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*The Cover Page depicts: Origin of Life*  
*Cover Design: Sanatan Rout*
EDITORIAL
ORIGIN OF LIFE

Once upon a time discussion is on some deep questions of existence such as the creation of the Universe, the Origin of life etc., were considered to be the exclusive monopoly of religious texts. Today science has ventured to address these so called metaphysical issues in rational manners. Origin of the universe and its evolution through several epochs has been explained to a great extent by modern cosmology. Chemical and biological evolution of matter and origin of species have been understood to a great extent. However, spontaneous creation of life from nonliving matter has been a burning question till today.

This question is as old as humanity. It abounds with exotic theories, which are never totally rejected or accepted, but merely go in and out of fashion.

It is generally agreed that all life forms are evolved by a common descent from a single primitive life. It is not known how this early form of life came into existence, but scientists think it was a natural process which might have taken place on Earth, as early as 3.9 to 4.2 billion years back.

Until the early 19th Century many people believed in the spontaneous generation of life from non-living matter. But it was disapproved by Louis Pasteur. He showed that without spores no bacteria or viruses can grow on sterile material. The first idea that 'Primeval soup' of organic molecules could be created in a reducing atmosphere through the action of sunlight was proposed by Alexander Oparin in 1924. Around the same time in 1928, JBS Haldane also suggested that the Earth's pre-biotic oceans, which were very different from the present day oceans, would have formed a "hot dilute soup". In this soup, organic compounds, the building blocks of life, could have formed. This idea was called biopoiesis.

The assumption of Oparin and Haldane was supported by the famous Urey-Miller experiment of 1953 in which a spark discharge was passed through a highly reduced mixture of gases - methane, ammonia, hydrogen and water which purportedly mimic an early earth atmosphere. It yielded a minute quantity of amino acids and some other organic molecules. This experiment showed how organic molecules could have formed on early Earth from inorganic precursors. In 1960, Sidney W. Fox succeeded in showing the spontaneous formation of peptide structures under conditions that might have existed early in Earth's history. He demonstrated that amino acids could spontaneously form small peptides.

This chemical evolution theory is mostly speculative. In spite of the successful synthesis of all prebiological molecules in the laboratory, none of the early Precambrian rocks contain anything that can be recognized as prebiological organic matter. Meteorites are older than the Earthly rocks and found to contain structures, probably of organic matters. Despite a few objections the chemical theory about origin of macro-molecules is widely accepted.

In late 1970s, it became more clear that the early Earth's atmosphere was probably volcanic in origin and composed largely of carbon dioxide and nitrogen rather than a mixture of reducing gases assumed by the Urey-Miller model. A paper published in 'Earth and Planetary Science Letters 2002' it was reported that the chemical properties of the Earth's interior have been essentially constant over Earth's history, leading to the conclusion that life might have originated in other environments or by other mechanisms. Kelley in 2010 proposed that life arose in undersea hydrothermal vents. But this idea has also not been widely accepted.

Some propose that early Mars was a better place for the origin of life than the early Earth. The molecules which combined to form genetic material are more complex than the primordial soup of organic chemicals that existed on Earth four billion years ago. For a longtime scientists, who worried about life's origin or existence of life elsewhere in the universe, have worked on the fringes of science; generating hypotheses with little confirmatory data, toiling on the borders of fact and fiction.

The origin of life is a big question in science. It begins to place life and us in the universe. It is true that we really do not have a clue how life originated on Earth. What created life out of the inanimate compounds that make up living things? No one knows, how was the first organism assembled? Nature has not given us the slightest hint. If anything, the mystery has deepened over time.

While many assessments of origins of life are pessimistic, the search for life beyond Earth continues. Evolutionary biologist like Ernst Mayr, have felt that the search for extraterrestrial life, astrobiology is more popular with some group of physical scientists. This work highlights many important aspects, such as the universal nature of biochemistry, innovative instruments for detecting extraterrestrial molecules and the presence of life elsewhere in the solar system.

Research on origin of life has had a chequered history and has a long way to go; but it is interesting that this field of science, still continues to be a mystery.

Tarani Charan Kara
Introduction

Undoubtedly, amongst the most remarkable natural anomalies on the surface of our planet lies the beautiful landscape of the Dead Sea, being flanked by mountains to the east and the rolling hills of Jerusalem to the west, giving it a divine beauty. What precisely gives the Dead Sea its name? The Dead Sea is different from all other water bodies on Earth, because it is incredibly salty, with a saline level between 28 and 35 percent. By comparison, the world's saltiest oceans are only 3 to 6 percent salty. Dead Sea means "Sea of Salt" in Arabic, and in Hebrew the meaning is "The Sea of Death". It is called the Dead sea because the salinity level of this water body results in a harsh and insensitive environment which is unsuitable for survival of life. The shore of the Dead Sea is the lowest dry point on the Earth which has attracted visitors from different parts for thousands of years. The Dead Sea provides a dense, rich blend of salts and minerals that supply industry, agriculture and medicine with some of its finest products.

Life in the Dead Sea

The name Dead Sea originated because early visitors believed that life did not exist in or around the area because of high salinity. Due to the high level of salinity, the usual aquatic flora and fauna of the sea are unable to survive in this water. However, some microbes exist in this extremely salty sea. The microorganisms present in the Dead sea are known as halophilic i.e salt loving. These microorganisms mainly belong to the domain Archaea and are around 1,000-10,000 per ml which is much lower than that found in regular sea water. The Dead Sea temporarily comes to life in the wake of rainy winters. In 1980, after one such rainy winter, the normally dark blue Dead Sea turned red. Researchers from Hebrew University of Jerusalem found the Dead Sea to be heaving with a type of algae called Dunaliella. The Dunaliella in turn nourished carotenoid-containing (red-pigmented) halobacteria, whose presence caused the change in colour. Since 1980, the Dead Sea basin has been dry and the algae and the bacteria have not returned in measurable numbers.

Geographical Location

The Dead Sea is fascinating and interesting. It is different from other water bodies because visitors can float effortlessly on the waters of the Dead Sea. It lies in the Jordan Rift Valley. This vast stretch of water body receives a number of incoming rivers, including River Jordan the main tributary. There are some small perennial springs present around the Dead Sea, forming pools and quicksand pits along the edges but there are no outlet streams.
The Dead Sea is 377 m deep, the deepest hypersaline lake and its water has a density of 1.240 kg/L, which makes for effortless floating. Rainfall is scarcely 100 mm per year in the northern part of the Dead Sea and barely 50 mm in the southern part. The Dead Sea zone’s aridity is due to the rain shadow effect of the Judean Hills lying to the west of the Dead Sea. The highlands on the east of the Dead Sea receive more rainfall than the Dead Sea itself. The Dead Sea is constantly being supplied with water from nearby small drainages, but the Dead Sea itself has nowhere to drain. The only way water can escape from the Dead Sea is through evaporation. As water evaporates, dissolved mineral salts are left behind and get confined within the Dead Sea. Water temperatures in the Dead Sea can exceed 90 degrees Fahrenheit during the summer and 68 degrees in winter.

**Formation of the Dead Sea**

Dead sea is ancient and as with many other geological formations, it did not just happen overnight. It took several million years before it shaped into its current state.

It began its formation around three millions years ago when activity at the boundary between the Sinai sub plate and the Arabian plate caused major upheavals of the Mediterranean seabed, which covered most of modern-day Israel at the time. Between these two plates a block of crust sank, forming a graben or depression. As the Mediterranean evaporated, some water was retained in the graben, creating a series of lakes in the graben that disappeared and reappeared as a result of long scale climatic changes in the area. The last of these lakes, Lake Lisan, which stretched from the northern portion of the Araba Valley to the Sea of Galilee, eventually dried up forming 3 km thick beds of salt 15000 years ago leaving behind the current Dead Sea.

**Composition**

The mineral content of the Dead Sea is incredibly different from that of ocean water. The exact composition of the water of the Dead sea varies mainly with season, depth and temperature. The average concentration of ionic species (in g/kg) of Dead Sea surface water is Cl⁻ (181.4), Br⁻ (4.2), SO₄²⁻ (0.4), HCO₃⁻ (0.2), Ca²⁺ (14.1), Na⁺ (32.5), K⁺ (6.2) and Mg²⁺ (35.2). The total salinity is 276 g/kg. The composition of the salts, as anhydrous chlorides on a weight percentage basis, are: calcium chloride (CaCl₂) 14.4%, potassium chloride (KCl) 4.4%, magnesium chloride (MgCl₂) 50.8% and sodium chloride (NaCl) 30.4%.
In contrast, the salt content in most of the oceans and seas is approximately 97% sodium chloride. The concentration of sulphate ions \( (\text{SO}_4^{2-}) \) is very low, and the concentration of bromide ions \( (\text{Br}^-) \) of the Dead Sea is the highest of all water bodies on Earth. The salt concentration of the Dead Sea fluctuates around 31.5%.

**Geological significance**

The Dead Sea is an integral part of the geologic structure of the Middle East, and there are many unique aspects of the Dead Sea that make it geologically significant. Earthquakes take place due to large scale transform faulting. Dead Sea Transform Fault Zone running through the Dead Sea region is a left-lateral strike-slip fault, which is a fault where movement is mostly horizontal and parallel to the strike. The slip rate, or rate of movement along the fault ranges from 1-10 mm annually. The fault connects the diverging plate boundary in the Red Sea to the Taurus converging plate boundary in the north, between Turkey and Syria, and runs along the Araba Valley, a 160 km stretch from the Dead Sea to the Gulf of Aqaba. The Dead Sea fault was the source of several large historical earthquakes, with the last major one being the 1995 earthquake that hit the Gulf of Aqaba and measured 7.3 on the Richter scale. Geologists predict that given the slip rate, the Dead Sea fault running through the Araba Valley should trigger 7.0 earthquakes every 200 years.

**Mineral Resources**

The Dead Sea is exceptionally rich in minerals and happens to be the most mineral-rich large water body in the world. The deeper the water in the Dead Sea, the higher is the concentration of salt. With evaporation, the dissolved minerals are left behind, leading to high concentrations of minerals in the sea, such as sodium, potassium, calcium, bromine, and magnesium salts.

Erosion of the surrounding horizontal strata also contributes to the high concentration of minerals. Further, along the shoreline there exists thermo-mineral springs containing many minerals, predominantly sulphur. Twenty one type of minerals are present in the Dead Sea, out of which twelve types are not found in any other water body. Rock types that are found in the area include granite, other igneous rocks, acidic silicates, gravel, clay, sandstone, rock salt, and alluvial deposits.

The Dead Sea is so rich in minerals that makes it a desirable and profitable location for mineral extraction. While the northern basin of the Dead Sea has remained mostly untouched by industry and has been primarily set aside for tourist use, the southern basin, which is shallow and extremely rich in minerals, is being tapped for its mineral resources. The mining companies extract potash and other chemical products such as magnesium chloride, industrial salts, de-icers, bath salts and table salts, and raw materials for the cosmetics industry. They use a very unique
method to take potash and other minerals from the Dead Sea. In addition to mining, solar energy can also be harnessed for evaporating the water in the Dead Sea by constructing evaporation ponds, which help in extracting pure potash and other minerals. However ecologists apprehend that potash production may upset the environmental stability of the area by emitting dust, carbon dioxide, sulphur dioxide, and carbon monoxide into the air, as well as by producing ozone-depleting methylbromide. From the Dead Sea brine, Israel produces (2001) 1.77 million tons of potash, 206,000 tons of elemental bromine, 44,900 tons of caustic soda, 25,000 tons of magnesium and sodium chloride. On the Jordanian side of the Dead Sea, Arab Potash (APC), formed in 1956, produces 2.0 million tons of potash as well as sodium chloride and bromine annually.

**Presence of Sinkholes**

The shorelines of the Dead Sea are spotted with hundreds of sinkholes clustered at twenty different sites surrounding the sea. These are somewhat recent geological phenomena of the region, first came to lime light in 1980's. Their dimensions reach up to 10 metres in depth with a diameter of 25 metres. The sinkholes are distributed parallel to the tectonic features of the Dead Sea rift. An imperative condition that contributes to the development of sinkholes on the surface is the presence of a salt layer. Geologists of Geological Survey of Israel are of the opinion that the Dead Sea sinkholes are formed due to the reaction between subsurface salt layers and groundwater. However, possibility could also be the decrease in the Dead Sea's water level leading to a drop in hydrostatic pressure within pre-existing cavities, causing them to collapse. (Fig.2). Sinkholes present a serious problem to the Dead Sea region, threatening resorts, hotels, as well as the potash and mineral plants on the southern basin.

**The shrinking of the Dead Sea**

The Dead Sea is actually shrinking. It shrinks as much as 13 inches annually. From a depression of 395 m below sea level in 1970 it fell 22 m to 418 m below sea level in 2006, reaching a drop rate of 1 m per year. As the water level decreases, the characteristics of the Sea and surrounding region may substantially change. The Dead Sea has been gradually evaporating as its main source of fresh water, the Jordan River, has been siphoned off just below the Sea of Galilee to supply drinking water for Israelis, Palestinians and Jordanians. Many regional efforts are being tried including the Red Dead Canal, to save the functioning Dead Sea from evaporating.
Health Benefits

It is one of the world's first health resorts. It has been the supplier of a wide variety of products like balms for Egyptian mummification and potash for fertilizers. People also use the salt and the minerals from the Dead Sea to create cosmetics and herbal sachets. The Dead Sea area has become a major centre for health research and treatment for several reasons. The mineral content of the water, the very low content of pollens and other allergens in the atmosphere, the reduced ultraviolet component of solar radiation, and the higher atmospheric pressure at this great depth each have specific health effects. Floating is a novelty and uniqueness that not only attracts the visitors but also they come for the therapeutic value of the mud and salt water. It is helpful for ailments such as arthritis and skin disorders such as psoriasis.

Visitors from around the world travel to the Dead Sea to soak up the salt and other minerals found in the water. Salts and minerals promote proper blood circulation, wash away dead skin cells and regenerate living skin cells. Additionally, the salt and minerals can relieve tense muscles and prevent infections. Many health and beauty products, such as scrubs and soaps found in spas, contain salt and minerals of the Dead Sea. Here the air is extremely dry and temperature is also high throughout the year with a maximum temperature of 30°C during winter, and 40°C during summer making the Dead Sea a tourists destination for 365 days a year.

Conclusion

The Dead Sea area has become a major centre for health research and treatment for several diseases. Explorers and scientists usually come to this area to analyze the minerals and conduct research about the unique climate and also to prevent the Dead Sea from shrinking. At a regional conference in July 2009, officials expressed increased concerns that the water level of the Dead Sea is declining. Some suggested various industrial activities around the Dead Sea need to be reduced. Others advised a range of possible environmental measures to restore the previous conditions. This might include in increasing the volume of flow of water from the Jordan River to replenish the Dead Sea. Experts also asserted a need for strict conservation efforts such as limited agriculture and preventing sources of pollution. Other alternatives suggested in tackling the Dead Sea problems include the renewal of the flow of water of the Jordan River through the use of desalination and changes in the water policies of the Jordan River.

Further Reading


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SOLAR FENCING

*Bishnu Prasad Behera
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Solar fence system enables the control movement of animals by giving them a short, sharp but safe shock, which is sufficiently memorable. This is similar to electric fencing, but it is energized by solar photo voltaic systems harnessing free energy available in the nature. Solar fence has the capacity to power over long distances of multi-wire fences. This has promoted the use of electric fencing on to large properties and enabled the control of all animals, including wild ones. Solar fencing need not have physical strength because it seldom comes under pressure but it must be well designed and constructed to absorb the impact of animals. It has an extensive range of energizers, which is based on a high energy pulse of flow impedance which effectively controls animals even over long distances. Fencing system provides both an economic and a practical solution to achieve maximum protection through effective control of animal trespass and browsing. Better protection of crops can be done from animals by this fencing.

Important features

This type of fence is easy to construct. Power fence can be erected to target specific species only. The maintenance cost is less. All domestic and wild animals can be controlled economically. Strip grazing and additional subdivision can be possible. The system can be modified to control a variety of animals for easy operations. The trespassers and predators are discouraged. It gives a short, sharp shock to the intruder, which is not harmful.

Working principle

The Solar module generates the DC energy and charges the battery. The output of the battery is connected to energizer or controller. The energizer produces a short, high voltage pulse at the regular rate of one pulse per second. The live wire of the energizer is connected to the fence wire and the earth terminal to the earth system. Animal or intruder touching the live wire creates a path for the current through its body to the ground and back to the energizer via the earth system and thereby completes the circuit. Thus the intruder receives a shock. The greater the shock the intruder receives, the more lasting the memory for him to be avoided in future. The energizer has to be set up with its earth terminal coupled to an earthing or grounding system. The live terminal is coupled with the live insulated wires of the fence. Energizer sends an electric current along an insulated steel wire. The shock felt is a combination of fence voltage and pulses time or energy. The higher the joule rating of the energizer, the greater is the shock and the fence performance.
Technical specifications

1. One solar fencing system, named Security Power Fence System (SPF) is designed with cyclic wave technology of high voltage deterrent system which would detect and deny physical intrusion by giving the intruder a short, sharp and painful but safe shock. The system should check the fence 50 or less times a minute. When the fence wires are cut or tampered with, a built-in alarm will immediately alert the monitoring personnel and the security authorities. The line sketch of the solar fencing system is shown in the Fig. 1.

2. The SPF should be of 2mt. height from the ground.

3. Warning sign boards made of waterproof material meant for outdoor use should be placed all sides. The boards are to be painted with fluorescent yellow background and black lettering. The size of the board should be 500mmx250mmx3mm.

4. Energizer: The electrical specifications of the energizer will be as follows:
   - Description: High voltage energizer.
   - Peak level of voltage: 10000 volts.
   - Maximum impulse duration: ON time-0.05 sec., OFF time-1.3 sec.
   - No. of pulses/min-45 Max.
   - Quantity of Electricity per impulse: 2.5m.CMax.
   - Discharge/impulse: 4.8 joules.
   - Peak value of current: 10 amps.
   - Period for which the instantaneous value of the output current exceeds 300mA: 1.5m.s
   - Battery: 12 volts/72Ah/Dry Rechargeable Sealed Maintenance free battery, Exide/Amaron make Charger: 40 Wp Solar photovoltaic module & standby battery charger 30-40 watt output 230V AC operated. The Energizer and the fence will be capable of integration with other security devices like CCTV, Access Control, Movement Detector, Intruder alarms, Pollution Monitoring Systems, Security lighting system, fire and smoke detection system etc. to form an integrated security network.

5. Alarm System: The alarm system should be AUDIO in nature to indicate intrusion in the protected zone. It should be hooter, with a minimum of 60 dB output (adjustable type).

6. Other components: These comprise various components like Fencing Posts, HT wire Insulators and End Strain Insulators, End and corner strain hooks, Permanent wire tightening devices, Earthing System, Tension maintenance devices, Joint clamps, Lightning Protection devices, Maintenance Free Battery, Warning Signboards etc.

All end, corner, section and pull through posts will be supported adequately. The wire fencing must be of high carbon steel, heavily galvanized to withstand the atmospheric conditions of the site. The insulators used on intermediate security posts will be made up of high-density polyethylene UV resistant/stabilized. It should have a shield to prevent arcing between wire and post. The insulators
should have glossy surface to prevent dirt build up and facilitate cleaning. The construction and design of the insulator should be such that it should facilitate triggering of an alarm in the event of an intruder attempting to climb. The wire thickness should be 2.5mm dia and the provision to adjust with tensioners. Strain insulator hooks are designed for suitably attaching tensioner and strain insulator to strain posts. These hooks are made of spring steel and hot dip galvanized/Zinc coated to minimum of 30 microns coating thickness. The hooks for the corner posts should have sufficient strength to withstand loads in both the directions.

Each and every wire of the fence system should be tightened and ensured that there is no sagging of the wires with tighteners/strainers. The earthing is an integral part of an effective electric fence system. Separate earth system should be made for the power fence. The earthing for the fence should not be connected to the mains earthing system. The earthing system should be made highly effective particularly in difficult or dry soil conditions of the site. A lightning diverter kit along with safe earthing system should be provided to block and divert most voltage spikes from lightning strikes. Solar fencing with lighting system is shown in the Fig.2.

The control unit is capable of working from uninterrupted power supply. It is provided with a battery back up to ensure uninterrupted power supply. The battery should have capacity to supply requisite power for 12 hrs. to the connected load. The control electronics should have a built-in UPS back up.

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Google images on Solar Fencing.
Introduction

Our country celebrates science day on February 28 every year. This is done to honor Chandrasekhar Venkat Raman, who was the only Nobel laureate, the country produced in science from its own soil. On February 28, 1928, Raman amended his discovery of scattering of light and related effect, which now bears his name, "Raman effect" for which CV Raman won the 1930 Nobel Prize for Physics.

What is Raman Effect?

Raman scattering or Raman Effect is the inelastic scattering of photons from an atom or a molecule. The famous Indian physicist C.V. Raman discovered this effect in the year 1928. In general most photons are elastically scattered from an atom or molecule, with the scattered photon having the same energy and wavelength as the incident photon. This phenomenon is known as Raleigh scattering and it accounts for the blue color of the sky. However a small fraction (1 in 10^7) of the scattered photons have a frequency different from the incident photon. Raman who was working on the molecular diffraction of light, which ultimately led to the discovery of Raman Effect, observed this effect in liquid. The Russian scientists Gregory Lands Berg and Leonid Mandelstam first observed this effect in crystals. Raman received the Noble Prize for this work on inelastic scattering of photons. The shift in wavelength of in- elastically scattered radiation provides the chemical and structural information of the molecule.

From classical point of view the derivation of Raman scattering is straightforward from mathematics, while the quantum picture is more pictorial and fits better with the appetite of chemist.

When the energy of incident light is not large enough to excite the molecules from the ground test to the lowest electronic state, the molecule will be excited to a virtual state between the two states. The electron cannot stay long in the virtual state and will immediately go back to the ground state. If the electron goes to where it is originated from, then the wavelength of the scattered light is the same as the light source, which is called Raleigh Scattering. It is also possible that the electron goes to vibration state different from where it is excited, and then there is an energy difference between the emitted photon and the incident photon. If the emitted energy is smaller than the incident energy, the process is called the Stokes scattering. The opposite is called the anti-Stokes scattering. Thus, the
observed Raman shift of the Stokes and anti-Stokes are a direct measure of vibrational energy of molecule. Raman scattering can occur with a change in vibrational, rotational or electronical energy of a molecule. The Raman effect has been applied as a vibrational spectroscopic tool for analyzing the composition of solids, liquids and gases.

**Raman Spectroscopy**

The quantum illustration of different cases of scattering

For decades, Raman's discovery could not be converted into easily usable or affordable tools. In his time, equipments for lasers and spectrum separation and scanning were primitive, bulky and costly. Only in 1980s' did laser technology progress to the point where it was compact and economic. This new technology was most popularly established in the CD player, a laser could scan a disc to play music. But today, Raman's discovery has finally become a breakthrough technology. Hand-held scanners, weighing just one third of a kilo, are being used by US narcotic squads in airports to detect drugs. Security experts think that Raman scanners may be the best device to detect explosives carried by terrorists. Safety inspectors are using Raman scanners to detect hazardous chemicals and gases. Police forces are using scanners for forensic work.

**Raman spectroscopy: The molecular detector**

Raman scanners work by detecting the molecular structure of the object they are scanning. If a beam of light shoots on an object, a very small part of it interacts with the atoms of the object and scatters light in a pattern or spectrum unique to that particular molecule. This is Raman Effect. It is difficult to detect and typically needs lasers to amplify the signal. Every molecule has a different Raman pattern. This is why Raman scanning has been called the fingerprinting of the Universe. It can identify substances as surely as fingerprints can identify humans.
Identifying the chemical composition of a substance typically requires chemical and physical tests that take time, may be days. They typically require a sample to be extracted and destroyed while testing. But Raman scanning can take just twenty seconds without cutting, extracting or destroying a substance. Scanners have a laser, spectroscopic and electronic heart that can recognize Raman pattern. This yields almost instant recognition of target substance.

**Surface Enhanced Raman Spectroscopy:**

Scientists in many fields including space and telecom began research applications for the Raman Effect. Some found ways to enhance the Raman Effect by adding surface metals, making the effect easier to detect. The weak Raman signal can be greatly enhanced by the introduction of Surface Enhanced Raman Scattering (SERS) spectroscopy. It was accidentally discovered while people tried to do Raman Scattering on the electrode in 1974. The original aim was to generate a high surface area on the roughened metal. Gradually people realize surface area is not the key point in this phenomenon. After a period of search in the dark, the progress was made in 1977 when different groups found the rough silver electrode produce a Raman spectrum that is million fold intense than what was expected. The enormously strong signal is debuted Surface Enhanced Raman Scattering. Now SERS is a universal accepted surface sensitive technique. All electrochemical processes can be studied by SERS.
**Key features of SERS:**

The key features are summarized briefly as follows:

- SERS occur when molecules are brought to the surface of metals in a variety. The smooth surface is not active for enhancement.

- Large enhancements are observed from silver, gold, and copper, if the metal nano particles are used in the system, the particle size for enhancement of Raman effect to happen, ranges from 20nm-30nm.

- Molecules adsorbed in the first layer on the surface show the target enhancement. However, the enhancement also has long-range effect of about tens of nanometer.

- The excitation profile (scattering intensity vs. exciting frequency) deviates from the fourth power dependence of normal scattering.

SERS is among the most sensitive techniques available to study surface science. Such scanners can identify minute quantities of bacteria, chemical pollutants or explosive elements.

Scientists aim ultimately to create a database of Raman patterns of every substance for easy identification. This is similar to Nandan Nilekami creating a national database for fingerprints and irises to identify every Indians. Database has already been created for narcotics, pollutants and explosives, which is why scanners have already become practical tools. Every time they are used to catch a drug smuggler or terrorist or to detect a cancer or pollutant, we can give thanks to Sir C. V. Raman.

The insatiable human quest for knowledge and understanding of natural world leads to scientific theories. From these theories, new technology is created. It seems, there is deep symbiosis between discovery in physics and new technology. Thanks to the technology which showed why Raman Effect is so important- it fingerprints the world.

It would be appropriate to conclude this article by describing the feelings of Professor Raman, a patriotic physicist, when he attended the Nobel Award ceremony as a citizen of British India, not of an independent India. The American representative who was present at the ceremony described Raman's emotional state: "Sir Venkata Raman, the Indian prize winner, upon returning to his seat on the platform after receiving his prize at the hand of the King, was visibly moved by his emotion and sat with the tears streaming down his face."

Confirming this, Raman recalled, "When the Nobel Award was announced, I saw it as a personal triumph, an achievement for me and my collaborators - recognition for a very remarkable discovery, for reaching the goal I
had pursued for 7 years. But when I sat in that crowded hall and I saw the sea of western faces surrounding me, and I, the only Indian, in my turban and closed coat, it dawned on me that I was really representing my people and my country. I felt truly humble when I received the prize from King Gustav; it was a moment of great emotion, but I could restrain myself. Then I turned around and saw the British Union jack under which I had been sitting and it was then I realized that my poor country, India, did not even have a flag of her own, and it was this that triggered off my complete breakdown."

About the famine of ideas in the Indian university system Raman remarked before his death on November 21, 1970, "Even a man of sensitivity and imagination can become bound and un-free when he has to falsify his feelings. If he forces himself to say that he likes what he dislikes and that he believes what he does not believe then he will have to pay the price in that his spontaneous and his creative faculties would dry up." But there are no more Ramans in India today because university system takes care to dry up creative faculties.

GRAPES-THEQUEENOFFRUiTS

Prof. Gopendra Kishore Roy

Crunchy texture together with dry, sweet, tart flavour have made grapes an ever popular between meal snack as well as a refreshing item in both fruit and vegetable salads. Grapes are considered to be one of the world's favourite fruits listed in top ten with mango and banana. Since pre-historic days, grapes have been used as such or in dried form as raisins or in converted wine form as a popular alcoholic drink. Originally grown as a wild creeper, the domestication of grapes began 6000-8000 years ago in the Near East. Natural occurrence of yeast - a micro-organism in the skin of grapes led ultimately to the innovation of alcoholic drink such as wine. By the ninth century, the city of Shira (in old Persia) in the middle east was known to produce some quality wine from cultivated grapes. Over the years, the growing of grapes spread to Greece, Italy and other regions of Europe as well as to north Africa and finally to north America. In 1300 A.D. Persian invaders are believed to have introduced cultivated grapes into the north of India which later spread to South India during the reign of king Mohammed-bin-Tughaluk as described by the Moorish traveller Ibn Batuta. Grapes, though native to Europe and the Mediterranean regions, are now widely cultivated almost all over the planet. The present annual world production of grapes is around 71.5 million tons with India’s contribution of one million ton.
Varieties of grapes

Grapes come in more than 50 varieties in black, blue, blue-black, golden, red, green, purple and white colours with a juicy pulp inside. The main two types of grapes are the American and the European ones and both come in the seeded and seedless forms. Indian grapes are primarily of white (seeded and seedless), black (seeded and seedless), red (seedless) and purple (seeded) in colour.

Nutritional content of grapes

Grapes, also called "The queen of fruits" are rich source of minerals and vitamins in addition to a host of other nutrients and provide appreciable amount of energy. The table below gives the nutritional details for grapes.

Table: Nutritional details per 100 grams of purple or green grapes

<table>
<thead>
<tr>
<th>Energy: 69 kcal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constituents</strong></td>
</tr>
<tr>
<td>Carbohydrates</td>
</tr>
<tr>
<td>Sugars</td>
</tr>
<tr>
<td>Dietary fibre</td>
</tr>
<tr>
<td>Protein</td>
</tr>
<tr>
<td>Fat</td>
</tr>
<tr>
<td><strong>Minerals</strong></td>
</tr>
<tr>
<td>Iron</td>
</tr>
<tr>
<td>Magnesium</td>
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<tr>
<td>Potassium</td>
</tr>
<tr>
<td>Sodium</td>
</tr>
<tr>
<td>Zinc</td>
</tr>
<tr>
<td>Calcium</td>
</tr>
<tr>
<td>Manganese</td>
</tr>
<tr>
<td>Phosphorous</td>
</tr>
</tbody>
</table>

Vitamins Amount, mg/micg

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Amount, mg/micg</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>10.8 mg</td>
</tr>
<tr>
<td>K</td>
<td>20 microgram</td>
</tr>
<tr>
<td>B₁, B₂, B₃, B₆ &amp; B₉</td>
<td>0.46 mg</td>
</tr>
</tbody>
</table>

As is evidenced from above, grapes contain all necessary minerals and most of the vitamins required for the body. Fresh grapes are enriched with a host of antioxidant including polyphenols such as resveratrol and other biologically active compounds in their natural environment, all of which may either contribute to the beneficial effects or provide the optimal conditions for a certain phyttonutrient to exert its particular individual benefit.

Health benefits

1. Grape is a quick source of energy and a good blood and body builder.
2. Grape juice is recommended in case of constipation, gout, rheumatism, skin and liver disorders. It can also reduce fever.
3. Potassium and sodium present in grapes are important stimulators for the nervous system while magnesium helps in muscle contraction.
4. Grapes are one of those rare fruits which are completely free of cholesterol.
5. With small protein and dietary fibres, grapes are easily digestible.
6. Grapes are low caloric fruits.
7. Vitamin K in grapes helps in blood clotting and vitamin B helps in controlling metabolism rates.
8. Folate (vitamin-B9) found in grapes is important during the pregnancy period.
(9) Presence of abundant minerals helps to detoxify the liver and strengthen the digestive system.

(10) White grape juice replenishes the iron content present in the body and prevents fatigue.

(11) Research studies on grapes have indicated that the grapes provide cardiovascular benefits like better regulation of blood pressure, better regulation of total cholesterol and its effective reduction, reduce LDL cholesterol level, better inflammatory regulation in the blood and reduce cell adhesion to the vessel walls.

(12) Grapes act as a good cleansing agents for the human system improving the flow of bile and urine.

**Protection against ailments:**

(i) Reduction in heart disease: Grapes help in reducing clumping of platelets and harmful blood clots. It has been reported that people consuming a glass of red wine made out of grapes were less likely to suffer from heart diseases. Resveratrol in red wine can also increase blood flow in the brain by 30% thus greatly reducing the risk of stroke.

(ii) Cancer protection: Grapes are known to have high amounts of caffeic acid- a substance known to fight cancer at the cellular level. Through a recent study, it has been discovered that purple-coloured concord (a variety of grape) grape juice helps in preventing breast cancer. A group of antioxidants called bioflavonoids present in grapes and red wine helps in strengthening cancer fighting cells and are also known to kill the cancerous cells.

(iii) Guard against Alzheimer's disease: Resveratrol, a beneficial polyphenol present in grapes helps in the treatment of Alzheimer’s disease. In addition, grapes help fight neurodegenerative diseases.

(iv) Reduction in aging effect: Grapes have been shown to have benefits in reducing the effects of aging. The natural antioxidant resveratrol of the grape appears to have positive effect on the genes responsible for the process of aging. Being rich in vitamin-C, the intake of grapes reduces the production of malondialdehyde, a by-product of oxidation and thus delays aging.

(v) Protection against diabetes: A recent study shows that grapes may slow the progression of type-1 autoimmune diabetes. Keeping in view the numerous health benefits and protections against a few killer diseases, grapes are to form an indispensable item in our daily food intake. However, while purchasing, choose grapes that are plump and free from wrinkles. They should be intact, not leaking juice and firmly attached to a healthy looking stem.

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E-mail: gkroyster@gmail.com
SPACE TECHNOLOGY IN DISASTER MANAGEMENT

A. Subbarao, Priya R and Krunal J Joshi

Introduction

There are several types of Natural disasters like earthquakes, floods, tornadoes, tropical cyclones, wildlife, tsunami, volcanic eruptions, landslides etc., that inversely affect the national progress and human life causing damage, death and loss of valuable goods.

The recent cloud burst that hit Uttarakhand, the heavy earthquake that affected Gujarat in 2001 and a number of disasters of the recent time clearly shows that India is one of the world's most disaster prone countries of the world. About 40 mha of India's geographical area is flood prone (National Flood Control Commission Report, 1980). One of the important ways to escape from these potential risks is to develop technologies for early prediction of disasters, proper strategy for disaster management and developing awareness among the civilians to overcome the critical situations, during natural disaster.

A Disaster management process is broadly divided into three parts i.e.:

1. **Early-warning**: If the occurrence of an event is known earlier then proper planning could be done to evacuate the common people and their movable property to a relatively safer place.

   Technical expertise, facilities and communication network are required for collecting ground data in real time forecasting and then disseminating the forecast & warning informations.

2. **Disaster relief**: This consists of organizing relief camps, air dropping of food and other materials, medical facilities, etc. This is the most critical step and actions have to be taken on the spot at the earliest.

3. **Rehabilitation/Reconstruction**: The victims need to be rehabilitated; they have to be provided with essential services by restoring/establishing communication till the situation comes to normal.

   Space Technology is playing an important role for minimizing the adverse effect of Natural disasters. Satellite imagery, giving real-time information over a large area and space-based technologies like telecommunications, global navigation satellite systems, Geographic Information Systems and Web Technology can be used for prevention, preparedness, relief, reconstruction, warning and monitoring the various phases of disaster management.

   Polar Orbiting satellites provide higher resolution imageries, even low temporal frequency, are used for detailed monitoring, damage assessment and long-term relief management. It is known that Geo-stationary...
satellites provide continuous and synoptic observations over large areas on weather including cyclone monitoring. In the recent times, Very Small Aperture Terminals (VSAT) and Ultra Small Aperture Terminals (USAT) are also used with increasing capability.

**Natural Disaster management systems in India**

India, the seventh largest country having second largest population of the world, surrounded by the Himalayas on the north, northeast and northwest the Bay of Bengal on the east, the Indian Ocean on the south and the Arabian Sea in the west, is prone to various natural disasters such as droughts, floods, earthquakes and cyclones. The reasons are mainly due to its tropical climate, unstable landforms, high population density, poverty, illiteracy and lack of adequate infrastructure.

It is known that the Ministry of Home Affairs, Government of India is the nodal ministry for handling such natural disasters. It has started many institutions at national, state and district levels for strengthening disaster management programme in India. Some of them are given below:

- National Disaster Management Authority (NDMA)
- State Disaster Management Authorities
- District Disaster Management Authorities
- National Institute of Disaster Management
- National Disaster Response Force

**Space Technology Applications: Role of Indian Space Research Organisation (ISRO)**

Department of Space is providing major support to the disaster management programme of the Government of India. Indian National Satellite (INSAT) and Indian Remote Sensing (IRS) series of satellites provide informations related to warning dissemination, monitoring and damage assessment, tracking cyclones and measurement of wind vectors, communication support etc. The capability of Geographic Positioning System (GPS) of USA and our indigenous IRNSS-series, to precisely determine the position of a location is being used to measure ground movements associated with plate tectonics.

The launch of Resourcesat series and Cartosat series with much better imaging capabilities and frequent coverage has increased India's capability for managing disaster effect, particularly floods. Earlier the ISRO launched Technology Experiment Satellite (TES) and its data were used to monitor the potential flood threat to Himachal Pradesh in 2004 with high spatial resolution of about 1 metre. RISAT series satellites use Synthetic Aperture RADAR and thereby having capability of imaging during both day & night and during adverse cloudy conditions (including flood and cyclone monitoring capabilities). Mobile telephony, MSS reporting terminal and VSAT based communications have enhanced communication capabilities in disaster affected areas. For users like Shipping Authority, Airports Authority of India, Coast Guard,
Defence (Army, Navy and Air force) and Mountaineering expeditions, ISRO is providing satellite-aided Search & Rescue services on an operational basis through participation in the COSPAS-SARSAT international programme. Further, Ext-C band based satellite communication nodes can be extremely helpful because of the little effect due to weather or clouds (wherein antenna size will be smaller than that of the normal C-band antenna).

Moreover, DAT (Distress Alert Terminal), a compact instrument, can send message to a controlled hub in case of distress situation. This DAT can be placed in Buses or other vehicles (during Religious Yatras or in normal case) especially when the vehicle is moving in difficult terrains. DAT can also be given to the solders/mountaineers/expedition groups in mountain regions, so that during avalanche kind of situations, the affected groups can be easily located & proper rescue operations can be conducted.

ISRO has established a Decision Support Centre (DSC) at National Remote Sensing Centre (NRSC), Hyderabad, under its Disaster Management Support Programme (ISRO-DMSP). It provides dedicated services for timely information meeting the user needs in terms of information content, turn-around-time and format. Such information will be disseminated to the State and Central user agencies. ISRO has reorganised Disaster Management Support Programme (DMSP) in May 2013, having functional designates, for monitoring the activities and for providing policy guidelines and for subsequent interaction with other ministries on Disaster Management. A wing of this which is called Decision Support Centre (DSC) at NRSC is meant for providing appropriate response to major natural disasters in India. Another wing of this is to plan operationalization of Airborne synthetic Aperture Radar (ASAR) and collection of high resolution data using Airborne Laser Terrain Mapper (ALTM), Large Format Digital Camera etc for DMSP (for example, DMSAR was delivered to NRSC, Hyderabad, from Space Applications Centre, Ahmedabad in December 2012). NRSC/ISRO has been instrumental in providing operational flood information services, free of cost, to several states through State Remote sensing Application Centre (SRSACs), Flood management improvement support Centre (FMISC), etc. National Disaster Management Authority (NDMA), for post-flood (mitigation measures) in the country has been identified to give guidelines for flood management utilizing remote sensing data.

**Indian experiences in operational use of satellite data for disaster management**

Mapping of flood-affected areas is an important application of satellite remote sensing in flood management. In order to assess the extent of damage due to crop-loss, destruction of infrastructure facilities etc., multi-date satellite imageries are used. Meteorological satellites are useful for monitoring and forecasting cyclones. A Cyclone Warning Dissemination System (CWDS) consisting of over two hundred
disaster warning receivers installed in cyclone prone areas of the country, provide warning to coastal villages about an impending cyclone (the recent example being Phailin that struck Odisha & Andhra Pradesh in October 2013).

Monitoring and assessment of droughts is required to minimize the reduction in agricultural productivity. Since Vegetation Index (VI) derived by satellite data is sensitive to moisture stress, it is used to monitor drought conditions. National Agricultural Drought Assessment and Monitoring System (NADAMS) is a developed establishment for drought management.

Satellite data, aerial photographs and GIS techniques are used for terrain classification and preparing maps showing landslide prone zone-formation.

Satellite imagery could be used in delineating neo-tectonic structures and to elucidate seismo-tectonic conditions in earthquake-prone zones.

Satellite imagery in infra-red region and ground/aerial photographs has been instrumental in mapping damaged-areas by forest fires.

**Disaster management courses in India**

It is found (for example, htcampus@hindustantimes.com) that there are about 2000 colleges which offer a course on disaster management topic in their MBA programme.

If these students are made aware of the role of Space Technology in Disaster Management, they can be harnessed and many of them grouped together to form volunteering-teams to assist people during post-disaster events.

They can also be trained to assist as linkages between the paramilitary personnel and the respective state-wise nodal agencies.

In other words, ISRO can also establish a Technology Management Group (TMG), which can constantly evaluate the technologies developed within centers and their relevance for Disaster Mitigation & Disaster Management activities.

**Conclusion**

Constant developments in space technology have led to improved capabilities to support disaster management. The emergency communication, navigation, remote sensing and subsequent warning systems & rescue operations have become an inherent part of disaster management. Satellite imageries do play an important role as they can be used to identify the affected areas, estimating the extent of damage and chalk out the rescue strategy.

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**NANOMEDICINE AND DIABETES**

Prof. Padma Lochan Nayak

**Introduction**

Nanotechnology, engineering and manufacturing at the scale of a nanometer or nano-scale (nanometer = 10^{-9} meter) is a new technology which is already present in many parts of industry and medicine, and the impact of nanotechnology is growing bigger day by day. Nanomedicine, the application of nanotechnology in the field of medicine, has already offered some new solutions, and many pharmaceutical companies are trying to develop targeted drug delivery using nanotechnology. Nanotechnology offers some new solutions in treating diabetes mellitus. Boxes with nanopores protect transplanted beta cells from the immune system attack, artificial pancreas and artificial beta cell instead of pancreas transplantation. Nanospheres as biodegradable polymeric carriers for oral delivery of insulin are just some of them. The abilities of nanomedicine are huge, and nanotechnology could give medicine an entirely new outlook.

Nanotechnology, nanomedicine, and nanorobotics are terms that still sound like science fiction to most people. Yet, nanotechnology is now already present in our lives; computer and cell phone industry, plastic industry are making products with nanotechnologymade parts. The impact of nanotechnology on medicine is growing every day.

**Nanotechnology**

The prefix 'nano' comes from the Greek word nanos, which means one-billionth part of something. So, nanotechnology can be described as engineering and manufacturing at the scale of a nanometer or nanoscale (nanometer = 10^{-9} meter). Just to give a sense of how small things are, here are some entities and their average size: atom diameter 0.15 nm, diameter of double strand DNA 2 nm, and that of a cell is 1000 nm (Fig. 1).

![Fig. 1. Nanofibrils behind a human hair for comparison](image)

The aim of nano-scientists is to virtually imitate nature. They are trying to construct objects out of their most basic components, atom by atom, the way that nature does. This offers an unprecedented degree of precision and control over the final product. As a fundamental understanding of how nature works at the atomic scale, we can consider nanotechnology as an enabling technology; it will enable us to do radical new things in
virtually every technological and scientific arena. Nanotechnology was started in 1989, when a group of engineers at IBM company managed to create the smallest-ever company logo; they spelled IBM letters out of individual xenon atoms (Fig. 2). Since then, nanotechnology has become a part of almost every field of industry. In the year 2003, 18,347 patents related to nanotechnology were issued. The biggest assignee is Genentech, Inc. with 1427 patents, followed by IBM with 293 and Hitachi with 177 patents. In the last year, governments and corporations worldwide have ploughed over 4 billion USD into nanotechnology. However, despite great investments and hard scientific work, things are actually moving a bit slowly. Most scientists believe that nanotechnology will start to seriously influence our lives around the year 2020.

1) Nanoscale structured materials are parts of nanomedicine with a rapid evolution, because of the impact of pharmaceutical industry. Pharmaceutical companies are trying today to develop targeted drug delivery systems using nanotechnology and drugs that already exist. The fact is that we do have useful drugs, but in some cases with pure bioavailability. The problem is how to deliver drugs right to the point where required. The possibilities are great. For example, researchers are contemplating the possibility of using magnetic nanoparticles containing drugs to be delivered to specific parts of the body by means of magnetic field. Drugs can also be attached to nano-ligand, the role of which would be to deliver the drug only to the target tissue while at the same time reducing its side effects. Some drugs have the problem of poor water solubility. The NanoSystems company, which is part of the Elan Corporation, has developed a process called nanonization to solve this problem. First, drug crystals are reduced until they become particles of less than 400 nm in diameter. To stabilize the particles and prevent aggregation, a thin layer of polymeric surface modifiers is adsorbed onto crystal surfaces. The outcome is a suspension that functions like a solution, which can be used in various dosage forms, like pills, sprays or creams. Medical nanomaterials may

**Nanotechnology in Medicine**

The application of nanotechnology to medicine is called nanomedicine. Nanomedicine subsumes three mutually overlapping and progressively more powerful molecular technologies: nanoscale structured materials and devices; genomics, proteomics and artificially engineered microbes; and medical nanorobots.

**Fig. 2** - In 1989, IBM Fellow Don Eigler became the first person in history to move and control an individual atom. Eigler and his team used a custom-built microscope to spell out the letters IBM with 35 xenon atoms.
also include smart drugs that become active only in specific circumstances. Yoshihisa Suzuki from Kyoto University has designed a novel drug molecule that releases antibiotic only in the place of an infection. Suzuki bound the molecule of gentamicin to a hydrogel using a newly developed peptide linker. The linker can be cleaved by a proteinase enzyme produced by Pseudomonas aeruginosa. Tests on rats have shown that the antibiotic is not released if no *Pseudomonas aeruginosa* bacteria are present. If any bacteria of this type are present, the enzyme produced by the microbes cleaves the linker and gentamicin is released to kill the bacteria. This is highly desirable because the indiscriminate prophylactic use of antibiotics is associated with the emergence of drug-resistant bacterial strains.

2) Artificially engineered microbes are already being used to produce human hormones, by the method of genetic engineering.

3) Medical nanorobots are still only a theory, but scientists are working to develop them. Robert A. Freitas has designed an artificial red blood cell called respirocyte, a spherical nanorobot of about the size of a bacterium. This respirocyte would be made up of 18 billion atoms, precisely arranged in a crystalline structure to form a miniature pressure tank. The tank would hold as many as nine billion oxygen and carbon dioxide molecules. When respirocytes are injected into an individual's bloodstream, sensors on the surface would detect oxygen and carbon dioxide levels in the blood. The sensors would then signal when it is time to load oxygen and unload carbon dioxide, or vice versa. Respirocytes could store and transport 200 times more gas than red blood cells. Although still only a theory, respirocyte could become a reality tomorrow (Fig. 3).

Diabetes

Diabetes mellitus is a metabolic conditions caused either due to lack of insulin, resistance of insulin to body cells, or both (Daneman, 2006). Diabetic persons generally experience hyperglycaemia as a result of the body's inability to maintain normal blood glucose levels. Diabetes has been recognised for millennia and was known to be a fatal disease until the development of insulin therapy. Now all types of diabetes mellitus are treatable with insulin or anti-diabetic drug therapy. However, long term complications remain high.
Diabetes mellitus is the fifth most common causes of death in the world and it is estimated that one in eight deaths (12.2%) among 20 to 79 year-olds were attributable to Diabetes (International Diabetes Federatio, 2009). The Life expectancy is reduced, on an average, by more than 20 years in people with Type 1 diabetes and by up to 10 years in people with Type-2 diabetes (Diabetes U.K., 2011).

Types of Diabetes

There are mainly two types of diabetes mellitus i.e. Type 1 diabetes mellitus (TIDM) (previously known as insulin dependent diabetes mellitus (IDDM) and Type 2 diabetes mellitus (previously known as non-insulin dependent diabetes mellitus (NIDDM) which accounts for 99.4% of all cases in Scotland. The other categories of diabetes include gestational diabetes (observed during pregnancy), during induced diabetes and others.

Out of the two main types of diabetes Type 2 diabetes mellitus is the most prevalent form of diabetes, which results from insulin resistance, with or without a secretary defect. it primarily occurs with increasing age and is associated with genetic and environmental risk factors. Type 2 diabetes is commonly preceded by a long period of abnormal glycaemic control and is part of the metabolic syndrome associated with hypertension, dyslipidaemia and hyperglycaemia. The condition has a stronger genetic aetiology than TiDM although environmental factors such as diet, exercise obesity and smoking do contribute to the development of type 2 diabetes.

Nanomedicine and Diabetes

Mauro Ferrari of Ohio State University and Tejal Desai of Boston University have created what could be considered one of the earliest therapeutically useful nanomedical devices. They created a tiny silicon box that contains pancreatic beta cells taken from animals. The box is surrounded by a material with a very specific nanopore size (about 20 nanometers in diameter). These pores are big enough to allow glucose and insulin to pass through them, but small enough to impede the passage of much larger immune system molecules. These boxes can be implanted under the skin of diabetes patients. This could temporarily restore the body's delicate glucose control feedback loop without the need of powerful immunosuppressants that can leave the patient at a serious risk of infection.

Another possible permanent solution for diabetic patients could be artificial pancreas. The original idea was first described in 1974. The concept of its work is simple: a sensor electrode repeatedly measures the level of blood glucose; this information feeds into a small computer that energizes an infusion pump, and the needed units of insulin enter the bloodstream from a small reservoir. However, the main problem and the reason why most patients refused to have such an artificial organ was its size. Today, it is logical to assume that nanotechnology can solve the problem. An American company, Medtronic MiniMed, has been working on a device called Long Term Sensor System (LTSS), which links an
Implantable long-term glucose mini sensor with an implantable insulin mini pump. The
main problem is how to develop and refine a sophisticated algorithm to translate glucose
levels determined by the sensor into appropriate insulin dosages. Testing of the LTSS has been very promising and MiniMed scientists think that they can bring an artificial pancreas to market in near future. It is not hard to imagine what the artificial pancreas might bring to diabetes patients. Ideally, it would mean nearly normal glycemia, no checking of blood glucose levels, no risk of hyper/hypoglycemia, no (or very few) chronic diabetic complications, no chronic immunosuppression as in islet transplantation, etc. There is no doubt that with its small size, artificial pancreas would be an acceptable solution for every diabetic patient.

Todd Zion from Nanostructure Materials Research Laboratory has developed technology for diabetes treatment called SmartCell. The author says about his technology: “When glucose rises in the bloodstream, it will eat away SmartCell’s structure. As the SmartCell protein matrix breaks down, insulin is released. The more glucose is present, the faster matrix will erode.” SmartCell technology means that diabetics could stop endlessly checking and rechecking their glucose levels, injecting more insulin as needed, because the drug will handle the chore. An injection a day is all that diabetics will need. No blood testing, no multiple shots. Early round of experiments with lab rats has begun, and the preliminary results are promising.

Radwant M.A. and Aboul-Enein H.Y. from Department of Clinical Pharmacy, College of Pharmacy, King Saud University, Riyadh, used polyethylcyanoacrylate (PECA) nanospheres as biodegradable polymeric carriers for oral delivery of insulin. The administration to streptozotocin-induced diabetic rats showed a very good hypoglycemic effect. Should the effect be proven in human research, it might significantly improve patient compliance.

One great alternative for pancreatic tissue transplantation could be so-called artificial beta cell. There are many attempts worldwide to develop such a cell. One possible way to accomplish this is to change certain molecules on the beta cell surface that are normally targets for an immune attack. Another approach is to insert new genes into naturally occurring cells. The cells can be genetically altered so that they could not only produce insulin, but could also respond to the rise and fall of blood glucose, just as normal pancreatic beta cells do. Illani Atwater of from Sansum Medical Research Institute, Santa Barbara, CA, is working on inserting the proinsulin gene into a keratinocyte cell line attached to a glucose sensitive promoter gene, as well as the genes for GLUT2 glucose transporters and glucokinase phosphorylation enzymes. No matter which way leads toward the solution, the result will be the same, i.e. artificial beta cell that will produce insulin in response to the rise of blood glucose, and no target for the immune system. So, without immunosuppression, isn’t artificial beta cell a better solution than pancreas transplantation?
Scientists are also trying to create a nanorobot which would have insulin departed in inner chambers, and glucose-level sensors on the surface. When blood glucose levels increase, the sensors on the surface would record it and insulin would be released. Yet, this kind of nano-artificial pancreas is still only a theory (Fig. 3).

Fig. 3: Nanobots killing a virus

Conclusion

Banting and Best discovered insulin 85 years ago; so that thousands and thousands of lives have been saved. Today, diabetic patients can reach old age, but the effort for treatment is enormous. The primary concern of modern diabetology must be the quality of life of diabetic patients.

Not long ago industrial revolution happened, atomic energy was discovered, computer was invented, and internet has become a part of daily living. So it is not hard to imagine that nanotechnology will become an important part of our lives tomorrow. Furthermore, nanotechnology is not science fiction anymore, it is taking place today. Scientists and governments around the world have recognized the possibilities of nanotechnology, and great effort in developing such technology is taking place today. Nanotechnology created devices are already around us, in industry and in medicine. The abilities of nanomedicine are huge, and nanotechnology could give medicine an entirely new outlook. Imagine, for example, in the near future, your doctor has diagnosed you with diabetes, saying "Don't worry, it's something like common cold. I'm going to insert a nanorobot into your bloodstream, and the problem is solved".

Nanorobots which have the size of a bacterium are not cleaning atherosclerotic plaques, killing viruses and healing diabetes yet, but the possibility that they will be doing it in a few years is rising every day.

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Synergy Institute of Technology, Phulanakhara, Bhubaneswar
IS THERE A MALE MENOPAUSE OR ANDROPAUSE?

Prof. Bhabendra Kumar Patnaik

Menopause is the period in a woman's life where the ovaries cease to produce an egg cell every four weeks. Menstruation declines gradually or in its frequency with advancing age. At certain stage (45 to 55 years) it ceases abruptly and thus menopause occurs. The physiological and emotional changes following hormonal imbalance in post-menopausal women include symptoms like palpitation, hot flushes, sweats, vaginal dryness, loss of libido and depression. To obviate the symptoms hormone replacement therapy has gained repeated attention by scientists involved in the subject.

The question arises "Do men also have symptoms which may be termed as "male menopause" or "Andropause". Unlike women who abruptly stop being fertile following menopause, men do not experience sudden change in fertility. Changes in male reproductive system occur gradually. Despite the senescent changes that occur in reproductive system of male, there is no single episode in his physiology which can be comparable to that of menopause in women. In women, gametogenesis starts in embryonic stage and terminates at menopause. On the other hand, in men spermatogenesis begins at puberty and continues throughout life. The sudden decrease in the estrogens in females is not matched by gradual decline in androgens in male. However, on the basis of a few cases of men suffering from abnormal hypofunction of the testes associated with loss of potency and libido, certain cardiovascular changes, chills and sudden perspiration, numbness and vertigo as well as instability, some scientists have suggested that such men have undergone "Andropause".

Since abrupt cessation of reproductive capacity comparable to the menopause in women does not occur with aging in a majority of men, the use of the term "Andropause" may appear controversial. However the controversy notwithstanding the following description refers to aging changes in reproductive system of man with emphasis on salient features.

Reproductive System of Man

The male reproductive system includes external genitalia (Penis and Scrotum, a sac that contains on each side a testicle or testis). The accessory ducts are paired epididymis, paired ductus deferens (vas deferens), paired ejaculatory ducts and urethra. The accessory glands are paired seminal vesicles, prostate gland and paired Balbourethral (Cowper's) glands.
Penis is the male organ of copulation. The testes produce and store viable spermatozoa. They also synthesize and secrete androgenic hormone, testosterone. The spermatozoa in the seminiferous tubular lumen are transferred to epididymis for further storage. The tail of the epididymis continues into vas deferens which transport spermatozoa into dilated ampulla. The seminal vesicles secrete fluid into ejaculatory ducts. Each ejaculatory duct commences at the union of seminal vesicle with the vas deferens and terminate at their union with prostatic urethra.

The prostate gland releases its prostatic fluid into prostatic urethra and the Bulbourethral glands discharge their mucoid secretions into penile (anterior) urethra. At the moment of sexual climax during intercourse, the semen (spermatozoa with secretions of glands) is propelled out of the urethra by rhythmic contractions of bulbo and ischiocavernosus muscles.

**Aging changes in male reproductive system**

Aging changes in male reproductive system primarily occur in testes. Significant changes also occur in accessory ducts and glands. The changes are both anatomical and physiological. Among physiological changes, the most prominent change is in the level of hormones. The sexual behaviour is influenced by such changes. Manifestations of the influence are exhibited in mating behaviour such as sex drive (libido), pattern of erection, frequency of mounts, intromission, ejaculations, intercopulatory and post copulatory intervals and intensity of orgasmic experience. The other factors which determine sexual in-adequacy in elderly seems to be psychological, social changes related to aging (e.g. willing partner), diseases and chronic illness and medications.

(a) **Testes**: The mature testis has three classes of cells: germinal, Leydig and Sertoli. Germinal cells give rise to spermatozoa and the Leydig cells produce testosterone and other androgens. The Sertoli Cells support sperm differentiation, act as nurse cells for developing sperms and secrete inhibin which suppress secretion of gonadotropic hormone, ICSH (Interstitial Cell Stimulating Hormone). The thickening of basement membrane and tubular wall causes ischaemia in seminiferous tubules. This leads to a gradual decline in spermatogenesis in aged men. This is followed by decrease in number and abnormality in shape and size of the spermatozoa. A gradual decline in the number and function of both Leydig and Sertoli cells has also been reported. The loss of Leydig cells leads to a decrease in production of testosterone but at a much slower rate as compared to estrogen depletion in women.

(b) **Ducts and glands**: Examination of epididymis, seminal vesicle and prostate gland indicate some loss of surface cells but they continue to produce the fluid that helps to carry sperms.

After 45-50 years, the prostate gland is either enlarged (benign hypertrophy) or
reduced (senile atrophy), both the changes being progressive till death. Enlargement of prostate causes retention of urine due to distortion of urethra. Prostatectomy relieves the urinary obstruction. Prostate is also common site for carcinoma, which can be confirmed by prostrate specific antigen (PSA) test.

(c) **Hormonal changes**: The principal hormone of the testis, testosterone, a C_{19} steroid, is synthesized in Leydig cells of the testis. Most of the secreted testosterone circulates in blood being bound to plasma proteins (sex steroid binding globulin and albumin). The free biologically active testosterone is about 1-2\% of the total blood circulation. In target organs, testosterone is converted to a more potent dehydrotestosterone. Testosterone is known to promote synthesis of proteins in certain tissues especially skeletal muscle and is associated with retention of calcium, phosphorus, sodium, chloride and water.

Testosterone secretion decreases in old age. This is related to the number of Leydig cells and their decreased responsiveness to ICSH. The free form of circulating testosterone becomes low due to increase in sex hormone binding globulin, with advancing age.

In man, the daily cycle of testosterone production reaches two peaks i.e. one in the evening and the other in the morning. In aged man even though there is a comparable evening peak, the morning peak level is only half the level seen in younger man. By the age eighty the overall testosterone level may be 60\% of what it was when he was thirty years old. Limited longitudinal data on small number of subjects confirm the decline of testosterone. In most studies, the level of estrogens present in small quantity is usually not changed in elderly men.

(d) **Fertility**: Fertility varies from man to man. Paternity has been documented upto 94 years of age. It appears that fairly old men can father children. But a gradual decline in fertility with aging has been reported.

(e) **Sexual activity**: Age related decline in sexual activity and sex drive (libido) occurs in otherwise fully functional men. The sexual responses become slower and less intense. However, in a majority of men the decline in sexual function is also influenced by factors other than the level of testosterone. These are impaired penile vasculature, depression, chronic illness, diseases and medication.

It is normal for erections to occur less frequently than when younger and aging men have less ability to experience repeated ejaculation. The frequency of intercourse also declines with age. Penile erection is more difficult to achieve but once accomplished erection is maintained for a longer period of time than is the characteristic of young man.

Injections of a variety of vasoactive substances and consumption of aphrodisiac and viagra (sildenafil) have been used to
remove erectile dysfunctions and to raise sexual activity. A decline in sexual function caused by illness and medications can be regulated through expert medical advice. Sex is more likely if willing partner is available and if sexual activity has continued from middle age. It is believed that a decline in sexual function is also partly related to the decline in testosterone level. More over changes in intrinsic cellular processes of aging which affect almost all tissues including the reproductive tissue, has also a bearing on sexual function. In addition as stated earlier the influence of individual variations and disruptions linked to chronic illness, diseases and drugs can not be ruled out.

(f) **Hormone replacement therapy:** When androgen deficiency occurs due to primary testicular failure in situations like castration, disease and underdevelopment, the only effective treatment is administration of testosterone.

If the testes are normal but there is a deficiency of anterior pituitary gonadotropins, injections of FSH and LH (ICSH) stimulate development of Leydig cells, secretion of testosterone and spermatogenesis. In certain cases of hypogonadism, the hypothalamus may not release Gonadotropin Releasing hormone (GnRH). In such cases injections of GnRH can stimulate anterior pituitary to secrete gonadotropins and thus the normal testicular function is activated.

Testosterone replacement therapy increases bone mass, muscle strength, psychosexual and cognitive functions in elderly men with increased hormone levels. But there are also potential adverse effects such as gain in weight, mild gynecomastia, aggravation of prostate disease, alterations in lipid and carbohydrate metabolism, induction of sleep apnea and increase in erythropoiesis and fibrinolysis. More studies on hormone replacement therapy in elderly men are necessary to assess the risk to benefit ratio.

Aging is a natural process. Unlike the female reproductive system, the male reproductive system undergoes aging gradually. In advanced age, one must try to remain physically and mentally active by maintaining a healthy life-style. Aging by itself does not prevent a man from being able to have or enjoy sexual relationship.

**References**
APPLICATIONS OF LANGMUIR-BLODGETT THIN FILMS

Sandhyarani Acharya

Introduction

The structural design/arrangement of a molecule is the most fundamental aspect to show its application in different fields. The best material property can be achievable if the molecule can be of one molecular or several molecular thicknesses. Material science offers tools for tailoring material's fundamental properties via modification of molecular/monomeric units called thin films. Thin film of few a nanometer thicknesses is the subject of great interest as it has many practical and commercial applications. The thin film of the material offers the possibility of tailoring material properties either by molecular engineering of the individual molecules using modern methods or by having control over the architecture of the film. Such type of endeavors can be achieved if the experimental techniques are available to allow the assembling of the molecules to form 2D or 3D structures. Thin films have controllable thickness, surface uniformity and high degree of orientational order which makes them potential candidates to show tremendous applications in various fields, especially in molecular electronics.

Many techniques are there to deposit the material on solid substrates such as thermal evaporation, sputtering, electro deposition, molecular beam epitaxy, adsorption, self assembly and Langmuir-Blodgett. Among all, the Langmuir-Blodgett method is the most promising one for the preparation of such films as it allows the fabrication of ultra thin, highly ordered film of the materials. A multilayer film can also be obtained by transferring several layers of the molecule on the solid substrate.

History

Benjamin Franklin is the first person to get the credit for the discovery of the floating monolayer of the thin films. His most significant observation was the difference in the spreading characteristics of oil in water and glass surface. After several years of research on monolayer films, Raylish measured the thickness of the floating oil layer split on the surface of water based on the laboratory experiment of Agnes Pockels who has designed a basin with a movable surface barrier. Irving Langmuir was the first man to perform the studies on the floating monolayer on water. He, with Katherein Blodgett, has transferred the organic fatty acid molecules on to a solid substrate from the water surface. The transferred film is named after them as Langmuir-Blodgett film. The technique of deposition of the film is called Langmuir-Blodgett (L-B) technique. After the pioneering work of both the scientists it took almost half
a century by the researchers to take advantage of this technique. In 1979, during the 1st international conference of the LB films, the use of the technique has been accepted for defining various architecture of the molecules having different functionality according to the demand of the application in various fields.

The most appealing feature of the LB film is the intrinsic control of the internal layer structure down to the molecular level and precise control over the layer thickness. In short, we can say that the LB technique has the ability to control the organization of the molecular components in molecular level.

**Instrument:** A typical LB instrument is shown in figure-1. Essentially all LB film works begin with the Langmuir-Blodgett trough, or Langmuir film balance, containing an aqueous sub phase. Moveable barriers that can skim the surface of the sub phase permit the control of the surface just as area available to the floating monolayer.

**Figure-1 :** Schematic diagram of LB trough. The Wilhelmy plate monitors the surface through a microbalance interfaced with computer. Barrier movement is also controlled by computer.

The dilute solution of the material is then carefully placed on the sub phase of the LB trough with a micro syringe. The solvents evaporate quickly and the surfactant molecules spread over the sub phase surface in the LB trough. The layer is then transferred to any solid surface. After the material is taken on the solid surface, the film can be tested as per required applications.

**Mechanism**

For the formation of LB film, it is necessary for a substance to be water insoluble but soluble in volatile organic solvents. LB compatible materials consist of two fundamental parts, 'head' and 'tail'. The 'head' part is a hydrophilic (water loving) chemical group, typically with a strong dipole moment and capable of hydrogen bonding, like - OH, - COOH, -NH₂ etc. The 'tail' part on the other hand is hydrophobic (water repelling) typically consisting of a long aliphatic chain. Such molecules, containing spatially separated hydrophilic and hydrophobic regions, are called amphiphiles. The dilute solution is then minutely placed on the sub phase of the LB trough with a microsyringe. The solvents evaporate quickly and the surfactant molecules spread over the sub phase surface in the LB trough.

If amphiphile molecules arrive at the air-water interface, the initial high energy interface is replaced by lower energy hydrophilic - hydrophilic and hydrophobic - hydrophobic interfaces, thus lowering the total energy of the system. Hence, the molecules at the interface are anchored, strongly oriented normal to the surface and with no tendency to form a layer more than one molecule thick. The formation of the LB film depends upon...
two important factors, one is the surface pressure, \( \pi \) (this quantity is the reduction of surface tension below that of clean water), and the second one is, surface area of the spreading film. The force exerted is directly proportional to the surface tension. There are several techniques available to monitor the state of the floating monolayer. The measurement of surface pressure \( (\pi) \) as a function of area per molecule \( (A) \) in the monolayer films is known as the isotherm characteristics. This characteristic is easily obtained through a plot and provides much useful information about the mono-molecular films at the air-water interface. As the pressure increases, the two dimensional monolayer goes through different phases that have some analogy with the three dimensional gas, liquid, and solid states. If the area per molecule is sufficiently high, then the floating film will be in a two-dimensional gas phase where the surfactant molecules are not interacting. As the monolayer is compressed, the pressure rises signaling a change in phase to a two-dimensional liquid expanded (LE) state, which is analogous to a three dimensional liquid. Upon further compression, the pressure begins to rise more steeply as the liquid expanded phase gives way to a condensed phase, or a series of condensed phases. This transition, analogous to a liquid-solid transition in three dimensions, does not always result in a true two dimensional solid. Rather, condensed phases tend to have short-range structural coherence and are called liquid condensed (LC) phases. If the surface pressure increases much further the monolayer will ultimately collapse or buckle, not still being a single molecule in thickness everywhere. This is represented by a sudden dip in the surface pressure as the containment area is decreased further (figure-2).

Figure-2: Deposition scheme during up and down stroke

**Research Application**

Langmuir-Blodgett deposition has been an important tool for preparing highly organized molecular assemblies in which intermolecular interactions such as distance, orientation, and extent of interaction and thickness of the molecular layers can be controlled. The arrangement pattern promotes the molecule to show different applications in various fields. The LB film behavior can be optimized to show specific application.

Citing a particular example as a biosensor, Langmuir-Blodgett technique helps the immobilization of enzymes which shows the performances of biosensor. The LB monolayer of poly (3-hexylthiophene) P3HT / steric acid (SA) was transferred to an ITO (Indium-Titanium Oxide) surface. The enzyme immobilized on the LB film, P3HT/SA/\( \beta \)-gal/GaO, electrode was used for the estimation of
lactose from 1-6 g/dL. These electrodes are stable up to 40°C and a self life of 120 days at 4°C. Also this lactose sensor electrode can be used more than 10 times with 3% loss in current response, with the same sensitivity towards lactose. Langmuir-Blodgett film of P3HT based galactose bio-sensor is stable up to 45°C with a self life of more than 90 days.

Similarly, in the field of molecular electronics, the Single walled carbon nano tube (SWCNT) can be aligned through LB technique which exhibits the advance properties of a high performance transistor. The monolayer SWCNTs (figure-3) are readily patterned for device integration by micro fabrication, enabling the high currents (3mA) SWCNT devices with narrow channel widths. In this method a massive parallel arrangement of the nano-tubes can be obtained which is able to show high performance. A monomolecular LB film of fullerene derivative (figure 4) on Au (111) substrate is showing a very good rectification property. Other major applications of LB technique in molecular electronics as PLED (Polymer light emitting diode), OLED (Organic Light emitting Diode), directional electron transfer etc.

**Conclusion**

The Langmuir-Blodgett technique is a unique one to make highly ordered molecular arrangement either in the monomolecular or in the multimolecular form. These ultrathin films are of nanometer thickness. It is very stable, has a controllable thickness and surface orientation property. This makes the LB film to show various applications in the field of nano technology.

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SOME LESS KNOWN FACTS ABOUT ALBERT EINSTEIN

Prof. Bhagaban Patra

Albert Einstein is a household name. He is popularly known as an outstanding scientist and a Nobel laureate in physics. He is famous for his discovery of the theory of Relativity. The impression of the general public that Albert Einstein got the Nobel Prize for discovering the Relativity is totally wrong.

1. No Nobel for Relativity

Here is a very interesting story about this. In the year 1921, the Royal Swedish Academy of Sciences, which selects Nobel Prize recipients could not become consensus on whom to award the prize for 1921 and deferred it for one year. In 1922 Albert Einstein was awarded the most covetous Nobel Prize in Physics for the year 1921 and Niels Bohr was given the Nobel Prize in Physics for the year 1922. But in the official notification Einstein was pointedly informed that he was given the Nobel prize for discovering the particulate nature of light i.e. for solving the photoelectric effect and NOT for the theories of Relativity. Further the committee said that he was not to mention Relativity in his acceptance speech because they regarded his theory of Relativity as far speculative.

Einstein was disgusted and while thanking the committee, expressed his inability to attend the award ceremony due to prior commitments. But the King of Sweden expressed his displeasure with the developments and arranged a state dinner in Einstein's honour requesting that he should give a speech explaining Relativity. The invitation was accepted. Thus the Royal Swedish Academy of Sciences rejected the greatest scientific discovery and deprived Einstein of the honour.

2. Fortune favoured Einstein only after 30:

Most of the great men show the brightness of their future during their childhood days. But in case of Albert Einstein such speculation seems to be reversed. Fortune favoured him only after the age of thirty. During his childhood days and early youth, Einstein did not show any sign of future prospect. Born in the year 1897 in the city of Ulm in southwestern German, he did not have an auspicious start of life. It took about thirty years for him to achieve success in his lifelong ambition to become an academic scientist and in particular a theoretical physicist.

As a child he started speaking late, being always intensely absorbed with his own thought he was insolent and defiant of authority. Due to his nonconformist spirit he was expelled from one school and asked to leave another. In the year 1900, he graduated from a polytechnic with four years degree course in Zurich, Switzerland with low marks and negative references of the professors, which debarred...
him from getting a suitable professional employment in any University and technical institute from Norway to Italy and he had to resort to part-time tutoring for his livelihood. Through his own actions he had firmly placed himself on a road to failure and obscurity. However, with the help of his close friend Marcell Grossman's father; Einstein was hired as a patent clerk third class in the patent office at Bonn under the Swiss Government in 1902 and worked there for seven years. Earlier in 1901, he submitted a Ph. D thesis to Prof. Alfred Kleiner of the University of Zurich hoping that a doctorate degree would improve his career prospect. To his bad luck, the thesis was rejected, His father Hermann Einstein, a business man did not survive to see the success and celebrity status of his son as one of the most famous scientist and the theoretical physicist of the world and died in late 1902.

The commissioner of the patent office, U.S.A., declared in 1899 that everything that can be invented has already been invented. But in 1900, Henri Poincare, the leading French Mathematical Physicist proclaimed that only three remaining problems in physics to be solved were (i) Brownian Motion, (ii) Photoelectric Effects and (iii) Inability to find the luminiferous ether. Einstein dedicated himself to solving all the three problems identified by Poincare and succeeded in 1905 based solely on the sheer power of his genius. In 1909, he got his first academic job and rapidly rose through the professional ranks and within five years he held one of the world's most prestigious professorship in becoming a celebrity in 1914. Thus fortune favoured him only after he attained the age of thirty. He was awarded the Nobel Prize in physics meant for the year 1921 after one year in 1922 for the solution of the photoelectric effect and not for the discovery of the celebrated theory of Relativity.

3. Einstein's most expensive divorce:

During 1896 to 1900 while Einstein was reading in the polytechnic institute in Zurich, he was involved in love affairs with Maleva Marie, the only female student of his class. Einstein and Maleva shared a passion for science and a contempt for the established conventions of the society and the academia. They became colleagues, soul mates and eventually passionate lovers but Einstein's parents strongly disapproved their mixing with each other and opposed their marriage. In the meantime Maleva become pregnant with Einstein's child, after he passed out the polytechnic course and was unemployed while Maleva could not complete the course. This fact was kept secret from his family and others. Maleva returned to her Serbian home, delivered a girl child, left her with her relatives and returned to Einstein in Switzerland. It was nearly certain that Einstein did not see his first daughter at all. In 1902, while his father Harmann was on the deathbed, he relented and permitted Einstein to marry Maleva. Inspite of
his mother's continuing opposition Einstein married Maleva in 1903. Although they were married for fifteen years and had two more issues, one son and one daughter, the marriage did not survive the fame and celebrity that Einstein ultimately achieved. Serious friction developed between the couple due to difference in their personal problems.

Starting in 1912, Einstein began an affair with his first cousin Elsa. The two women were completely different, Maleva had been his intellectual colleague and Elsa was very much inclined to him and loved cooking. Being emotionally attracted towards Elsa, Einstein delivered a written ultimatum to Maleva and begged her for a divorce. But Maleva adamantly refused the divorce criteria, which finally compelled Einstein to make a remarkable offer to her. The Precondition of the second divorce suit was that Einstein would give Maleva half of his academic salary plus she would get all his prize money if he received the Nobel Prize. After painful deliberation Maleva finally agreed to the divorce. After Maleva and Einstein were divorced, he promptly married Elsa. In 1922, when Einstein won the Nobel Prize in physics, he kept his word and handed over to Maleva the entire Prize receipt of $500,000 at current evaluation and thus their divorce became the most expensive one in the history.

FOOD ALLERGY- SOME BASIC FACTS
*Kshyanaprava Dhakamant
**Sanjaya K Dash

Introduction

Food allergy is a common word; often when we observe some irregular symptoms in our body, we say that it is due to food allergy. Some common examples are swelling in some portions of skin, swelling of the lips, problems in the digestive tract, the airways (which cause wheezing and breathing problems) and the skin, etc. However, many a time we confuse with the terms 'food allergy', 'food hypersensitivity, 'food intolerance', 'food poisoning', etc. So let us discuss some of these aspects.

What is food allergy?

Food allergy causes a specific immunological reaction in the body that can be observed and diagnosed by various tests. Here we must understand that an immunological reaction is a reaction against foreign molecules entering the body. The basic purpose of such reaction is to protect the body. But when such reaction is extreme and is caused by certain foods that do not have any adverse effect on most people, then we call that as food allergy. For example, peanut is a common food, but some people immediately show abnormalities in their body behaviour after they consume peanuts. Some people show abnormal reactions when they consume mushrooms. We say that the person is allergic to peanut (or mushroom). These adverse reactions are immediate and localized; that affect a specific part of the body.

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Food allergy, food hypersensitivity and food intolerance

As we discussed earlier, these are the terms which are most often confused. A food allergy is an adverse immune response to a food protein. They are distinct from other adverse responses to food, such as food intolerance, pharmacological reactions, and toxin-induced reactions.

Food hypersensitivity includes all types of over-reactions that an organism can have against a food component. Food hypersensitivity can be divided into 'food allergies' and 'food intolerances'. If a food or food component develops an adverse reaction in a body, which has no relationship with the immune system, then it is called food intolerance. The common example is the lactose intolerance occurring in nearly 50% of the adult world population. People with lactose intolerance do not have the enzyme lactase to digest the sugar in milk (which is mostly lactose). In other words, the food intolerances is due to non-digestion/absorption of a specific food or food component. Other common types of food intolerances include intolerance of alcohol, fructose, gluten, certain types of fibers and food additives. But the food allergy is specifically related to the immunological reactions in extreme conditions. However, one thing is common in them, both refer to abnormal reactions to otherwise safe foods. Many a times the symptoms of food intolerance and food allergy are confusing and the physician must be consulted for proper advice.

Who are more prone to food allergy?

People of all age groups show food allergy, though it is more common in infants and young children. A report says that about 2% of all adults have food allergy. A food intolerance or allergy can be of a short-term duration or it can continue lifelong. If the food intolerance symptoms are not identified at an early age, it may lead to more serious problems in later part of life.

Children of atopic (allergic) parents are more likely to have an allergy. It is reported that children with one atopic parent have about two times the risk of developing food allergy as infants whose parents do not have allergies. If both parents are atopic, the risk increases four to six times.

Types of food causing food allergies

Although an individual could be allergic to any type of food, such as fruits, vegetables, and meat. However, there are eight types of food such as milk, eggs, peanuts, tree nuts, seafood, shellfish, soy and wheat. These are often referred to as "the big eight" and account for 90% of all food-allergic reactions. Sesame, tree nuts including pecans, pistachios, pine nuts, and walnuts, are also common allergens. Other foods containing allergenic proteins include synthetic and natural colours, and chemical additives.

Signs and symptoms of food allergies

The common symptoms for food allergies are given below.
Symptoms of allergies vary from person to person. And also the amount of food required to trigger an allergic reaction also varies from person to person. There are three common types of allergy testing: skin prick test, blood test, and food challenges. An allergist can perform these tests, and they can also go into further depths depending on the results.

A severe allergic reaction is known as 'anaphylaxis'. The whole body is affected, usually within minutes of exposure to the allergic material, which can be a food, drug or insect stings, etc. In fact, sudden release of chemical substances, including histamine, from blood cells and tissues cause the anaphylactic reaction, which is triggered by the reaction of the antibodies (immunoglobulin E) with the allergen. In anaphylactic shock, bronchial tissues swell and blood pressure drops, causing choking and collapse.

**Cure for food allergies**

Currently, there are no medications that cure food allergies. Strict avoidance is the only way to prevent a reaction. For people who are extremely sensitive, this may involve the total avoidance of any exposure with the allergen, including touching or inhaling the problematic food as well as touching any surfaces that may have come into contact with it. Most people outgrow their food allergies, although peanuts, nuts, fish, and shellfish are often considered life-long allergies. For babies that are born into families where close relatives suffer from allergies, exclusive breast-feeding for 4-6 months have proven to give some protection against some allergies.

If the food is accidentally ingested and a systemic reaction (anaphylaxis) occurs, immediate advice of the doctor should be taken. Some of the treatments include epinephrine, antihistamines, and steroids. However, it is always better to avoid the food/agents that normally cause allergy.

**Further reading:**


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WATER RESOURCE MANAGEMENT FOR INCLUSIVE DEVELOPMENT OF THE SOCIETY

Madhumita Das

In India the water availability varies with the sources. It is estimated to be 590 BCM in surface and 492 BCM in replenishable groundwater aquifers. The utilisable water in the country is therefore rounded up to 1122 BCM, which is more or less constant per annum. Owing to rising demand for water due to population and overall growth in developing sectors, the demand and supply balance gets upset and has resulted in to water scarcity at different rates and magnitude.

Water woes in the country

Fresh water is an ever dwindling resource across the World. Water pollution caused by rampant disposal of untreated or semi-treated wastes into the environment, climate change including abnormal rise of air temperature, recurrence of drought and flood and vagaries of monsoon, along with urban and industrial development aggravate the situation and curtail the water allocation in different sectors to a substantial extent. An exponential decrease in par capita availability of water is evident with rising population in India (Fig.1). The sector-wise allocation of water is progressively increasing with population in domestic/livestock and industrial fronts while a quadratic decrease is marked in agricultural irrigation (Table 1).

The population induced water scarcity is thus an impending reality in this sector. Water-stressed countries are those with <1700 m³ of water per person per year while regions with fewer than 1,000 m³ per person per year are defined as water-scarce. People living in.

Table 1: Projected water demand of various water users in past, present and future in India
(Unit: Billion Cubic Meters)

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<th>2025</th>
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</tbody>
</table>

Note: '-' No data available
water-stressed regions must make judicial decisions about using water for personal consumption, agriculture, or industry but water scarcity directly correlates with poverty. It hinders economic development, strains the environment, and drastically limits food availability.

**Water quality scenario**

In India groundwater available at shallow aquifers (<15 m from ground surface) are mostly represented by Ca - HCO3 type with salinity (EC) < 0.75 mS/cm at 25°C. Groundwater with salinity within 0.75 to 3.0 mS/cm are of mixed cation and anion types and >3.0 mS/cm and the water is mostly dominated by Na - Cl type in general. Besides, other hydrochemical types are also available in this general category based on local environment, anthropogenic intervention and other factors. In addition to occurrence of F, Fe, As, nitrate, sulfate and heavy metals have also been observed in few localized places across the India.

The water quality data of groundwater at shallow aquifers (6 to 15 m from surface) is more or less suitable for different water use sectors including irrigation. However, water from dug-wells are however susceptible to degrade by anthropogenic intervention. The nitrate pollution and presence of coliform in shallow depth dug - well water are reported from sporadic places. Groundwater quality at deeper aquifer however varies from place to place. Localized incidence of salinity, arsenic, fluoride and iron content have surfaced mostly due to geo-genic influence except coastal salinity. Occurrence of heavy metal ions have also been observed in some groundwater aquifer in industrially active areas. As per the published report of CGWB, the major parameters that determine the quality of groundwater are:

**Salinity and TDS**

The salinity is of two types, coastal and inland salinity. Coastal salinity is mainly due to the influence of sea. India has a long coastline of 6100 Km covering Gujarat, Maharashtra, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Odisha & West Bengal, where fresh water overlies saline water and saline water overlies fresh water are a common occurrence. This apart increase of salinity by seawater intrusion due to over exploitation of groundwater aquifer has also been reported from Minjur area of Tamil Nadu and Mangrol - Chorwad- Porbander belt along the Saurashtra coast. The Inland groundwater salinity mainly occurs in Maharashtra, Punjab, Rajasthan, Haryana, Gujarat, Karnataka, Uttar Pradesh, Delhi, and Bihar.

**Fluoride**

Nineteen states of India are identified with the problem of excess of Fluoride content in the groundwater. The maximum concentration of Fluoride level in the ground water of those states varies from 7.0 mg/l in Tamil Nadu (Erode) to 48.0 mg/L in Haryana (Rewari)

**Iron**

It is in an essential element present in both plants and animals. High concentration of Iron in ground water has been observed in
more than 1.1 lakh habitats in India. Iron contaminated ground water has been reported from Assam, West Bengal, Odisha, Chhattisgarh, and Karnataka; Bihar, UP, Punjab, Rajasthan, Maharashtra, Madhya Pradesh, Jharkhand, Tamil Nadu and Kerala and North East states.  

**Arsenic**

High level of As is observed in the ground water at different places of West Bengal, Bihar, Assam and Uttar Pradesh. The occurrence of Arsenic in ground water is mainly in the intermediate level of aquifers located between 20 -100 m depth from the ground.

**Nitrate**

Decomposition of organic matters, percolation of water soluble fertilizers, unplanned disposal from urban wastes and land fills are the major causes of nitrate pollution of the groundwater. However, nitrate is an essential nutrient for plants. In India, highest nitrate concentration is found in the groundwater of Bikaner, Rajasthan.

The Analysis of water quality status of the country carried out by Central Pollution Control Board (CPCB) with respect to the biochemical oxygen demand (BOD) and the content of pathogenic bacteria (total coliform and faecal coliform) reflects a gradual degradation of water quality of the country over time. It is mainly due to inappropriate disposal of wastes and its mismatch with the cleaning facility and natural reviving capacity of the environment. A large number of water bodies are identified as polluted stretches for taking appropriate measures to restore their quality under water quality management programme, which mostly come under Ganga Action Plan and National River Action Plans.

**Coping mechanism to combat water distress**

Use of fresh water and food production are intricately connected. One ton of grain production requires 1,000 tons of water. Out of the various uses of water, the requirement of water in agriculture is the highest and it varies from 75 to 90% of the total available water of the region. Water scarcity thus creates food shortages, raises food prices, and increases a countries' dependence on food import. Being an agricultural driven economy with vast geographical expanse, our country needs to manage the existing water reserves cautiously in order to avoid future water strain. Therefore, in agricultural sector there is a need to

- Improve efficiency in water management under irrigated production system, encourage adoption of techniques for rain-water harvesting, in-situ conservation of rain-water and watershed management. Improve water productivity by introducing crop diversification, residual soil moisture utilization, multiple use of water and conjunctive use of available water resources in a particular agro-ecosystem.

- Reform the Water User Association and Pani Panchayat system for efficient irrigation management and agricultural development at farm level.
- Devising an institutional linkage mechanism for effective irrigation water use and overall development in irrigation agriculture scenario.

- Reduce subsidies on power and implement customized pricing models to counter groundwater exploitation and hence to check excessive withdrawal of groundwater.

**Industrial Sector**

There is a need to promote recycling of waste and zero discharge. Encourage investment in recycling and treatment of industrial wastewater through regulations and subsidies for water treatment plants.

**Domestic Sector**

- Implement policies to make rain-water harvesting mandatory in cities with new construction Projects.

- Propagate efficient water usage practices through community based education programs.

- Prioritizing the implementation of the National River Link Project (that connects 30 large rivers and canals and generates 175 Trillion liters of water by the interlinking of rivers) is also an important step for the government because it will reduce regional disparities in water availability.

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**NEW GENERATION APPLICATION OF BAMBOO FIBRE**

**Himansu Shekhar Mohapatra**

**Introduction**

Bamboo is one of the fastest growing and most abundant woody plants in tropical countries. The rate of growth, up to 1 m per day, is very attractive for commercial applications. Therefore, bamboo is gaining increasing attention as an alternative crop with multiple utilizations. It is estimated that there are up to 1500 bamboo species having commercial potential. Bamboo has recently attracted a great deal of attention as a natural, green and eco-friendly new-type raw material for textile applications. The relatively long length of bamboo monofilaments (1.5-3.2 mm) coupled with its antibacterial properties makes it suitable for specialty textile materials such as sanitary napkins, bandages, surgical clothes and food-packing bags.

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Recently, its potential value for textile yarn production has emerged. Bamboo fibers are relatively long (1.5-3.2 mm) and thus, ideal for paper production. Paper production in China dates back 2000 years, whilst in India, 2.2 million tonnes of bamboo per year are processed into pulp, making up about two-thirds of total pulp production. As a regenerated cellulose fibre bamboo fibre is
100% made from bamboo through a high-tech process. The raw material bamboo is well-selected from non-polluted regions in Yunnan and Sicuan Province, China. They are all 3-4 year old new bamboo, of good character and ideal temper. The whole distilling and production process is a relatively green process without pollution. The supplier company manufactures bamboo fibre strictly according to ISO 9000 and ISO 14000. More important, bamboo fiber is a unique biodegradable textile material. As a natural cellulose fiber it can be 100% biodegradable in soil by micro-organisms and sunshine. The decomposition process does not cause any pollution in the environment. Bamboo fibre comes from nature and completely returns to nature in the end. Bamboo fibre is praised as the natural, green and ecofriendly new type textile material of 21st century.

**Bamboo as a natural antibacterial**

It's a common fact that bamboo can thrive naturally without using any pesticide. It is seldom eaten by pests or infected by pathogen. Scientists found that bamboo owns a unique anti-bacteria and bacteriostatic bio-agent named "bamboo Kun". This substance is combined with bamboo cellulose molecules tightly all along during the process of being produced into bamboo fibre. Anti-oxidant bamboo leaves mainly contains polyphenols (flavonoids and phenolic acids). In addition to its multiple physiologic and pharmacologic activities, Anti-oxidant bamboo can be used as a food antioxidant, which not only blocks the chain reaction of spontaneous oxidization of lipid, but also chelates transition metals, acting as a primary and secondary antioxidant synchronously. The bamboo fibre contains more than 93% of $\alpha$ -cellulose and retains the antibacterial properties. Cloth based on bamboo fibres has antibacterial properties especially against methicillin resistant Staphylococcus aureus. Bamboo fibre has particular and natural functions of anti-bacteria, bacteriostasis and deodorization. It is validated by Japan Textile Inspection Association that, even after fifty times of washing, bamboo fibre fabric still possesses excellent function of anti-bacteria, bacteriostasis. Its test result shows over 70% death rate after bacteria being incubated on bamboo fibre fabric. Bamboo fiber's natural anti-bacteria function differs greatly from that of chemical antimicrobial. The later often tends to cause skin allergy when added to apparel.

**Bamboo Intimate Apparels**

These include sweaters, bath-suits, mats, blankets. Towels are comfortable for hand and have special lustre bright colours, good water absorbent. Bamboo fibre has such a sole function as anti-bacteria, which is suitable for making underwears, tight T-shirts and socks.

Its anti-ultraviolet nature is suitable to make summer clothing, especially for the protection of pregnant ladies and children from the exposure of ultraviolet radiation.

**Bamboo Non-Woven Fabric**

This is made by pure bamboo pulp, which has the same property as viscose fibres. However, bamboo fibre has wide prospects in the field of hygiene materials such as sanitary napkin, masks, mattresses, and food-packing bags due to its anti-bacterial nature.
Bamboo Sanitary Materials

These include bandage, masks, surgical clothes, and nurse's wears and so on. The bamboo fibre has natural effects of sterilization and bacteriostasis, therefore, it has incomparably wide foreground on application in sanitary material, gauze, mask, absorbent pads, food packing and so on. In the medical scope, it can be processed into the products of bamboo fibre gauze, operating coat, and nurse's dress, etc.

Because of the natural antibiosis function of the bamboo fibre, the finished products need not to be added with any artificial synthesized antimicrobial agent, so it won't cause the skin allergy phenomena, and at the same time, it also has competitive prices in the market.

Bamboo Decorating Series

It has the functions of antibiosis, bacteriostasis and it is ultraviolet-proof. It is very advantageous for utilization in the decorating industry. Long time exposure to ultraviolet radiation causes skin cancer. Curtains, television covers, wallpaper and sofa covers can all be made from bamboo fibre.

Bamboo Bathroom Series

Bamboo towel and bathrobe have soft and comfortable hand feeling and excellent moisture absorption function. Its nature of antibiosis function keeps bacterium away so that it will not produce bad odour.

Conclusion

The bamboo fibre has a natural effect of sterilization and bacteriostasis and therefore, it has incomparably wide foreground on application in sanitary material such as sanitary towels, gauze mask, absorbent pads, food packing and so on. From the medical science point of view, it can be processed into the products of bamboo fibre gauze, operating coats and nurse dresses etc. Because of the natural antibiosis function of the bamboo fibre the finished products need no adding of any artificial synthesized antimicrobial agent. Therefore, bamboo fibre products may not cause skin allergies and at the same time it has a competitive advantage in the market.

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QUIZ : PHOTOSYNTHESIS
Sanjeeb Kumar Das
Padmini Bisoi

1. What amount of light falling on earth is utilized for photosynthesis ?
   a) 2%  b) 1%  
   c) 0.5%  d) 0.2%

2. Who proposed that impure air is purified in the presence of light and green plants ?
   a) Priestley  b) Ingenhousz  
   c) Emerson  d) De Saussure

3. Chlorophylls are
   a) Sterols  b) Steroid
   c) Tetrapyrroles  d) Chromo proteins

4. Solarisation of chlorophylls is
   a) Photo-reduction  b) Photo-oxidation
   c) Oxido-reduction  d) Photolysis

5. DCPIP (Dichlorophenol indophenol) is used to demonstrate
   a) Photolysis of water  
   b) Hills reaction  
   c) Calvin Cycle  
   d) hatch & Slack cycle

6. Which colour of light is adsorbed during bacterial photosynthesis
   a) Red  b) Blue
   c) Far Red  d) U-V rays

7. How many turns of Calvin cycle are taken to produce one molecule of hexose ?
   a) 1  b) 3  
   c) 6  d) 12

8. Dimorphic chloroplast are found in
   a) Sugar beet  b) Sugar cane
   c) Rice  d) Wheat

9. What is common between Photosynthesis & Respiration ?
   a) Cytochrome  b) Light
   c) ADP  d) O₂

10. In C₃ plants like paddy, the photosynthesis yield is reduced due to
   a) Respiration  b) Carboxylation
   c) Hydrolysis  d) neoglucogenesis

11. When RUBISCO behaves like an oxygenase?
   a) Temperature is increased  
   b) CO₂ is reduced  
   c) O₂/CO₂ ratio is increased  
   d) All the above

12. What is the By-Product of Bacterial Photosynthesis ?
   a) O₂  b) H₂O
   c) S  d) H₂S

13. The Source of energy for CO₂ fixation is
   a) CO₂  b) Light  
   c) Water  d) Chlorophyll

14. Molis half leaf experiment shows relationship between
   a) Transpiration & Respiration  
   b) Respiration & Photosynthesis  
   c) Photosynthesis & CO₂  
   d) Photosynthesis & Light

15. Hatch and Slack Cycle is not found in
   a) Sacharum munja  
   b) Zea mays  
   c) Triticum aestivum  
   d) Euphorbia tirucalli
In plants, the radiant energy is stored in the form of chemical energy in:

- (a) ATP
- (b) NADPH$_2$
- (c) Glucose
d) DNA & RNA

What is the by-product of photolysis of water?

- (a) CO$_2$
- (b) O$_2$
- (c) NO$_2$
d) None of these

Which of the following technique was used by Calvin for tracing the pathway of Photosynthesis?

- (a) Chromatography
- (b) Electrophoresis
- (c) Spectrophotometry
d) None of the above

PEPCO has an advantage as compared to RUBISCO. It is that:

- (a) RUBISCO fixes CO$_2$ only in C$_4$ plants where as PEPCO does it both in C$_3$ & C$_4$ plant
- (b) RUBISCO is subjected to photorespiration but PEPCO is not
- (c) PEPCO is found in all chlorophyllous cells but RUBISCO is not
d) None of these

The correct chemical formula for "chlorophyll b" is:

- (a) C$_{55}$H$_{72}$O$_5$N$_4$Mg
- (b) C$_{55}$H$_{77}$O$_6$N$_4$Mg
- (c) C$_{55}$H$_{70}$O$_6$N$_4$Mg
d) C$_{55}$H$_{70}$O$_5$N$_4$Mg

Why does life exist?

Jeremy England, an assistant professor at the Massachusetts Institute of Technology has proposed an idea that the origin and subsequent evolution of life follows the fundamental laws of nature.

He has derived a generalization of the second law of thermodynamics that holds for systems of particles with certain characteristics. The systems are strongly driven by an external energy source such as an electromagnetic wave, and they can dump heat into a surrounding bath. This class of systems include all living things. England indicated that when a group of atoms is driven by an external source of energy (like sun or chemical fuel) and surrounded by a heat bath (like the ocean or atmosphere), it will often gradually restructure itself in order to dissipate increasingly more energy. This could mean that under certain conditions, matter inexorably acquires the key physical attribute associated with life.

The chemistry of the primordial soup, random mutations, geography, catastrophic events and countless other factors have contributed to the fine details of Earth’s diverse flora and fauna. But according to England’s theory, the underlying principle driving the whole process of origin and evolution of life on Earth is dissipation - driven adaptation of matter.

Jeremy’s ideas are interesting and potentially promising, but extremely speculative, especially when applied to life phenomena remarked Shakhnovich a Harvard University, Professor of Chemistry, Chemical biology and biophysics.

- Editor

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**ANSWERS**

1. (d)   2. (a)   3. (c)   4. (b)   5. (b)   6. (c)   7. (c)   8. (b)   9. (a)   10. (a)
11. (d)   12. (c)   13. (b)   14. (c)   15. (c)   16. (c)   17. (b)   18. (a)   19. (b)   20. (c)

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1. "SCIENCE HORIZON" aims at developing the scientific outlook of students as well as the general people and seeks to give them information on scientific developments. It is published as a monthly magazine.

2. The authors desirous of writing and contributing articles to the magazine should first assimilate the ideas of the theme and present it in simple language and popular style.

3. The authors are requested to write clearly on one side of A/4 size paper. The relevant pictures in 4cm X 6 cm size are welcome. Photo copies of manuscripts are not accepted for consideration.

4. Each article will be ordinarily of two to three printed pages in A/4 size papers.

5. The article shall be profusely illustrated with pictures.

6. At the end of the article the author should give the references and suggestions for further reading.

7. The reference of books, journals, sources, ideas and essential points collected by the writer should be mentioned in the bibliography. This will enhance the quality and fidelity of the writing and give the reader an opportunity for making further studies.

8. Matter translated from other languages and illustrations should indicate the original sources otherwise those would not be accepted. The articles which are not selected are not returned to the authors. However, if the author wants, such articles may be collected from our office.

9. As far as practicable the articles should be based on contemporary science and must be easily comprehensible to students at the secondary level.

10. The writers should present difficult concepts of science through stories of everyday life, heart-rendering songs, pictures, satirical cartoons or attractive dramas.

11. All units in the articles should be given in the metric system.

12. The title of the article should be brief and attractive. Moreover, subtitles may be given in long articles. The writings should be coherent and cohesive.

13. There should not be repetition of specific words. While ensuring the contemporary spirit of the writing, it should reflect some valuable lesson for the society. It is also necessary to avoid mistakes in spelling, language use and factual details.

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