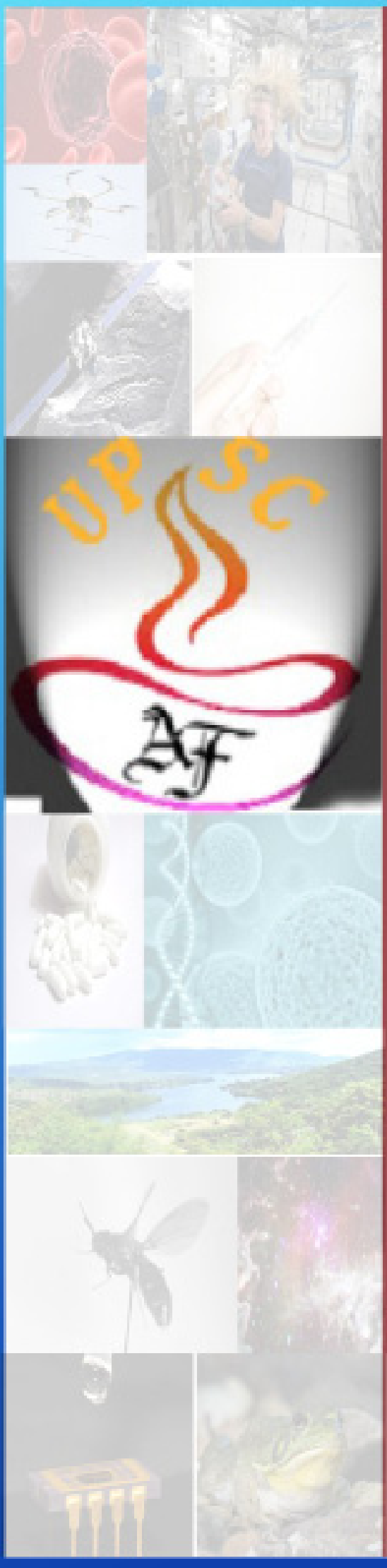

News for Oct-Dec 2016

SCIENCE AND TECH.

THE CRUX OF THE HINDU

Vol. 08

Important News in the field of

Space
Atomic Energy
Environment and Ecology
Bio-Technology
Computer and IT
Defence
Agriculture
Miscellaneous

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AN INITIATIVE BY UPSC ASPIRANTS

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Science and Tech.
The Crux of The Hindu
Vol. 08
News of Oct-Dec 16

Aspirant Forum is a Community for the UPSC Civil Services (IAS) Aspirants, to discuss and debate the various things related to the exam. We welcome an active participation from the fellow members to enrich the knowledge of all.

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Contents

aspirantforum.com

Science and Tech.
The Crux of The Hindu
Vol. 08
News of Oct-Dec 16

About the 'CRUX'

After the success of our monthly magazine The Crux of The Hindu and PIB, we are introducing a new and convenient product, to help the aspirants for various public services examinations. Today, the knowledge of the Current Affairs (Science and Technology) constitutes an indispensable tool for all the recruitment examinations. However, as per the examinations are concerned, it is quite tedious task to memorise each and every news. Moreover, every news as given in magazines and newspapers may or may not be relevant from exam perspective which forces the candidates to spend a quality time in extracting useful matter and framing notes. This problem of aspirants strikes our minds and made us to think for a sure shot solution as a result of which our experts have come out with the unique magazine of Science and Technology, Crux of Science and Technology. This trimonthly convenient product is going to save our aspirants' time. The whole concept of the CRUX is to provide you with a summary of the important news and current affairs, from an exam point of view. By reading the CRUX, you will be able to save your precious time and effort, as you get all the relevant matter in a summarized and convenient form. The Crux is particularly helpful for the Civil Services, Banking, SSC and other exams that have a current affairs section. The material is being provided in such a manner that it is helpful for both- objective and descriptive sections. Our aim is to help the candidates in their effort to get through the examinations. Your efforts and dedication inspire us to keep going. It is our sincere effort to make your journey easier.

Best Wishes
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aspirantforum.com
Science and Tech.
The Crux of The Hindu
Vol. 08
News of Oct-Dec 16

SPACE

Subsurface Ocean lies deep within Saturn's moon Dione

Saturn's moons Titan and Enceladus are already known to hide oceans beneath their icy crusts, but a new study suggests a subsurface ocean lies deep within Dione as well. The findings, based on new data from the Cassini mission to Saturn, suggest that Dione harbours a deep ocean between its crust and core.

In this study, researchers of the Royal Observatory of Belgium showed gravity data from recent Cassini flybys can be explained if Dione's crust floats on an ocean located 100 kilometres below the surface.

The ocean is several tens of kilometres deep and surrounds a large rocky core.

The researchers believe that Dione's ocean has probably survived for the whole history of the moon, and thus offers a long-lived habitable zone for microbial life. "The contact between the ocean and the rocky core is crucial," said Attilio Rivoldini, co-author of the study.

"Rock-water interactions provide key nutrients and a source of energy, both being essential ingredients for life," Rivoldini noted.

Seen from within, Dione is very similar to its smaller but more famous neighbour Enceladus, who'sSouth Polar Region spurts huge jets of water vapour into space.

Dione seems to be quiet now, but its broken surface bears witness of a more tumultuous past. The study findings were published online in the journal Geophysical Research Letters.

The Cassini-Huygens mission is a cooperative project of NASA, ESA (European Space Agency) and the Italian Space Agency. After almost 20 years in space, the Cassini mission will end on September 15, 2017, NASA recently said.

Scientists find oldest known planetary disc

Astronomers believe they have found the oldest known planet-forming disk — a 45-million-year-old ring of gas and dust that orbits around a young star. Circumstellar discs around red dwarfs like this one are rare to begin with, but this star, called AWI0005x3s, appears to have sustained its disc for an exceptionally long time, according to the study published in The Astrophysical Journal Letters.

"Most discs of this kind fade away in less than 30 million years," said lead researcher Steven Silverberg from University of Oklahoma in the US. "This particular red dwarf is a candidate member of the Carina stellar association, which would make it around 45 million years old (like the rest of the stars in that group). It's the oldest red dwarf system with a disc we've seen in one of these associations," Silverberg noted. The discovery relied on citizen scientists from Disk Detective, a project led by NASA's Goddard Space Flight Center's Marc Kuchner that is designed to find new circumstellar disks.

"It is surprising to see a circumstellar disc around a star that may be 45 million years old, because we normally expect these discs to dissipate within a few million years," one of the researchers Jonathan Gagne from Carnegie Institution for Science said.

New study on universe expansion: Indian physicist feels vindicated

Indian astrophysicist AbhasMitra, whose revolutionary theories challenging the existence of "black holes" and "dark matter" remain uncontested till date, again feels vindicated. Mitra is former head of theoretical astrophysics at the Bhabha Atomic Research Centre and now adjunct professor at the HomiBhabha National Institute in Mumbai.

He says the prediction he made four years ago that the universe may not be undergoing accelerated expansion — contradicting the view of mainstream cosmologists — has now found support from an independent study reported by physicists from Oxford University.

Under the prevailing cosmological model, the universe created after the Big Bang is not just expanding, but the expansion is actually accelerating: a discovery for which the Nobel Prize in Physics was given to three astronomers in 2011.

This discovery was based on an analysis of "red shift" or unexpected "dimness" of light from supernovae, the stunning thermonuclear explosion of dying stars, picked up by the Hubble space telescope and large ground-based telescopes.

This reported "red shift" was attributed to the existence of a mysterious substance named 'dark energy' and led to widespread acceptance of the idea that the universe is dominated by this "Dark Energy", driving its expansion with acceleration.

But in a series of peer reviewed publications since 2012, Mitra had shown that there is no dark energy at all and "must be an artifact for explaining a complex inhomogeneous universe by an oversimplified Big Bang model".

In his publications Mitra had shown that because there is no dark energy, there can be no acceleration of the universe. “But nobody listened to my exact theoretical results questioning the existence of the dark energy,” Mitra told this correspondent.

Casting doubts

That situation seems to have now changed with the publication of a new, more detailed, study by Oxford University researchers in “Scientific Reports”, a sister publication of the reputed journal Nature. The Oxford team, led by Subir Sarkar, has also cast doubt on the standard cosmological concept of accelerating expansion of the universe, lending strong support to Mitra’s prediction.

The researchers analyzed the emissions from a staggering 740 supernovae and concluded that the evidence for an accelerating universe is “flimsy”. They have admitted that their work “serves to demonstrate that a key pillar of the standard cosmological model is rather shaky”.

While claiming that the study by Oxford scientists has supported his theory about a non-accelerating universe, Mitra said his studies call for a paradigm shift from the Big Bang models that require the existence of dark matter that has not yet been detected.

Soyuz MS-01 successfully lands on Earth with three on board

The landing module of the Russian spaceship Soyuz MS-01 successfully touched down on Sunday in the steppes of Kazakhstan with three crew members on board, according to the Russian Mission Control Centre.

Astronauts Anatoli Ivanishin, TakutyaOnishi and Kathleen Rubins, of Russia, Japan and the U.S. respectively, returned to Earth after completing a nearly four-month mission on the International Space Station.

The MS-01, the first ship of the new Soyuz model, landed about 140 to 150 km southeast of Zhezkazgan city. During their tenure on the orbital platform the three astronauts performed about 40 scientific experiments.

The ISS is currently made up of 14 permanent modules and orbits at a speed of more than 27,000 km per hour at a distance of 400 km from Earth. The orbit of the platform is raised periodically as the ISS loses between 100 and 150 metres in height due to terrestrial gravitation, solar activity and other factors.

Two new planets seen

Brazilian astronomers have discovered two new planets around a star similar to the sun known as HIP 68468. The two new planets, dubbed “super Neptune” and “super Earth”, are the first to be discovered by Brazilian astronomers since the discovery in 2015 of a planet similar to Jupiter, according to Brazil’s G1 news website on Friday.

Astronomer Jorge Melendez, of the Institute of Astronomy, Geophysics and Atmospheric Sciences, University of Sao Paulo, and head researcher, said that one of their objectives was to compare the solar system with other planetary systems, Xinhua news agency reported. The planetary environment around HIP 68468 is quite different from the system that includes Earth, he said.

While the mass of the newly discovered planets was similar to that of Earth’s and Neptune’s, the planets rotate very close to their star, which suggests they may have migrated from a more exterior to a more interior region of their planetary system. Super Earth, or HIP 68468b, has a mass that is three times larger than Earth’s, and its orbit is barely 3 percent of the distance from Earth to the Sun.

NASA’s MMS breaks Guinness record

NASA’s Magnetospheric Multiscale mission (MMS) has set the Guinness world record for highest altitude fix of a GPS signal at 70,000 kilometres above the surface of the Earth. Operating in a highly elliptical orbit around Earth, the four MMS spacecraft incorporate Global Positioning System (GPS) measurements into their precise tracking systems, which require extremely sensitive position and orbit calculations to guide tight flying formations.

Earlier this year, MMS achieved the closest flying separation of a multi-spacecraft formation with only 7.2 km between the four satellites. When the satellites are closest to Earth, they move at up to 35,405 km per hour, making them the fastest known operational use of a GPS receiver. Still in the first year of its prime mission, MMS is giving scientists new insight into Earth’s magnetosphere.

The mission uses four individual satellites that fly in a pyramid formation to map magnetic reconnection - a process that occurs as the sun and Earth’s magnetic fields interact.

New light on dark matter

Dark matter is as mysterious as it sounds – very little is known about it, save that it makes up about 85 per cent of all the matter in the universe. Now, German and Hungarian scientists have thrown some light on a type of dark matter particle that has been postulated, known as the axion. They have established that axions can have a mass between 50 and 1500 micro electron volts, making them some ten billion times lighter than the electron.

This computation has been published in the journal Nature. An interesting fact is that these calculations were done numerically using a (Bluegen/Q) super computer, JuQueen, housed in the Julich Supercomputer Centre in Germany. Dark matter is so known because it interacts weakly with matter and so is notoriously difficult to detect. Yet, indirect proof of its existence comes from observation of rapidly rotating galaxies, which cannot be held together merely by the gravitational pull of the matter they contain – there has to be a lot of invisible stuff known as "dark matter" to prevent them from flying apart with the force of their own energies. Such inferences imply that nearly 85 per cent of the universe is made of dark matter, the known matter only contributes 15 per cent.

Several candidate particles have been postulated that may constitute dark matter – both highly massive and lightweight – but none of the experiments have detected any such particle so far, directly. Axions are particles proposed by extending quantum chromodynamics (QCD) the theory that describes "strong interactions," the way quarks and gluons bond to form matter particles such as protons, neutrons etc. Though they have been proposed and there are experiments to study them (for instance, the Axion Dark Matter Experiment, ADMX), there has been no real handle on these until now. The present work sets a mass bound on the axions, between 50 and 1500 micro electron volts, as mentioned earlier. This would require that there exist ten million such particles for every cubic centimetre of the universe. Also, because dark matter is not evenly spread out, but occurs in clumps, there should be nearly a trillion axions per cubic centimetre in the Milky Way – our galaxy.

Knowing the expected mass range of the axion not only gives a better understanding of the particle itself, but also can serve as a guideline for doing experiments. Instead of firing in the dark, ADMX, for instance, now has a definite range to study keenly.

aspirantforum.com
Science and Tech.
The Crux of The Hindu
Vol. 08
News of Oct-Dec 16

ATOMIC ENERGY

Pune researchers fabricate a flexible nanogenerator for wearable electronics

Producing wearable electronics that uses a portable nanogenerator which generates electric power when pressure or twist is applied got a shot in the arm, thanks to research carried out by Pune researchers. The nanogenerator, which was fabricated by them, produced 14 volts when thumb pressure was applied. The results were published recently in the journal Advanced Materials & Interfaces.

To demonstrate the potential of the nanogenerator to power small electronic devices, pressure equivalent to thumb pressure was continuously exerted on the nanogenerator for 20 minutes by using a vibration producing motor. About 28 micro watt per square cm power and 14 volt that was generated was stored in a capacitor and used for charging a mobile phone.

Currently, there is considerable research emphasis to develop flexible or wearable devices. Such devices should be portable, lightweight, shock-resistant, and inexpensive. And the devices should ideally be powered by harvesting easily available mechanical or vibration energy, making battery or related wiring redundant. Piezoelectric materials, which can generate electrical power locally through stress or flexing, are a great proposition in this regard.

To produce the nanogenerator, researchers from Pune's Indian Institute of Science Education and Research (IISER) and the National Chemical Laboratory electrospun a piezoelectric polymer [P(VDF-TrFE)] directly onto a flexible, conducting carbon cloth. The carbon cloth was produced by the researchers by heating a piece of cotton cloth at 800 degree C for several hours in an inert atmosphere.

To improve the piezovoltage of the polymer fibres, the researchers coated the fibres with a stronger, inorganic ferroelectric material (BaTiO3) paste. "The nanoparticles from the coating helps fill the gaps between the polymer nanofibres and increase the piezoelectric property," says Prof. SatishchandraOgale from the Department of Physics and Centre for Energy Science, IISER Pune and the corresponding author of the paper. In addition, the ferroelectric material was also incorporated into the polymer to further enhance the piezoelectric property. This was done right when the polymer was electrospun.

The amount of BaTiO3 fibre incorporated into the polymer had to be optimised at 5 per cent. When the fibre density was less inside the polymer the density of interfaces (where the separation of positive and negative charges takes place) formed between the fibre and the polymer was also less. But flexibility was reduced when too much was added and it also led to more internal charging resulting in electrical short.

The coated polymer was covered by another piece of flexible carbon cloth before the device was sealed. The carbon cloth on either side of the device acted as two electrodes. The carbon cloth too contributes to the enhanced piezovoltage generated by the nanogenerator through its peculiar morphology as a substrate.

"The cloth has a surface microstructure which produces good bonding between the cloth (electrode) and the active layer. The bonding will be poor in the case of a metal layer," says Prof. Ogale. "Due to the roughness of the cloth surface, when you press or flex the device the applied force is transmitted along different directions of the piezoelectric active layer. And this improves the piezoelectric property of the nanogenerator." If the electrode were a flat metallic surface then the force applied would be transmitted in only one direction.

"When thumb pressure was applied on the polymer alone 2-3 volt was produced. In the case of the polymer with BaTiO3 coating, the piezovoltage generated was 7-8 volt. But 14 volt was produced when BaTiO3 was incorporated into the polymer and also coated on the fibre surface," says DiptiDhakras from NCL and the first author of the paper. "The voltage of 14 volt with a current of several microamperes is the highest power output reported for wearable type of nanogenerator using conducting cloth as the electrode," notes the paper.

Chennai team turns leather waste into carbon for electrodes

Researchers at the Vellore Institute of Technology University, Chennai, have successfully converted leather solid waste (wet blue leather splits) containing chromium (III) into porous carbon matrix for use as electrodes in supercapacitors using a simple, sequential, two-step process. This approach not only yielded "excellent porous electrode material for supercapacitors", but also effectively addressed the management of chromium-containing leather solid waste, which is considered to be the major issue of leather manufacturing industry. The results were published in the Journal of Hazardous Materials.

Chromium (Cr) is widely used in leather tanning as it imparts toughness to leather. Though Cr(III) present in

leather waste is not toxic, it can undergo spontaneous oxidation and get oxidised into Cr(VI) which is toxic. The conventional disposal methods, such as land filling and incineration, cannot be considered as an ideal way of disposing the waste in an eco-friendly manner.

"The prime constituent of leather is collagen fibre. So we thought of converting the collagen fibre into carbon fibre without oxidising the Cr(III) to Cr(VI)," says Dr. L. John Kennedy from the Physics Division - Materials, School of Advanced Sciences, VIT University, Chennai, and the corresponding author of the paper.

As a first step, the leather waste was precarbonised by heating it for four hours at 400 degree C. The precarbonised material was soaked in potassium hydroxide overnight and then heated at higher temperature in an inert atmosphere to produce porous carbon that contains inter-connected nanopores of all three sizes — micropores (less than 2 nm), mesopores (2-50 nm) and macropores (over 50 nm). Since the carbon contains all the three types of pores, it is called hierarchical porous carbons (HPCs).

Role of pores

The pores of different sizes are formed by pore drilling and pore widening due to the combined effect of potassium hydroxide and temperature. In addition to pore formation, graphitic stable carbon structure is also formed. The chromium present in the leather induces graphitisation in the carbon material; the graphitic content present in the material improves its electrical conductivity property. "We are not only taking care of chromium disposal, the metal actually improves the property of the carbon," he says.

Hierarchical porous carbon is considered as a promising material for making electrodes that can be used in supercapacitor devices.

Three types

The three types of interconnected pores have very different roles in rendering the carbon a good electrode material. (While the micropores enhance the electrical double layer formation, the mesopores provide ion-transport pathways with low resistance, and the macropores serve as ion-buffering reservoirs to reduce the diffusion distance.)

At 900 degree C, the specific capacitance value was 1960 Farad per gram using one molar of potassium chloride electrolyte; the specific capacitance value was less at lower temperatures. "The mesopore volume increases with increasing temperature and this leads to higher specific capacitance," Dr. Kennedy says.

As the hierarchical porous carbon is highly porous and has higher surface area, adequate ions diffuse into the inner pores of the electrode material. Since more ions are adsorbed on these electrodes compared to normal electrodes, the charge storage capacity becomes higher. "We have explored and proved the potential of converting hazardous leather waste to an excellent electrode material for energy storage device concept," he says.

Hungry bacteria can extract energy from sewage

Sewage contains a source of energy that can be harvested by using hungry bacteria, researchers from Ghent University in Belgium have discovered.

"The levels of organic matter in sewage are too low to be directly recovered. We investigated how we can use bacteria to capture this material," said one of the researchers Francis Meerburg.

"We periodically starve the bacteria, in a kind of 'fasting regimen' Afterwards, waste-water is briefly brought into contact with the starved bacteria which are gluttonous and gobble up the organic matter without ingesting all of it," Professor Nico Boon said.

"This enables us to harvest the undigested materials for the production of energy and high-quality products. We starve the rest of the bacteria, so that they can purify fresh sewage again," Boon explained.

The researchers said their approach is unique because they have developed a high rate variation of the so-called contact-stabilisation process.

By using the contact-stabilisation process, up to 55 per cent of the organic matter could be recovered from sewage, the researchers said. This is a huge step forward, because the existing processes cannot recover more than 20 to 30 per cent. The researchers calculated that this amount can provide sufficient amounts of energy to completely treat sewage without the need for external electricity.

"This is an important step in the direction of waste-water treatment that is energy neutral, or even produces energy," Professor Siegfried Vlaeminck said.

A clue into making biodegradable plastic

For the first time, scientists from MIT have succeeded in decoding the structure of an enzyme that is used by bacteria to make polymer chains which is used for storing carbon when going through nutrient deficits. What is special about these polymers is that they make up a range of "biodegradable" plastics.

Known as Polyhydroxyalkanoic acids (PHAs), these pol-

ymer chains have properties ranging from thermoplastics to elastomers depending on the type of monomers attached to them. Their property of being biodegradable renders them of great value in producing environment-friendly plastics for industrial use; however, the process is not cost-effective.

One such PHA is polyhydroxybutyrate (PHB). Knowing the structure of the enzyme PHB synthase can greatly help in developing the process further. While the present work does not promise biodegradable plastic at competitive rates just yet, it is a step in that direction.

In making these polymers, a culture of a gram negative bacteria — Cupriavidisnecator — is allowed to multiply significantly on a substrate. Then the colony is put through a deficiency of a particular nutrient, while being supplied carbon. In response, the bacteria produce these long polymer chains to store the available carbon. The polymers can be extracted from the bacteria and used. A bacterium can produce polymers that measure up to 85 per cent of its weight.

“One of the keys to being able to understand a system in enough detail to engineer it is being able to visualize the components that are required to produce a desired product. For close to 20 years, groups around the world have been working towards determining the structure of the enzyme responsible for producing PHAs,” says Catherine Drennan, professor of biology and chemistry at MIT, the author of a paper published in Journal of Biological Chemistry.

Elizabeth Wittenborn, a graduate student and first author of the paper, came up with the structure of the enzyme through a process of crystallography. Her analysis revealed a “dimer” configuration of Pha synthase — namely that it was made up of two identical subunits. Each of this has an active site where the polymerisation occurs.

This differed from earlier surmises that the active site resided in the interfaces of the subunits. This analysis also revealed that the enzyme had two openings through which the starting material entered and the formed polymer emerged.

Prof. Drennan says that now that the structure is known, it is possible that thermal and mechanical properties may be improved by changing the polymer composition.

aspirantforum.com
Science and Tech.
The Crux of The Hindu
Vol. 08
News of Oct-Dec 16

ENVIRONMENT AND ECOLOGY

'Blindly trying to protect something does not help the ecosystem'

Mridula Srinivasan is a marine biologist, presently, she is chief of Protected Species Science Branch at National Oceanic and Atmospheric Association, USA. At NOAA, she advocates for and provides scientific advice on issues related to protected species such as dolphins, whales, corals, sea turtles and sea birds. In this interview, she speaks of the importance of the scientific approach in conserving marine mammals such as dolphins and how it may be implemented in India.

Since your PhD in 2009, you have studied marine mammals in detail. What are the most significant aspects of your study? I am interested in predator-prey interaction… and how climate variability affects dolphin distribution and demographics. Also, my colleague in the US is leading the effort to develop suction-cup non-invasive tags to track dolphins. We have done a few trials in New Zealand on dusky dolphins. It's very promising but there is a long way to go. The state of the science is that we are unable to non-invasively track dolphins.

We do agree that preservation of marine mammals is important, but at which point does the science come in and how?

Ultimately animal conservation is about managing people; as for the animals, you cannot really manage them, only their habitats. There are various tradeoffs. So, conservation is a challenge. But to get to that point where you start talking about conservation, you still need to do the science. You need to know where your animals are, how many of them and what impacts them, isolate the most critical threats against the smaller ones. The science is in trying to understand the animal's environment, behaviour, biology. If you don't know that, it's very difficult to propose solutions. So you need to know the biology of how these animals behave. Once you know the baseline, how they react to impacts, then you can propose mitigative solutions.

You have specialised in behavioural ecology and studied the dusky dolphin and its preservation. What has been the takeaway, in terms of conserving marine life?

Conservation is really about economics. If there is some development that needs to happen, conservation is the first thing that's compromised. This is true all over the world. But in the US, at least there is still the science-based conservation. You have to enforce the rules and regulations, but you have to be practical about them. In India and other countries where you're trying to develop things, make sure standard of living is uplifted, conservation takes a back seat. When you seek to preserve a species, or a habitat, or solve a problem – are you getting all the information you need to do this? I think that's lacking in India at the moment. Are you working with organisations in India on conservation efforts? You speak of the importance of handling stranding animals, would you explain this?

We are trying [to work in India]. We do work with some of the organisations at ministry level.

We are seeing if we can help support a national structure for stranding response. It is important having some best practices, because you want everyone following consistent guidelines. It goes back to this point: When you see an animal on the beach – dead or alive – and you collect some data and push it back, you are just taking care of the immediate problem. What you are not addressing is why that animal is on the beach in the first place… This has an impact – it is an indicator of ocean health. Oftentimes, you may not know what the cause of death is, but you get some clues, and you want to collect as much data from the animal as possible… Data is just the step to asking more questions. It is important to put together a picture about the animal and then talk about conservation.

If you try to protect something blindly, then you are not helping the animal, the habitat or the ecosystem. You have to make sure the right people are on the table, getting the data, processing and publishing the data.

Indo-U.S. collaboration to focus on pelagic fish resources

From predicting harmful algal blooms (HAB) and fishery of small pelagic species, there is quite a lot that earth scientists could tell the world.

The Ministry of Earth Sciences, India and the National Oceanic and Atmospheric Administration (NOAA), U.S., are jointly working on a research collaboration programme to use combined scientific and technical skills in enhancing the observations of the Earth.

The collaborative programme, implemented through the National Marine Fisheries Services, NOAA and the Centre for Marine Living Resources and Ecology (CMLRE)

and the Indian National Centre for Ocean Information Services (INCOIS), would focus on prediction of pelagic fish resources, especially sardines.

The small pelagic, Indian oil sardine, mackerel and anchovies, contribute almost 55 per cent of the marine fish catch from the south eastern Arabian Sea. Of this, the sardine alone accounts for almost 16 per cent. Almost 90 per cent of the artisan fishermen directly or indirectly rely on these fishes for their livelihood and so the inter-annual variations in the availability of these fishes have a considerable impact on the economy of the common men, pointed out M. Sudhakar, director, CMLRE.

Increasing frequency and extent of harmful algal blooms in the coastal and oceanic area of the Indian Exclusive zone is a cause for concern, as it disrupts biogeochemical cycles and possibly enhances the oxygen minimum zones. This in turn affects marine ecosystem processes such as energy flow and prey availability for mid- and upper-trophic predators. Therefore, the understanding of formation mechanisms of the harmful algal blooms, its spread and the environmental set-up favouring their production is of utmost significance, he explained.

The institutions together would develop improved predictive capability for the small pelagic of the south eastern Arabian Sea especially sardines and develop harmful algal blooms monitoring and prediction system for the coastal oceanic occurrence, he said.

There would be technological support and sharing of expertise for the development of statistical forecast models on the abundance and distribution of small pelagic fishes and biophysical models to relate plankton production to physical ocean dynamics.

The lessons learnt from sardine fishery management in the California current would also come in support of the Indian fishery programme, the researchers hope.

India begins to drill into the Antarctic ice

An Indo-Norwegian project to understand the response of Antarctic ice shelves to the global warming has begun in the less-studied areas of East Antarctica, especially the Dronning Maud Land (DML), which is characterised by loosely-connected ice shelves along the 2000-km-long coast. Ice shelves of East Antarctica are poorly understood when compared to the West Antarctica region.

Climatologists are increasingly worried about the large uncertainties in the future Antarctic contribution to the global sea-level rise since the Antarctic contribution to the climate changes has increased significantly during the past two decades.

"Under the project, mass-balance, dynamics, and climate of the Dronning Maud Land coast, East Antarctica (MADICE), geophysical field measurements, ice core drilling, ice-sheet modelling and satellite remote sensing-based studies will be conducted to understand the future Antarctic contribution to the global sea-level rise," said ThambanMeloth, a senior researcher of the National Centre for Antarctic and Ocean Research (NCAOR), Goa, and one of the co-leaders of the team for 2016-17 field campaign.

Under the MADICE, research will be conducted during 2016-17 and 2017-18 Antarctic field seasons.The scientific programme, jointly funded by the Ministry of Earth Sciences, India and the Research Council, Norway, has NCAOR and the Norwegian Polar Institute (NPI) as the partnering research institutions. The Indian contingent includes C. M. Laluraj, K. Mahalinganathan, BhanuPratap, and PrashantRedkar of the NCAOR.

The researchers will try to better understand the current status and dynamics of ice shelves in Dronning Maud Land to decipher its response to the future climate change, said a communication.Studies on the mass balance and long-term evolution of the Antarctic ice rises (grounded ice mass leading to an elevated part of the ice shelf) and assessment of its impact on the Antarctic ice-shelf stability and ice-sheet loss too will be carried out. Attempts will also be made to reconstruct the recent changes in Antarctic climate using ice cores and its possible teleconnections to global climate.

Each field campaign will include over-snow traverse and camping over ice shelves for nearly two months. Maitri, India's Antarctic research station, will serve as the logistic support base, explained Mr. Meloth.According to Dr. Meloth, since the exploration region is highly crevasse-prone and has never been studied before, the team would use crevasse detecting radar system at hazardous spots.

The flash floods in Kerala come from a distance

The flash floods (Kallakadal) that wreaked havoc in the coastal areas of Kerala come furtively from a distance, nearly 6,000 km away from the Southern Ocean, scientists have concluded.

Kallakadal, as they are locally known, or flash floods that swept across the Kerala coast in 2005 caught the scientific community and local communities off-guard. There were no apparent oceanographic reasons or scientific explanations for the process.

During the event, the sea surges into the land and inun-

dates vast areas to leave a trail of destruction. In 2012, UNESCO formally accepted the term for scientific use.

While locally visible weather features like cyclones or storm surges could account for the usual coastal flooding, it is the absence of such elements that baffled the scientists.

Adding to the mystery

Locals termed the process Kallakkadal, to suggest that the sea came in stealthily to steal away all their belongings. The failure of the ocean forecast systems to predict the process added mystery to it. Studies carried out by the scientists of the Indian National Centre for Ocean Information Services (INCOIS), Hyderabad, revealed that the flash-flooding reported along the south-west coast was caused by the swell waves coming from the Southern Ocean.

The researchers — P.G Remya, T. M. Balakrishnan Nair S. Vishnu, B. Praveen Kumar and B. Rohith — recently published a paper in the Journal of Geophysical Research (Oceans) explaining the process.

Assessing the 2005 events and the generation mechanism and environmental conditions that caused the flooding, researchers suggested the "meteorological conditions in the Southern Indian Ocean create helpful conditions for the generation of long period swells. These oceanic regimes are marked by strong westerly jet streams in the atmosphere. Sometimes, low-pressure cyclonic circulations (clockwise circulation) will be formed within these westerlies, and very slowly they move northward..."

These anomalous wind patterns, they say, have a strong northward component, and sustain over the ocean for a long period, typically around two to three days. These strong winds and the availability of large ocean area create helpful conditions for the generation of swells. According to the paper, these swells travel northward and reach the Indian coasts within three to five days creating havoc in the coastal areas.

It was also found that all the 10 high-wave incidents that were reported along the coast in 2005 were driven by a surge in swell waves coming from the Southern Ocean.

A clue to the future

The proper monitoring of the oceanic-atmospheric conditions in the Southern Ocean should give a clue on the possible development of the events, and the subsequent generation and propagation of swells in the Indian Ocean, said Dr. Nair, the co-author of the paper and Head, Information Services and Ocean Sciences Group of the Centre.

The intensity and direction of the swells can be predicted, and with advance knowledge about the tidal conditions in the Northern Indian Ocean forecasters would be able to predict the high wave activity/ Kallakkadal events in the NIO coastal regions at least to two to three days in advance, he said.

Why and how do zebras and squirrels get stripes?

How did the zebra and the squirrel get their stripes? The answer depends on who you ask or what you read. There are several charming stories about this. On a more serious note, this question has intrigued biologists for long and a consensual answer appears on the horizon.

As children, we were told that when the little squirrel brought little pebbles to help Lord Rama's army in building the bridge to Lanka, Lord Rama fondly petted the squirrel in appreciation with his fingers and that is how its stripes came to be.

As for the zebra in Africa, Rudyard Kipling in his charming "Just so stories" wrote (www.boop.org/jan/justso/leopard.htm) that two ancestral zebras decided to "melt" into the landscape as camouflage to escape the leopard and the Ethiopian hunters. A Ugandan parable has it that the dark donkey and white horse were fused into one another by an angry god in order to stop them from fighting, and out came the zebra.

Scientific reasons

While these are charming folk tales and legends, the evolutionary biological explanation is slowly emerging. Scientists have been toying with a few broad set of answers. One of them is similar to what Kipling wrote, namely, that the stripes allow them to merge into the woodland background, so as to escape predators. Another says that stripes help in cooling the body from overheating.

The third is based on the fact that hunters find moving striped objects difficult to target accurately – the so called "motion dazzle confusion effect." A fourth one points out that parasites, mosquitoes and flies, find it impossible to attack striped animals, while they can feast on uniformly coloured animals such as the "dull donkey." It is the last one, escape from parasites attack, which has gathered much support for the advantage of stripes on animals in the African environment.

Dr. Tim Caro of the University of California Davis, and Dr. Susanne Akesson from Lund University, Sweden, have been the proponents of this theory. DrAkesson and her colleagues point out that horse flies and similar parasites, which feed on the blood of animals, are attracted to light

that is oriented in a particular direction (polarisation) or glare. This glare attracts and helps these insects zone in on the target. Dark skin polarises light better than brown or white. But if the skin were striped dark and white, it becomes less attractive to the bloodsucker bugs.

Akesson has argued that the black and white pattern "is ideal in its functions of disrupting this signal of reflected polarized light" and, in effect, is camouflaged to flies as well as big cats." (A science writer, who covered this research paper, has suggested that we use Zebra striped wall paper to shoo away mosquitoes and flies, worth trying!)

Taking on this and studying the skin colouration and striping of a whole set of animals of the donkey/horse family (called the equids), Dr Caro and colleagues studied in detail seven different members of the equid family across the Old World (largely tropical regions of Africa and Asia), on one hand, studying their skin colouration and striping, and the location and prevalence of blood-sucking flies such as the horsefly and the tsetse across this broad region of Sub-Saharan Africa on the other. Their paper, "The function of zebra stripes," which appeared in the journal Nature Communications (April 2014, DOI:10.1038/ncomms 4535), finds the strongest connection between the biting fly annoyance and the number, spacing and intensity of stripes in the face, neck, belly, rump, flank and legs of the striped equids.

In effect then, stripes evolved in African equids largely to protect them from the blood sucker insects which abound and thrive in the African tropics. Stripes fool these bugs, perhaps by the disruption of the polarisation of light falling on the striped pattern on the hair and skin. Is this why zebras or striped squirrels are not found in the U.S., Northern Europe or Russia? Neither is the climate there welcome to such bloodsucker insects.

The biological mechanism behind how these stripes are written on the body of these animals (squirrels, African striped mice and zebra) is also becoming clear, thanks to a recent paper by R.Mallarino and coworkers, which has very recently appeared in the journal Nature (doi:10.1038/nature20109). The gene MITF is known to be a master regulator of the cells known as melanocytes or pigment cells, which generate colour in hair cells and thus the skin. And another called ALX3, through its protein, appears to repress the regulator MITF.

In yet another twist, so common in the molecular biology of development, the gene ALX3 is involved in normal facial development and a deficiency in its function leads to malformed noses in humans.

Likewise, mutations in the other gene, MITF, leads to small eyes, deafness and some related disorders. How nature has recruited these two genes in order to draw lines on their bodies and thus protect some of these tropical mammals is one of those surprises that evolutionary biology often throws at us.

Influence of orography on tropical rain physics

The size of rain drops influences natural events such as soil erosion and landslides. Larger drops could cause more soil erosion that may serve as triggering factors for landslides. The size of rain drops is influenced by the orography (topographic features of mountains) of places when the rain rate is high, says a study carried out by R. Harikumar, a scientist of the Indian National Centre for Ocean Information Services, Hyderabad. The size of rain drops has a significant effect on soil erosion and landslides. Larger drops could cause more soil erosion that may serve as triggering factors for landslides,

In a paper published in Atmospheric Science Letters, Dr. Harikumar found that rainfall in the Western Ghats region has larger drops compared with those in plain lands when the rain rate is high.

The study was carried out by comparing the rain drop size distribution characteristics at coastal and high altitude tropical stations. Rain data were collected from Kochi, Sriharikota, Munnar and Thiruvananthapuram.

Rainfall at Munnar consists of less number of bigger drops than in Kochi, Sriharikota, and even than Thiruvananthapuram. The rain in the Ghat region was dominated by bigger drops, which could account for more incidents of soil erosion, the paper concluded.

The drop size distribution characteristics at Munnar were very different from other stations. The only difference that Munnar possessed when compared to other stations was that, topographically, it was a hill-station situated on the Indian Western Ghats, it said.

The rain in Munnar was found to be made up of fewer but larger drops compared with any other stations in the plains, especially when it rained heavily. Even when it rained heavily in Kochi and SHAR, it is made up of more number of smaller drops compared to Thiruvananthapuram. Such a difference for Thiruvananthapuram also is attributed to the difference in orography at Thiruvananthapuram compared to Kochi and SHAR, the paper concluded.

The rain physics at Thiruvananthapuram and Munnar were comparable. Thiruvananthapuram has an orographic similarity with Munnar as it closer to the foothills. Kochi is quite far from the foot hills of the Western Ghats, and hence, orographuically, so different from Thiruvananthapuram.

Atmospheric moisture transport on a global scale

Atmospheric rivers and low-level jets are important mechanisms by which water is transported in the atmosphere. Atmospheric rivers (AR) carry 90 per cent of ocean moisture transported to the mid-latitudes. Similarly, most of the moisture transported from ocean to land in the tropics is via low-level jets (LLJ). A recent global study has confirmed that these phenomena play a major role in the occurrence of extreme rainfall events, and their absence leads to droughts.

One of the important findings of the study is that both these phenomena would play an important role in future climate scenario as well as in affecting the highly sensitive regions such as the Arctic and Antarctic. The study was published recently in the Annual Review of Environment and Resources.

For example, a more intense South American low-level jet in a warming climate suggests an increased transport of moisture from the north to southeast of the Andes and an increase in the frequency of rainfall extremes in southeastern South America.

“Atmospheric rivers carry an amount of water vapour roughly equivalent to the average flow of water at the mouth of the Mississippi River,” says Dr. M.R. Ramesh Kumar from the Physical Oceanography Division, National Institute of Oceanography, Goa, and a co-author of the paper.

When ARs make a landfall, they often release water vapour in the form of rain or snow. Those that contain the largest amounts of water vapour and the strongest winds can create extreme rainfall and floods. These events can disrupt travel, induce mudslides and cause catastrophic damage to life and property.

Not all ARs cause damage; most are weak systems that often provide beneficial rain or snow that is crucial to water supply. A detailed study of moisture transport could provide a better understanding of observed changes and enable projections of future climates. Such studies could lead to better rainfall forecasts in monsoon regions and throw light on the role of transport of moisture in intense rainfall events and droughts.

While rainfall from LLJs occurs mostly in summer, ARs can produce rainfall in winters too. Atmospheric Rivers are 1–2.5 km in high and 300–500 km wide plumes of winds with high water vapour content, stretching over distances of at least 2,000 km. A LLJ is a region of relatively strong wind in the lower part of the atmosphere. It can be several thousand kilometres long, a few hundred kilometres wide and a few thousand metres in depth. While AR is mostly an extra-tropical phenomenon, LLJs can occur in both tropical and extra tropical regions.

Invasive algae species found in Tamil Nadu

Researchers at the Central University of Punjab have identified a seaweedSargassumzhangii, growing along the rocky shores from Vedaranyam to Pattukottai and Thondi to Pamban in Tamil Nadu.

This is the first reported case of the seaweed outside China. The team led by Dr. Felix Bast from the Centre for Biosciences, Central University of Punjab, found luxuriant growth of the seaweed all around the rocky shore. The results were published recently in theJournal of Plant Taxonomy and Geography.

Need for action

Its presence in Indian shores far away from China highlights its invasive potential and the need to take immediate action to prevent its spread to other regions.

“In addition to studying the morphological features, we also carried out DNA barcoding using two loci — a mitochondrial gene (COX1) and a spacer sequence (ITS) — to identify the algae. We found the algae from the Tamil Nadu shores matched with S. zhangii of China,” says Dr. Bast, senior author of the paper.

“We have no clue how it spread to India. It could be through spores transported in ballast water or through natural dispersion. It is endemic in China, but now found in India. It is possible that with time it may spread to other areas,” he says.

The team was able to make an inference of the evolutionary relatedness of the algae collected from Indian shores

and those in China by measuring the pair-wise genetic distance between the two isolates of the algal species. "The genetic distance is very low and so the algae is closely related to the one found in China. Also, the introduction into Indian shores has been recent as the genetic distance between the two isolates is low," says Dr. Bast.

The researchers did not rely entirely on the morphological features of the algae for identification as morphological features can change in response to biotic and abiotic factors. So they relied on DNA barcoding as well. According to Dr. Bast, many algal species in GenBank have been wrongly identified by relying on DNA barcoding. "BLAST identity alone will be error-prone due to cross-amplification of DNA of epiphytic algae growing on host seaweed," he says. So the researchers combined DNA barcoding with phylogenetic-based approach to identify the species.

"This is the first time DNA barcoding has been used in India for characterising invasive species," Dr. Bast says.

By using two loci instead of one for DNA barcoding the researchers increased the reliability 10 times. Since the two loci are from two different genome compartments (one is from the nucleus and the other is from the mitochondria) it increases the reliability of the inference.

Bengaluru researchers mimic nature to produce richer colour

In a novel approach that mimics nature; Bengaluru-based researchers have designed crystalline materials that selectively scatter specific colours of light. Dyes and pigments produce colour predominantly through selective absorption of light. But scattering of light by particles which are arranged in an ordered, periodic pattern produces structural colour, which gives butterfly wings their colour and sheen.

The backlit colour display of a mobile or a laptop monitor becomes difficult to read under intense light. But if the front panel were to be made of structural colour then the ambient light would become a source of colour. By producing crystals that scatter wavelengths corresponding to red, green and blue light, structural colours can be used in place of the conventional LED and LCD monitors, too.

In nature, nanosized particles and colloids are responsible for producing structural colours. Compared with atoms, colloidal particles are 10,000 times bigger, and, so, conventional lab techniques to move the particles over long distances to form an ordered, periodic pattern have been riddled with problems.

The novel approach adopted by researchers at the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) and Indian Institute of Science (IISc) in Bengaluru has overcome the challenge of transporting the particles to target sites; the size and symmetry of the growing crystallites are also controlled. The results were published in the journal Proceedings of the National Academy of Sciences.

"We need some mechanism which will drive the particle in a given direction to a long distance. We solved this by creating an energy gradient on the surface of a Moiré pattern. The energy gradient dictates where the colloidal particle should go and nucleate and grow in an ordered fashion," says Chandan K. Mishra from the Chemistry and Physics of Materials Unit, JNCASR, and the first author of the paper.

To produce the Moiré pattern the researchers first imprinted an optical grating (which has linear trenches drilled on a glass surface) on a soft polymer. Rotating the optical grating at a small angle and repeating the imprinting on the soft polymer led to the creation of a geometrical pattern. The Moiré pattern with channels of non-uniform depth was the template on which the colloidal particles get deposited at specific sites on in an orderly pattern.

"There is an energy gradient within the geometric pattern which drives the particles to the desired locations," says Prof. Ajay Sood of the Department of Physics, IISc, and a coauthor of the paper. The energy gradient comes from the variation in the depth of the channels and the presence of small particles driving the colloidal particles to the specific sites in the pattern.

In the presence of smaller particles (which are added along with the colloidal particles), the colloidal particles are attracted towards the channel wall. "Since the channel has a gradient in depth, the smaller particles drive the colloidal particles to the deeper portions of the channel where the particle is surrounded by tall ridges on either side. This is the final resting place of the colloidal particle. If all the particles come to this point they form a crystal," says Prof. Rajesh Ganapathy from JNCASR, one of the corresponding authors of the paper. The nucleation initially begins at the sites where the ridges have maximum height and then progressively spreads to sites where the channel height is decreasing. The distance between two nucleation sites is predetermined to scatter a particular colour, for instance, red.

The process is repeated with colloidal particles of a different size which will grow into crystals with a different separation distance between them (periodicity). Due to a different separation distance the crystals will then scatter light of a different wavelength. "Our eventual goal is to

make these patterns and drop particles of three different sizes at the same time and the Moiré pattern will decide where each particle size should go and form crystals that scatter red, green and blue wavelength," says Prof. Ganapathy. "What we have done is the first step — controlling the colloidal self-assembly using the Moiré pattern."

IIT Madras researchers prove the superiority of arsenic water filter

Exhaustive research carried out by a team of researchers led by Prof. T. Pradeep from the Department of Chemistry at the Indian Institute of Technology (IIT) Madras, spread over four years, has put to rest the scepticism about the merits of the arsenic water filter developed by them. The water filter has been in operation for three and half years in about 900 sites in India, serving close to 400,000 people.

Arsenic in drinking water is the largest natural mass poisoning in the history of humanity, affecting 13 crore people globally. The problem of arsenic in the environment, known for over 1,002 years, has not been solved satisfactorily, due to the non-availability of appropriate and affordable materials. Arsenic is a slow poison, causing numerous adverse health effects, including cancer and genetic anomalies.

The technology developed at IIT makes use of confined metastable 2-line iron oxyhydroxides and its large adsorption capacity to remove arsenic in two different dissolved forms (arsenate and arsenite). The filter was able to reduce the arsenic concentration in the water from 200 ppb (parts per billion) to well below the WHO limit of 10 ppb. The results were published recently in the journal Advanced Materials.

"The arsenic removal capacity of the material filter was found to be 1.4 to 7.6 times better than all the other available materials," says Prof. Pradeep. "The superior arsenic uptake capacity is due to its inherent structure. Nanostructured iron oxyhydroxide makes many sites available for arsenic uptake. The ions of arsenic adsorb on the nanoparticles at specific atomic positions. No nanoparticles are released into the purified water due to the biopolymer cages in which they are contained." The team mimicked the average arsenic concentration seen in West Bengal — 200 ppb of arsenic — for carrying out several laboratory studies. Though studies were carried out at a pH of 7.8, the team found the adsorption capacity of the filter was not compromised in the pH range 4 to 10. "The pH of drinking water is in the range of 6.5 to 8.5. But we tested the filter in a wide range of pH so it can be used for other purposes as well," says Prof. Pradeep.

"A filter composed of 60 grams of the material can be used safely for removing arsenic from 1150 litres of water and till such time the concentration of arsenic in the filtered water does not cross the WHO limit of 10 ppb," he says. Once the filter has reached its saturation limit it has to be reactivated or recharged with new material.

Reactivation is done by soaking the material in sodium sulphate solution for an hour at room temperature. It is further incubated for about four hours after reducing the pH to 4. "Using this reactivation protocol we reused the same filter seven times," he says.

Studies were carried out to test if the adsorbed arsenic leached from the filter. The team found that the amount of arsenic that got leached was 1 ppb in the case of arsenite and 2 ppb for arsenate. "Soil in the affected regions also contains arsenic, typically around 12 ppb of arsenic, which is the background concentration. The amount of arsenic leached from the saturated filter was far less than the background concentration," Prof. Pradeep says. Leaching of arsenic from disposed filters was one of the biggest criticisms by a few researchers who had worked on arsenic filters. Arsenic, being an element, cannot be degraded further to simpler species.

Since the arsenic filter developed by the team has so far been in use at a community level, studies were carried out to test its performance as a domestic water filter. A domestic three-stage filter was developed to remove particulate matter, iron and arsenic. Input water containing 200 ppb of arsenic and 4 ppm (parts per million) of Fe(III) was passed through the filter for a total volume of 6,000 litres (translating to 15 litres of water per day for one year). "The output was below the WHO limit for both arsenic and iron throughout the experiment," he says.

"For a family of five, arsenic-free drinking water can be produced at $2 per year," he adds.

In the course of the development of this technology, he and his former students incubated a company, InnoNano Research Pvt. Ltd. at IIT Madras. In July this year, the company received venture funding to the tune of $18 million. "With this research, a home grown technology appears to be all set for global deployment. Knowledge is no more a limiting factor for solving the arsenic menace," he said.

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BIOTECHNOLOGY

Fruitfly sperms emerge tail-first

Three scientists from the Tata Institute of Fundamental Research (TIFR), Mumbai have made a breakthrough in obtaining, for the first time, a time-lapse image of sperms being released from the testis of a fruit fly (Drosophila melanogaster). This video and the inferences they draw from it could lead the way to further research on male contraception and fertility studies.

The researchers found that tails of the sperms are the first to exit the cell within which they are formed, and they are, in fact, literally pulled out by a mechanism which remains to be understood. This finding differs from what has been believed till now, namely, that sperm cells are pushed out by the surrounding tissue. The results were published in Developmental Cell.

"It has provided a new concept of sperm release by suggesting that the process is somewhat passive and assisted by some kind of suction in the ducts. We are now working on first proving that this hypothesis is correct, and then [we] will try to understand the mechanism that produces the suction," Krishanu Ray, Professor at TIFR and the corresponding author of the paper says in an email to this correspondent.

The second and very surprising find is that every time the sperm heads collide with a neighbouring cell, that cell gathered a small protein called actin around the indented membrane and pushed back the sperm. "This has literally created a new paradigm, and we are yet to figure out its actual implication. It may provide an explanation of why the sperm cells don't penetrate somatic cells when then travel through the ducts before meeting an egg," says Dr. Ray.

In order to study the movement of the sperm within the testis, Pankaj Dubey, the first author of the paper, had to selectively label the filamentous actin and sperm heads within a live Drosophila testis. Subsequently, time lapse 3-D imaging data was obtained using a confocal laser scanning microscope. In an interview published in the journal, Dr. Dubey says that the greatest challenge was keeping the Drosophila testes alive and stable in its position within the field of view for a long time, as they moved vigorously in tissue culturing medium. They overcame this by applying a small layer of plastic paraffin film, supported by a paper wick, on top of the dissected testis to immobilise it.

Presently known methods of male contraception targets controlling sperm development and release in a way that does not affect the fertility itself, or the capacity to produce sperm. In this context, it is a natural question to ask whether this method has applications to the study of contraceptives for men. Dr Ray clarifies that there is some way to go before one can talk of applications, as the researchers first "have to establish a similar assay in a mammalian or vertebrate system".

Scientists design a universal flu vaccine

A new generation of universal flu vaccines has been designed, to protect against the future global pandemics that could potentially kill millions of people.

The vaccine, designed by an international team of scientists, has the potential to give protection for up to 88 per cent of known flu strains worldwide in a single shot, spelling the end of the winter flu season, the researchers said.

"The components of this universal flu vaccine would be short flu virus fragments - called epitopes - that are already known to be recognised by the immune system. Our collaboration has found a way to select epitopes reaching full population coverage," said Pedro Reche of Complutense University, Madrid, Spain

Every year researchers choose a strain of flu as the vaccine, hoping that it will protect against the next year's strains.

"We know this method is safe, and that it works reasonably well most of the time," said Derek Gatherer of Lancaster University in Britain.

"However, sometimes it doesn't work - as in the H3N2 (influenza A) vaccine failure in winter 2014-2015 - and even when it does it is immensely expensive and labour-intensive. Also, these yearly vaccines give us no protection at all against potential future pandemic flu," Gatherer added.

Previous pandemics include the "Spanish flu" of 1918, and the two subsequent pandemics of 1957 and 1968, which led to millions of deaths.

Currently, annual flu epidemics are estimated to cause up to half a million deaths globally, recent reports from the World Health Organization revealed.

Scientists have also devised a US-specific vaccine with coverage of 95 per cent of known influenza strains in the country. The researchers have applied ground-breaking computational techniques to design the vaccine.

"Based on our knowledge of the flu virus and the human immune system, we can use computers to design

the components of a vaccine that gives much broader and longer-lasting protection," Gatherer said, in the study published in the journal Bioinformatics.

IISc's catalyst renders drinking water E. coli-free

Drinking water can now be made completely free of E. coli in about 30 minutes by exposing it to sunlight, thanks to a catalyst developed by researchers at the Indian Institute of Science (IISc), Bengaluru. The bacterium E. coli is responsible for most water-borne bacterial infections. The results were published on September 2, 2016 in the journal RSC Advances.

Conventional methods that rely on UV light to kill pathogenic bacteria are often expensive and need relatively more sophisticated process. Now, the IISc researchers have made it possible to easily rid the water of E. coli bacteria by synthesising a zinc oxide photocatalyst that absorbs both UV and visible light to kill the bacteria. "We studied E. coli, but the catalyst can potentially kill all harmful bacteria," says Prof. Giridhar Madras from the Department of Chemical Engineering at IISc and the corresponding author of the paper.

Uniqueness

"Our catalyst is unique as we have doped it with a metal and a non-metal (copper and nitrogen) so that it absorbs both visible and UV light," says Prof. Madras. "Our catalyst is far efficient than conventional catalysts as it absorbs both."

Visible light comprises more than 40 per cent of the electromagnetic spectrum and UV light 4 per cent. The catalyst absorbs both components and generates free radicals that kill the bacteria. Such is the efficiency of the catalyst in the presence of sunlight that it is able to reduce the E. coli load in water from 10 million to zero in about 60 minutes. "The rate of killing the bacteria increases with an increase in the intensity of sunlight. We did our experiments between 11 am and 3 pm," Prof. Madras says.

But to be effective, the catalyst (in a powder form) must be kept in suspension to increase the chances of interacting with the bacteria and killing them. "We kept stirring the water to keep the catalyst in suspension, else it will settle at the bottom and its efficacy will be reduced. We are now trying to coat the catalyst on a glass plate and suspend the glass plate in water to kill the bacteria," says Prof. Madras.

How it works

"Conventional catalysts like TiO2 are active only in the UV region as it has a wide band gap. In the case of ZnO, we have reduced the band gap by co-doping it with copper and nitrogen," says Rimzhim Gupta from IISc and the first author of the paper. "The co-doped ZnO catalyst will be able to absorb even the longer wavelength of 400-700 nm which is the visible range of the spectrum."

Unique roles

The band gap of a semiconductor determines the wavelength of light required to activate a photocatalyst and kill the bacteria by producing free radicals. In this case, copper and nitrogen have unique roles in reducing the band gap.

While the nitrogen shifts the valence band, the copper shifts the conduction band.

"When you shine light of appropriate wavelength on a photocatalyst, the electrons and holes get separated. The electrons and holes themselves can produce free radicals that kill the bacteria. Superoxide radicals (free radicals) can be generated when electrons from the conduction band react with dissolved oxygen, and holes in the valence band react with hydroxyl group and produce hydroxyl radicals," says NeerugattiKrishnaRaoEswar from IISc and a coauthor of the paper.

"We found superoxide and hydroxyl radicals were more effective in rupturing the cell wall and killing the bacteria."

The first 1,000 days: pregnancy and beyond

It is now well established that the health and habits of a pregnant woman modify the development of health (and disease) of her yet-to-be-born baby. The first 1,000 days from conception to the second birthday of the child are thus vital. In this connection, it has been said that "Man is what he eats in the first 1,000 days". It is during this period that the infant's body and brain develop at a rapid pace, setting up the stage for the growth and development of the child through adulthood. The mother-to-be influences the health and happiness of her baby not only through her genes, but also via the message that they carry, through her health condition during pregnancy. If she is anaemic, has diabetes, smokes or drinks a lot, is sick through infection or even with non-communicable diseases, these and related factors affect the health of her progeny even in later life. She thus plays an intergenerational and epigenetic role.

That there are what are called Developmental Origins of Health and Disease (DOHaD for short) has become clear over the last 30 years. DOHaD has become a globally recognised concept, tells us how we can use effective

methods to advise, intervene and promote good health in children and mothers. There is, in fact, a professional journal called Journal of DOHaD . Suggestions are also made in DOHaD on how to modify these so as to ensure appropriate health for the mother and her children.

That the condition and environment in which the pregnant mother lives differ from country to country, or even state to state within a country, is self-evident. What obtains in the US is not the same in Uganda. What obtains in Manipur is different from that in Madurai. Thus one size does not fit all. For example, the eminent diabetologist-DrChittranjanYajnik of Pune has shown that Indians store their fat in the abdominal region, and thus are not obese but have what he calls the thin fat body phenotype, very different from the western obese type. This thin fat phenotype appears associated with the risk of the epidemic of chronic non-communicable diseases such as diabetes, BP and the like.

Studies of this type, which are context-dependent, are promoted by DOHaD. At the recent meeting of DOHaD, organised by Dr Abdallah Daar of Canada and held in Stellenbosch, South Africa, Dr Shane Norris of South Africa highlighted how in sub-Saharan Africa interventions in early life can effectively promote lifelong better health. The sad fact is, as Peter Byass of Sweden pointed out, maternal mortality and infant mortality in Africa are rather alarming and need to be brought down effectively.

Many cost-effective methods were discussed, some of them easily applicable in India. One theme that was highlighted by DrAtulSinghal of London and others at the meeting was the benefits of breast-feeding. Happily enough, mothers in much of rural India (also in rural Africa) still breast-feed their infants. World Health Organisation points out how breast feeding promotes sensory and cognitive development, and protects the infant against infectious and chronic diseases. Exclusive breastfeeding reduces infant mortality due to common childhood illnesses such as diarrhoea or pneumonia, and helps for a quicker recovery during illness. And one point made in this connection by Soraya Seedat of South Africa was that when an alcoholic (or substance abusing) mother feeds her baby, the negative effects of it on the latter can last until the child becomes 7 years or so old. Counselling and intervention here becomes of great value for the health of both the mother and her offspring. The first 1,000 days are when the mother-infant interaction is at its highest, and Dinky Levitt of South Africa emphasised its long-term benefits, while Elona Tosca of Oxford pointed out how social interventions help the health outcomes of adolescents and youth. A particularly important and incisive point was made by Andrew MacNab of Canada, who has been running what WHO calls as the Health Promoting Schools, in which school children are taught what is called haptic learning (or learning by doing), in which awareness and practice of healthy habits (use of a toothbrush!) are brought forth. He talked about a new set of 3 “R”s, namely, resilience, relationship and real-time learning.

Counselling, intervention and implementation are the cornerstones of DOHaD. And there are examples that DOHaD offers which can be easily adopted and adapted in many countries including our own. We, in India, have the disturbing situation where as many as 48 million children are stunted - largely due to both real and hidden hunger, both in them and their mothers. Several solutions have been found by our own scientists and health workers, and are being practised. With renewed and consistent efforts, and through what we learn from other countries through DOHaD, there is every chance that such worrisome numbers can be drastically brought down at the soonest.

IIT Hyderabad finds a chink in E. coli armour

Researchers at the Indian Institute of Technology, Hyderabad have made a promising start to render E. coli bacteria more susceptible to host immune response. The researchers have found a potential way of preventing the bacterial surface-associated polysaccharide — capsular polysaccharide (CPS) — from attaching on the surface membrane and forming a protective encapsulation of the bacteria, thus making the E. coli vulnerable to attack by the host’s immune system.The CPS is synthesised by the bacteria and exported to the surface to offer protection by evading the host immune response. Surface-association of CPS also offers impermeability to antibiotics, thus establishing infection in the host. Certain surface-associated bacterial proteins help in the attachment of CPS on the bacterial surface.

“If you know how the CPS is attached to the bacteria’s membrane protein then we can design a drug that can go and bind to the protein and prevent the CPS from getting attached to the bacterial surface,” says Dr. ThenmalarchelviRathinavelan from the Department of Biotechnology, IIT Hyderabad. “The CPS is not the same in all the E. coli strains but varies. In all, there are 80 such capsular polysaccharides. We have modelled the 3D structures and developed an organised repository of

72 CPS varieties," says Dr. Rathinavelan the corresponding author of a paper published in the journal Nucleic Acids Research."The database is called EK3D [E. coli K antigen 3-Dimensional Structure Database]." The database can facilitate the development of efficacious drugs against E. coli infections.

After developing the models of 72 CPS structures, the team has proposed the binding site of CPS on the bacteria's membrane protein surface. The results were published in June 2016 in the journal Scientific Reports.

Dual role

"The bacterial membrane protein has a dual role. Besides facilitating the binding of CPS, it also conducts water from inside the bacteria to outside and from outside to inside to maintain the osmotic pressure," she says. The team has identified five water diffusion points (two inside and three outside the bacteria. The osmotic pressure becomes high when the amount of CPS is more on the surface. Under such circumstances, water is transported from inside the bacteria to outside to dilute and spread the concentration of CPS and avoid the rupturing of the cell. This also helps in keeping the CPS in a hydrated condition and prevents further accumulation of CPS on the surface. But when the concentration of CPS is less on the surface the pressure inside the bacteria reduces. Water is transported from outside to inside the bacteria to normalise the pressure. "Basically, optimal concentration of CPS should be maintained, and this is achieved through water conduction, called osmo regulation," Dr. Rathinavelan says. The team is now working on proving what they had observed — the attachment region of CPS to the bacterial membrane protein and the dual role of the protein in conducting water. "If we can alter the water conduction property of the protein we can control the accumulation of CPS on bacterial surface and make the bacteria accessible to the host immune system," she says. "Alternatively, if we block the CPS binding site with a drug molecule then CPS cannot bind to the bacterial membrane. The site where the protein binds to the membrane can also be targeted. These strategies may pave the way for tackling emergence of multi-drug resistance in Gram-negative bacteria."

Kochi researchers target residual glioma cancer cells

Scientists at the Amrita Centre for Nanosciences and Molecular Medicine at Amrita University, Kochi, have come a step closer to using photodynamic therapy for treating residual cancer cells of a high-grade brain tumour (glioblastoma). Photodynamic therapy uses a photosensitive drug that becomes active under the action of light and converts molecular oxygen into reactive oxygen species that kill cancer cells.

While the photosensitive drug injected into the body intravenously is not cancer-cell specific and is less efficient in absorbing light to generate reactive oxygen species, scientists at the Amrita Institute have turned to nanotechnology and used light in the near-infrared region to achieve better results. Light in the near-infrared region can penetrate to about 0.8 cm into body tissues.

"The drug encapsulated in a nanoparticle has peptides functionalised on its surface and is selectively absorbed only by cancer cells. The nanoparticles containing the drug have better ability to kill cancer cells as they absorb three times more light in the near IR region than the free drug," says Dr. ManzoorKoyakutty from the Amrita Centre for Nanosciences and Molecular Medicine. "We have incorporated a photosensitiser into the nanoparticle to enhance the light absorption capacity." Dr. Koyakutty had carried out studies on mice while he was in Erasmus University Rotterdam, the Netherlands.

A unique chemical bonding used for anchoring the photosensitiser to the nanoparticle increases the stability of the drug by as much as nine times, says Dr. Koyakutty. The prolonged period of stability of the drug provides a longer window for therapy; light in the near-infrared range can now be given in fractions to activate the drug at regular intervals.

"Even if the tumour mass is removed from the brain, some residual cancer cells will be present near the tumour site. We can't remove healthy brain tissue that contains some cancer cells. So once you remove the tumour mass we can apply the nanoparticles containing the drug at the site where the tumour was present and use near-IR [light] to kill cancer cells in the neighbouring areas," says Dr. Shantikumar Nair, Director of the Centre.

"Recurrence is very high in the case of glioma. Patients don't have a cure if it recurs. So if recurrence can be prevented patients can have substantial additional life," says Dr. Nair.

"Photodynamic therapy is a well known treatment option but can be used only when cancers are near the skin as light cannot penetrate deep. So it has not become a popular treatment option but has potential," says Dr. Rajiv Sarin, Professor, Radiation Oncology and in-charge of Cancer Genetics Unit at Tata Memorial Hospital, Mumbai. "Getting clinical benefits in patients with cancer is more challenging as cancer is seldom near the surface."

The scientists are planning to undertake studies on mice and then larger animals.

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IISER Kolkata makes breakthrough in targeted cancer drug delivery

Targeted delivery of anticancer drugs exclusively to cancer cells and controlled release of the drugs in a sustained manner inside cancer cells has been achieved by a group of researchers from the Indian Institute of Science Education and Research (IISER) Kolkata. Porous carbon nanospheres about 150 nm in diameter and packed with drugs inside the pores has been designed in such a way that they cannot get inside normal cells and kill them. The results were published in the journal Carbon.

A team led by Dr. Sayan Bhattacharyya from the Department of Chemical Sciences, IISER Kolkata, used the commonly available lemon grass to synthesise the porous carbon nanospheres, which act as drug carriers. "It's a very simple and cheap process to produce carbon nanospheres from lemon grass. Also, it is possible to scale up the production," Dr. Bhattacharyya says.

The anticancer drug doxorubicin is covalently bound both inside the 3.6-3.8 nm diameter pores and also on the surface of the nanospheres. "Since the inside of the cancer cell is acidic (pH 5.5-6) the hydrazone covalent bond gets broken slowly and the drug is released. Normal cells have a neutral pH and the covalent bonds are less likely to be broken and therefore the drug cannot be released," says SutanuKapri from the Department of Chemical Sciences, IISER, Kolkata, and the first author of the paper. "Also, in the presence of acidic medium, a proton gets added to the amine group of the drug and helps in the release of the drug from the pores."

To make the targeted delivery nearly fail-proof, the researchers attached folic acid to the nanospheres. The folic acid attaches to the folate receptors found on the surface of cancer cells and the nanospheres gain entry into cancer cells. Normal cells contain very few folate receptors and so nanospheres are nearly prevented from getting inside. Due to poor folate expression in normal cells, even after 15 hours, the amount of drug available inside normal cells was negligible compared with cancerous cells.

"The efficiency of nanospheres to get inside healthy cells will be less compared with cancerous cells. The larger the size of particles, the slimmer the chances of getting inside cells," says Dr. SankarMaiti from the Department of Biological Science, IISER, Kolkata, and one of the authors of the paper, while explaining how the relatively large (150 nm) nanospheres selectively target only the cancerous cells. All these checks and balances ensure that drug release is minimal inside the healthy cells. In contrast, conventional chemotherapy is not designed to target only the cancerous cells. Cancer treatment tends to kill more of healthy cells than cancerous cells. Besides targeted delivery, the researchers had designed the nanospheres for controlled release of the anticancer drug.

"Usually, there is a sudden burst of drug inside cancerous cells. But we can control the release of the drug inside cancerous cells over a 24-48-hour period, useful for clinical applications. This is mainly because the drug is chemically trapped inside the pores of the nanocarriers," says Dr. Bhattacharyya.

Since the nanospheres contain numerous pores, the surface area increases, and a greater quantity of drug can be loaded inside the nanocarriers. Unlike when drugs are physically adsorbed on the surface of a nanocarrier, there is a possibility of premature release of the drug into blood.

Compared with freely available anticancer drug, the researchers found that the quantity of drug carried by nanospheres was 10 times more inside cancerous cells. Though nanocarriers cannot enter the nucleus, higher doses of the drug ended up inside the nucleus after 15 hours.

"So nanocarriers can effectively deliver drug in a controlled manner at targeted sites only if they have a porous structure, the drug remains inside pores and is covalently bound to nanospheres and is released only when the pH is acidic," says Dr. Bhattacharyya.

Sugar pill beats two drugs in migraine trial for children

Neither of the two drugs used most frequently to prevent migraines in children is more effective than a sugar pill, according to a study published in The New England Journal of Medicine.

Researchers stopped the large trial early, saying the evidence was clear even though the drugs — the antidepressant amitriptyline and the epilepsy drug topiramate — had been shown to prevent migraines in adults.

"The medication did not perform as well as we thought it would, and the placebo performed better than you would think," said Scott Powers, lead author of the study and a director of the Headache Center at Cincinnati Children's Hospital Medical Center.

A migraine is a neurological illness characterised by pulsating headache, sometimes accompanied by nausea, vomiting and sensitivity to light and noise.

It's a common childhood condition. Up to 11 per cent of those in the age group 7-11 years and 23 per cent of

15-year-olds have migraines.
At 31 sites nationwide, 328 migraine sufferers within ages 8 to 17 were randomly assigned to take amitriptyline, topiramate or a placebo pill for 24 weeks. Patients with episodic migraines (fewer than 15 headache days a month) and chronic migraines (15 or more headache days a month) were included.
The aim was to figure out which drug was more effective at reducing the number of headache days and to gauge which one helped children to stop missing school or social activities. As it turned out, there was no significant difference among the groups: 61 per cent of the placebo group reduced their headache days 50 per cent or more, compared with 52 per cent of the children given amitriptyline and 55 per cent of those who took topiramate. And there was no significant difference among the three groups in reducing the school days or other activities missed.
The drugs also produced side effects in some children, such as fatigue, dry mouth, and tingling in their hands or feet. A few cases were more severe.
One child on topiramate attempted suicide. Three taking amitriptyline had mood changes; one told his mother he wanted to hurt himself, while another wrote suicide notes at school and was hospitalised.
Because of the side effects, Powers and his colleagues questioned whether the benefits of either drug outweighed its risks. In 2014, the Food and Drug Administration approved topiramate for the prevention of migraine headaches in adolescents between 12 and 17 who had fewer than 15 headache days a month. In light of the new study, Powers said he hoped the FDA and doctors would re-examine that decision.

Other experts were not yet ready to give up on drug treatment.

"Am I now going to feel obligated to tell patients that these drugs are no better than a placebo? No," said Dr. Eugene R. Schnitzler, a professor of neurology and pediatrics at Loyola University Chicago Stritch School of Medicine.
"I'll simply say, 'We have data in adults that it's effective, but less convincing data in children and adolescents.'"
Even if the drugs are not effective for children overall, "that doesn't mean for any one individual, a drug might not work," said Dr. David Gloss, a neurologist and a methodologist for the American Academy of Neurology.
A team of physicians, including Gloss, is revising the academy's guidelines on pediatric migraines and planning to assess nondrug approaches.
A trial published last year found taking amitriptyline and learning coping skills in a cognitive behavioral therapy programme more effectively reduced headache days for chronic sufferers in ages between 10 and 17 than the drug given with only basic headache education.

Fatty acids from fish may prevent Alzheimer's

Omega-3 polyunsaturated fatty acids from fish may help to remove metabolites, including amyloid-beta, which is one of the factors that lead to Alzheimer's, finds a study conducted by researchers from the University of Macau.
The research published in the FASEB Journal suggested that Omega—3 polyunsaturated fatty acids (PUFAs) found in fish oil could improve the function of the glymphatic system, which facilitates the clearance of waste from the brain.
To make this discovery, scientists first used transgenic fat-1 mice, which express high endogenous Omega-3 PUFAs in the brain, to investigate the effect of Omega-3 PUFAs on the clearance function of the glymphatic system. Compared to the wild-type mice, the fat-1 mice with enriched endogenous Omega-3 PUFAs significantly promote the clearance function of the lymphatic system, including the amyloid—beta clearance from the brain.

Pune researchers develop a promising anti-leishmanial drug compound

Researchers at Pune's National Centre for Cell Sciences (NCCS) have identified a coumarin derivative for the treatment of cutaneous leishmaniasis. Since Leishmaniadonovani (which causes Kala-azar) and Leishmania major (which causes cutaneous leishmaniasis) share 95 per cent similarity in their genome, the coumarin derivative developed by the researchers may be used for treating Kala-azar as well.
The incidence of cutaneous leishmaniasis is much higher than that of the visceral form but in parts of India incidence of visceral leishmaniasis is much higher. The re-

sults were published on October 21 in the journal PLOS ONE.

"The focus of our study was on the development of oral drug candidates for the treatment of cutaneous leishmaniasis," says Dr. Singh. Most of the drugs currently being used have side effects and are injectables. There is also a dearth of oral drugs that can be used for treating this disease.

In order to develop an orally administrable drug, the researchers used computer assisted drug designing in which computational tools were used to design and develop new drug candidates. A few of these selected compounds were screened in the laboratory.

In vitro studies

A team led by Dr. Shailza Singh from NCCS used one of the coumarin derivatives on leishmania parasites for in vitro testing. "What we observed was that the treated parasites exhibited size reduction and morphological alterations and appear to lose their motility. The compound also inhibited the proliferation of promastigotes (a morphological stage in the development of the parasite)." says Dr. Singh.

One of the major handicaps of the derivate compound is its hydrophobic nature. To address this and to increase the efficacy of the derivative, the researchers encapsulated the compound in liposomes. Liposomes are spherical vesicles which enclose water droplets and are used as a vehicle for administering drugs.

"Liposomes, which are 150 nm in diameter, have the property of increasing the shelf life of drugs and enhancing hydrophilicity," she says.

"We saw similar but enhanced effects when the compound was encapsulated in nanoliposomes," says VineethaMandlik from NCCS and the first author of the paper. Also, the nanoliposomes, which released the compound in a slow and sustained manner — 93 per cent over a period of 50 hours, reduced the proliferation of parasites.

Mice studies

The researchers then tested the compound in mice having cutaneous lesions. The progression of infection was assessed in terms of the footpad thickness of the mice. "In the untreated mice we observed progression of infection in terms of scarring and ulceration and increase in footpad thickness. But no such symptoms were seen in the treated mice," says Ms. Mandlik.

The beneficial effects in mice were seen even when the compound was administered orally at a dose of 5 mg per kg body weight. Earlier studies had used 5-6 times higher dosages of other drugs such as miltefosine.

"So the compound shows promise and may be considered for better and effective drug candidate generation," says Dr. Singh. "Its therapeutic potential in treating leishmaniasis however needs further assessment."

The team is looking for partners and collaboration to help develop gel-based formulation of the compound for in vivo study in mice. "The derivative is very effective and we want to take it forward for mechanistic study." says Dr. Singh.

Lifelike model of mammary gland

In a first, scientists have developed a lifelike, 3D model of mammary gland which mimics the structure and function of the real organ, an advance that may help better understand the mechanisms of breast cancer. Researchers from Cardiff University in the UK and Monash University in the Australia were able to grow mouse mammary cells into three-dimensional mammary tissue. The 'organoid' mimics the structure and function of a real mammary gland.

This enables researchers to increase their understanding of how breast tissue develops, and provides an active model for the study of disease and drug screening. As well as determining how to grow these lifelike mammary glands, researchers also discovered how to maintain them in culture to allow ongoing experimentation.

"Much of how breast tissues respond to external stimuli such as hormones is, as yet, unknown," said Trevor Dale of Cardiff University. "In order to fully tackle the mechanisms that lie behind breast cancer we first need to understand how healthy breast tissue develops," Dale said. "As such, developing a model of a normal breast with the actual architecture of a mammary gland has long been a 'Holy Grail' for cancer researchers," he said.

"This model allows us to really study the basic biology of how the breast develops — how hormones work, what are the genetic influences," said Thierry Jarde, from the Monash Biomedicine Discovery Institute.

"Further down the track we hope to use this model in tandem with models of breast cancer in order to carry out effective drug—screening," Jarde said. The findings were published in the journal Nature Communications.

NCBS researchers find a biomarker for stress-induced memory loss

Timely intervention to prevent or delay hippocampus-linked memory loss that occurs as a result of chronic stress may now be possible, thanks to the discovery of

a biomarker — a reduction in hippocampal volume at an early time point after the onset of chronic stress. The reduction in the hippocampal volume is not only linked to stress-induced memory loss, it may, in fact, be an early risk factor for the eventual development of cognitive impairments. The results were published in the journal Scientific Reports.

A reduction in hippocampal volume and the consequent hippocampus-linked memory loss at the end of chronic stress is already well known both through animal studies and by studying the human brain. "So our question was different. We wanted to study how the diseases progresses and how the damage evolves over time," says Prof. SumantraChattarji from the National Centre for Biological Sciences (NCBS), Bengaluru and one of the authors of the paper.

While all studies in the past have compared the effect of stress on hippocampal volume and memory loss by using two groups of animals (control and experimental group) and studying the effects at the end of the stress period, these researchers took a different approach. They studied the effects in the same animals before and at the end of the study and also at regular intervals during the course of the 10-day stress study in rats.

Rats react to stress much like humans and hence rats are used as model animals to study the effect of stress on behaviour. "We undertook a longitudinal study for 10 days and subjected the animals to stress for two hours a day and assessed the animals' ability to form memories. We got some surprising results," he says. "At the end of the third day, MRI scans revealed a perceptible and significant reduction in the hippocampus volume. We did not expect to see this within three days."

The study highlights that rats subjected to stress even for a brief period of three days is sufficient to induce damage to the hippocampus volume. Three days of stress is no where close to being labelled as suffering from chronic stress.

The second major surprise was on the fifth day of the stress. Though MRI scans of the rats on the third day revealed hippocampus volume loss, the rats did not suffer from any hippocampus-linked spatial memory loss even on day five. There was little difference in spatial memory between stressed rats and unstressed rats. The rats examined at the end of 10 days of stress showed bigger loss of hippocampal volume on the eleventh day and also significant loss of spatial memory on the thirteenth day. "That there was significant loss of memory at the end of 10 days of stress despite no loss on day five was a surprise," he says.

"We know from earlier work that at the end of stress both hippocampal structure and function are expected to be down. But what we find is that these two go downhill in different ways — structure goes down early and memory loss comes later — but at the end they are both down," Dr. Chattarji says.

"That means the structural change can act as an early indicator of loss of memory that happens later. The structural deficit precedes the functional or behavioural deficit," he says. In other words, there is a delayed manifestation of stress-induced impairment of memory loss and the full impact of stress on memory impairment becomes evident at the end of the stress.

The animals that suffered the biggest loss in hippocampal volume on the third day of stress continued to exhibit significant decrease in volume a day after the end of stress. These rats were also the ones that eventually suffered the biggest impairment of spatial memory after the end of stress.

"Right now we don't know for how long hippocampal volume reduction and memory loss last. Clinical evidence suggests that memory loss persists for extended period," says Mohammed Mostafizur Rahman from NCBS and the first author of the paper. "We had earlier shown that dendrites shrink in size and other studies have shown structural changes in cellular morphology."

CCMB scientists unravel skin colour genetics of Indians

A study of skin colour of 1,167 people belonging to 27 ethnic groups living in Uttar Pradesh and Bihar found that social structure defined by the caste system has a "profound influence on skin pigmentation". The skin colour was found to vary significantly among ethnic groups and social categories studied.

Accordingly, Brahmins of Uttar Pradesh have the fairest skin while Manjhis (Majhwars) have the darkest skin (highest skin pigmentation). Bhagats exhibit maximum variation in skin pigmentation. Four social groups — general, scheduled caste, other backward caste and religious group — were studied. The results were published in The Journal of Investigative Dermatology.

The association of rs1426654, a key single nucleotide polymorphism (SNP) in SLC24A5 gene, with skin colour has been well established. In fact, this SNP explains 25-38 per cent of pigmentation differences between Europeans and west Africans. "In addition to rs1426654, our study found another SNP (rs2470102) to be significantly

associated with skin colour in the Indian population," says KumarasamyThangaraj from the Centre for Cellular and Molecular Biology (CCMB), Hyderabad and the corresponding author of the paper.

The new SNP was found to independently affect skin pigmentation variation among the Indian population. While the well known SNP (rs1426654) has been found to have a significantly larger effect on skin colour ranging from Europeans to western Africans, the new SNP that the Indian researchers discovered is predominant in India/Asia. But both SNPs taken together are able to better explain the variation in skin colour among the Indian population than each of the SNP individually. The two SNPs together account for over 38 per cent of the variability in skin colour in the Indian population. The researchers compared the skin colour with the genotype of the individuals. Homozygous (similar) mutant alleles tend to cause lighter skin colour while homozygous wild alleles tend to cause darker skin colour. "So those with homozygous mutant alleles of the new SNP had fairer skin compared with those who had homozygous wild type alleles," he says. The difference in skin colour persisted even when the contribution by the well known SNP was adjusted. "This shows that the new SNP has an independent effect on skin colour," says Dr. Thangaraj.

People who had a combination of similar (homozygous) mutant alleles of both the new and the known SNP had the fairest skin; they are said to belong to the H1 haplotype. The frequency of the H1 haplotype was far higher (96 per cent) in people with lighter skin than in darker skin (37 per cent). "A particular haplotype is not exclusive to a social category. Though the frequency is less, we do find H1 haplotype in dark skinned social category. This is why we have fair-skinned people even in the dark skin social category and dark-skinned people in the otherwise fair skin social category," he says.

In a subsequent study, Dr. Thangaraj and his team genotyped 1,825 individuals belonging to 52 diverse populations in India. They found the allele frequencies of the two SNPs were similar among the Indian population and spread across the population. "Like in Uttar Pradesh and Bihar, the proportion of both mutant and wild homozygous alleles is distributed in differently frequencies in different populations across the Indian population. Also, the H1 haplotype was not exclusive to any particular population or social category," he says.

The study found that ultraviolet radiation-based selection model alone cannot account for the entire range of variation in skin colour seen in the Indian population. Rather, it is interplay between selection pressure for lighter skin in response to relatively less sunlight and admixture of the two founding populations of India.

TCIS: Ultrathin, water-repellent surface chemistry at work

Scientists at the TIFR Centre for Interdisciplinary Sciences (TCIS), Hyderabad, and Central Electrochemical Research Institute, Karaikudi, have developed a material which, when coated on other substrates, can render them both water repellent (hydrophobic) and oil repellent (oleophobic). This is extremely useful in improving the applicability of a range of products, from car wind-shields to medical aids such as surgical implants and other tools. In fact, the material is superhydrophobic, as its water-surface contact angle is above 170 degrees.

Materials which repelled water and oil have been engineered earlier, but these required treatment with very high temperatures, and even then, formed sheets which were many layers thick. The ultrathin, superhydrophobic sheets mentioned above are formed by just one layer of atoms, and so, are transparent as well.

The analogy of a water-repellent lotus leaf goes only so far, "When you put low surface tension organic liquids or oils on a lotus leaf, it will completely wet the leaf. But these nanolayers can also bring roughness in to the surface along with low surface energy, because of which low surface tension liquids will also roll off from the surface, just like water does," says T.N. Narayanan, now at TCIS, Hyderabad, in whose lab these materials have been developed.

Dr. T.N. Narayanan and collaborators made fluorinated graphene oxide from flurographite by oxidising and exfoliating it. Exfoliating the graphite, which is a stacked array of carbon atoms, causes it to expand and form individual sheets of graphene – a state of carbon in the form of thin sheets comprising single layer of carbon atoms. This looks like a powder to the naked eye, but when viewed through a transmission electron microscope, shows up as transparent thin sheets.

Realising that in order to be useful to industry, this material needed improved binding capacity, or adhesion to substrate, the group developed it further. They mixed it by hand with polydimethyl siloxane to make an ink which could be sprayed on to the surface which was needed to be coated.

Going further, the researchers improvised on a chemical vapour deposition technique to directly deposit the fluorographene on to the substrate thereby removing the

need for a binder. Describing this as an "accidental discovery," Dr. Narayanan adds, "Recently, we found that ultrathin films of fluorographene can be made on any substrate using a facile method at relatively higher temperature of 500 degrees Celsius. Ultrathin superhydrophobic films were made on various substrates from glass to metals in large area using this vapour deposition. This will be beneficial in many fields in coating technology…"

Oil drilling machines use these sort of superhydrophobic films to prevent corrosion. The research group has been approached by one such company for use in its oil drilling machines where reducing the thickness of the coating is economically enormously beneficial. The film may be used in surgical implants and surgical tools, too, as due to its extreme hydrophobicity, biofilms do not form on the surface of these tools, acting as an anti-bacterial agent.

"We are on the way to ensuring its protection via proper IP. A few companies and persons already have shown interest in different aspects of this material… We are collaborating with leading institutes such as University of California, USA and Bar-Ilan University, Israel, etc. for developing different applications of this material," adds Dr. Narayanan.

Scientists develop a tiny blood pH sensor

Researchers at the Indian Institute of Technology (IIT) Kharagpur have successfully developed a small device to measure the pH of any solution, with preliminary studies showing its usefulness to measure the pH of blood. Unlike the conventional approach of measuring the pH of blood potentiometrically, the device works by measuring the impedance. The device was found to have satisfactory pH sensitivity in the physiological pH range.

In contrast to conventional arterial blood-sampling devices that are bulky as they use three electrodes and with time-consuming processes, the miniature device relies on venous blood sampling for pH measurement. The results were published in the journal RCS Advances.

Three electrodes

The sensor has an aluminum electrode that is deposited on a glass substrate and made into two electrodes with a minimum gap by manually removing a small portion of aluminum around the midpoint of a long strip of aluminium film.

"The electrodes are then coated with molybdenum disulphide nanoparticles and Nafion in a small region around the gap between the two electrodes. So only a small amount of analyte is required for pH measurement," says Prof. Soumen Das from the School of Medical Science and Technology, IIT Kharagpur, who is the corresponding author of the paper.

The pH of a solution is a measure of the number of hydrogen ions produced or available in a solution; when the solution is acidic the pH will be less than 7 and the number of hydrogen ions will be more.

The Nafion layer that is coated on aluminium electrodes selectively allows the hydrogen ions to diffuse into the layer. This leads to an increase in the conductivity of the Nafion layer and a reduction in its impedance. "Because of the Nafion coating, the hydrogen ions become preferential mobile carrier ions. That's why the conductivity increases when the pH reduces," says Ranjan Mukherjee also from the School of Medical Science and Technology, IIT Kharagpur and a coauthor of the paper.

The sensitivity of the device improves when the electrodes are coated with molybdenum disulphide nanoparticles and then coated with Nafion. While the sensitivity of pH measurement for the electrodes when coated with only Nafion was 347 ohms per pH, it was as much as 6,193 ohms per pH when electrodes were coated with molybdenum disulphide nanoparticles and a Nafion layer.

Preliminary study using capillary blood showed that the estimated pH was close to that of the venous blood pH. For example, the pH of venous blood was 7.39 when measured using blood gas analyser and 7.38 when measured using the device developed by the researchers. So the device can be developed for use as a point of care device for measuring the pH of blood.

The device was able to detect the pH of the blood in 10 seconds which is far better than commercial blood pH sensors where the response time is 30-40 seconds. The time taken to measure the blood pH is lesser than the time taken for the blood to clot.

Hence, there is no need to use heparin (an anti-coagulant drug) when the tiny device is used for measuring the pH of blood, thus avoiding any errors associated with the use of heparin.

"As it is a new approach we need to carry out more tests to validate the device. This is a proof-of-concept study," says Prof. Das.

ICGEB finds distinct biomarkers for dengue and chikungunya

Researchers at Delhi's International Centre for Genetic Engineering and Biotechnology (ICGEB) have identified specific metabolites that can potentially be used as biomarkers for distinguishing dengue and chikungunya

infections and co-infection by these two viruses. The results were published in the journalScientific Reports.

Both these virus infections exhibit similar and overlapping symptoms in patients because of which making differential diagnosis becomes challenging. It gets further complicated in the case of a co-infection.

Currently, antigen-based and antibody-based diagnostic tools are available for dengue, and the diagnosis can be made within the first few days after infection. However, in the case of chikungunya, the diagnostic tool is antibody-based. Antibodies take time to develop in a patient and so diagnosis gets delayed. Currently, there is no tool to diagnose co-infection by dengue and chikungunya viruses.

"There is great need to develop new tools for diagnosing these two infections, especially co-infection by these viruses," says Sujatha Sunil from the Vector Borne Disease group at ICGEB and one of the senior authors of the paper. Another study by her group published this year found that nearly 10 per cent of dengue patients in Mumbai were, in fact, co-infected by dengue and chikungunya viruses.

A team led by her and Dr. Neel SarovarBhavesh from the Transcription Regulation group at ICGEB set out to identify metabolome or collection of metabolites in the blood that are specific to dengue and chikungunya mono-infection and co-infection.

"The problem with dengue and chikungunya diagnosis is that we won't be able to identify an ongoing infection visà-vis a past infection," says Dr. Sunil. "This is because the diagnostic tool used looks for antibodies." In India, even though antigen-based testing is available for dengue, it is not approved by the government, making it difficult for government hospitals to use it.

"Diagnostics based on metabolites is highly sensitive as we are looking at changes at a molecular level. The sensitivity is high enough to identify minor changes that may occur in co-infections as well as in mono-infections by the viruses," she says.

The researchers are not relying on particular metabolites but looking at a cluster (combination of 5-6 metabolites) of metabolites instead. They found the metabolite cluster signatures to be very distinct and, hence, the sensitivity high in the case of mono-infection and co-infection. "The crux of the study was to identify a metabolite cluster for co-infection as there is no diagnosis for it," says Dr. Bhavesh.

New tools, applications

Though metabolites are routinely looked for in many conditions (such as creatinine to know the health of kidneys) and diseases, the knowhow to look at metabolites for these two infections in a more sensitive manner has come only recently. "We are now able to detect even subtle differences or perturbations during disease condition. This has become possible because of newer tools such as the nuclear magnetic resonance (NMR) spectroscopy," says Dr. Bhavesh.

The metabolite clusters can be used for various applications — biomarkers, studying disease progression, evaluating therapeutic potential of drugs and disease management. The present study was restricted to a small patient population — 11 patients with dengue, 15 with chikungunya and 12 co-infected.

The results have to be validated on a larger patient population before distinct metabolites and clusters can be exploited for differential diagnosis.

TCIS scientists hold up a mirror to cheat malaria parasites

Nature loves symmetry, but it is when this symmetry breaks that interesting possibilities show up.

An example from chemistry is the case of biomolecules, where chiral asymmetry offers a possibility for drug developers. The constituents of proteins — the amino acids — have a chiral structure, which may in principle be right-handed or left-handed. It so happens that all naturally occurring proteins are made up of L-amino acids.

This property is being made use of in Kalyaneswar Mandal's lab in Hyderabad to develop a mirror image protein molecule, which can be used to curb the progress of malaria caused by Plasmodium falciparum.

Agents of malaria

There are six types of parasite that can cause malaria; of these, P. falciparumcauses a particularly virulent form of the disease, which can, in many cases, lead to fatality. This parasite has a complex life cycle. One of the important steps is invasion of red blood cells by the parasite, and a crucial part of this is the formation of a junction between two proteins called the apical membrane antigen 1 (AMA1) and the Rhoptry neck protein (RON2).

The strategy is to prevent this junction from forming. "Our goal here is to block the AMA1 and RON2 interaction and inhibit moving junction formation to prevent the invasion of red blood cells by malaria parasite; which, in turn, will shut down the transmission of the disease. Since both AMA1 and the RON2 proteins are parasite proteins, AMA1-RON2 interaction is an ideal target for drug discovery," says Dr. Mandal, a reader at TIFR Centre for Interdisciplinary Sciences, Hyderabad.

The core technique is to mimic in reverse the chirality

of the molecules, known as mirror image phage display. One of Dr Mandal's chief collaborators in this project is Dr. MarutiUppalapati from the University of Saskatchewan, Canada.

Laying bait

The mirror-image phage display uses the chemically synthesised mirror image form of a natural target protein molecule as a bait to screen bacteriophage derived peptide/protein libraries from identifying L-peptide/protein ligand. After this, the D-amino acid form of the selected L-peptide/protein ligand is synthesised chemically in the lab. This binds to the natural protein target with an equal affinity.

Now that the D-amino acid has taken the place of the L-amino acid in one of the proteins, the junction of AMA1 with RON2 cannot take place as the handedness of the two molecules does not match. Because of this, the parasite's life cycle will not be complete and it will be rendered harmless.

Unique combination

This method has been pursued by Dr. Mandal during his earlier research stint at the University of Chicago with Professor Stephen B.H. Kent, where he first used a unique combination of chemical protein synthesis and mirror image protein phage display to develop a D-protein antagonist of the vascular endothelial growth factor (VEGF-A).

This work, which was tested in a mouse model, demonstrated the potential of D-proteins "as a unique class of biologics for neutralising the action of natural protein targets," he says.

Super-resolution microscope to study onset of Alzheimer's in the works

One way to understand how Alzheimer's disease progresses is to study the way certain protein factors affect the formation of amyloid plaques that are so central to the progression of the disease. While it is required to know how this happens in the human brain, scientists are TIFR Centre for Interdisciplinary Sciences, Hyderabad, are studying this in a lab.

Alzheimer's disease is characterized by the accumulation of amyloid-beta (AB) in the brain in the form of plaques. In addition to this, there are other factors correlated with development of this disease. One such factor is the protein apolipoprotein E4 (apoE4), whose presence is the strongest genetic risk towards later emergence of Alzheimer's. Kanchan Garai's lab has undertaken experimental work to determine how apoE4 interacts and facilitates the growth of these amyloid plaques.

In a paper published about two years ago in the journal Biochemistry, he and Carl Frieden of Washington University have written about their first experiments on the effects of apoE proteins on the aggregation of amyloid beta peptides. Now, they are in the process of building a super-resolution microscope which can help in giving both high resolution and quantitative pictures of the complex that will further reveal the mechanism. As a prelude to this, they have built a spectrometer which can detect the complexes with a high degree of sensitivity.

DrGarai explains that there are three common protein variants (isoforms) of apoe: apoE2, apoE3 and apoE4. About 77.9 per cent of people have apoE3, 13.7 per cent have apoE4 and 8.4 per cent have apoE2. Therefore, a large fraction of the population having apoE4 is at risk of getting Alzheimer's.

"We examined the effects of apoE proteins on the aggregation of amyloid beta peptides and showed that apoE interacts with the AB aggregates. Most importantly apoE stabilizes the early aggregates commonly known as the oligomers… Our study showed that apoE4 stabilizes the oligomers more than apoE3 or apoE2. So we hypothesise that apoE4 exerts its toxicity in Alzheimer's by stabilizing the toxic oligomers of AB," he says. The oligomers of AB are believed to be the most potent toxic species.

Working out the way this interaction takes place is therefore crucial to this approach of understanding Alzheimer's. The goal of this group is to get a handle on the interactions and asses the toxic effects of the apoE-AB complexes. "Finally we would like to come up with strategies to alter the interactions to impact the progression of the pathology in the brain of people with Alzheimer's," he says.

Custom built

For this purpose they have built a state-of-the-art spectrometer that can perform multichannel fluorescence correlation spectroscopy (FCS) and single molecule Fluorescence Resonance EnergyTransfer (smFRET) measurements. The researchers will use it to detect, quantify and characterise the oligomers of AB and their complexes with apoE. "My setup performs significantly better than commercially available ones. We are now building a stochastic optical reconstruction microscopy. We hope that this will give us a resolution which is 10-20 times better than regular optical microscopes," adds DrGarai.

aspirantforum.com

Science and Tech.
The Crux of The Hindu
Vol. 08
News of Oct-Dec 16

COMPUTER & IT

Software protects laptop even in sleep mode

Researchers have come up with a new software to safeguard data even when the computer is in sleep mode. The software, Hypnoguard, was developed to protect "data-in-sleep" by researchers from Concordia University, Canada.

When installed, the system encrypts the computer's random-access memory (RAM) before it enters sleep mode, and then decrypts the data upon waking with hardware-backed uncircumventible user re-authentication.

Researchers designed the system by integrating password-based authentication with widely available hardware security features.

"Protecting data is especially difficult when a computer goes to sleep, which happens after a certain period of user inactivity," said Lianying Zhao from Concordia University.

"Professionals for whom security is paramount — government agents, journalists and businessmen — should benefit the most..." said researchers.

IIT Madras group develops alternative system for communication during disasters

One of the first things to get affected during natural disasters and accidents is the communication network. In a country where over a billion use mobile phones, providing mobile connectivity during a disaster, at least for emergency usage, is a priority.

In this context, an IIT Madras team is developing a low-cost communication system that can enable rescue workers to communicate with a locally established centre and, through this centre, to the National Disaster Management Agency (NDMA) in Delhi.

The plan is also to enable citizens within the reach of this system to communicate essential messages, such as "I am safe" or basic information – name, age, gender, etc, of persons discovered. The whole system is compatible with basic model mobile phones, as most users in India do not own smart phones. The system, named DISANET, allows basic services such as voice, text and video communications to be exchanged within this network of rescue workers, Master Operation Centre and the NDMA.

The design has four subsystems — WiFi, a satellite link, single-carrier GSM and LTE (Long Term Evolution) which is a standard for high-speed wireless communication for mobile phones and data terminals. The compact system can be easily transported in trucks to the site of the Master Operation Centre within a few hours of the disaster. The wireless system should provide coverage over an area of approximately 1,000 square kilometres.

At present, people who are involved in rescue operations, such as police personnel, use walkie/talkie handsets (VHF/UHF). "VHF/UHF handsets are expensive, costing anywhere up to a couple of lakhs of rupees. So the police are very selective of who gets to use them… Much of the police force depends on GSM for its communication needs, and they are subject to all the disruptions that affect GSM network," says DevendraJalihal of the Electrical Engineering department of IIT, who along with David Koilpillai, also from the same department, is developing this system.

Rescue workers with GSM handsets, WiFi cameras and WiFi nodes can spread out over an area of 12-25 square kilometre to form the primary deployment area. These workers supply communication between the affected area and the Master Operation Centre (MOC). The MOC has pico- or micro-sized LTE-Base Stations which are mounted at a height of 15 to 20 metres.

This is achieved by a tethered-balloon that is inflated and hoisted at the MOC. But this system is being improved – instead of balloons, drones are being tested. "We tested a variant of this during Mahamaham [festival] at Kumbakonam in February, this year, for Tamil Nadu Police. Police personnel with smart phones could initiate and receive calls using WiFi channels. We are proposing this kind of system whenever there is a large gathering, as the GSM network experiences 'congestion' and the police need another line of communication," says DrJalihal.

The architecture, which mainly supports usage by rescue workers, can be extended to allow citizen victims to send short SMSs communication.

Also, the rescue team can directly communicate with citizens about the arrangements using FM broadcast, which citizens receive on their mobiles. This enables the flow of authenticated information from the authorities to the citizens and prevents rumour-mongering during times of disaster.

"We are now trying to build a GSM network with low cost hardware and open source software and hope to test it in the next couple of months," says DrJalihal.

aspirantforum.com
Science and Tech.
The Crux of The Hindu
Vol. 08
News of Oct-Dec 16

Toys controlled by thoughts!

Some of the most popular toys on the children's list to Santa on Christmas eve like remote-operated cars, helicopters and toy robots may soon be controlled via a headset using the power of thoughts, scientists say.

Researchers from the University of Warwick in the UK have developed a technology which allows electronic devices to be activated using electrical impulses from brain waves, by connecting our thoughts to computerised systems.

This could be based on levels of concentration — thinking of your favouritecolour or stroking your dog, for example, researchers said.

Instead of a handheld controller, a headset is used to create a brain-computer interface, which is a communication link between the human brain and the computerised device.

Sensors in the headset measure the electrical impulses from brain at various frequencies — each frequency can be somewhat controlled, under special circumstances.

This activity is then processed by a computer, amplified and fed into the electrical circuit of the electronic toy.

"Whilst brain-computer interfaces already exist — there are already a few gaming headsets on the market — their functionality has been quite limited," said Christopher James, professor at Warwick.

"New research is making the headsets now read cleaner and stronger signals than ever before — this means stronger links to the toy, game or action thus making it a very immersive experience," said Prof. James.

The cell phone as your identity give-away

You thought that when your cell phone is tapped, it reveals your conversations and deals. But what a group of scientists from the University of California at San Diego (UCSD) has done is to tap your phone — not to listen in but to take cotton swabs from the back and front of your cell phone, gather the tiny amounts of chemicals sticking on the surface, analyse them and reveal the lotion, skin cream and other personal 'life style chemistries'.

Pardon the poetic license the group has used in pluralising the word chemistry — they meant the great diversity of molecules swabbed out of the phone surface. The swab from the back of the phone tells about what was in your hand and that from the front, what was in your face. But then, you say, the amount they collect will be in micrograms or less, and will be a complex mixture; how can they analyse and identify each of them? They have shown that it is now possible to do so using a triad of methods. The first is the use of what is called liquid chromatography. Here, a solution containing a mixture of compounds is allowed to go through a column packed with solid particles, and slowly flushed out. They come out of this obstacle race based on their structure and shape, affinity to the packed column material and so forth.

Identifying molecules

This method has now become so advanced that the minute mixture in the swabs can be separated into individual components. (Drs. Martin and Synge, who received the Nobel Prize in 1952 for developing the method of chromatography, would be impressed with the advances in the field, leading to ultra-performance, during these six decades). The UCSD group of Professor Pieter Dorrestein used such an ultra-performance liquid chromatography (UPLC) to separate dozens of compounds from these phone swabs.

The next step is to identify the molecules. For this, they used the technique of mass spectrometry, which reveals the molecular weights of the compounds studied. The principle is to impart an electric charge and ionise the molecule, and accelerate it using an electric field of known strength. (One form of doing so is known as quadrupole method). The velocity with which the molecule reaches the detector depends on the molecular weight of the compound. (Dr. Aston, who was given the Nobel prize in 1912 for inventing the method of mass spectrometry, and Fenn and Tanaka, who, too, were given the Nobel prize in 2002, for advancing the method, would be delighted with this novel method called quadrupole time of flight, or Q-TOF mass spectrometry). In the process, the molecules are also broken down into smaller fragments. One then uses a previously collected and stored library of such fragments of thousands of molecules, and using informatics, puts back the jigsaw puzzle to determine the structure, size and shape of each of the molecules in the sample that was injected into the mass spectrometer. The combination of UPLC and Q-TOF thus enabled the group to determine the molecular structural details, and thus the identity, of each of the individual components in the swab mixtures.

Having collected the swabs from the phone and analysed the contents of the molecular ensemble therein, they next did the same from the swabs collected from the volunteer individual who used the phone, and found that the results of the 'chemistries' matched. To be sure, they did this experiment with 39 volunteers and found the results reproducible. One interesting point that came out was that these chemicals on the phone surface tend to stick on for months! The third method used was the analysis of the 'big data' obtained from such a plethora of compounds using bioinformatic methods, in order to get an idea of the molecular networking involved. This method, too, has come a long way over the last five decades, allowing us now to analyse and identify the metabolic details of molecules.

The overall profile

While many of the chemicals detected were common to the swabs and the hands of the user, some chemicals, such as the ones from diet (piperine from black pepper), or drug molecules (antihistamines, ibuprofen) from medicine users, were found only on the hands. Thus, the overall profile of the individual is important to an investigator and not just what is found on the phones.

Interpretation of such chemical traces can thus allow, for example, a crime investigator to learn about the life style, or the food/medication used by the individual who used the phone recovered from a site. A database obtained this way can be used by itself, or it can supplement DNA profiling where available. The UCSD group suggests that such a database would help in forensics (tracking an individual), or terrorist tracing (useful for the military), but also for toxicology (to monitor exposure to environmental pollutants) and in medicine (patient specific metabolism, response to medications, even without response to a needle).So, a selfie is not just about how nice you look. It reveals a lot more than your lovely face.

aspirantforum.com
Science and Tech.
The Crux of The Hindu
Vol. 08
News of Oct-Dec 16

DEFENCE

Confusion prevails over Class : Which aircraft are replacing Mig-21 and Mig-27 in India ?

India yet again has sent indirect requests through Diplomatic channels to various countries inviting them to bid for supply of 90 + Single engine combat jets with Transfer of Technology to be Made in India. Single engine requirements asked by India might have dashed hopes of many countries who were considering offering their twin-engined fighter jets to India , which also now limits India's options to only American legacy F-16 fighter jet and Sweden's Gripen fighter jet but there is still confusion which aircraft's new fighters will be actually replacing in IAF . Indian Air Force by 2020 will be retiring around 11 Squadrons of Light Class Mig-21s Point defence fighters along with Medium class Mig-27s Strike aircraft which brings the figure to nearly 200 aircraft. Both aircraft which IAF is retiring is of two different types and class of fighters. India's Indigenous LCA-Tejas were seen as original Mig-21 replacements for which IAF already has placed orders for 120 jets in form of Block variant of MK-1 and MK-1A . But Indian Air force requirements in Light class category was near 300 aircraft's which had left plenty of opportunities for DRDO and HAL to work on more improved variants of LCA-Tejas to meet this requirement but Saab's Gripen E offered to India is of same class as LCA-Tejas while F-16 can be considered as same class of Mig-27s but definitely not optimised for strike roles .

Project-75 India : After Scorpene data breach debacle ! Who is the front runner?

Predictably entire global submarine industry is eagerly awaiting realise of a formal request for proposal by Indian defence ministry under Project-75I under which India plans to build Six Next generation conventional submarines for Indian Navy in its own shipyards with technology transfer but recent data breach regarding France's DCNS Scorpene-class submarine might have further delayed India's P-75I. Under 2005 contract with DCNS along with India's Mazagon Dock Limited has been building Six Scorpene-class submarines in India and first of its INS Kalvari already has started sea trials. DCNS were seen has frontrunners to bag orders for 3 more Scorpene submarines which could later also compete for P-75I with Shortfin Barracuda Block 1A but repeated delays and cost escalations along with vital data breach regarding Scorpene class has certainly forced Indian defence ministry to rethink seriously possible proposals by other International suppliers Including from Russia and Germany. Germany's ThyssenKrupp Marine Systems (TKMS) will bid for Indian P-75I by offering Type 212A or Type 214/Type-218 depending on India's requirements. Indian Navy from early 80's have operated four Type209/1500 submarines built by TKMS's Subsidiary HDW. While German offer clearly looks strong on paper and is based on HDW's long and formidable expertise on submarine development, which has led to an impressive list of customers operating Type 212A/Type-214 submarines around the world . The major downside of German submarines is their expensive acquisition cost along with operating cost , another road block could be various export control regulations which come with German weapons . Siemens developed fuel cell-based AIP system which comes with Type Submarines are that they rely on electrochemical generators that use hydrogen-oxygen fuel cells which lead to very high running costs. India will also need to invest in additional facilities to store expensive and vulnerable chemicals used in Siemens AIP Systems and according to many Defence Analysts Siemens AIP Systems require stringent requirements in terms of organisation and training of submarine and support personnel in maintaining them . Russian offer of Amur-class submarines is based on Lada-class submarine developed by Rubin design bureau under Project 677 which Russia claims is 4th Generation non-nuclear submarine which was first convinced in late 80's to replace 3rd generation Kilo class submarines also used by Indian Navy . Amur Class will see elements of Kalina-class which is a successor to Lada-Class and Amur-1650 currently been offered to India which will be significantly smaller and more compact

than the kilo-class boats but will be equipped with high-powered but efficient electric motor, which technology wise is similar to Type Submarines offered by Germans . Russia already has offered to equip vertical launchers to fire India's Brahmos cruise missiles and lately even Germans have made similar offering but when it comes to technology transfers and integration of Indian developed submarines systems like torpedoes and AIP Systems , Russians have offered that provisions and options in their submarines , which Germans have not. AIP systems developed by Russia and India uses same AIP technology were both rely on generating hydrogen on the submarine from standard diesel fuel which is radically different and more economical than German AIP technology used on Type Submarines on offer to India. Conclusion : Russia offers economical, Indigenisation and better transfer of technology but Lada-Class upon which Amur-1650 will be based upon has not really enjoyed major success back home .technical and operational shortfalls have already lead to work on Kalina-class submarines .German Type Submarines offer comes with steady, reliable and tested technology for India but at Higher price tag . Since P-75I will be India's last purchase of conventional submarines based on imported technology and next conventional submarines for Indian Navy will be based on Indigenous design using Indigenously developed submarine technologies , P-75I will play a crucial role in development of P-76 and choice made by India under P-75I will lead to adaptation of major design philosophy which will have its influence on Indigenous efforts in near future for which India needs to choose wisely keeping in mind future requirements

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Boeing KC-46A Pegasus : India's NextGen Tanker ??

Media reports are indicating that Boeing has offered military aerial refuelling and strategic military transport aircraft, KC-46 Pegasus, amidst growing uncertainty over India's tender for six multi-role tanker transport (MRTT) aircraft. In previously (Will Boeing KC-46A Pegasus Vs Airbus A330 MRTT war re-ignite for India's Mid-air Refueling tender ?) I had put together some fact check on both Boeing KC-46A Pegasus and Airbus A330 MRTT and had concluded that India will benefit from cheaper operational cost and economic of scale when it comes to KC-46A but will lose on exceptional long haul operational capability if we reject A330 MRTT. A330 MRTT lost out twice after been declared winner due to the high acquisition and operational cost which was red flagged by Finance ministry when cheaper options like Russia's Il-78MD-90 were offered which was rejected due to poor after sales and service support usually associated with all Russian equipment . KC-46A based on commercial 767 jet airliner has been in production since mid 80's while A330 scores big on its long-haul capacity and has 6350nm when compared to KC-46A's 3850nm but it still falls short on range when compared to Il-78MD tankers operated by Indian Air force at present, which critics will argue makes A330 MRTT a better choice . But KC-46A lobby will counter that Indian Air Force tankers will not operate outside its area of influence in the region and higher internal fuel capacity of Sukhoi-30 which is the main stay of IAF also negates the requirement for tanker standby which mostly likely will be used by other mid and light class fighters . KC-46A provides what India wants but A330 MRTT provides added additional capabilities which Indian Air force will like to have in its fleet. Indian Defence minister should take IAF onboard and consult with them on Boeing's KC-46A offer and let IAF gauge if KC-46A can meet their operational requirements.

Why India is still chasing Mirage??

Kargil war exposed Indian Air forces inability to fight conventional and maintain Airpower at 18,000 feet, only saving grace from that war was that French built Mirage-2000H performed exceptionally well over mountainous terrain and got desired results for India which was instrumental in pushing back Pakistani Army from Kargil sector . India's cancelled MMRCA tender had roots in Kargil war and post-Kargil war assessment by IAF recognised the need for new Multi-Medium role combat aircraft and the obvious choice was to purchase 126 upgraded Mirage-2000-V (Dash 5) from France . IAF's love affair with French Mirage-2000 is well known , Air Force in 80's wanted 80 more Mirage-2000 over 50 which were already ordered by India and already had created required additional Infrastructure at airbases where Mirage-2000s were based . When India was all set to order expensive additional Mirages then came the Soviet Union counter offer with their latest Mig-29 Air Superiority fighter jets at throw away price .an offer which India could not refuse and plans to buy additional Mirages was dropped indefinitely. MMRCA debacle and India placing orders only for 36 Rafale combat jet which is the successor to framed Mirage fighter jets will only keep IAF in the quest for more of this type in near future. No matter which Single-engined fighter jet India selects airforce will always push for additional Rafale fighter jet like they have been

doing in past for additional Mirages. IAF, in fact, is still pushing for the purchase of two additional Mirages from France for its attrition replacement . India can only hope Air Force doesn't make French Rafale an obsession and keep wasting time and resources in engaging with government in acquiring more Rafale that it affects its future planning and negate India's indigenous fighter programs like Tejas MK-1 ,MK-2 and 5th Generation AMCA fighter jet program .

No Advance Stealth fighter for India till 2025?

According to Defence analysts RaneshRajan close to idrw.org, IAF is not likely to get a futuristic stealth fighter any time before 2024-25, even though talks with Russia have seen some progress but According to Rajan, Top IAF Brass is not fully onboard fifth-generation fighter aircraft (FGFA) which India plans to Jointly develop with Russia due to continuous access denial approach adopted by Russia. IAF already has raised deep concerns regarding technical capabilities of the aircraft and have asked Russia to showcase prove of concept to validate their claims which IAF believes has not matured enough to be considered real 5th generation technology. Rajan said that a Senior IAF official he spoke to feels FGFA is still an expensive joint project with Russia and Russians are not making any attempts to clear our (IAFs) lingering technical doubts about the projects nor have given direct access to the aircraft to gauge its performance . IAF is currently happy with higher workshare and better price offered to India but is also worried that technology maturity might take another decade before production of full-fledged aircraft tweaked to India's requirements is fully tested out and enters production . India and Russia have already finalised $295 million preliminary design contract in December 2010 but the final contract which was supposed to be signed by 2012 has been repeatedly delayed with technical and price differences which continue to mar the joint project between two countries .

Surgical Strikes: Next Strike might come from Sky

PJ-10 BrahMos Cruise missiles represent one of the finest joint ventures in Indo-Russian defencecooperations . DRDO and NPO over last 15 years have fully exploited growth potential of BrahMos Cruise missiles by developing new and improved blocks and are now working on the development of ASCM (Air launched Supersonic Cruise Missile) BrahMos-A which will make it deadlier than ever before . India recently carried out maiden flight of Su-30MKI with an inert BrahMos missile and IAF plans to have around 40 Su-30MKI aircraft which will be modified to be BrahMos missile and first live firing might take place from the aircraft by end of this year . India's recent successful cross-border strikes in POK has rattled Pakistani Military establishments but this will not deter them and they will continue to support terrorist to carry on their low-cost proxy war with India and with additional Pakistani military reinforcements now guarding this terror launch pads and camps , it will only make it very difficult for India to carry out such cross-border raids without causalities or with risk of counter ambush . BrahMos-A which will 500kgs lighter but will carry 300kg warhead will allow India to decimate any enemy or terror infrastructure with impunity , while Su-30MKI the launch platform continues to stay outside the reach of Pakistan's longest range Surface-to-Air missiles range and also well with Indian Airspace. BrahMos-A will be formidable than present Russian-supplied KH-31A/ supersonic ASCM due to its advertised range of 290 km which is quite an improvement over 70-110 km provided by this missile systems. While KH-59ME is main Air-to-Surface ASCM of Indian Air Force with a reported range of 280kms but the missile is subsonic and remains firmly at subsonic speeds of Mach 0.72 to 0.88 over its whole mission profile which could allow enemy's Air defence Systems much-needed reaction time to Intercept.BrahMos-A will provide India capability to fully exploit its range when the launch platform does not need to be positioned deeper inside .BrahMos-A will also allow India to carry out surgical strikes at mountain areas and high value Pakistani military establishments and latest blocks employ enhanced manoeuvrability and ability to fly through multiple waypoints prior to striking the target with pin-point accuracy .

DRDO gearing up for year-end trials of its Air Independent Propulsion systems

Faced with heavy criticism over its handling of indigenous 'Air Independent Propulsion (AIP) program leading to them been excluded from last two submarines of Scorpene conventional submarines been build at the Mumbai-based Mazagon Docks Limited (MDL) under Project-75. DRDO has revealed that land based full-scale operation of a land-based prototype of the indigenously built AIP system is likely to be demonstrated by end of this year to Indian Navy . Independent Propulsion (AIP) technology enables future Indian-built submarines to stay underwater for longer than a conventional submarine. but

DRDO developed AIP already has missed crucial deadlines which mean they will not be ready to be integrated with French developed kalvari class submarines. Well-informed sources close to idrw.org have informed us that , it might take few year more for completion of all trials with last of kalvari class submarines dropped from plans to get indigenous AIP systems , DRDO and Navy will have to talk on which submarines underwater sea trials will be carried out and it is most likely that Russian-supplied Kilo might be modified and used to test Indigenous AIP systems .

Aero India 2017 : Major talks to be held to decide on Next Single-engined fighter for IAF

India's Ministry of Defence (MOD) and Potential Aircraft manufacturers likely to bid for India's Single engine fighter jet requirements will have direct talks will all official stakeholders on sidelines of upcoming Aero India 2017 said a well-informed source close to idrw.org. Advance discussions will take shape around Aero India 2017 and MOD is in hurry to wind up talks after final agreement on the purchase of 36 Rafale fighter jets with France was concluded recently said the same source. Saab's Gripen E and Lockheed Martin's F-16V (Block 70) are on the offer to India and both Companies have already made their Proposals which has been studied in depth by India. Saab has offered to help produce Tejas MK-1A and also co-produce India's 5th generation AMCA fighter jet, which seems to have some sought of air force backing after Indian Air Force chief Air Chief Marshal Arup Raha publically said that he regards Gripen to be generation newer than F-16s. Lockheed Martin has offered to move its US-based F-16 production facility to India and also use same facilites in India to export F-16V to potential buyers or offer upgrade packages to other current operators of F-16 which will be carried out in its Indian plant. Indian MOD is looking to select another type of fighter jet by March 2017 but Industrial sceptics are already predicting much longer negotiation time circle, since it will much more complex negotiation which will involve transfer of technology ,offset clauses along with partnership agreements with Private and Public defence companies in India which will also need to develop infrastructure to support their production in India.

INS Aridhaman shaping up and might be launch in 2018

" India's second nuclear submarine INS Aridhaman is in the final phase of construction as its elder sibling INS Arihant has been quietly commissioned into Indian Navy and the Development of Aridhaman is gaining pace lately, " Said well-informed reliable sources close to idrw.org. INS Aridhaman will see a launch in 2018 before it embarks on series of Harbour and Sea trials before it is inducted into Indian Navy. INS Aridhaman is the second nuclear-powered ballistic missile submarine being built by India. Aridhaman is being built in Visakhapatnam. It is currently being outfitted. Aridhaman will have enhanced features in terms of weapons and equipment due to technological advancement and will defer technologically in comparison to Arihant. Aridhaman will feature 8 launch tubes instead of the 4 giving her double the firepower of Arihant and ability to could carry 24 K-15 Sagarika short range SLBMs or 8 K-4 long range SLBMs giving her double the firepower of Arihant. Aridhaman reportedly will also have improved Nuclear reactor which will be able to deliver higher output due to better calibrations with the same pressurised water reactor found on Arihant. INS Aridhaman will be fitment of indigenous systems like ISS (Integrated Sonar Suite),State-of-art sonar integrated sonar system USHUS sonar developed by NPOL of the DRDO . Aridhaman will also get new K-5 SLBM which will have a range of 5500+ and will have the ability to hit targets up to 8000km with a lighter payload. K-4 (3500+) and K-15 (1000-1800km) SLBMs have already been successfully completed their developmental trials and have also successfully been test fired from Arihant

India's Quest for Combat Drones might get Trump boost :Defence Expert

Wary of President Hillary Clinton blocking the sale of Combat drones to India, Jittery Indian officials were trying to fast track purchase of Combat drones from the United States but Obama administration refused to budge and carried on with delay tactics since he wanted to leave that decision to be taken by his successor said Defence Analyst RaneshRajan to idrw.org . India for long has been

eyeing American developed Predator Drones and Jet powered Avenger Drones from the United States . India also has been looking at purchasing 40 unarmed Predator XP for surveillance but Americans have been wary of India's demand for application of such armed drones Since they most likely could have been used in targeting Terror camps in Pakistan , which could have escalated tensions between Nuclear-armed neighbours . President-elect Donald Trump during his election campaign's did speak favourably on Strategic partnership with India and how he regarded India has a great Strategic partner and wanted to help partner India in combating terrorism emerging from the neighbourhood . Many in the Indian Defence circle were wary that Clinton might have denied Combat drones to India, like her predecessor fearing an adverse reaction from Pakistan, but now many are breathing a sigh of relief that they still have a chance to get combat drones from United states now under Trump presidency said, Rajan .

After S400, Russia is keen to supply another deadly Air Defence missile System to India

Long before a deal for the supply of S-400 Air Defence System was concluded between Russia and India , Russian officials on sidelines of Defexpo 2016 held in Goa earlier this year had confirmed to author that Russia has offered to supply Buk-M2E air defence missile system to India . Officials of Almaz-Antey had confirmed that upgraded Buk-M3 with 70 km range, which is 20kms more range than its predecessor was offered to India to work in tandem with S-400 long-range Air Defence System. Buk-M2 first developed in 1988, only entered serial production after 15 years is considered one of the finest weapons in its class. Buk-M2E is multi-channel, multifunctional, highly mobile medium-range air defence missile system (ADMS) which is designed to engage tactical and strategic aviation aircraft,cruisemissiles.helicopters . Buk-M2E is capable of working independently or as a part of air defence formation under Air defence brigade automated command and control system along with S-400 systems or with Tor-M1 . When asked about how it is different from Indo-Israeli developed LR-SAM Air Defence System, Almaz-Antey officials claimed that ADMS provides highly effective air defence for troops on the move in any conditions and can provide 24 hours ,all weather around the clock operation . While it can continuously provide high mobility and comes with excellent cross-country capabilities . 70 km ranged upgraded Buk-M3 can also be used for guarding administrative and industrial installations and was in the news when Buk-M2E was used to bring down Malaysia Airlines MH17 near the town of Grabovo, in the Donetsk Region in eastern Ukraine, killing all 298 passengers and crew on-board. Buk battalion comes with one command vehicle, a target acquisition radar (TAR) vehicle, six transporter erector launcher and radar (TELAR) vehicles and three transporter erector launcher (TEL) vehicles. Each TEL vehicle is a tracked chassis that carries one row of four ready-to-fire missiles in launch tubes, connected to a turntable style launcher assembly mounted on the rear of the vehicle. Each vehicle also has its own phased-array radar mounted on the turntable assembly. As for the missiles, each one weighs 710kg and measures 5.5m in length, with an explosive load of 180kg.

Russian S-400 Triumf Air Defense System

T-90SM : King of Thar

Indian Army might be finally getting Main Battle Tank which it always has been desiring for long after it send a proposal of recommendation to Defence ministry to procure nearly 500 new T-90S Modernized Main Battle Tanks for western sector bordering Pakistan. T-90SM was first unveiled in August 2011 at Nizhny Tagil, Russia by Uralvagonzavod . T-90S Modernized upgrade was largely based on feedback taken from various customers who operate them and Indian Army being one of the largest T-90S MBT operators , Developers tried to address all shortfalls and recommendations made by Indian Army to tap more export orders from India. T-90S MBT was Generation a head when compared to T-72 MBT in terms of sensors ,countermeasures,enhanced armour protection with modernized turret system along with enhanced firepower but it still carried few major flaws of T-72 tanks , which were poor crew survivability chances once tank has taken direct hits from modern anti-armour weapons and other was that it scored poorly on crew comfort due to cramped interiors and also due to lack of basic amenities like Air conditioning when compared to modern west-

ern battle tanks . T-90SM is totally new tank internally due to improved chassis and new modular turret which for the first time in Russian Battle Tank design history factored in better crew comfort and their survivability . T-90SM now can also handle desert conditions far better due to improvements made in sensors which can now operate at much higher temperatures and now comes packed with new 1130 HP V-92S2F Diesel engine which with automatic gear shifter and steering wheel control helps negate underperformance issues due to Desert heat conditions . Crew survivability has been improved by separating ammunitions from the fighting compartment. Part of the ammunition is stored in special compartments separated from the turret by a blast door. Internal crew compartment also has a fire suppression system . Crew comfort has also been improved by providing optional add-on features like Air Conditioners and Auxiliary diesel-generators. T-90SM has modular armour ERA and ERA panels mounted on rear and side projections. for Crew protection from the secondary flux of tank fragments an anti-fragmentation panel made of aramid fabric has been added . T-90SM also now has increased situational awareness to close threats thanks due to 4 TV cameras mounted on the roof covering all angles of the vehicle. tank also uses early warning threat sensors and countermeasure to protect the tank over 360 degrees. T-90 MBT fleet in Indian Army with new purchase will touch 1300 tanks , with ageing 2000 + T-72s in line for retirement soon and Indigenous Arjun MBT still struggling to enter large-scale production, T-90SM will act has a bridge between T-90S and Future MBT (FMBT) which Indian Army plans to procure post-2025.

Indigenous Kaveri Engine onboard LCA-Tejas will Boost its Export Chances

France's engine maker Snecma as part of offset obligation for 36 Rafale fighter planes purchased by India from another French company Dassault will help revive Kaveri engine and make it flight-worthy within 18 months. As per current negotiation upgraded Kaveri will be integrated with LCA-Tejas prototype by 2018 and first flight will be completed by 2020. If accepted by Indian Air Force ,Kaveri will be integrated with production variant of Mk-1A version of the Light Combat Aircraft for which IAF has already placed orders for 83 aircraft types or it will be reserved to power Ghatak UCAV. As per Snecma's internal assessment shortcomings on Kaveri engine can be fixed and the engine is nearly 70-75% completed and can be certified within 18 months. Integration of Kaveri engine on LCA-Tejas and mass production of Mk-1A variant will be short in the arm for Indian Defence industry and will help India secure export orders of the LCA-Tejas . If India can manufacture Kaveri engine with low price tag while maintaining Quality and good service life and is accepted by Indian Air force it will send right signals to a prospective buyer interested in LCA-Tejas and it will also keep India's Defence export policies not depended on component manufacturers and their government re-export agreements. LCA-Tejas at present is powered by American GE's F-404 engines which require United States Government permission to re-export this engines . India likely to offer LCA-Tejas to export customers with either GE's F-404 or Kaveri engine to give prospective buyers options to choose which is a rare advantage in current fighter aircraft business . The addition of Kaveri engine in LCA-Tejas will also help in the development of more powerful engines to power India's 5th Generation AMCA Project .a modified Kaveri engine is also planned to be used to power India's Stealth Ghatak UCAV which will make it first flight by 2023-24 if go head to the project comes by end of 2016.

An Analysis On Possible Complete And Comprehensive Umbrella Of Protection By A Missile Defence System Like S400 Safeguarding India's Sovereignty

With Indian Govt. opting for S400 missile defence system (MDS) for securing the borders of India it is a welcome decision. A decision that should have been put into effect a lot earlier. It is heartening to see defence planners thinking on a comprehensive strategy to counter the possible threats perceived by the Indian defence advisors & organization. The thinking behind the induction of MDS S400 is a part of that strategy which emphasises on countering possible threats in the form of destructive missiles & invading fighter aircrafts emanating from across the border of India with the perception of two front war percieved by our defence analysts and defence wings. The decision making and the initiative that of the Indian Govt. in this regard is quite appreciable. Why only S400 of Russia for Indian borders? S400 has the farthest range of performance envelope and is most efficient and dared missile defence system amongst the prevalent ballistic missile defence shields. Russia historically have provided India with defence equipment of crucial capabilities bolstering her deterrence capabilities. Hence Russian S400 system becomes a natural choice. Determining number of MDS required to protect the Indian borders. When one

considers the number of S400 systems(12 systems) decided to be implemented it seems that the military planners have either thought of deterring threats at few sections of the length of the country's border or the induction of more MDS like the S400 throughout the country shall be a gradual process thereby covering greater lengths of country's border. Number of MDS like S400 that may be required to defend the aforesaid threat perception can be reached through an analysis which is as follows: Flying distance across the length and breadth of India stands at 2755 Kms (approx., but can be more) from Kashmir to KanyaKumari and 2151 Kms from Gandhi Nagar to Itanagar(length is incomplete, a correct estimate of the distance from extreme west to the north eastern tip of Arunachal Pradesh and will be more) respectively. Taking into account the whole of India's borders we can divide it into 7 sections. From KanyaKumari up till the northern tip of Sikkim, from KanyaKumari till extreme west of Rajasthan ,from The northern tip of Sikkim till J & K (excluding POK), from extreme west of Rajasthan till J&K (excluding POK), the eastern region from northern tip of Sikkim till Arunachal Pradesh , Andaman & Nicobar islands and Lakshadweep. Taking into consideration the curvatures of the landscape with 30% redundancy into account for comprehensive coverage ensuring overlapping domains of coverage and the demand of extreme quick reaction from the nearest MDS (quick reaction required due to the curvatures of borders) having probability of quickest interception would require approximately 68 MDS of S400 with the overlapping domains. The overlapped domains of coverage having at least 100 Kms as common coverage area between 2 MDS should be another criterion for calculations to determine the number of required MDS. From KanyaKumari up till the northern tip of Sikkim and extreme west of Rajasthan 7 + 30% redundancy = 7 + 3 (2.1 rounded up to 3)=10 MDS, so 10 x 2=20 units of S400 should be required (each side with 10 S400s). From The northern tip of Sikkim till J & K (excluding POK) and from extreme West of Rajasthan till J&K 5 + 30% redundancy = 5 + 2 (1.2 rounded up to 2) =7 DM,so 7 x 2=14 (each side with 7 S400) S400 will be required. Likewise from Northern most tip of Sikkim till Southernmost tip of Mizoram the requirement should be 2 + 30% redundancy = 2 +1 =3 MDS. Likewise from southernmost tip of Mizoram till extreme south east of Arunachal Pradesh the requirement should be 2 +1 =3 MDS. Across the extreme south east to north of Arunachal Pradesh the requirement should be 1 +1 =2 MDS. From Extreme North of Arunachal Pradesh till Extreme West of Arunachal Pradesh the requirement should be 1+1 =2 MDS. From thereon till Northern tip of Sikkim the requirement should be 2 + 30% redundancy = 2+1=3 MDS. Actually military planners should keep provision for 4 more MDS in this eastern region from Northern tip of Sikkim till Arunachal Pradesh taking into account the acuteness of the curvatures of the landscape and obstacles. Since Myanmar and Bangladesh does not feature in serious threat perceptions so a total of strategically placed 13 MDS according to perceived threat should suffice. Likewise, Andaman and Nicobar islands merit 3 S400 systems i.e. 2+1 MDS. and Lakshadweep 2 MDS i.e. 1+1 . All the assumptions are made on the basis of the coverage of the longest reaching missile 40N6 of S 400 system with performance range of 400 Kms. In addition to the conclusive numbers of MDS to be implemented 9 (5 for borders with Pakistan + 4 for the Eastern region including Sikkim till Arunachal Pradesh) more MDS should be in reserve for unforeseen contingencies keeping in mind the POK region and other sensitive regions along China & Pakistan borders, and, another 7 for cannibalizing during war. Army/Air force will have to ensure to protect the MDS from threats emanating from inside the country. Such systems along with the calculated redundancies have to be placed in active mode all along the designated section of the border. MDS in reserve should be placed or moved according to evolving threat perceptions and perceived locations of usage. Missiles of such systems have to be available in sufficient numbers per system for quick installation after a launch. Follow on replacements against the initial reserve of such missiles systems would be required keeping in mind their shelf life. Like every system has its own maintenance cycle the MDS won't be an exception. But all in all it will be a very potent inclusion in the inventory of the army/air force making it extremely capable of meeting aerial threats from outside the borders of India. Apart from acquiring missile defence systems like S400 by means of import India should try to develop her own missile defence system to avoid dependence on foreign made defence equipment. But Indian defence industry seems to be deficient of that technological knowhow. Since Russia is the traditional partner providing top notch defence equipment and India is not looking towards US missile defence system like THAAD it may be a potent proposal for India to put forward to Russia in a Govt. to Govt. dialog to make S400 in India for induction into Indian defence. In that way the full umbrella of missile defence system can be achieved without importing all the S 400 systems to India.

aspirantforum.com

Science and Tech.
The Crux of The Hindu
Vol. 08
News of Oct-Dec 16

GTRE-SAFRAN Kaveri Aims for 90kN Thrust to beat General Electric's F404-GE-IN20 to power LCA-Tejas MK-1A

French company Safran and India's Gas Turbine Research Establishment (GTRE) will come together to revive India's long-delayed Kaveri gas turbine engine once Ministry of Defence (MOD) clears French defence manufacturer Safran proposal to fix Kaveri engine for free to meet mandatory DassaultRafale offset regulations in India . The French company is confident that engine can be made flight-worthy in next 18-24 months period since it earlier had carried out an internal assessment of the whole program and had found it to be 70-75% completed. GTRE plans to offer completed Kaveri engine to be powered by HAL proposed upgraded LCA-Tejas MK-1A but to get IAF nod on the engine ,newKaveri engine will have to develop 90-95 kN uninstalled thrust as per media reports. According to government reports, Kaveri was able to achieve 72kN Thrust in its current avatar but to be considered reliable and alternative powerhouse for LCA-Tejas MK-1A by 2020. Safran and GTRE plan to target and accomplish the desired thrust above 90kN to meet these requirements .at present, General Electric's supplied F404-GE-IN20 engines are able to generate 85 kN uninstalled thrust . If Safran and GTRE are able to complete Kaveri gas turbine engines development in the desired timeframe right before Tejas MK-1A goes into production then IAF might consider them to be used in later batches of Tejas MK-1A which goes into production but only if thrust goals are meet. a Dry variant of Kaveri engine generating 52kN Thrust will be used to power Ghatak UCAV but certainly, Kaveri engine will not make it to LCA-Tejas MK-1A nor into LCA-Tejas MK-II which has engine thrust requirement in the range of 98kN . GTRE till now has developed 9 prototypes of Kaveri gas turbine engine which combine have clocked 2200 hours of the test in ground and altitude conditions .

aspirantforum.com
Science and Tech.
The Crux of The Hindu
Vol. 08
News of Oct-Dec 16

AGRICULTURE

Genetic secrets of purple rice

The mysterious ways of genes influencing the character of crop plants through long periods of domestication, selection and modern breeding continues to perplex genomics specialists, as found out by the genome researchers working on coloured rice, Purpleputtu recently. Even the whole Genome Sequencing (WGS) of the Purpleputtu rice variety has not fully opened the windows to the genetic secrets to the researchers.

Researchers at the SciGenom Research Foundation, Chennai, said the genome sequencing of Purpleputtu revealed around 65,000 unique genetic mutations compared with the reference sequence, of which about 50 are in the genes of the colour pathway. The question of how specific genes and gene networks control the expression of its uniqueness, the purple colour, still remains an unanswered mystery, say researchers.

In most cultivated white grain rice varieties, a regulatory gene, Rc is missing 14 base pairs, which is believed to have changed the phenotype of seeds from coloured to white. The presence of the 14 base pairs is believed to help regulate the anthocyanin pathway enzymes to produce coloured seeds, and its absence is accounted for the grains remaining more or less white.

The sequencing revealed that the 14 base pairs of Rc gene were absent in Purpleputtu variety. Yet, its seeds remained true to the nomenclature and were found retaining the colour, explained George Thomas, Director, SGRF, and Arjula R. Reddy, advisor to the Foundation. This leads to the conclusion that there are alternative regulatory pathways operating in Purpleputtu, they explained.

IIT scientists develop irrigation maps of India

For the first time, high-resolution maps of irrigated areas of India from 2000-2015 have been prepared using remote sensing data. The maps were validated with ground-based survey data. High-resolution irrigated water maps are essential for estimation of irrigation water demand and consumption on a spatial scale, crop productivity assessments and hydrologic modelling.

The maps were developed by a team led by Dr. Vimal Mishra from the Civil Engineering Department, Indian Institute of Technology, Gandhinagar, Gujarat. The results were published in Scientific Data, a journal from the Nature g roup.

While the irrigation maps developed by the Food and Agriculture Organisation (FAO) are of low resolution, the high-resolution maps of International Water Management Institute (IWMI) are available for just one year and do not cover the entire country.

“So we developed annual irrigated area maps at a resolution of 250 metres for the period 2000-2015 covering all the agro-ecological zones of India,” says Dr. Mishra. “We used the remote sensed vegetation index data from MODIS [Moderate Resolution Imaging Spectroradiometer] and high resolution (56 metre) land use/land cover data from the National Remote Sensing Center (NRSC) to prepare the maps.”

In the case of some States the maps tend to overestimate the irrigated areas while in others it underestimates. “Generally, humid areas lead to overestimation of the irrigated areas because of less variation in peak vegetation index, which is used as a threshold to identify irrigated and non-irrigated areas.

Also, the resolution of remotely sensed vegetation index data may not be able to fully capture irrigated areas of small land holdings in India. And, a 250-metre pixel is considered fully irrigated even if there is partial irrigation in a small field within a pixel,” he says. However, the maps have better accuracy in the case of arid and semi-arid regions as vegetation is restricted to areas that are irrigated and therefore the vegetation index truly reflects the vegetation health. “For most States we found our estimates of irrigated area are better in accuracy than the maps developed by IWMI,” he says.

“Since a majority of agro-ecological zones of India fall in water-limited conditions, we assume that our method is effective for India,” they write. The developed dataset showed better accuracy against the ground-based survey than previously available datasets.

The estimation of irrigated area can be further improved if vegetation index data is available at higher spatial (to resolve small land holdings) and temporal resolution (to accurately capture crop growth cycle, which is essential to differentiate crops that are irrigated and not irrigated).

“We have plans to update the repository every year. By February 2017 we will upload the irrigated area data [in the form of maps] for 2016,” Dr. Mishra assures. The irrigation maps from 2000 to 2015 for the entire country are

available in a Geotiff format in a repository and can be be freely accessed by researchers and others.

To highlight the trend and response of irrigation to rainfall variations, the authors chose the Indo-Gangetic Plain, which had witnessed severe drought in 2002 and 2015. To understand how unusual the 2015 drought was, the authors looked at the magnitude of deficit in 2015 monsoon rainfall and also looked at the long-time data from IMD.

“When we analysed the data, two regions — Indo-Gangetic Plain and Marathwada regions — were very distinct. These two regions faced very severe monsoon rainfall deficit in 2015,” he says. “We hypothesised that single monsoon deficit alone cannot result in a severe water shortage in these regions that was witnessed in the post-monsoon season of 2015 and summer of 2016.”

The GRACE satellite data showed an alarming depletion of groundwater in the post monsoon season of 2015. The combined depletion of surface and groundwater resources was caused by the two consecutive droughts over the Indo-Gangetic Plain region.

“The deficit for two consecutive years 2014 and 2015 was 51 per cent. The drought in the Indo-Gangetic plain based on two consecutive monsoon rainfall deficits was ranked one during the period of 1906-2015. Statistical analysis showed that the two-year drought was unprecedented and had a return period of more than 500 years. It means low probability of two consecutive years being drought years,” says Dr. Mishra.

aspirantforum.com
Science and Tech.
The Crux of The Hindu
Vol. 08
News of Oct-Dec 16

MISCELLANEOUS

Indian researchers' solution to marine oil spills

Researchers from the Indian Institute of Science Education and Research (IISER) Pune, the Central Salt & Marine Chemicals Research Institute (CSMCRI), Bhavnagar and National Chemical Laboratory (NCL), Pune have developed a membrane with exceptional hydrophobic and extremely high oil-loving (oleophilic) properties. The superior water-repellent and oleophilic membrane can potentially be used for tackling the globally challenging issue of marine oil spills.

Such is the hydrophobic nature of the synthesised metal-organic framework (MOF) that the water contact angle is nearly 176 degrees — the "first example of an ultrahydrophobic MOF." At the same time, the MOF membrane has a superior affinity for oil (oleophilicity) with an oil contact angle of nearly zero degree. The results were published in the journal Chemistry - A European Journal.

"The membrane was fabricated by mixing bulk MOF material with a binder and solvent and spray coated on to an inexpensive polypropylene substrate. The substrate is stable in organic solvent," says Ankit M. Kansara from CSMCRI and one of the authors of paper. "The membrane is 100-120 micrometre in thickness."

"The MOF is inherently ultra-microporous in nature and the porosity is retained when the thin film-like membrane is formed on the matrix. Because of the highly porous nature of the material, the coated MOF's surface area is as high as 1,000 metresq per gram," says Soumya Mukherjee from IISER and the first author of the paper.

The ultrahydrophobicity was achieved by synthesising the MOF with a high density of fluorine; fluorine is inherently hydrophobic in nature and any material that is fluorine-rich becomes hydrophobic. By virtue of being highly hydrophobic, the MOF membrane, by default, becomes distinctly oleophilic or oil-loving in nature. The marked influence of fluorines was strongly supported by theoretical insights provided by Dr. Arnab Mukherjee from IISER and a coauthor of the paper.

"The use of more fluorine makes the MOF water stable. Water stability is a prima facie criterion for industrial applications and being environmentally benign," says Mr. Mukherjee.

When water-oil mixture is passed through the membrane the oil permeates by rapid absorption, while water is retained above the membrane. "The oil permeation was 100 per cent in the case of an oil-water mixture," says Prof. Sujit K. Ghosh from IISER and the corresponding author of the paper. "So if you put the membrane in an oil-water mixture, it can perfectly separate oil from water. The membrane acts like a filter."

Water-oil emulsification takes place in the sea when water gets mixed with oil under high water current conditions. "It is very difficult to separate oil and water from an emulsion. So in another experiment, the oil was completely separated from water when we passed the water-oil emulsion through the membrane," says Mr. Mukherjee. The emulsion droplets demulsified at the very instant they touched the membrane, and oil passed through while water was wholly retained above the membrane. The separation of water-oil emulsion was totally driven by gravity with no external force applied. The best part is the recyclability traits of the membrane. When external mechanical force in the form of ultrasonic waves is applied in the presence of a hydrophobic organic solvent, the constituents of oil come out of the pores of the oil-saturated membrane. "The oil tends to come out due to the presence of competing hydrophobic molecules during the ultrasonification process lasting 30-60 minutes, depending on the size of the membrane and volume of oil absorbed," says Mr. Mukherjee.

The membrane is then heated at 70 degree C to remove the organic solvent and quickly regenerate the MOF. The organic solvent tends to evaporate after some time, even if the membrane is not heated.

"There was 100 per cent removal of oil from the membrane. We were able to get back all the oil used," Mr. Mukherjee adds.

IIT Bombay researchers a step closer to treating Parkinson's

Researchers from the Indian Institute of Technology, Bombay (IIT B) have taken the first successful step at regenerating neurons in a Parkinson mouse model by using mesenchymal stem cells (MSCs) encapsulated in an amyloid hydrogel. The hydrogels which provide scaffolding for stem cells to develop into neurons when implanted in the brain are developed from a special class of proteins called amyloids. The results were published in the journal NPG Asia Materials.

Neuron-like cells

The hydrogel enabled the delivery and engraftment of mesenchymal stem cells in two regions of the mice brain

— substantia nigra and striatum — where the cells were injected. “We do not have direct proof that mesenchymal stem cells have become neurons. But the stem cells transplanted at the substantia nigra site were differentiating into neuron-like cells,” says Subhadeep Das from IITB-Monash Research Academy, IIT Bombay and the first author of the paper.

“We wanted to first know if the cells were surviving and were contained at the site. So the time point was short, and we sacrificed the animals at the end of the seventh day after transplantation,” he says. “Further studies for prolonged periods will tell if the mesenchymal stem cells become matured neurons.”

In the case of Parkinson’s, neurons based in the substantia nigra region of the brain release dopamine at the striatum. Since the connection between the two regions is lost in the case of Parkinson’s, the researchers implanted the stem cells at both the sites.

But before transplanting the stem cells encapsulated in the hydrogel into the brain of the mice, the researchers tested the hydrogel in the lab for toxicity. Both neural precursor cell lines and mesenchymal stem cells were cultured in the amyloid hydrogel. And 2D and 3D culture tests for toxicity were carried out for both short (24 hours) and long (120 hours) term and the results compared with a collagen hydrogel, which served as control. “The compatibility of amyloid hydrogel was similar to collagen,” says Das.

Besides being a good scaffold that facilitates the differentiation of stem cells into neurons and not being toxic, the hydrogel should also not trigger the immune system from mounting a violent reaction against it when implanted into the brain. So the researchers injected the hydrogel into rat brain to test for any possible inflammatory response or immune rejection of the amyloid hydrogel. While two types of inflammatory cells - microglia and atrocytes - accumulated near the hydrogel, their levels subsided by 21 days.

In a next step, they implanted the hydrogel containing the mesenchymal stem cells in the brain of the Parkinson mouse model. “The hydrogel was able to improve the viability of the transplanted cells and were able to contain them at the site where they were implanted,” says Das. The control cells that were not contained in hydrogel were three times less viable than the cells contained in the hydrogel.

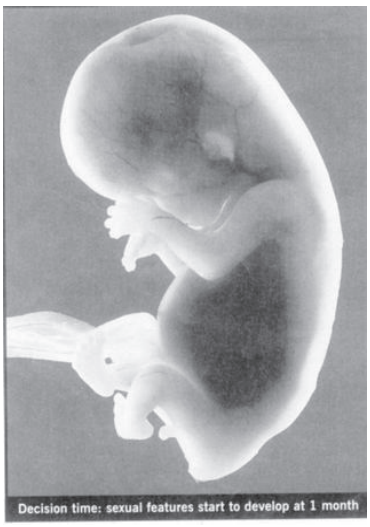
“Amyloids are among the most robust protein/peptide-based materials ever evolved in nature. We just utilised these superior materials property of amyloids for targeting stem cell delivery in the brain and their differentiation to neurons. On the one hand, amyloid-based hydrogels are capable of protecting delicate stem cells within the hydrogels matrix, while on the other hand, they are able to guide the differentiation of stem cells towards neurons,” Samir K. Maji from the Department of Biosciences and Bioengineering, IIT Bombay and the corresponding author of the paper says in a release.

Major challenges

There are three major challenges when stem cells are transplanted or injected into the brain - the cells should survive, should not migrate to different places where they are not required, and should become functional neurons and integrate with the existing neural circuit. “Our material has solved the first two challenges. We are now working on the third one,” says Das confidently.

Can a human live up to a thousand years?

How long does an average human live? In 1900 the average life expectancy of humans across the world was 31 years, and today it is about 68. This improvement is largely due to the fact that death-causing infection can now be won over by medicines that did not exist back then. Health practices help in increasing our life span. Proper nutrition, exercise and “good habits” (what they are depends on whom you believe or follow) are known to do so. Ayurveda, Yoga, natural medicines and tonics are some of the “classical” methods in this context. The more we learn about each of these, the more we understand the basis behind how they help (or hinder) the body in keeping fit.


Decision time: sexual features start to develop at 1 month

As the body ages, it becomes less and less efficient. Senescence sets in, and we try to find methods to fight it. The body of a youth is fitter, in general, than that of a senior citizen. It was here that Markandeya in Hindu mythology won over Tithonus is Greek mythology. Markandeya wanted to be sixteen for ever while Tithonus was given eternal life, not eternal youth. The former realised that a youthful body is fitter.

What then happens to the body as we age? The body has several parts, most of them dependant on, and interacting with, one another. If one of them weakens, it tells on the others and, thus, the whole body. The more we understand the anatomy and physiology, the better we are in attempting to keep the overall body fit and working well. Too much consumption of sugar, for example, tends to affect the physiology and function of the blood, kidney, the nerves and the eye. Smoking affects the lungs and several other parts of the body. Too much food and little exercise bloats up the body and weakens its efficiency. Inefficiency in one component or part of the body tells on our overall health. If the heart does not pump blood efficiently, it tells on our overall metabolism. Cardiologists attempt to correct this pump (and often succeed). They may do so by putting in stents which restore proper blood flow. They may even remove the "bad" heart and replace it by transplanting a healthy one.

Transplantations of cells (such as in blood transfusions), tissues (such as the cornea of the eye) or even a whole organ (heart, kidney) have now become standard methods of repairing body parts.

Advances in cell biology today have made researchers attempt to "build" such body parts - cells, tissues and organs. Cells of various types can be, and are now being, made in the lab using stem cell-based methods, though not tissues yet. But in the not-too-far future, tissues and simple organs are on the cards. This needs biologists working with engineers in the nascent fields of design and engineering. For example, our own researchers in the defence sector, led earlier by Dr A P J Abdul Kalam, had made metallic stents to insert in the blood vessels and light weight metallic alloys to replace the bones in the legs of polio patients. Getting closer to using biological materials themselves, a group in the U.S. had already engineered a human bladder over 20 years ago and inserted it in the body of a young man. He is doing well. Likewise, bioengineering a human ear is on its way. Collaboration between scientists at the IIT Hyderabad and the L V Prasad Eye Institute aims at "bioprinting" a cornea of the eye by successively printing actual cells layer on layer. (This is somewhat similar to the 'inkjet' mode of printing used in earlier generation printers). Biosynthetic organ regeneration is the new goal.

One such 'audacious' goal is to build a whole human eye from scratch. The researcher asked: "if a lizard can rebuild its cut-off tail, or a salamander its lost eye, why can we not awaken the hidden salamander in us"? What he means is: let us look at the genes in the amphibians, and their counterparts in us humans, look for how its genes go on to build its eyes, and attempt to do similar with our genetic counterparts". Biomedical sciences are moving into an era where poorly performing (or non-performing) body parts can be made in the lab and inserted in humans. This is the audacious goal of one Dr Aubrey de Grey of California, who has founded what is called SENS (or strategies for engineered negligible senescence) and says:

"The man who will live up to 150 years is already with us" and "who knows, we may soon live up to 1000".

Reminds me of an old 1946 Ford Prefect car that we had in the 1970s. We first changed its tyres, then its carburetor, then got its engine re-bored and valves changed, changed its radiator, spark plugs, and wipers, repainted it and then sold it before leaving Kanpur. It must surely be chugging away somewhere, reminding one of what General McArthur once said of old soldiers: they never die, they just fade away! But Dr. Aubrey de Grey says old bodies may never die; they just get redone.

Flu infection depends on the year you were born, says study

The first type of flu virus you encounter as a child gives you protection against similar strains, and leaves you vulnerable to others, research suggests When flu strikes, why are some family members reduced to shivering wrecks under their duvets, while others get off with little more than a snuffle? Scientists now have an answer, showing that the generation you belong to — and even the year of your birth — predicts how vulnerable you will be to a given strain of seasonal virus.

The flu virus a person first encounter as a child, they found, leaves a permanent "imprint" on the immune system, giving them robust protection against similar strains and much weaker protection against less closely related varieties of the illness.

Michael Worobey, head Ecology and Evolutionary Biology at the University of Arizona and a senior author of the study, said: "It's not the age, it's the birth year that matters."

In future, seasonal vaccines could be targeted at people of particular ages who are most likely to benefit, and in pandemics when medications are scarce, vulnerable age ranges could be prioritised for protective measures.

"It's breaking new ground for flu, where predictions are really hard," said Worobey. "For any given potential pandemic virus, we can actually now say ... this is the age group that you can expect is going to end up in hospital dying and this is the age group who will be protected."

The age effect is seen because influenza A viruses — the kind considered most likely to cause pandemics — have evolved into two major branches known as type 1 and type 2.

Up until 1968, all viruses in circulation belonged to the type 1 branch; between 1968 and 1979, type 2 dominated. Since then, strains belonging to both branches have been in circulation simultaneously, but with one type tending to dominate each year. "It's like an oak tree that has a trunk that splits into two major branches and 1968 becomes this really clear dividing line," said Worobey.

Using vast databases of historical epidemiological data, the scientists tracked the susceptibility of each birth year from 1918 to the present to the different flus in circulation during their lifetime.

The findings, published in the journal Science, showed that the strains in circulation early in life — most people have had flu by the age of five — have a profound impact on which types of flu they would be more sensitive to in the future.

"The [first virus you encounter] seems to set you up for life to be quite good at protecting yourself, not just against that particular virus, but also close cousins of that virus," said Worobey.

The scientists also studied two bird flu viruses, H5N1 (belonging to the type 1 branch) and H7N9 (type 2), each of which already has caused hundreds of cases of severe illness or death in humans. Scientists are concerned that in the future either of these strains could gain mutations that allow them to not only jump from birds into humans, but also spread rapidly between people, triggering a deadly pandemic.

They found that if a person's first flu infection belonged to the same branch as the avian strain, they had a 75 per cent reduced chance of hospitalisation and about an 85 per cent smaller chance of dying. The findings explain the surprising observation that H5N1 tends to cause far more mortalities in younger people — contrary to what might be expected, while H7N9 tends to be most devastating in the elderly population.

"We're not a completely blank slate when it comes to how susceptible we are to these emerging flu viruses," said Worobey. "Even if we've never been exposed to H5 or H7 viruses, we have ... protection against one or the other." This happens, he said, because when a person is infected by flu, their original antibodies are woken up as the body's first line of defence, meaning if they are poorly-matched they will be less efficient at attacking the virus. Previously, people had put these patterns down to younger people being more likely to encounter birds, or the virus being more aggressive in elderly people.

Professor John McCauley, a flu expert at the Francis Crick Institute in London who was not involved in the work, said the findings were based on good data and convincing. "It most certainly would help target limited vaccine," he added.

The scientists said it was not yet clear whether current childhood flu vaccines — which tend to involve components from both branches — would mean in future children would have higher protection against flus of both types.

WHO: Zika no longer a public health emergency

The World Health Organization announced that the Zika virus outbreak, linked to deformations in babies' heads and brains, no longer poses a world public health emergency, though it warned that the epidemic remains a challenge.

Brazil, the epicentre of the outbreak, has however refused to downgrade the risk, while experts swiftly lashed out against the world health body's decision.

"The Zika virus remains a highly significant and long-term problem, but it is not any more a public health emergency of international concern," the world health body's emergency committee chair Dr David Heymann said.

While Zika causes only mild symptoms in most people, pregnant women with the virus risk giving birth to babies with microcephaly — a deformation that leads to abnor-

mally small brains and heads.
It can also cause rare adult-onset neurological problems such as Guillain-Barre Syndrome (GBS), which can result in paralysis and even death.
In the outbreak that began in mid-2015, more than 1.5 million people have been infected with Zika, mainly in Brazil, and more than 1,600 babies have been born with microcephaly since last year, according to the WHO.
The UN's global health agency declared the Zika epidemic a global health emergency in February 2016.
Earlier this year, researchers warned that at least 2.6 billion people, over a third of the global population, live in parts of Africa, Asia and the Pacific where Zika could gain a new foothold, with 1.2 billion at risk in India alone.
Brazil yesterday said it would continue to treat the outbreak as an emergency.
"We will maintain the emergency (status) in Brazil until we are completely tranquil about the situation," Health Minister Ricardo Barros told journalists.
In most cases worldwide, people have been infected with the virus by mosquitoes, though some have contracted the disease through sexual contact.
The WHO was careful yesterday not to dismiss the risk still posed by the virus, which has been detected in 73 countries worldwide, mainly in Latin America and the Caribbean.
"We are not downgrading the importance of Zika, in fact by placing this as a longer term of programme of work, we're sending the message that Zika is here to stay and WHO's response is here to stay in a very robust manner," said Dr Peter Salama, director of the agency's health emergencies programme.

Good cholesterol may not help with heart disease

Although well associated with lowering cardiovascular disease risk high-density lipoprotein (HDL) — known as good cholesterol — may not always be able to protect against heart disease.
A new study published in the journal Cell Metabolism has suggested that it increases the inflammatory response of certain immune cells called macrophages.
This can potentially counteract its well-established anti-inflammatory effect in various other cell types, the study said.
"Good cholesterol's functions are not as simple as initially thought, and appear to critically depend on the target tissue and cell type," said Marjo Donners of Maastricht University, the Netherlands.
"In the end, it is the balance between its pro- and anti-inflammatory effects that determines clinical outcome," Donners added.
In the study, the researchers found that HDL treatment enhanced inflammation in macrophages, in contrast to its effects in other cell types. Similarly, macrophages taken from mice with elevated HDL levels showed clear signs of inflammation.
This pro-inflammatory effect induced by HDL showed enhanced pathogen protection, the researchers said.
Lung macrophages ingested disease-causing bacteria upon exposure to HDL. On the other hand, mice with low HDL levels were impaired at clearing these bacteria from the lungs.
The results demonstrate that HDL's pro-inflammatory activity supports the proper functioning of macrophage immune responses.

Paving the way to backpack-sized gravimetry

A high degree of precision in measuring gravity comes in useful in many contexts — from minute measurements of plate tectonics and seismology to searching for minerals underground. Gravimeters, which are used for this purpose, are often bulky.
Now, scientists from Germany, Canada and the U.S. have demonstrated an atom-chip, quantum device which paves the way to developing gravimeters that can fit into a backpack.
Also, the newly proposed device would improve by a factor of ten the accuracy of measurement attributed to currently available gravimeters.
The research has been reported recently in Physical Review Letters.
The device uses a cloud of ultracold atoms which are trapped in a centimetre-size chip using lasers and magnets.
This cloud of atoms is allowed to fall and, using lasers, is split into two and routed through different paths. When the two parts recombine, the interference pattern gives a measure of the gravitational field on them.
Using atomic interferometry to measure gravity is not new and has been around for a while. In this method, atoms are cooled to a temperature near absolute zero when their quantum nature is dominant.
They are then made to traverse different paths using lasers, and the interference pattern is observed. Measurements using this process can be made more precise if the atoms are first squeezed together to form a so-called

Bose-Einstein condensate .
Bose Einstein condensate
This is a state of matter where all the atoms of the substance occupy the same quantum level – in other words, they coalesce into a blob and can be described by a single wave function.
Using a Bose-Einstein Condensate (BEC) instead of independent atoms contributes to the aim of miniaturisation – the BEC has a diameter which is about a hundred times smaller than a non-BEC atom cloud.
The BEC atoms are trapped near the surface of a chip using atom-chip technology.
Using lasers and magnetic fields, about 10,000 atoms are compressed to form the condensate, within about 15 seconds, which lies just below the surface of the centimetre-sized chip.
The laser is then made to "kick" the BEC and it connects with a fifty per cent probability. This results in the cloud being split, and a part of it is kicked and shoots up while the other falls without feeling the kick. The two pieces are made to follow slightly different paths, with the part that was kicked having followed a longer path.
When they eventually meet and interfere, they give a measure of the gravitational field. The researchers suggest that further miniaturisation should be possible with some modifications and that this demonstration will pave the way for small high-precision backpack-sized gravimeters to help in geodetic earth observation and exploration.