward in a supernova remnant, or when the flow of particles from the Sun, the solar wind, impinges on the magnetic field of a planet to form a bow shock.

Under certain magnetic field orientations and depending on the strength of the shock, particles can be accelerated to close to the speed of light at these boundaries. These may be the dominant source of cosmic rays, high-energy particles that pervade our galaxy.

Scientists are particularly interested in "quasi-parallel" shocks, where the magnetic field and the "forward"-facing direction of the shock are almost aligned, as may be found in supernova remnants. The new study, led by Adam Masters of the Institute of Space and Astronautical Science, Sagamihara, Japan, describes the first detection of significant acceleration of electrons in a quasi-parallel shock at Saturn, coinciding with what may be the strongest shock ever encountered at the ringed planet.

"Cassini has essentially given us the capability of studying the nature of a supernova shock in situ in our own solar system, bridging the gap to distant high-energy astrophysical phenomena that are usually only studied remotely," said Masters.

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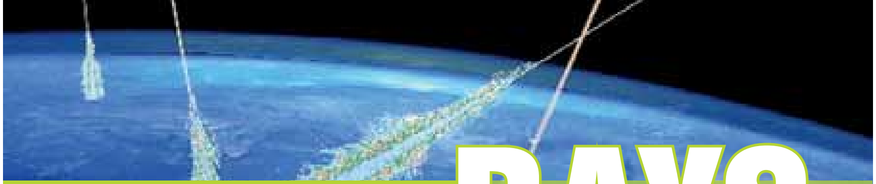

COSMIC RAYS

Particles that bombard the Earth from anywhere beyond its atmosphere are known as cosmic rays.

Cosmic rays include Galactic Cosmic Rays (GCRs), coming from outside the solar system; Anomalous Cosmic Rays (ACRs), coming from the interstellar space at the edge of the heliopause; and Solar Energetic Particles (SEPs), associated with solar flares and other energetic solar events.

Galactic Cosmic Rays

These are the high-energy particles that flow into our Solar System from far away in the galaxy. GCRs are mostly pieces of atoms: protons, electrons, and atomic nuclei that have had all of the surrounding electrons stripped during their high-speed—almost the speed of light—passage through the galaxy.

Most galactic cosmic rays are probably accelerated in the blast waves of supernova remnants. This does not mean that the supernova explosion itself gets the particles up to these speeds. The remnants of the explosions, expanding clouds of gas and magnetic field, can last for thousands of years; this is where cosmic rays are accelerated.

Bouncing back and forth in the magnetic field of the remnant randomly lets some of the particles gain energy, and become cosmic rays. Eventually, they build up enough speed that the remnant can no longer contain them, and they escape into the galaxy.

Since the cosmic rays eventually escape the supernova remnant, they can only be accelerated up to a certain maximum energy, which depends upon the size of the acceleration region and the magnetic field strength.

However, cosmic rays have been observed at much higher energies than supernova remnants can generate, and where these ultra-high-energies come from is a big question. Perhaps they come from outside the galaxy; from active galactic nuclei, quasars, or gamma ray bursts.

Anomalous Cosmic Rays

While interstellar plasma is kept outside the heliosphere, which shields the Solar System from galactic cosmic radiation by an interplanetary magnetic field, the interstellar neutral gas flows through the Solar System like an interstellar wind, at a speed of 25 km/sec. When closer to the Sun, these atoms undergo the loss of one electron in photo-ionization or by charge exchange.

Photo-ionization is when an electron is knocked off by a solar ultra-violet photon, and charge exchange involves giving up an electron to an ionized solar wind atom. Once these particles are charged, the Sun's magnetic field picks them up and carries them outward to the solar wind termination shock.

The ions repeatedly collide with the termination shock, gaining energy in the process. This continues until they escape from the shock and diffuse toward the inner heliosphere. Those that are accelerated are then known as Anomalous Cosmic Rays.

ACRs are thought to represent a sample of the very local interstellar medium. They are not thought to have experienced such violent processes as GCRs, and they have a lower speed and energy. ACRs include large quantities of helium, oxygen, neon, and other elements with high ionization potentials; that is, they require a great deal of energy to ionize, or form ions.

Solar Energetic Particles

Atoms that are associated with solar flares, SEPs move away from the Sun due to plasma heating, acceleration, and numerous other forces. Flares frequently inject large amounts of energetic nuclei into space, and the composition varies from flare to flare. The mechanisms involved in producing a solar flare can be better understood by studying the composition and charge of these particles. On the scale of cosmic radiation, SEPs have relatively low energies.

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Planetarium

Available Shows

Stars of the Pharaohs
35 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

Universe
22 Min. Full-dome Show

Kaluoka'hina
35 Min. Full-dome Show

The Life of Trees
33 Min. Full-dome Show

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- For the Planetarium daily schedule and fees, please consult the Center's official website: 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.

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

Guided Tours Schedule
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Students EGP 2
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- For the list of shows available at the "Listen and Discover" and the schedule, please consult the Center's official website: www.bibalex.org/psc.
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Show fees
DVD shows:
Students EGP 1
Non-students EGP 2
3D shows:
Students EGP 2
Non-students EGP 4

History of Science Museum

Visitors INFO

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[from 10:00 to 15:00]

Guided Tours Schedule
Saturday to Thursday
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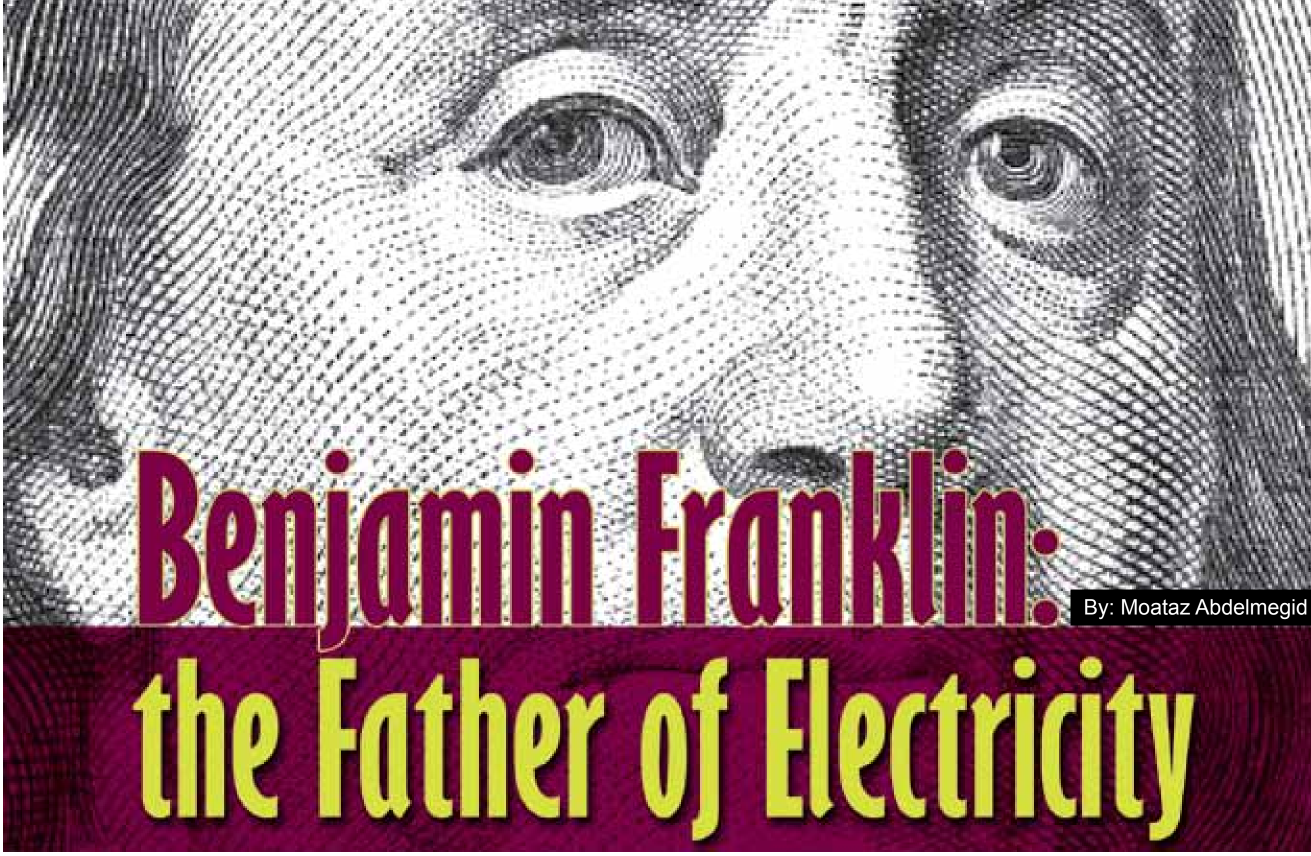
- For non-audience of the Planetarium, Museum entry fees are EGP 0.50.
- Museum Tours are free for ticket holders.



Benjamin Franklin: the Father of Electricity

By: Moataz Abdelmegid

If you take a look at any USD 100 bill, you will see the picture of Benjamin Franklin's wise, calm face on it. Benjamin Franklin was by far the most famous American of his time; people all over the world simply pictured him whenever anyone said the word "American".

Benjamin Franklin was one of the Founding Fathers of the United States; he helped craft the American Constitution and the American Bill of Rights. Franklin was a political theorist, a civic activist, a politician, a statesman, a diplomat, an ambassador, and a satirist. He created the US postal system, established the first circulating library in the United States, owned and franchised many of his printing presses.

Franklin was an outstanding scientist as well. He studied smoky chimneys, invented bifocal spectacles, studied the effect of oil upon ruffled water, identified the "dry bellyache" as lead poisoning, and investigated fertilizers in agriculture. His scientific observations show that he foresaw some of the great developments of the 19th century.

Benjamin Franklin was named the Father of Electricity because of the several experiments that he conducted, trying to explain the nature of electricity. In this field, Franklin is most known for his famous "Kite Experiment", also known as "Ben's Kite" or "Franklin's Kite". The experiment's purpose was to uncover then unknown facts about the nature of lightning and electricity.

Benjamin Franklin's wildly dangerous kite experiment has grown into an American legend. Almost everyone has heard of Franklin flying a kite with a key in an electrical storm, but few of us actually understand how the experiment works. Ben hypothesized that lightning is an electrical phenomenon and that the electrical effect of lightning might be transferable to another object and cause an effect that could be recognized as electricity.

In the 1700s, the electrical nature of lightning was continuously the subject of discussion in the society of science. Benjamin Franklin tried to find a way to prove that lightning was actually electricity. This realization dawned upon him, when he observed how much electricity and lightning had in common; such as their color, crooked direction, and crackling noise.

Of course, now it is ridiculous to even consider that lightning was not electricity, but back in the 18th century, people had no idea about things like positive and negative charges, and Franklin wanted to show that lighting was a form of static electricity on a huge scale.

In 1752, Benjamin Franklin proposed an experiment with conductive rods being used to attract lightning to a "Leyden jar", which was an early form of what we know today as the "capacitor". Right after Franklin proposed this unique idea, a French experimenter, Thomas-Francois Dalibard, carried out this experiment in northern France using conductive rods.

One year later, another attempt to replicate the experiment was conducted by the German physicist, Georg Wilhelm Richmann, in Saint Petersburg in August 1753; he described his experiment as "trying to quantify the response of an insulated rod to a nearby storm". While the experiment was underway, a supposed ball lightning appeared and collided with Richmann's head leaving him dead with a red spot on his forehead, his shoes blown open, and parts of his clothes singed.

An explosion followed "like that of a small Cannon" that knocked the engraver out, split the room's door frame, and tore the door off its hinges. Reportedly, ball lightning traveled along the apparatus and was the cause of his death; he was apparently the first person in history to die while conducting electrical experiments. Georg Wilhelm Richmann's electrocution was a clear warning for all the scientists who were pursuing.

Benjamin Franklin realized how extremely dangerous it is to use conductive rods to capture the electricity from lightning; he, thus, decided to conduct the experiment using a kite instead of the conductive rod. The increased height allowed him to stay on the ground and the kite was less likely to electrocute him.

He decided that within the modified experiment he would fly a silk kite during a thunderstorm; on the other end of the kite was a metal key placed in a Leyden jar. He attached his kite to a silk string, tying an iron key at the other end; he then tied a thin metal wire from the key and inserted the wire into the Leyden jar. If lightning was indeed electricity, the charge would be collected by the key in the jar. If the jar had no charge before flying the kite and was full after, then he would have proven that thunderclouds contained electricity.

In 1752, the 46-year-old Ben Franklin decided to conduct their experiment and fly their kite. The story narrates—with no significant record to prove the occurrence of this incident—that the kite was struck by lightning, and, when Franklin moved his hand towards the key, a spark jumped across and he felt a shock, proving that lightning was electrical.

Here is what I believe actually happened: Franklin kept the string of the kite dry at his end to insulate him while the rest of the string was allowed to get wet in the rain to provide conductivity. The key was attached to the string and connected to the Leyden jar, which Franklin assumed would accumulate electricity from the lightning.

The thunderstorm cloud passed over Franklin's kite, whereupon the negative charges in the cloud passed onto his kite, down the wet silk string, to the key, and into the jar. Franklin, however, was unaffected by the negative charges because he was holding the dry silk ribbon, insulating him from the charges on the key.

The kite was not struck by visible lightning, because if it had done so, Franklin would almost certainly have been killed, but Franklin noticed the strings of the kite were violently repelling each other and deduced that the Leyden jar was being charged at that moment. When he moved his free hand near the iron key, he received a shock because the negative charges in the key were so strongly attracted to the positive charges in his body, a spark jumped from the key to his hand.

Franklin probably conducted some form of the experiment later on to extract sparks from a cloud, but instead of waiting for the kite to be struck by lightning, he flew the kite before a thunderstorm appeared to collect enough charge from a cloud to prove the existence of electricity. He knew that if his kite really was struck by lightning while he was holding on to it, he would have been dead right on the spot.

Fearing that the test would fail or that he would be ridiculed, Franklin took only his son to witness the experiment with himself and published the accounts of the test in third person. A part of the legend told was that Franklin suggested for safety reasons that the person flew the kite from within a dry area. This meant that the kite had to be flown from within a building, and through a window, but there is no record or proof to confirm if he actually did so.

Realizing that the electrical energy in lightning could be charged over a conductor and into the ground, Benjamin Franklin invented the lightning rod and the conductor, providing the lightning an alternative path to Earth.

Many people may be unaware of Benjamin Franklin's various achievements beyond politics. Aside from his great researches and discoveries in the field of electricity, he also presented several inventions that are graced by his name to this day. One of these inventions is the Glass Harmonica.

This invention has given Franklin "the greatest personal satisfaction" quoting from his words. The harmonica was created in 1761, when Franklin got an inspiration, after the concert of Handel's Water Music, whose parts were played on tuned wine glasses.

His harmonica did not require water tuning, it was smaller than the originals, and it used glasses that were blown in the proper thickness and size. Furthermore, these glasses did not require water and they created the proper pitch. The instrument itself was rather compact, as the glasses were nested. Finally, the harmonica had a foot treadle, which was used to turn the spindle where the glasses were mounted.

The Franklin Stove is also one of his very well known inventions. In the 18th century, people mostly used a fireplace as the main source of heat. These places were rather inefficient, producing a lot of smoke and losing much of the generated heat. The sparks were also very dangerous, as they could lead to a fire.

In order to fix these problems, Benjamin Franklin invented a new type of stove. This invention had a hood-like enclosure in the front; while on the rear side, there was an air box. This newly invented stove generated more heat and required less wood.

In 1775, Franklin served as the Postmaster General for some time. In order to analyze the best routes for delivering the mail, Franklin invented an odometer, which helped him to measure his carriage route mileage. Benjamin Franklin also invented the Bi-focal glasses in 1784 simply because he was getting older, his vision was declining and he was not comfortable with switching between glasses for close-up and distance viewing.

Although Benjamin Franklin made several contributions in different fields of science, and presented to us many inventions that are still in use up to our day, but still his greatest and most famous piece of work was the Kite's Experiment for which he is known up to this day.

Franklin himself was aware that he lived in an era that was unfortunately too early to enjoy the possibilities of electrical convenience in industry and daily life. He foresaw the ubiquity of electricity that we now enjoy and was certainly jealous.

Franklin was invited to meet the King of France and explain his vision of that future after the fame of his kite's experiment spread. The Benjamin Franklin kite experiment demonstrated the daring and genius of America's first great polymath and an influential Founding Father.

It is worth mentioning that later in his life, lightning actually struck his own house, but the lightning rod that he installed over the house by himself saved his life and saved the house from burning.

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Science & Nature

THE NEXT ALTERNATIVE ENERGY SOURCE: ELECTRICITY OUT OF THIN AIR

By: Lamia Ghoneim

We humans are certainly creative specimens; so creative to the extent that in our search to find energy to power our exceedingly consuming lives, we have managed to harness—or aspired to harness—almost every possible energy source on Earth, and even beyond the Earth's atmosphere.

As the need for renewable energy is now at its peak, it seems that harnessing the power of the Sun, wind, waves, and atoms is no longer enough. We now feel the need to pull electricity out of nothing but thin air; or humid air, to be more accurate.

It has been dubbed "Hygroelectricity", short for "humidity electricity", which basically means pulling electric charges that are naturally formed in humid air; scientists are already in the early stages of developing devices to harness it.

As fascinating as it may seem, it is not really the novelist of ideas. In fact, scientists have been fascinated with the notion of harnessing thunderstorms and other naturally formed electricity for centuries. Aside from lightening, they also noticed that sparks of static electricity formed as steam escaped from boilers; workers who touched the steam even got painful electrical shocks.

Nicola Tesla, the electricity genius himself, has experimented extensively with this topic. He was certain that the interaction between air and water in the atmosphere generated an electrical charge, and he dreamed of capturing and using that charge.

However, up until recently, our understanding of the field of atmospheric thermodynamics was still rather elusive, and the idea of harnessing electricity out of air was deemed as one of those "pie in the sky" ideas.

Not anymore. Fernando Galembeck, of the University of Campinas in Brazil, presented a report at the 240th National Meeting of the American Chemical Society, detailing a future where everyone owns devices that capture electricity from the air—much like solar cells capture sunlight—and use them to light their house or recharge an electric car. "Just as solar energy could free some households from paying electric bills, this promising new energy source could have a similar effect," he said.

With the exception of the famous—and often disregarded—Tesla, most scientists believed that water droplets in the atmosphere were electrically neutral, and remained that way even after brushing up against charges on dust particles and other liquids. Recent evidence has suggested otherwise, which led Dr. Galembeck and his colleagues to dig deeper.

What they found, and then confirmed in the lab, is that, in fact, water in the atmosphere does pick up a charge. They used tiny particles of silica and aluminum phosphate—both common airborne substances—showing that silica became more negatively charged in the presence of high humidity, and aluminum phosphate became more positively charged. High humidity means high levels of water vapor in the air—the vapor that condenses and becomes visible as "fog" on windows of air-conditioned cars and buildings on steamy summer days.

This building of charges in humid air can accumulate and be transferred to other objects, explaining such phenomena like the charge buildup where steam escapes from boilers that had baffled and intrigued scientists for centuries.

Galembeck stated that, in the near future, it will be possible to develop collectors, similar to the solar cells that collect sunlight to produce electricity, to capture hygroelectricity and route it to homes and businesses. Just as solar cells work best in sunny areas of the world, hygroelectrical panels would work more efficiently in areas with high humidity, primarily in tropical climates, where access to electricity may be an issue today.

A safety payoff could even arise with the successful development and adaptation of the technology, as Galembeck claims that a similar approach might help prevent lightning from forming and striking. He envisions placing hygroelectrical panels on top of buildings in regions that experience frequent thunderstorms.

The panels would drain electricity out of the air, and prevent the building of electrical charge that is released in lightning. His research group already is testing metals to identify those with the greatest potential for use in capturing atmospheric electricity and preventing lightning strikes.

He concedes that the developments are not quite ready for prime time, but that early indications are that the approach holds great promise for bearing fruit with the benefit of additional research and development: "These are fascinating ideas that new studies by us and by other scientific teams suggest are now possible. We certainly have a long way to go. But the benefits in the long range of harnessing hygroelectricity could be substantial."

Nevertheless, however tantalizing the idea of free electricity from air maybe, the prospect of harnessing enough of it to be widely useful is still a matter of some debate among scientists, who do not all share Dr. Galembeck's optimistic view. They argue that based on the amount of charge gathered in the initial tests, the amount of energy that hygroelectricity could yield would be relatively small, saying that it is not likely to be useful for common, everyday applications.

Some even challenge the idea of hygroelectricity itself, saying it goes against the commonly held theory among scientists that water is electroneutral; that is, it cannot store a charge. Galembeck argued that, while he does not dispute the principle of electroneutrality in theory, he believes that real-life substances such as water have ion imbalances that can allow it to produce a charge.

While I agree that it may be too soon to translate the theory of hygroelectricity into potential applications, I also believe that, given the state of the world's need for electrical power and the struggle to find non-petroleum sources, no potential clean source should be automatically ruled out, least of all a promising one like this one.

In the search for renewable energy sources, hygroelectricity should be indeed a welcomed addition.

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TIDAL POWER

By: Moataz Abdelmegid

Tidal power, also known as tidal energy, is a form of hydropower that converts the energy of tides into useful forms of power, mainly electricity. Tides are more predictable than wind energy and solar power; as such, although not yet widely used, tidal power has potential for future electricity generation.

Among sources of renewable energy, tidal power has traditionally suffered from relatively high cost and limited availability of sites with sufficiently high tidal ranges or flow velocities, thus constricting its total availability.

However, many recent technological developments and improvements, both in design and in turbine technology, indicate that the total availability of tidal power may be much higher than previously assumed, and that economic and environmental costs may be brought down to competitive levels.

Background Check

The tide is a direct effect of the relative positions of the Earth and the Moon and, to a lesser extent, the Earth and the Sun. These powers are evident in how the gravitational forces of these celestial bodies move large bodies of water here on Earth. Although affecting the entire globe, these shifts are particularly apparent in places of shallow coastlines and sea floors; China, Korea, and UK are some of these places.

Historically, tide mills have been used, both in Europe and on the Atlantic coast of North America. The incoming water was contained in large storage ponds; as the tide went out, it turned waterwheels that used the mechanical power it produced to mill grain. The earliest occurrences date from the Middle Ages, or even from Roman times.

It was only in the 19th century that the process of using falling water and spinning turbines to create electricity was introduced in the United States and Europe. The world's first large-scale tidal power plant, the Rance Tidal Power Station, became operational in 1966.

For many years, scientists have dreamt of harnessing the energy stored in seas and oceans, and converting it into a useful form of energy, like kinetic energy that generates electricity. Modern science has reached three basic ways to tap the ocean for its energy. The first way uses the ocean's waves movement, the second way uses the ocean's high and low tides, and the third way uses temperature differences in the water.

1) Wave Energy

Kinetic energy, or movement, exists in the moving waves of the ocean; that energy can be used to power a turbine. The wave rises into a chamber; the rising water forces the air out of the chamber to spin a turbine that can be used to turn a generator.

When the wave goes down, air flows through the turbine and back into the chamber through doors that are normally closed. This is only one type of wave energy systems; others actually use the up and down motion of the wave to power a piston that moves up and down inside a cylinder, or that can be used to turn a generator.

Most wave-energy systems are very small, but they can be used to power a warning buoy or a small lighthouse.

2) Tidal Energy

The second form of ocean energy is tidal energy. When tides come into the shore, they can be trapped in reservoirs behind dams. Then when the tide drops, the water behind the dam can be let out just like in a regular hydroelectric power plant.

In order to make this happen, we need large increases in tides heights; an increase of at least 5 m between low tide to high tide is needed. There are only a few places where this tide change occurs around the Earth. Some power plants are already operating using this idea; one plant in France makes enough energy from tides to power 240,000 homes.

3) Ocean Thermal Energy

The third technology uses temperature differences in the ocean. If you ever went swimming in the ocean and dove deep below the surface, you would have noticed that the water gets colder the deeper you go. It is warmer on the surface because sunlight warms the water; but below the surface, the ocean gets very cold. That is why scuba divers wear wet suits when they dive down deep; their wet suits trap their body heat to keep them warm.

Power plants can be built in a way that uses this difference in temperature to produce energy. A difference of at least 21 degrees celsius is needed between the warmer surface water and the colder deep ocean water. Using this type of energy source is known as Ocean Thermal Energy Conversion (OTEC); it is being used in both Japan and in Hawaii in some demonstration projects.

Feasibility Check

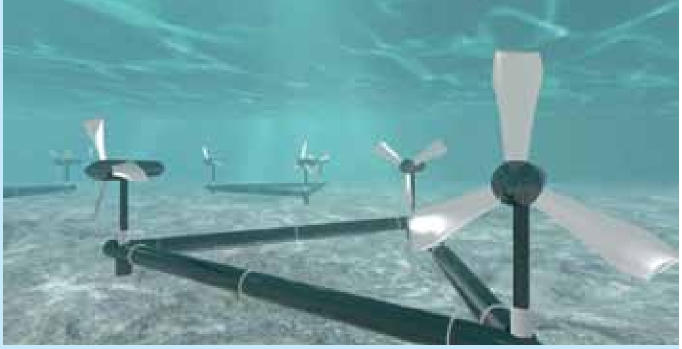
There are three major techniques followed in converting tidal energy into electricity:

1) Tidal Stream Generator

Tidal Stream Generators (TSGs) make use of the kinetic energy of moving water to power turbines, in a similar way to wind turbines that use wind to power turbines. Some tidal generators can be built into the structures of existing bridges, involving virtually no aesthetic problems.

2) Tidal barrage

Tidal barrages make use of the potential energy in the difference in height, or head, between high and low tides. When using tidal barrages to generate power, the potential energy from a tide is seized through strategic placement of specialized dams.



When the sea level rises and the tide begins to come in, the temporary increase in tidal power is channeled into a large basin behind the dam, holding a large amount of potential energy. With the receding tide, this energy is then converted into mechanical energy as the water is released through large turbines that create electrical power through the use of generators. Barrages are essentially dams across the full width of a tidal estuar

3) Dynamic Tidal Power

Dynamic Tidal Power (DTP) is an untried but promising technology that would exploit an interaction between potential and kinetic energies in tidal flows. It proposes that very long dams—for example, 30–50 km length—be built from coasts straight out into the sea or ocean, without enclosing an area.

Tidal phase differences are introduced across the dam, leading to a significant water-level differential in shallow coastal seas, featuring strong coast-parallel oscillating tidal currents such as found in China, Korea, and UK.

Is tidal energy a feasible alternative energy source?

Interest in tidal power resurfaced towards the end of the 20th century, as technological developments and improvements in design and turbine technology were found to have worked around the aforementioned tradeoffs.

Cheaper construction of power plant components and placement of tidal generators in locations where previously none were conceivable suddenly makes tidal power a promising alternative to fossil fuel-based energy sources. After all, it fits in well with the environmental awareness of the 21st century in how it is next to infinitely renewable, not to mention how the power generation process omits an absolute minimum of pollutants.

Moreover, it is actually a force to be reckoned with, being more predictable by far than the highly intermittent solar energy and wind energy alternatives. This predictability translates to easier implementation into existing power grids than the latter two options, never mind that it has yet to be as extensively implemented.

In investigating the feasibility of tidal power plants one should separately consider each type of technology applied in harnessing tidal power. As previously mentioned, currently two types of tidal power plants can be found in the world, with a theoretical third variant currently being subject to development. These are tidal stream generators, tidal barrage generators, and dynamical tidal power.

The tidal barrage is the pricy and hard to place option. The power plant itself is really just a dam that has been built to seal off the entirety of a tidal estuary. It is these estuaries that experts have deemed impossible to find in the past, whereas it is the dam structure that comes at unjustifiable costs. On top of these issues, there are the various threats that tidal barrages pose to marine life and the like.

Tidal Stream Generators instead use the moving water of the tide, functioning much like a water mill would in a stream. While the energy outlet is potentially less than it is with tidal barrages, it comes at a low cost and an equally low degree of ecological impact. For these reasons it is becoming the first choice of tidal generators in many parts of the world.

The theoretical Dynamic Tidal Power instead suggests long dams that go straight out into the ocean without enclosing any parts of the coast. These would generate power the same way as the tidal barrage, but without posing as a palpable danger to the surrounding ecosystem.

However, the cost effectiveness of this type of tidal power plant is debatable and it is doubtful that it could be universally employed; only along the coasts of shallow seas would such construction projects be feasible.

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Nuclear Power Plants: How Do They Work?

By: Moataz Abdelmegid

The nuclear power plant stands on the border between humanity's greatest hopes and its deepest fears about the future. On one hand, atomic energy offers a clean energy alternative that frees us from the shackles of fossil fuel dependence. On the other, it summons images of disaster; quake-ruptured Japanese power plants belching radioactive steam, the dead zone surrounding Chernobyl's concrete sarcophagus.

Electricity was generated by a nuclear reactor for the first time ever on 20 December 1951, at the EBR-I experimental station near Arco, Idaho in the United States. On 27 June 1954, the world's first nuclear power plant to generate electricity for a power grid started operations at Obninsk in the Soviet Union. The world's first commercial scale power station, Calder Hall in England opened on 17 October 1956.

Statistics speak as of 1 March 2011, there were 443 operating nuclear power reactors spread across the planet in 47 different countries. In 2009 alone, atomic energy accounted for 14 percent of the world's electrical production.

What happens inside a nuclear power plant to bring such marvel and misery into being?

Nuclear Power Plants in a Nutshell

Nuclear energy usually means the part of the energy of an atomic nucleus that can be released by fusion or fission or radioactive decay. The term "Nuclear Power" means the use of sustained nuclear fission to generate heat that can be utilized to generate electricity.

The idea of an atom began with the Greek philosopher Democritus, who claimed all matter consisted of little tiny particles; he called them "atomos", the Greek word for "invisible". He could not prove they existed though; centuries later, however, other scientists did. That discovery heralded the nuclear power movement, which has been sparking controversy and debate ever since.

Nuclear energy is utilized in a facility that we know as the Nuclear Reactor: an environment designed to initiate and control a sustained nuclear chain reaction. A nuclear power plant is a thermal power station in which the heat source is a nuclear reactor.

As is typical in all conventional thermal power stations, the heat is used to generate steam, which drives a steam turbine connected to a generator that produces electricity. Nuclear power plants are usually considered base load stations. This means that a very small amount of fuel can produce the target required amount of power; hence, fuel is a small part of the cost of production, while the major cost of production lies within the construction and operation of the facility itself.

Nuclear Power Plants Anatomy

Imagine following a volt of electricity back through the wall socket, all the way through miles of power lines to the nuclear reactor that generated it. You would encounter the generator that produces the spark and the turbine that turns it. Next, you would find the jet of steam that turns the turbine, and finally the radioactive uranium bundle that heats water into steam at the core of the reactor.

The water in the reactor serves as a coolant for the radioactive material, preventing it from overheating and melting down. In March 2011, viewers around the world became well acquainted with this reality as Japanese citizens fled by the tens of thousands from the area surrounding the Fukushima-Daiichi nuclear facility after the most powerful earthquake on record and the ensuing tsunami inflicted serious damage on the plant and several of its reactor units. Among other events, water drained from the reactor core, which in turn made it impossible to control core temperatures, resulting in overheating and a partial nuclear meltdown.

The conversion to electrical energy takes place indirectly, as in conventional thermal power plants. The heat is produced by fission in a nuclear reactor; directly or indirectly, water vapor—steam—is produced; the pressurized steam is then usually fed to a multi-stage steam turbine.

Steam turbines in the average nuclear power plant are among the largest steam turbines ever. After the steam turbine has expanded and partially condensed the steam, the remaining vapor is condensed in a condenser—a heat exchanger that is connected to a secondary side such as a river or a cooling tower. The water is then pumped back into the nuclear reactor and the cycle begins again; the water-steam cycle corresponds to what engineers know as "The Rankine cycle".

To make things simpler, let us just say that the basic part of the nuclear power plant is the nuclear reactor; and the basic part of the nuclear reactor is the "reactor core", which is where the nuclear fuel is—uranium for example. The fuel is placed in the reactor core in the form of fuel rods that are arranged with what is known as "control rods", which rigidly controls the rate of the reaction.

When the reactor is started, a nuclear fission reaction—chain reaction—takes place and the rate of this reaction is controlled in a way that the reaction does not precede too fast or too slow and the amount of thermal energy—heat—generated by the reaction is accurately calculated and controlled.

In order to sustain the reactor core at the same temperature, the heat generated by the reaction has to be absorbed by a continuous cooling stream of water. Once the water absorbs the heat of the reaction, it turns into super-heated steam, which is withdrawn from the reactor and introduced into a steam turbine where the steam—at high pressure and temperature—turns the blades of the turbine at extremely high speed converting the thermal energy into useful kinetic energy. The turbine will simultaneously rotate an electrical generator that is mounted with it on the same axis and the generator will convert the kinetic energy into electricity.

If the chain reaction goes too fast, it can generate more heat than the water can carry away; or if something happens to the cooling, the core can get so hot that it will start to melt. Once it melts, the chain reaction continues uncontrolled so the temperature rises even more and the core melts down through the concrete and steel, and if it gets far enough, down into the ground.

The molten core will diffuse into the surrounding media—layers of the ground for instance—until it gets diluted enough by this media that the chain reaction slows down; when the core loses its heat, the whole mass cools enough to solidify. It will remain physically and radioactively hot for many years. This melt down is what happened at Chernobyl in Ukraine back in the days of the Soviet Union and a lot of people were killed by high radiation and a lot of radioactive dust contaminated the land around the reactor.

Nuclear Power Plants in Egypt

The history of nuclear energy in Egypt dates back to the mid-20th century; the Egyptian nuclear power program was started in 1954. The first nuclear reactor was acquired from the Soviet Union in 1961; located at Inchass, Nile Delta, it was opened by late President Gamal Abdel-Nasser and produced power of 2 Megawatt. The disposal of its spent fuel was controlled by the Soviets.

In 1964, a 150 Megawatt; and in 1974, a 600 Megawatt nuclear power stations were proposed. The Nuclear Power Plants Authority (NPPA) was established in 1976; and in 1983, El-Dabaa site on the Mediterranean coast was selected for the project. The Nuclear program was then rejected just after Egypt was defeated by Israel in the 1967 war and the weakening of the Egyptian economy.

In 1968, Egypt signed the Nuclear Non-Proliferation Treaty but postponed ratifying it under evidences that Israel had undertaken nuclear weapon program. Consequently, the country lost many of its nuclear experts and scientists who had to travel abroad to seek work opportunities; some of them joined the Iraqi nuclear program and others immigrated to Canada. It is worth mentioning that a number of these Egyptian scientists died unexplainably.

Egypt's nuclear plans were frozen after the Chernobyl accident in 1986. In 2006, however, Egypt announced it will revive its civilian nuclear power program, building a 1,000 megawatt nuclear power station at El-Dabaa within the next 10 years. It is estimated to cost USD 1.5 billion, and it will be constructed in participation with foreign investors. In March 2008, Egypt signed with Russia an agreement on the peaceful uses of nuclear energy.

As of 2012, after years of stop-start efforts, Egypt's nuclear-energy ambitions are once again in flux. El-Dabaa has been targeted by protesters who are claiming that their land was wrongly taken by the Government to make way for the nuclear plant. As of 2012, and as a result of those protests, the site has been shut down.

None of the new governments that took charge since the Revolution of 25 January 2011 has made any statements about their plans for the nuclear plant or showed any intention to proceed with the construction process after it was suspended for years. Egypt pulled out of nuclear talks at Geneva; it withdrew from a second week of Non-Proliferation Treaty (NPT) talks in Geneva on 29 April 2013, which was the first step at the nuclear issue after the 25 January Revolution.

Now, with the excessively fast changes in the political scene, no one can really tell for sure what will become of the Egyptian nuclear plans. Until this moment, the future of nuclear energy in Egypt remains a question mark, and all the possibilities and options are valid.

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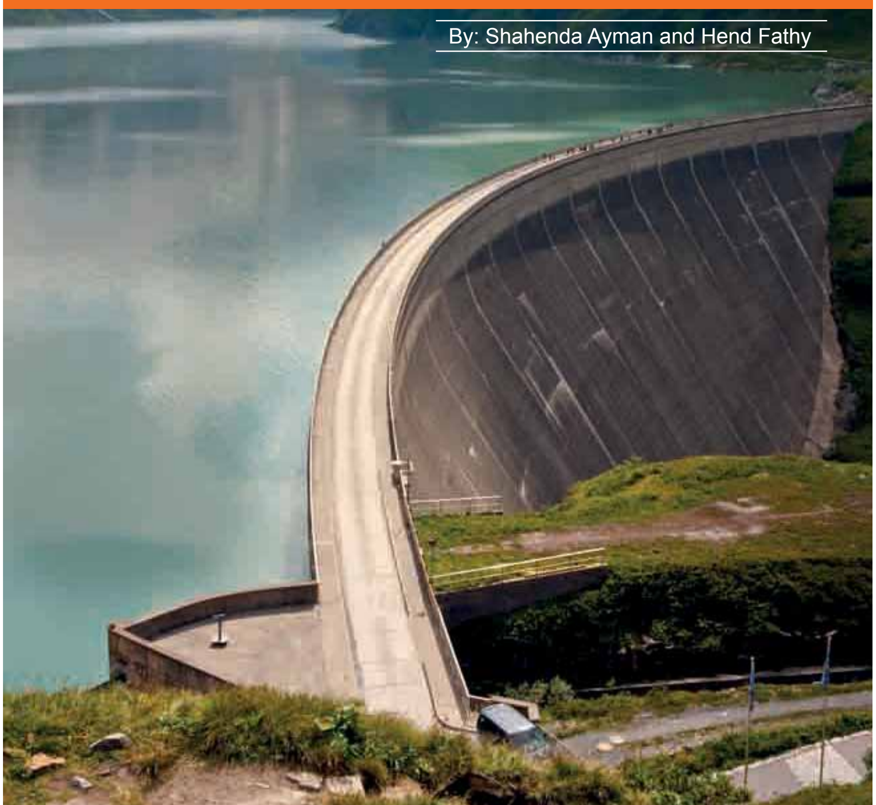
The Hydroelectric Power

Crisis in the Nile Basin

By: Shahenda Ayman and Hend Fathy



In the face of a global energy crisis, made even worse amidst environmental challenges, natural energy sources are probably our best chance. One such source is hydroelectric energy, which is generating electricity from the flowing water of rivers. It is considered a renewable source of electric energy as it takes nothing from the environment while the water keeps producing energy flawlessly.

To produce hydropower, a dam is built on a large river; a large volume of water is stored in a reservoir at a high altitude. A power generation plant consisting of multiple turbines is constructed downstream, at a much lower altitude. The reservoir and the power generation plant are connected by large pipelines known as penstocks.

When water is released from the reservoir, it flows down the penstock at high speed towards the turbine; naturally, the speed at which the water flows down the penstock will be directly proportional to the difference between the altitudes of the reservoir and the turbine. As the water flows down, its potential energy is converted into kinetic energy, which in turn works the turbine blades and produces electricity.

This process has its pros and cons. On the one hand, it is a clean source of energy; it does not pollute the environment or waste water. Hydropower is not expensive to maintain once the dam is built, also the water can be stored behind the dam to be used during peak times. The water can also be reused in agriculture, irrigation, civic water supply; therefore, losses are minimal.

Where other power stations normally take eight hours to restart, a hydropower station can restart in just a few minutes. Moreover, hydroelectricity power stations have a really long life, and they can generate electricity for many years, if not for decades.

On the other hand, building a dam is very expensive and needs large reservoirs, which cost a lot of money and a lot of time to construct. Sometimes, it involves relocation of families living in the area. Moreover, constructing a reservoir or damming a river at a certain location may lead to adverse ecological effects on its immediate surroundings. In other words, it cannot be constructed just anywhere; a proper land examination is a must prior to hydropower station construction.

There are many different types of dams, from mammoth hydroelectric generators—which produce 20% of the world's electricity energy and 88% of all renewable electricity—to the small sand dams of Kenya that are designed to store water for the dry seasons. Let us discover some of the most famous dams in the world:

Srisailam Dam (India)

This dam is constructed on the Krishna River, which flows in the Kurnool district of Andhra Pradesh. Srisailam dam is located at a distance of around 150 km from the capital city of Hyderabad, and is surrounded by the Nallamala Hills on the southern and eastern sides.

The construction of the dam started in 1960; taking over 20 years to be completed, it was opened in 1981. The dam is 512 m long, and holds the water at a height of 269.748 m; it has 12 radial crest gates through which water can be let out for power generation, and a reservoir covering an area of 800 km^2.

The dam is one of the 12 largest in the country in terms of hydroelectric power production but was specifically built in order to provide irrigation for the districts of Kurnool and Cuddapah, both of which are prone to severe droughts.

Nagarjuna Sagar Dam (India)

Standing at a height of 124 m, a length of one km, and holding back 11,742 million cubic liters of Krishna River water, Nagarjuna Sagar dam is located in the Nalgonda district of Andhra Pradesh in India.

Considered one of the largest dams built in Asia, this dam was completed in 1966, and features 26 individual crest gates. It is the tallest in the world to be made strictly from masonry; its creation resulted in the third largest man-made lake in the globe. The dam, and its canals, are incredibly important in the ability to irrigate nearby land.

Tarbela Dam (Pakistan)

Standing almost 152.4 m high, and straddling the Indus River for 2743.2 m, the dam, also known as Torabela or Pashto, was completed in 1976, and is considered the largest dam ever constructed on Pakistan's Indus River.

It is not the largest dam in the world only, it is the largest dam filled naturally by the Earth. It stores water not only to control flooding, but also for use in irrigation and the production of hydroelectric energy as well; it supplies about 16% of Pakistan's electricity.

Three Gorges Dam (China)

China's Three Gorges Dam is not only the world's largest hydroelectric dam; it is also the world's single largest source of electricity. This dam has a generating capacity of 22,500 megawatts, its height is about 181 m, and its length is about 2,335 m. The world largest dam may be China's most environmental catastrophe; this dam is located between the cliffs on the Yangtze River in central China and may trigger landslides caused by the increased pressure on the surrounding land. Also, it may lead to serious environmental problems, in addition to endangering the lives of many people who will live behind it.

Aswan Dam (Egypt)

The Aswan Dam is actually a pair of dams; the Aswan High Dam and the Aswan Low Dam. Before the building of a dam in Aswan, Egypt experienced annual floods from the Nile River that deposited four million tons of nutrient-rich sediment that enabled agricultural production.

The Aswan Dam benefits Egypt by controlling the annual floods on the Nile River, preventing the damage that used to occur along the floodplain. The Aswan High Dam provides about one half of Egypt's power supply, and has improved navigation along the river by keeping the water flow consistent.

Although the dams are a great solution for the energy crisis we are facing, we cannot deny that they are affecting the environment in some cases. Other dams do not only lead to environmental problems but also political problems. One example is The Grand Ethiopian Renaissance Dam, which is considered the most famous dam nowadays.

The Grand Ethiopian Renaissance Dam (GERD)

The Blue Nile is one of the two major tributaries of the Nile River; it originates in Ethiopia's Lake Tana and flows hundreds of miles north into Sudan and then Egypt. Almost 85% of Egypt's water supply is from the Blue Nile; with growing populations, Egypt is particularly dependent on it.

Ethiopia, known as the water tower of Africa, on the other hand, receives heavy rains annually on which it depends for agriculture, although there are few irrigation systems in place to use it. In 2011, Ethiopia announced plans to construct what would become Africa's biggest dam on the Blue Nile, the Grand Ethiopian Renaissance Dam (GERD), which Egypt considers a critical threat to its water security.

The Crisis: A Chronological Account

I bet we are all familiar with the "Entebbe Agreement" or the "Nile Cooperative Framework Agreement" lately proposed by Ethiopia to redefine the Nile Basin countries' shares of the Nile water, and annuls the downstream countries veto-power over upriver water management projects. Yet, not many people, including myself upon starting this article, have been aware of the historical root of this crisis.

The story goes back to 1902 when the British, as the major imperial power in East Africa, signed a treaty with the Ethiopian Emperor to consult with them regarding any water management projects on the Blue Nile. After independence, Egypt negotiated the 1929 Nile Water Agreement with the East African British colonies claiming its right to 48 billion cubic meters of the Nile flow, all dry season waters, and veto-power over upriver water management projects.

In 1959, Egypt and the Sudan signed the "Nile Water Agreement" that allocated 55.5 billion m^2 of water annually to Egypt, and 18.5 billion m^2 to Sudan. The treatment also allowed for the construction of the Aswan High Dam and two other dams in Sudan. However, the Agreement was completed before the upriver States achieved independence, and it badly affected them, and they later maintained that they had no obligation to abide by treaties signed for them by Great Britain.

In the 1980s, rain missed the Ethiopian highlands leading to a serious water crisis upriver and downriver, causing a disastrous famine in Ethiopia. This urged Egypt and Ethiopia to replace the language of confrontation with words of cooperation.

Yet, when Egypt doubled efforts to build the Toshka Canal irrigation project in the 1990s, the Ethiopian Prime Minister Zenawi protested in anger: "while Egypt is taking the Nile water to transform the Sahara Desert into something green, we in Ethiopia—who are the source of 85% of that water—are denied the possibility of using it to feed ourselves", and he began plans for the GERD.

The 1999 "Nile Basin Initiative" did not resolve the conflict between Egypt's and Sudan's claims of historic rights on the one hand and the upper river States' claims for equitable shares on the other. In 2010, six upstream countries signed the "Entebbe Agreement", which replaced the "Nile Basin Initiative", and which Egypt and the Sudan rejected.

In 2011, Ethiopia embarked upon the construction of the GERD. The project faced opposition from the downstream countries—Egypt and Sudan—concerned that their available water resources will be reduced. The three countries agreed to create The Tripartite Committee of Experts to assess the impact of the Dam on the Nile flow, which officially started its mission in May 2012 and submitted its report to the Governments of the three countries in June 2013.

The report has not been published, and there have been conflicting official and media statements about it. Ethiopian media quoted a statement for the Ethiopian Ministry of Water and Energy stating that the design of the Dam is based on international standards and that it would provide advantages to the three countries, and will not lead to damage to the two downstream countries. Egyptian media quoted the spokesman of the Egyptian Ministry of Water Resources and Irrigation statement that the report emphasizes that the studies submitted by the Ethiopian side are incomplete and calls for further technical studies.

However, what raises Egypt's deepest concerns is that Ethiopia already started diverting Blue Nile river flow as a preparatory action for starting the construction of the Dam, even before the Committee report came out.

The Dilemma: For or Against?

The USD 4.7 billion GERD is located at approximately 500 km North West of Addis Ababa. The Dam will be the largest in Africa: 1800 m long, 170 m high, with 74 billion m^2 storage capacity; it will generate 6,000 MW hydropower. Ethiopia maintains that the purpose of constructing the Dam is to generate hydropower to meet the increasing energy demand, and that hydropower is the only feasible and most cost-effective and accessible energy source it has at its disposal.

The Ethiopian Government views the GERD as a win-win development project that would contribute to overcoming centuries of mistrust among Nile Basin countries. It maintains that hydropower does not consume water, and in no way leads to significant harm to the water shares of the downstream countries. In addition, the Dam will improve water management, reduce evaporation loss, enhance water flow control flood and sediment, enhance navigation, and allow for power interconnection.

On the other side, Egyptian officials expressed deep concerns about the construction of the Dam. A group of engineering and agriculture experts in Cairo University known as the "Nile Basin Group" prepared a report in an attempt to study the possible side effects of the GERD.

They maintained that the GRED huge storage capacity will have harsh impact on Egypt's share of water and on the High Dam production during the filling period and during operation. During the drought period, this negative impact shall escalate as the water needed for electricity production will conflict with the supplies to downstream countries.

Reduction in Egypt's water supply will result in abandoning huge areas of agricultural lands, scattering millions of families, increasing water streams pollution, creating problems in water supply for drinking and industry, and posing challenges to river transportation, Nile tourism and fish farming.

The report also concluded that there are no sufficient structural studies for the Dam and that its collapse would result in catastrophic effects on both Egypt and Sudan including failure of dams, drowning of major towns and exposing millions to the dangers of death and relocation.

Such a critical issue cannot be handled but through rational political negotiations. It is inevitable that both sides cooperate to overcome this crisis with minimal harm to their respective interests.

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OFF THE GRID

By: Jailane Salem

The article you are currently reading owes its existence to electricity. It was typed on a laptop that was powered by electricity; its ideas were researched using the Internet, also available due to electricity.

While I am writing this, I feel a pleasant breeze wash over me, alleviating the heat, courtesy of a standing fan; a yellow light embraces all things in my room, shone by a light bulb hanging from the ceiling. As I contemplate what to write, I glance now and then to my mobile, checking if I have any new messages; every once in a while my mother calls me to check something out on television that she finds amusing, interesting, or aggravating.

What I have just relayed to you only took place during ten minutes or so; it is quite evident that electricity plays an essential part in my existence and yours as well, dictating many aspects of our behavior and lifestyle. It is a crucial component of our daily life since we use gadgets and services all available to us through electricity: a power we cannot live without… or can we?

If we re-imagine the scene I just described minus the presence of electricity, what would it have been like?

For starters, instead of feeling pleasantly refreshed by the constant breeze, I would instead have felt the heat more, and probably would have been somewhat sweaty. Instead of typing away at a laptop, I would have been writing away using pen and paper assisted by the glow of a nearby candle flame.

Whatever reading I did prior to my writing, would have probably been more time consuming, since I would have had to research books and magazines to find the information I wanted. Instead of being distracted by my phone, I would either have had better concentration or wasted the same amount of time whilst daydreaming. As for my mother calling me every once in a while, she might have called me to lend her my candle so she could light her own!

This is a scene that can be encountered during a power outage, or in a house where its people have decided to live off the grid.

Unplugged

Living off the grid is practiced by some people around the world. This is a decision they take for themselves to be powered independently, since the grid here refers to the power infrastructure that supplies buildings and homes with electricity.

Whichever company that runs the grid is the one that sends you the monthly electric bill; once you decide to live off the grid, you become responsible for your own supply. Some people install solar or wind power generators and create a system whereby they harness the Sun's or wind's energy, store it, and use it whenever they choose.

Other people who decide to live off the grid actually forgo the use of electricity, choosing instead to rely on old means to get by. They do without the refrigerator, the washing machine, the coffee maker, and any other electric contraption that we pamper ourselves with in this modern day and age. They instead lead simple lives that revolve around getting all sorts of chores done manually and without the shortcuts these electric machines have allowed us to take.

Now, one would wonder why unplug yourself? Why make your life seemingly more difficult when all these services have been created for your comfort.

Well, it seems that not everyone views these electric appliances and reliance on the government as a comfortable way of life. Some unplug themselves from the grid in the hope of de-cluttering their lives from all sorts of things that they view as entrapments into a lifestyle that is unsatisfactory to them, and that hinders them from living a more meaningful and fulfilling life.

Not everyone who decides to go off the grid does so for life. Some people do it for a short time, as a vacation, so that they can lead more relaxed lives and get in touch with nature. Others, go off the grid, but instead generate their own electricity and therefore lead the same life as before.

Those who decide to embrace a more natural way of life are forced to do more physical activities, and rely more on their own survival skills and self-sufficiency. Many end up harvesting their own food and getting their own water from wells and heating their homes using wood and coal; they become absolutely independent of utility companies. Such movements have taken root in different countries around the world, one being the USA.

"It is impossible to get an accurate count of exactly how many people in the United States live off-grid; but in 2006, Home Power magazine estimated that more than 180,000 homes were supplying their own power. Another 27,000 homes use solar and wind energy to offset their grid-connected life [source: USA Today].

The back-to-the-land movement accounts for some of these numbers, but more people in developed urban areas are looking to get off the grid as well. For most, it is a good way to be friendly to the environment; for others, it is a relief not to rely on overworked utility companies to meet their needs. Some people do it to be self-reliant or more in touch with nature. Many go off-grid to step away from society; still others do it because it is the most financially viable option available to them."

People who go off the grid, usually end up living on a piece of land that gets them closer and more attuned to mother nature. The Sun and wind become an essential part of their existence

because it provides them with the power needed for survival; another benefit is, of course, the reduced carbon foot print per individual.

It encourages them to be more environmentally friendly and consume less; instead, they focus on the necessities needed and forget about all the extras that add nothing but clutter to one's life. Changes can be very simple ones; for example, instead of using a hairdryer, a person would instead take their comb and stand in the Sun brushing their hair, enjoying the beauty that surrounds them, or sit in front of a cozy fire while their hair dries.

The last scene I have described seems quite idyllic; unfortunately not all people who do not use electricity lead such lives. While for some it is a choice to not use electricity, for others it is a curse that they must languish in the darkness once the Sun sets.

Unwelcome Darkness

Over 1.4 billion people are still without access to electricity worldwide; in India, about 70% of rural areas lack electricity and over 60% of rural households use kerosene lamps for lighting. Activities such as cooking, farming, and studying can be a great struggle because of the use of inefficient kerosene or paraffin lamps. Kerosene lamps used are costly—money and environmentally wise—they can be dangerous and emit greenhouse gases; however, not many people have other alternatives but to use kerosene lamps.

Fortunately, change is afoot; as clean energy makes advances every day, energy problems are being solved through innovative and sustainable means. There are millions of people in India, as well as worldwide who live without electricity; however, with the initiatives of providing suitable clean energy to them, their quality of life is improving.

One such initiative is the "Lighting a Billion Lives" (LaBL) scheme, which promotes solar energy as the environmentally friendly answer to India's energy shortages. The LaBL scheme is run by The Energy and Resources Institute in New Delhi and plans to eventually put 200 million lamps into use. Organizers have said that each lamp should work for ten years, saving between 500 and 600 liters of kerosene, which would produce about 1.5 tons of carbon dioxide.

The lamps are simple devices, which are charged during the day from a communal rooftop solar panel; they use between five and seven watts of power and have a battery that lasts up to eight hours. These lamps are equipped with a socket for charging mobile phones and a hand crank for topping up the power. Villagers pay between three and six rupees—six to thirteen US cents—a day to rent the lantern under the "Lighting a Billion Lives".

In this way, the solar energy that is abundant in India is put to great use. The average number of sunny days in India ranges from 250 to 300 days per year, with a solar energy equivalent greater than the country's total energy consumption. The use of these solar lamps have already started changing the lives of some villagers; shopkeepers can keep their businesses open for a longer period of time, housework can be continued at night, and students can now continue with their studies after darkness has fallen. Such changes are due to the first wave of 5,000 lanterns distributed across nine States in India.

By 2020, the Indian Government wants to achieve the goal of harnessing the power of solar energy into 20,000 megawatts as part of its National Solar Mission to promote renewable energy. This plan aims at having railway signals and water pumps eventually running on solar technology.

By the Power of the Lamp

Solar lamps are a huge part of revolutionizing the use of solar energy; this is due to the diligent work done by scientists in constantly developing and improving their solar products. There is a constant flow of solar products that aim at being more efficient, portable, durable, and so on; one such lantern runs on only water and salt.

Japan's Green House company has created a lantern that uses water and salt as a conductor instead of a dry cell or a rechargeable battery. "Using a dedicated water bag, the water and salt once placed in the lantern produce light, pure and simple. The lantern can generate electricity for eight hours per charge of water; you just keep refilling the bag every eight hours for continued light.

Inside the lantern is a magnesium rod—negative electrode—and a carbon rod—positive electrode—the magnesium rod can be used for up to 120 hours of power generation. What is drawing added interest is that the lantern can double as a charger as well as a light source. A USB port on the casing could be used to plug in a smartphone or some other device in the event of a power outage."

Another great development is that of the Luminaid, which was specifically designed to help in places where humanitarian aid is needed. After a natural disaster strikes, many people are left without proper shelter, and one of the first things to go is electricity. That is why two graduate students from Columbia University in New York designed a suitable solution that would help many in need.

Andrea Sreshta and Anna Stork worked together to bring about the creation of Luminaid. The idea is fairly simple; it resembles a plastic bag that can be manually inflated, and is the size of a small pillow. In an exterior pocket, a solar cell was placed as well as a rechargeable lithium-ion battery, and one single LED.

The device has one switch, which can be set to off, low, and high. When placed in the Sun, the battery can fully charge in two to three hours. On the low setting, Luminaid can give light for about six hours. On the high setting, it lasts around four hours. The Luminaid is made of waterproof material and can therefore float; it is also very pliable, which means it can be folded to take up little space and be easily shipped off in large numbers to whoever needs them.

One of the best features is the handle, which makes the inflatable lamp easy to hang and carry around. Stork explains: "We heard that, in the tent cities, people really wanted something they could easily take to the latrine at night, so it was very handy to have a handle to carry it around." It is that necessity that has inspired those two women to come up with a practical solution for a problem that plagues thousands of people.

Electric power, which one of its great advantages is the provision of light, is a blessing of modern living. It has allowed those fortunate enough to have a stable supply, to lead lives that are quite comfortable. Even though we sometimes take it for granted, one must never forget that, in order to keep this powerful energy flowing, we must consume responsibly.

With an eye towards the future, we have to devise sustainable plans to ensure the longevity of our resources, and also try to help those who are deprived of basic needs in this day and age, and ensure the availability of constant improvement to the quality of life of everyone.

Resources

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SELF-HEALING POWER

By: Jailane Salem

Within our bodies there is a power without which we as humans would never have been able to survive. Our bodies are equipped with the tools and power to heal itself and to regenerate in order to stay in tip-top shape; this power is always on, and helps us without us even knowing.

We are susceptible to foreign bacteria and germs that can wreak havoc on our bodies if left to their own devices; our immune system is alert to these trouble makers and fights to make sure they do not cause us harm. If harm is caused, then our body works relentlessly to get us back on our feet, all healed and healthy.

If you stop for a second and think how many times you fell down and scratched a knee or an elbow, you would no doubt say it happened countless of times. The moment a break in our skin occurs and we see blood, our immune system immediately goes to work to ensure we are protected from any further harm.

The moment you are wounded anywhere on your body, blood cells called platelets step up to the stage and get to fulfilling their role. Platelets basically stick together acting as glue where the cut occurred in order to form a clot. The clot forms because your body immediately realizes that the wound needs to be sealed off in order to protect itself from any invading microorganisms, and therefore nearby cells divide and multiply.

The clot—full of other cells called fibrin that act as an agent that holds it together—thus acts as a protective bandage to stop any more blood and other fluids from leaving the body, as well as barrier to anything trying to enter. After it is formed, a storm of activity takes place right underneath it.

Imagine it as a repair shop where all the technicians come together to repair a damaged device; each cell has a job to fulfill in order for the healing process to work. As cells multiply and divide in the wounded area, nutrients and building blocks are transported through a blood supply to the area, adapting to the particular size and shape of the wound. Whatever was damaged is under repair; even if a blood vessel was destroyed, a new one starts growing spontaneously in its place.

This process is so efficient that within a few hours the blood vessels would have already started forming into tissues. Not only that, but white blood cells also arrive to fight any infection to prevent us from getting sick. They attack any germs that may have gotten into the cut; they also get rid of any dead blood and skin cells that may still be hanging around the cut.

The clot that formed turns hard and dries to become a scab, which is a bit rough and dark reddish brown in color. In this manner, a double protection act is in place; one on the outside and another on the inside. Once the skin is fully healed, the scab naturally falls off. If you scratch at it prematurely, you would usually be left with a scar because you did not give it enough time to heal fully; this is why it is best to never irritate a scab, and just leave it to do its job.

All this flurry of activity takes place without us realizing it; it is an automatic response that we cannot control, initiate, or stop. Your body goes auto-pilot; we do not have to direct the blood to the wound, or direct any cells to start dividing and multiplying, or even direct the molecular waste products to be taken away. Our body realizes when our healing is complete and stops all the repairing actions by itself. A lot of this activity takes place while we sleep; while we dwell in dreamland, our body takes on the task of mending our tissues.

The human body is a powerful healing organism; if nurtured and taken care of properly it can perform miracles. Many times people have contracted illnesses that seemed impossible to heal; defeated by modern medicine, the powerful immune system would take charge and cure the body from any harm that resided within it.

Such cases are always dubbed as miraculous and a mystery to modern science. However, many scientists are paying more and more attention to these cases in an attempt to try and harness the body's powerful healing techniques and apply it whenever it is needed.

One such miracle recovery occurred in 2005. A man by the name of Charles Burrows noticed a strange lump on his stomach during summer; by November, he was in a lot of pain. After being examined, he found out he had inoperable liver cancer.

His tumor was the size of a baseball and was starting to strangle the portal vein going into the liver. "Doctors at the Phoenix Veterans Affairs Health Care System told Burrows, then 56 years old, there was nothing they could do. They told him to get his affairs in order because he had 30 days to live, maybe 60".

He quit his job and spent the next months in a daze; fortunately for him though, things did not go according to the doctors' prediction. "In February 2006, Burrows developed abdominal bloating, shaking, chills, and nausea. Soon after that, he noticed that the lump on his stomach was gone. By then, his daughter had found a doctor in private practice willing to consider treating him; however, the doctor could not find a tumor". The tumor had disappeared and Burrows was cancer free!

This is certainly the work of the immune system; this powerful system within our bodies can sometimes work in mysterious ways, but can yield unimaginable results that surprise and leave scientists speechless.

With cases like these happening every once in a while, it is clear that modern science still has a long way to go, and many enigmas to solve. With the advancement of technology and our growing understanding of the powers within ourselves, hopefully, we will one day reach an age where humans will be healthier and less prone to succumbing to illness.

Resources

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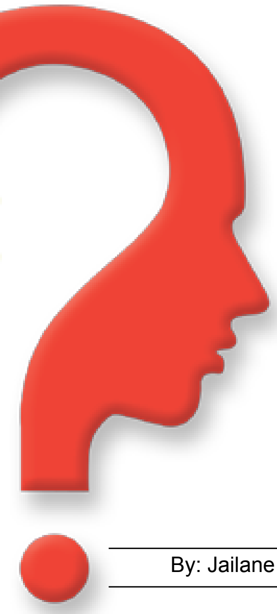
Savants: Humans with Mindboggling Powers



By: Jailane Salem

The word savant is defined as someone with detailed knowledge in some specialized field. Anyone who is a savant thus knows a lot about a certain subject; what differs though is that they do not arrive at their knowledge through the academic track, but through a magical gift bestowed upon them. To understand more about the phenomenon of savants, one must look into the "savant syndrome".

The savant syndrome is an extremely rare condition; it affects people who have neurological disorders including autistic disorder, and it gives them extraordinary abilities. Their condition deeply affects their ability to perform simple daily tasks, such as talking or social interaction; instead, they compensate with skills that far exceed the capacity of cognitive power of most people.

Autistic savants account for 50% of people with savant syndrome, while the other 50% have other forms of developmental disability or brain injury. Quite remarkably, as many as one in ten autistic people show some degree of savant skills. These skills which they possess can only be described as being extraordinary, as having photographic memory, playing music perfectly after hearing it just once, or doing complex mathematical calculations in one's head without the help of a calculator.

The reason why some autistic individuals have savant abilities is still a mystery; there are many theories, however, though there is no well-established evidence to support any of them. One of the speculations is that these individuals have incredible concentration abilities and can therefore focus their complete attention to a specific area of interest.

Researchers in psychology feel that coming to a complete understanding of memory and cognition is unattainable, until conditions that help form the savant syndrome are understood and become scientifically accounted for.

One case that offered clues to researchers is that of Orlando Serrell. When he was ten years old, he was violently struck on the left hand side of his head by a baseball. After this incident, Orlando suddenly started exhibiting astonishing complex calendar calculating abilities. He could remember the weather of every day since the accident.

It seems as though his brain was rewired to act differently, and he was able to use a power within his mind that so far had been dormant, and that was awakened by the accident. Orlando's case implies that there is a deeply hidden potential for amazing skills or exceptional memory within all of us, and it can be accessed after unknown triggers in our environment prompt the locked doors within our minds to open wide.

According to Darold Treffert, a psychiatrist, almost all savants are endowed with prodigious memories, which he describes to be "very deep but exceedingly narrow". What he means by that is that savants may have an extraordinary memory, but they only focus on remembering one thing and have difficulty in applying their skills to other areas.

Scans of the brains of autistic savants suggest that the right hemisphere might be compensating for damage in the left hemisphere. Although many savants have difficulty in dealing with languages and comprehension, which are skills associated chiefly with the left hemisphere, they often show amazing skills in mathematics and memory, which are abilities linked mainly with the right hemisphere. Savant skills do not cover the whole spectrum, but can typically be found in one or more of five major areas: art, musical abilities, calendar calculation, mathematics, and spatial skills.

If you have seen the movie "Rain Man", then you have come across the depiction of Dustin Hoffman as an autistic savant. Who can forget that incredible ability, where Raymond (Hoffman) can tell the exact number of toothpicks that fell on the floor with only a simple glance? Hoffman's character was inspired by a real life person: Kim Peek.

Kim Peek was born in 1951 with severe brain damage and passed away in 2009. When he was born, doctors advised his father to admit him in an institution and forget about him. Kim's father fortunately disregarded the doctor's advice and decided to take good care of his son. Kim suffered from severe developmental disabilities, which affected his abilities to walk and learn.

Even though he was severely disabled, and had tested well below average on a general IQ test, what Kim could do was amazing; he had read about 12,000 books and could remember everything about them. He was nicknamed the "Kimputer", because he could read two pages simultaneously. His left eye read the left page and his right eye read the right page; it took him about three seconds to read through two pages and he could remember everything in them.

Kim could recall facts and trivia from fifteen subject areas from history to geography to sports. If someone told him a date, Kim could tell them what day of the week it was on the spot. He also had the ability to remember every music piece he had ever heard. He always awed people with his abilities and created interest wherever he ventured.

Another autistic savant is Stephen Wiltshire who is also known as the "Human Camera". As a young child, Stephen Wiltshire was mute; he was diagnosed as autistic and was sent to a school for special needs children. While he attended this school he discovered a passion for drawing; at first he started drawing animals, then London buses, then buildings and the city's landmarks.

Throughout his childhood, Stephen communicated through his drawings; he learned to speak by the age of nine with the help of his teachers. Stephen's phenomenal talent is that he can draw an accurate and detailed landscape of a city after seeing it just once. He drew a ten-meter long panorama of Tokyo following a short helicopter ride, and his detailed drawings are highly prized as works of art.

The savant syndrome calls into question the established ideas of brain functions. The development of these amazing skills shows us and scientists that the brain still has many mysteries to be unlocked and explored. Many hope that with better understanding of autistic savants, this could lead to the discovery of how people who are not autistic could be able to access the "savant" part of their brain. Who knows, maybe in the future the keys will be found, and extraordinary powers will be looked upon as quite ordinary.

Resources

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Pollution and the environmental impact of petroleum-based means of transportation in the last few decades have renewed the interest in electric vehicles that were initially invented in the mid-19th century.

By: Nadine Arab

ELECTRIC VEHICLES

Unlike normal vehicles that are powered by fossil fuels, electric vehicles have various alternative sources of power. Required electricity could be generated from solar power, tidal power, wind power, nuclear power and could be generated from fossil fuels themselves.

Electric vehicles use one or more electric motors or traction motors for their propulsion, and to generate enough power to push them forward. Recharging systems are various but the most common one is charging stations that provide conventional power outlets used to charge electric vehicles. The charging process takes hours; however, vehicles could be charged overnight or during the drivers' working hours.

Ridek Corporation is a leading source of innovation in electric vehicles' technology under the leadership of Dr. Gordon Dower; he has created a patented recharging system in 2012: The Curb Connect. This recharging system avoids the need for cables in which electrical contacts are fit into curbs such as angle parking spaces in the streets. When an electric vehicle is parked so that its front end overhangs the curb, the charging process immediately occurs.

Lots of people will probably be wondering how much would the recharging process cost be. According to General Motors (GM), as reported by CNN Money, the GM Volt will cost "less than purchasing a cup of your favorite coffee" to recharge. However, the reality is that the cost of operating an electric vehicle varies depending on which part of the world the owner lives; in some locations, owning a gas-powered vehicle could actually be much cheaper.

Those special vehicles have several advantages though. Although electricity used to charge those vehicles may come from carbon dioxide-emitting sources, the net carbon dioxide production from an electric vehicle is one-half to one-third of that of a comparable combustion vehicle. This proves how efficient electric engines are in comparison to combustion engines.

Moreover, electric vehicles produce almost no air pollutants and cause less noise pollution than normal vehicles, whether in motion or at rest. Another key advantage of those vehicles is their ability to recover energy normally lost during braking as electricity to be restored to the on-board battery.

Electric vehicles include electric trains, electric airplanes, electric boats, electric lorries, electric motorcycles, scooters, and more. However, as expected, electric cars are the most common electric vehicles.

There are several good examples for companies that have introduced this outstanding invention such as Tesla. Tesla's founder, Elon Musk, started PayPal; an e-commerce business allowing money transfers to be made online. After making his first fortune in PayPal, he spent it all on manufacturing electric cars.

Tesla produced cars with the retail price of USD 109,000, which is actually not very expensive as Tesla serves niche customers and is positioned as a competitor to the Porsches, Ferraris and Lamborghinis.

A very different market that is being pursued was the Chevrolet Volt market; its retail price is approximately USD 40,000. This may be considered also expensive but let us not forget that electric vehicles are positioned for a different market; namely, customers who are willing to pay.

However, they are much more affordable than Tesla's cars and also have different designs. Tesla's cars are mostly more exotic-looking vehicles while Chevy's cars are designed as four-door passenger vehicles and closer to how ordinary cars normally look like.

Another company would be Global Electric Motorcars (GEM), which is a Chrysler company whose vehicles are limited to highways and are less likely to be seen in cities. Those vehicles have not been widely introduced yet as implementing them would be a very expensive process.

According to the above information, electric cars are not cheap; only a specific class of society would be able to afford buying cars with such prices. The process of generating electricity itself is not cheap either; providing power supplies enough for use of electricity in our daily life, in addition to electricity required to run electric vehicles will be quite expensive.

However, in the current environmental circumstances, such eco-friendly inventions are becoming a necessity rather than a luxury. They are certain to help in the battle to reduce the consumption of fossil-fuels, which, in addition to their devastating environmental impact, are non-renewable sources of energy that are gradually disappearing from existence.

It is about time more attention and investment is dedicated to research and development in this field in order to spread the use of these environmentally friendly vehicles and take a bigger step towards saving this planet.

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While I was waiting in the long line for my turn to get fuel, I asked myself: Is not there any alternative source of energy that cars can run on?

The black smoke coming out from the car in front of me ended my thoughts as it entered my lungs, causing me to cough. At this moment, I wondered, if this happened to me by just one car, what would happen to our health and the environment by this huge number of cars?

By: Omar Raafat

WATER-FUELLED CARS

When I returned home, I googled for a solution to this issue and I found what I am looking for: a car that can run by water!

Waqar Ahmed, a Pakistani engineer, had the idea of inventing a car that runs on water to solve the world's energy crisis. This idea was viewed as science-fiction ten years ago, but it seems that this science fiction is about to become reality, and we can find these cars on the roads very soon.

Engineer Ahmed drove his water-fuelled vehicle in Pakistan as a demo in front of media, students, scientists, and politicians. He claimed that a 1000 CC car covers a distance of 40 km with one liter of water only.

The Pakistani engineer has been invited by Ambassador Jamil Ahmed Khan, Pakistani Ambassador to the UAE, in Abu Dhabi, to give a demo to Adnan Z. Amin, Director General of the International Renewable Energy Agency (IRENA).

How?

Water-fuelled cars do not run on water only; they use gasoline, but in smaller amounts than regular cars. Water fuel kits work by using a hydrogen-on-demand system that converts water into flammable hydrogen (H_2) or oxyhydrogen gas (HHO). These gases will be channeled into your fuel tank and mixed with the gasoline; as these gases are flammable, they can generate additional energy to move the car.

The idea of running a car on water depends on splitting hydrogen from water by using membranes and catalysts that reduce the required energy. The membrane acts as both the conductive bridge between the two electrodes for the electrochemical reaction, and the barrier that separates the hydrogen from the oxygen.

Hydrogen fuel is fed into the anode of the fuel cell; assisted by the catalyst, hydrogen molecules are split into electrons and protons. Electrons are channeled through a circuit to produce electricity, while protons pass through the polymer electrolyte membrane. Oxygen—from the air—enters the cathode and combines with the electrons and protons to form water.

Since the amount of energy is over the level the engine needs to achieve to put the car in motion and generate the necessary power, a certain percentage can be re-transferred into the conversion kit, where it could be used to electrolyze more water.

These cars run on fresh water, salt water is not an option here; this would be another blow to the already existing water crisis. However, scientists are currently working on an efficient way to make saltwater fresh and useable.

Japanese car manufacturer, Honda, began the commercial production of these eco-friendly cars; it plans to produce 200 cars of this kind within the next 3 years. “This is an important day in the history of fuel-cell vehicle technology and a monumental step closer to the day when fuel-cell cars will be part of the mainstream,” said John Mendel, Executive Vice President of American Honda.

Why?

Not only are you saving money on fuel, you are saving money on maintenance too! The more gas you use on your car, the more the engine gets battered, thus reducing its performance; by using water as an alternative, however, it enhances your engine power instead and improves performance, which means more money will be saved because water fuel will help your car engine last much longer.

Not only does converting your car to a water fuel system improve your mileage while you drive either in a city or on a highway, after installing a water fuel system, you will notice that the engine and gearshifts run smoother thanks to the effect water has on the combustion cycle inside your engine.

With this effect on your engine's power and performance, it follows naturally that the parts of your car such as the pistons and valves would last longer; thus saving your money, in the long run, when your car runs longer without requiring maintenance or replacement.

In addition to having faster acceleration, a water fuel system keeps the engines running cooler. It will reduce the operating temperature of the car engine, which in turn reduces the heat released into the environment. It also lowers harmful emission into the environment, as it cleans itself. This makes the air cleaner and safer for anyone to breathe, and it helps combat global warming.

If you want to install the water fuel system, you do not have to be concerned about the type or model of your vehicle, because water fuel systems work with both diesel cars and trucks.

In the near future, you will not have to spend too much time waiting to get fuel; not only that, but by using the water fuel system we will be able to save our environment for years and years.

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Supercomputers

By: Jailane Salem

Computers are an essential part of our daily lives; we use them for work as well as play; and as our dependence on them increases, we would be quite lost without them.

The computers we use, such as laptops and desktops, are great machines that can handle many things. We use them to browse the Internet, handle spreadsheets, create documents and so on. The majority of people use a Pentium computer running Windows, or a Macintosh. These computers can execute about 100 million instructions per second. Perhaps the computer you use can be faster or slower, but that is the average speed for most personal computers.

The computers we use are, of course, not the only kind out there. One example is the supercomputer; just from the name itself, you should have an inkling of just how powerful that computer can be. These computers are described to be at the frontline of contemporary processing capacity, especially their speed of calculation.

These supercomputers were first introduced in the 1960s designed initially and, for decades, mainly by Seymour Cray at Control Data Corporation. "While the supercomputers of the 1970s used only a few processors, in the 1990s machines with thousands of processors began to appear, and by the end of the 20th century, massively parallel supercomputers with tens of thousands of 'off-the-shelf' processors were the norm".

Supercomputers are important for various reasons; they are crucial in the field of computational science, and are used in areas that require computationally intensive tasks such as quantum mechanics, weather forecasting, climate research, oil and gas exploration to name a few.

A new supercomputer has recently entered the scene and snatched the title of world's fastest computer this year. I am talking about Tianhe-2, a supercomputer developed by China's National University of Defense Technology. It has generated quite a buzz in the tech world, and is quite significant for it being developed in China as well as being composed of mainly Chinese components except for its main processors, which are designed by US firm Intel.

It achieved processing speeds of 33.86 petaflops (1000 trillion calculations) per second on a benchmarking test, earning it the number one spot in the Top 500 survey of supercomputers. Since 1993, the fastest supercomputers have been ranked on the TOP500 list according to their LINPACK benchmark results. The list does not claim to be unbiased or definitive, but it is a widely cited current definition of the "fastest" supercomputer available at any given time.

Tianhe-2 is the fastest computer ever made and has overtaken its competitor, the US-designed Titan, which has achieved a performance of 17.59 petaflops per second. The supercomputer it has overtaken, Titan, was made in the USA by Cray at Oak Ridge National Laboratory and was made to be used in a variety of science projects.

These computers are no run of the mill computers and are capable of helping scientists with their projects, and are an absolute asset to the advancement of science and technology.

Resources

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If you asked a group of smartphone owners what annoys them the most in their phone, you would receive a lot of complaints. Even though they cannot live without them, they would tell you about how they freeze, crash, hang, disconnect from the network; and, if they are iPhone users, they would scream at it for autocorrecting everything they type!

The one thing they would all agree on, however, is that their batteries die out too soon. Gone are the days of your old black and white phone that you charged once every week.

Why It Happens

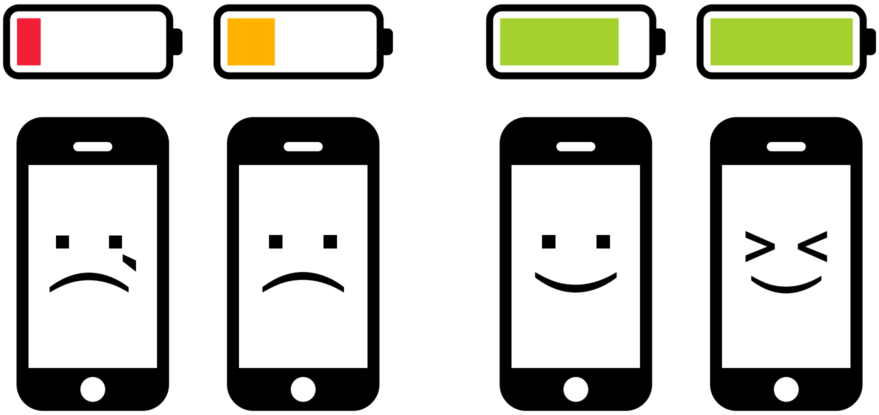
Most smartphones, tablets, laptops, or any other portable electronic devices use Lithium Ion batteries. These batteries are based on the movement of lithium ions from the anode to the cathode when powering a device, and the other way round when charging. Lithium Ion is a dated technology that has been used almost unchanged for 15 years.

As smartphones are new to the market, the room for innovation is huge. There are so many applications, features, and hardware components that can be added and re-imagined for smartphones. With the Lithium Ion battery, though, the technology is pretty much the same.

For the same battery size—and considering the requirements of aesthetic design for phones that prevent thick and large batteries—the maximum theoretical limit of utilization of the lithium compound's reaction present in the battery is about 80%. Scientists try to reach this limit but they only get incremental improvements, not nearly enough to make a difference.

Another factor that scientists try to minimize is the percentage of the battery's space that does not contain the lithium compound, but other 'control' circuits. They try to make these parts as small as possible to squeeze in more energy-producing Lithium, but this is also reaching its limit.

Lithium is also stored within graphite sheets that have a capacity for them. For years scientists have been stretching the limits of these graphite sheets by storing more and more Lithium within them; this limit is also being reached.



Sleepy Smartphones

By: Ahmed Ghoneim

The fact that smartphones are getting much more advanced means they are also consuming much more energy than before. As they have lots of added features such as super-fast Internet connections, bright and high-resolution screens, GPS and multitasking, phones consume more energy than a battery can give them for even a whole day. As long as Lithium Ion batteries do not improve, or the phones do not reduce their energy consumption, this problem will persist.

What to Sacrifice

The design of a mobile phone is a compromise between aesthetics, features, and battery life. To make a phone look slim and sleek, the battery's size has to be reduced, which effectively means shorter life. To add more features that will require more power, however, the battery life has to be sufficient. Designing a phone that balances these aspects is a very challenging task, one that manufacturers are partly failing in nowadays because you still have to charge your phone twice a day.

When comparing two of the most popular mobile platforms, Android and iOS, it was found that the iOS platform was much more battery-efficient than Android—comparison was done between several Android phones and the iPhone 4—because Apple decided to make a sacrifice.

They sacrificed true multitasking—having multiple programs running in the background while you work on one in the foreground—for battery efficiency. By having a system that allows only one program to be actively running, and all other programs in the background to be suspended, battery usage was reduced significantly.

What Android did, however, was the exact opposite. It provided true multitasking, which is much more advanced and mimics real computers, but had to sacrifice battery efficiency.

How to Attack

There are two main sides from which you can tackle the smartphone power problem; the first is to reduce the phone's power consumption. There are many typical power-saving tips that exist such as turning off GPS and mobile data; others advise you to lower your brightness or frequently lock your screen when not in use.

Moreover, there are a few power-hungry apps out there that you could find out about online and remove if you do not need. On the other hand, developers are now trying to optimize power usage by apps that require lots of data being sent and received, because the biggest power-drainer in a phone is its antenna, which sends and receives data.

A phone's antenna uses more than 65% of its total power. In the ages before mobile Internet, this was not a problem since you were not continually on the phone; with data connections, though, things are different. To be able to send and receive internet data—known as packet data—the phone's antenna has to rise to a certain level of energy.

Since nowadays phones are almost always online, that means the antenna is for lengthy periods of time at this "active" energy level. To make things worse, the standby energy level cannot be much lower than the active one because rapid switching between the two energy levels emits noise that disrupts communications. This means that even when you are not using the Internet, your phone's antenna is using energy just to stand by and wait for when you do.

Eta Devices—a wireless technology startup—has developed a solution to the antenna power problem. Their invention smartly selects an optimal voltage value with minimum power consumption to apply to the antenna. It does that about 20 million times per second, ensuring a much lower power consumption than usual.

Before applying this technology to phones, however, the company is first going to try it on 4G base stations—the stations with which your phone communicates. Since these stations already burn a whole lot of diesel oil to gain power and require a massive cooling effort, this technology—if successful—will benefit base stations a lot. Once this experiment is successful, they will roll out a chip version of their invention to be used in mobile phones instead of the current antennae.

The second side to tackle the smartphone power problem from is by increasing the amount of energy it can get. As we have already explained, there is so much energy you can fit into a slim battery in a slim phone. Since phone manufacturers are not going to make phones thicker, we need a completely new battery design that will allow it to provide more energy while staying thin. That is what the researchers at the University of Illinois have done.

The reason why Lithium Ion batteries are so popular is that they store a good amount of energy and can at the same time provide a lot of this energy in a short time when needed (high power). Since mobile phones undergo "bursts" of activity when streaming a video or making a call, high power is needed. Since they cannot charge fast enough, an empty Lithium Ion battery requires you to plug in your phone and wait for it to charge.

What the researchers have done is alter the structure of the Lithium Ion battery. Instead of having a 2-dimensional anode and cathode, they created a new 3-dimensional structure for them that makes the chemical reaction in the battery much more robust providing even more power than original Lithium Ion batteries and causing them to charge 1000 times faster.

This means that even if you run out of charge, you can plug your phone in and in an instant it will reach 100% charge. Their new battery design is even much lighter and thinner than original Lithium Ion batteries.

The new Lithium Ion battery is facing a few obstacles before it reaches the market, though. First of all, they have only developed this battery in the size of a button, which is not nearly large enough for mobile phones. They have to prove that they can be able to make it a lot bigger so that it can provide an adequate amount of energy when charged. Secondly, they have to reach a cost-effective production method so that this battery does not sell for too much.

Many governments have been waking up to the fact that we need new battery technology; the US alone spends millions of dollars funding battery research. With more and more exciting new discoveries every day, we can hope that one day we would go back to the beautiful days of not charging our phones for a week. Until then, brace yourselves, and carry a charger everywhere!

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TOP 10 CREATIVE WAYS TO PRODUCE POWER

By: Ahmed Ghoneim

Electricity is the most important form of energy we use nowadays; it powers nearly everything from factories to homes. The problem with power is that it is not abundant enough. We rely mostly on fossil fuels to generate heat, which in turn is transformed into electricity. With the looming end of fossil fuels, we face a world energy crisis. Amidst all the worries, however, some interesting ideas have come out to produce power; here are my 10 most favorite.

1

Charge while You Drink

For caffeine addicts like me, my mug is my best friend. Be it a chilly mug of CocaCola or a steaming hot Nescafe, I need my daily fix to keep going. Well, fortunately for me, I can now charge my phone while drinking!

That is what the people over at epiphany laboratories, a startup, have achieved. Pitching their idea on Kickstarter—a website that gathers “pledges” from people willing to support a startup—they have gathered USD 132,739, USD 32,739 more than their required goal to kickstart this project.

They have created a device shaped like a puck—the circular thing hockey players pass around; they have called it the “epiphany one puck”. The puck has an opening for a USB cable from which it can provide power. It has two sides, a blue and a red one; intuitively, you put a cold drink on the blue side and a hot drink on the red side. Once you do that, the device takes advantage of the temperature difference between your drink and the atmosphere to produce a current of up to one Ampere and charge any device that uses USB.

2

More Drinks

Ever since I was a little kid I was told in school that water is life. We are 75% water; we use water in almost everything, and without it we are surely to die. Water is used to produce electricity when it flows in rivers and waterfalls; but, did you ever hear of a battery filled with water?

A twist on a very old idea, the galvanic cell, in which two metal electrodes are submerged in solutions where they undergo chemical reactions, the water-powered clock needs only water and a splash of lemon juice. You see, the water with lemon juice is an electrolyte, which is a solution with positive and negative ions in it.

The water-powered clock contains two initially neutral metal electrodes of different substances that have different reactions to the solution. One metal deposits electrons into the water, turning some of the positive ions into neutral molecules and becoming positive itself. The other metal takes electrons from the water, turning some of the negative ions into neutral molecules and becoming negative itself. The result is one positive electrode and one negative one, which creates a cell.

When you connect a circuit to this cell, it provides it with electricity due to the electrical current that flows between the electrodes. Unfortunately, a simple galvanic cell made from lemon juice can only provide a certain amount of electricity enough to power a small clock, but not much more.

3

Bench Charger

Who ever said sitting down was useless? In a train station in Torino, Italy, there is an interesting bench that disagrees. You see, when you sit down on that bench, Light-Emitting Diode (LED) lights start to light up.

Based on an interesting idea by Massachusetts Institute of Technology (MIT) architecture students James Graham and Thaddeus Jusczyk that envisions harnessing normal human motion everywhere to generate power, the bench relies on the sudden weight from sitting down. When that happens, a flywheel hooked up to the bench turns. By turning, the kinetic energy in it powers a dynamo that generates electricity.

The bench has already become an interesting attraction for the people who visit the station; this application to the idea is only just a beginning, however. James and Thaddeus would like to apply this on larger scales in crowded areas, by, for example, adding pressure pads underground in crowded areas. The pressure pads would generate power from the thousands of footsteps a day on them, partially powering the train station. They envision lots of buildings generating part of their electricity this way.

4

Charge Your Hotel for a Free Meal

Denmark, one of the socialist heavens of northern Europe, is a pioneer of green movements. One of its hotels, the Crowne Plaza Hotel, generates part of its electricity from its residents. More human Power!

In exchange for a USD 36 free meal, you are required to ride on a bike for 15 minutes, producing 10 watt-hours of electricity that the Hotel uses. So instead of feeling guilty about overeating, you burn that meal even before you eat it, help the environment, and get your meal for free. Seems like heaven to me!

5

Yet another idea harnessing footsteps, Surya, a nightclub in the UK, is completely green powered. Using wind turbines and solar energy, the club is completely self-sufficient with electricity.

Added to that, the high-tech gear inside the club receives its power from none other than the people dancing inside of it. The whole dance floor is designed to absorb energy from the feet of the dancers. Cyclists and walkers also get free admission to the club, which makes it the greenest club in the world.

6

Reading Tea Leaves

If you drink a cup of tea, you should not throw out those leaves once you are done with it. No, it is not because you should read your future in them; it is because the future of energy is in them.

With the massive number of cups of tea being drunk each day, the amount of leaves they leave behind is quite a lot. Each year, the world produces 3.8 million tons of tea; what Pakistani researchers Tariq Mahmood and Syed Hussain have realized is that this amount of tea leaves being thrown each year is a waste.

Instead of throwing them out, they decided to recycle them. They have successfully reached production of biodiesel, ethanol, methane, propane and fertilizer from tea leaves. In their research at the Nano Science and Catalysis division in the Pakistani National Centre for Physics, Tariq and Syed have developed two methods for the recycling of tea leaves.

The first method, called gasification, is basically heating up organic material to very large temperatures in the absence of oxygen so that they do not burn, but turn to gas. The problem with this method was that it required a very large amount of energy to be exerted because it needed temperatures of up to 1000°C.

What they did, however, was make the process much less energy-intensive by using a catalyst. Using Cobalt they were able to reduce the temperature at which gasification occurs to 300°C. The Cobalt can be reused as many times as possible without running out, because a catalyst helps a reaction but does not become part of the end product.

The gasification process' direct end products were the hydrocarbon gases methane, propane, methanol, ethene and propyne, liquid which can be turned into biodiesel, glycerol and soap through a separate process called transesterification and charcoal solids which have chemical applications or can be used as fertilizer.

The second method uses a microbe, *Aspergillusniger*, to ferment the tea leaves. With the help of the amount of sugar people put into tea, the microbes converted 60% of the tea leaves into ethanol, which can be used as fuel. Ethanol also helps in the manufacture of biodiesel, which makes this method a possible supplementary to the first.

The main concern with this creative research is the first method. Is the energy used in gasification less than the energy harnessed from the tea leaves? Or is it an inefficient process? Can it be made more efficient in the future? Maybe one day your recycling bins will increase by one bin: tea leaves.

7

Train Station Again

Another idea by the Japanese, similar to the idea by the MIT students is also harnessing power from people's movement. In two of Tokyo's busiest stations, special flooring tiles are installed in front of the ticket turnstiles. The tiles are constructed from layers of rubber sheets and ceramic, to absorb footsteps' energy and generate power from them; the energy is then stored in capacitors.

Each step from a 60 kg person generates 0.1 Joules of energy, not a very large amount. With the large area of the tiles and the large amount of people in the bustling stations, it can generate a good amount of energy.

In Tokyo station, the average 400,000 people passing through it every day have given the station enough energy to power the electronic signboards in the station. However, in Shibuya station on the other side of Tokyo, 2.4 million people pass every day. The energy generated from the tiles over there has actually been used to provide electricity for other, more power-hungry parts of the station.

8

Cow Manure

Did you know that cows are one of the largest contributors to global warming? Yes, ladies and gentlemen, it is not only your cars that you should worry about, it is your cattle.

You see, cattle produce a large amount of methane from belching and flatulence. Methane, even though not present in the atmosphere as much as CO_2, is a major contributor to global warming and is much more dangerous than CO_2. As much as we worry about the increasing number of cows in the world, though, there is nothing we can do about them. We like our meat!

Another source of methane is cow's manure. Cow manure just stays there, rotting and emitting methane and bad smells without use. What research in the University of Texas in the US has shown is that burning all the cow manure over there could produce 100 billion kilowatt hours (kWh) of electricity yearly. This could power 10 million homes a year, assuming the yearly consumption of an average home is 10,000 kWh.

Burning manure is similar to burning coal, except it has the added benefit of less CO_2 production and the prevention of methane emissions that would otherwise be released into the air.

9

Garbage Power

Yet another organic—and bad smelling—idea that is gaining success in lots of countries is incineration; the burning of waste material—garbage—to decrease its mass and volume, making it easier to get rid of.

Even though it is not by any means a new idea—the first incinerator having been devised in the 1870s—it has started to gain immense popularity, especially in Northern Europe. The fact is burning things produces heat; as Northern Europe is cold, they harness this to heat their houses and schools.

The idea is so popular that Norway actually imports garbage from other countries! The other countries benefit by getting rid of their garbage, and Norway successfully recycles unused material that would otherwise be thrown in landfills.

It does not come without its limitations, however. There are a few treatment steps that have to be carried out to the by-product of these incinerations to prevent toxic waste from reaching the masses. All in all, though, it is a very green and useful application to garbage.

10

Anaconda Power

An emerging source of renewable energy is wave power. Still being recently developed, there are no commercial applications that harness it except for a wave farm off the north coast of Portugal. A recent development by a company named Atkins will most probably change that.

The idea is brilliant; just as the waves oscillate everything in the sea up and down along with them, anaconda does the same. A 200-metre-long water-filled rubber device that is tethered to the sea bottom, anaconda was named so due to its resemblance to a snake.

Filled with fresh water so that salt-water creatures do not take up residence in it, the rubber device is moved by the waves in a pulse much like the pulse you feel in your wrist. The pulse moves in the direction of the wave and once it reaches the end it pushes a turbine to keep it moving. Imagine yourself pushing a playground carousel every few seconds, will it ever stop spinning?

The advantage of wave power over wind is that it has a much higher efficiency, meaning a lot more percentage of the wave's energy can be captured; so much in fact that a single anaconda can power up to a 1000 houses. What do you think? Would you use an anaconda to power your house?

There are many creative ways to produce power. Some are practical and some are just for fun. What do you think of these ideas? Which were your favorites? Do you think one day we will be using one of those?

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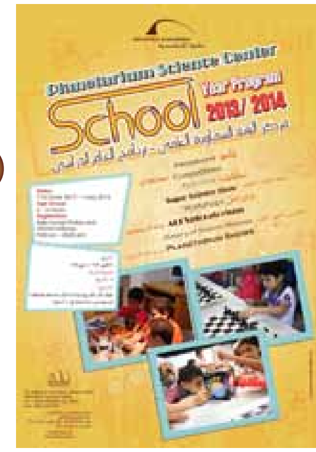
And the Winner is...

Illustrations: Faten Mahmoud

With the restless motion of modern technology that tries to offer smarter, more cost-effective and environmentally-friendly transportation solutions, our childhood friend—the bicycle—wins the race. Not only do bicycles not harm our environment and help us avoid traffic jams and parking problems, but also keep us physically healthy and fit. Hence, bicycles remain the best choice for short-distance transportation in cities.



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