

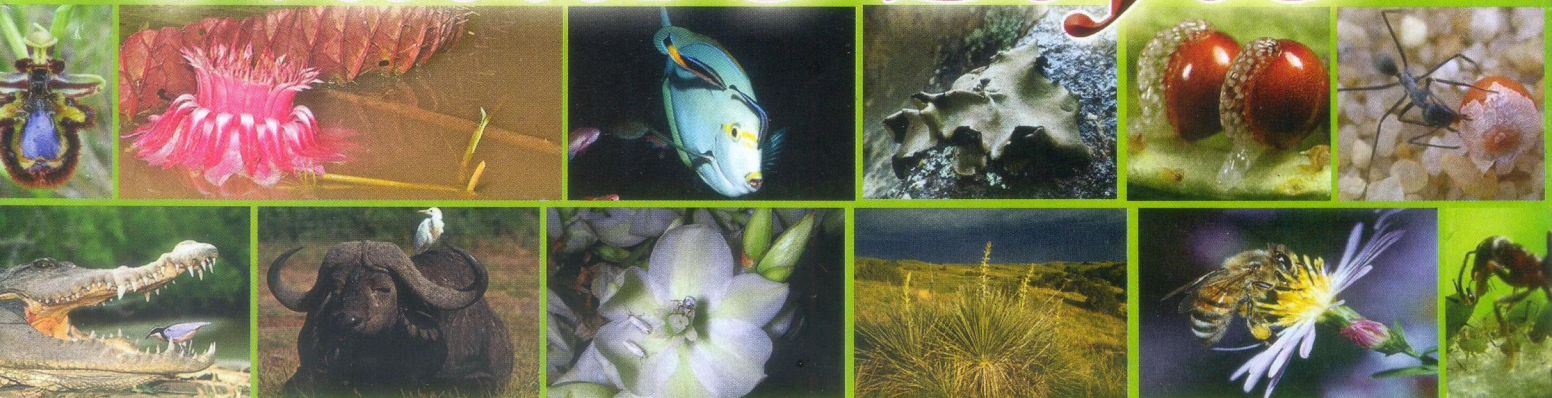
Science Reporter



A CSIR Publication



Living Together Nature Style



Also in the issue

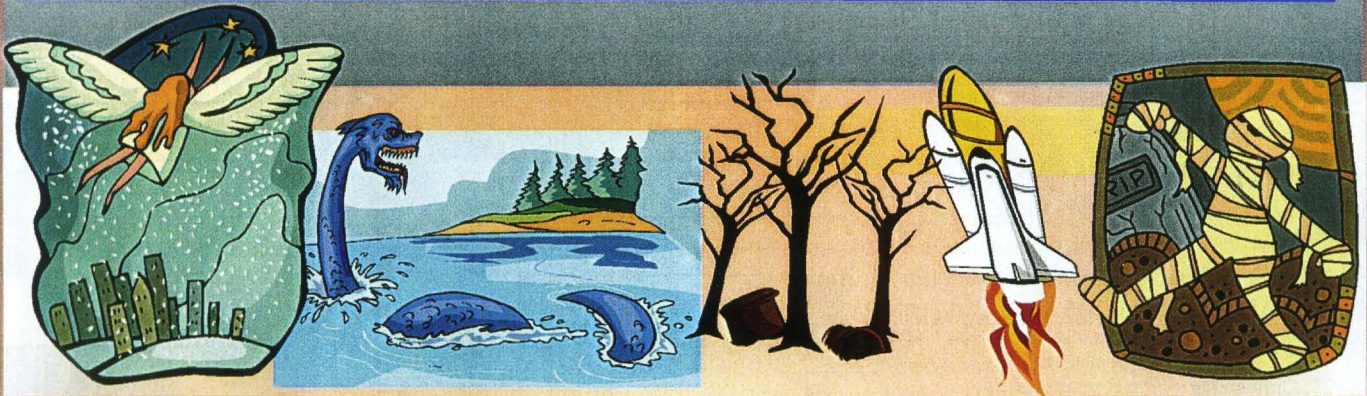
- ▶ Global Cyberlaw Trends
- ▶ GM Marathon
- ▶ Genomic Sequencing
- ▶ Puzzles, Quizzes & Crossword

Results!

Science Reporter's

Results!

Science Fiction & Science Cartoon Competition 2013!



Here are the results of the

Science Fiction Competition!

Best Entry: Willie's Diving School by Suneel Sule

Second Best Entry: Skin to Bone by Beas Chattaraj

Third Best Entry: Choices We Make by Pranay Suman

Besides, the following fiction stories have been found worth publishing:

1. Science through the Ages by Picaro
2. The Village of the Vegetarians by M. Saleemuddin

And here are the results of the

Science Cartoon Competition!

Best Entry: Apple Falling into Black Hole by Devansh Rastogi

Second Best Entry: World Ozone Day by Rehan

Third Best Entry: Consequences of Global Warming by Meghna

Fourth Best Entry: A Human Mind Never Changes by Saurav Verma

Besides, entries by the following have been found worth publishing:

1. Probiotics by Richa
2. Ozone Layer by Ayushi Pragma
3. After the Development of Technology by Jithin Sai

CONGRATULATIONS WINNERS!



COVER STORY

NATURE'S LESSONS ON LIVING TOGETHER!

MAYANGLAMBAM OJIT KUMAR SINGH

There are numerous instances of cooperation and survival in the plant and animal world



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PAVAN DUGGAL

Cyberlaws may have to tackle several issues to provide protection and preservation from increasing cyber attacks



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The advances in genomic sequencing have provided a clearer picture of the genetic basis of traits intrinsic to certain organisms



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The use of model organisms in biological science has come a long way



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PRABHAT KUMAR

The Spider lily is an ethereal beauty with an enchanting fragrance

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One of the first two female graduates of the British Empire

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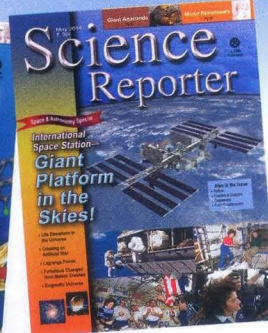
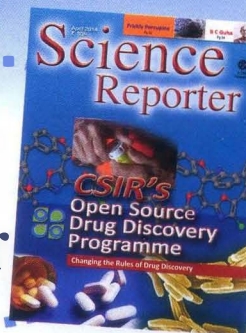
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Science Reporter



LAGRANGE THE MAN

The May 2014 issue of *Science Reporter* had a rich repast laid out for lovers of astronomy. Lagrange Points were explained in a lucid manner by Swati Saxena.

Lagrange is regarded as "the greatest mathematician of the eighteenth century" who made significant contributions to the theory of probability, vibrating strings, librations of the moon, three-body problem and Jupiter moons. The noted mathematician Hamilton professed Lagrange's works in *Calculus of Variations* as 'a kind of scientific poem'. His *Mecanique Analitique* is rated highly in the mathematical world.

Lagrange can be thought to be a shrewd man, because during the pre-revolution days he found favour with the court and after the revolution Napoleon (who believed in patronizing men of science – Monge, Berthollet, Laplace and others – recognizing his worth made him a Senator, a Count of the Empire, Grand Officer of the Legion of Honour and considered him to be 'the lofty pyramid of mathematical sciences'.

His friend Lavoisier, known as the Father of Modern Chemistry, was guillotined. Lagrange unhappy at the execution commented, "A second sufficed to cut off his head but centuries together will not suffice to produce such a man."

In another article, **Life Elsewhere in the Universe** (May 2014), Prof. Hari Om Vats has mentioned the

equation given by Frank D. Drake (under whose leadership Project Ozma, named after the fairy-queen of Oz, popularly known as SETI, was launched



in 1960), depending on four factors, for estimating the number of active civilizations in the Galaxy. Long time back I remember having read an article by Prof. Jayant V. Narlikar (the famous astronomer who did his doctorate under Prof. Fred Hoyle), where he said that the number of extraterrestrial supercivilizations – N – can be written as: $N = R \times S \times P \times E \times O \times I \times C \times L$

where R = the average rate of star formation in our Galaxy, S = fraction of stars that have planetary systems, P = average number of planets in a planetary system, E = fraction of the total number of planets that may be suitable for harbouring life, O = fraction of planets on which life actually originates, I = fraction of planets on which intelligent life evolves, C = fraction of planets on which communication technology develops and L = lifetime of the supercivilization.

There are eight unknown factors in the equation and one has to take recourse to a probabilistic estimate. Though this is not a very satisfactory approach but it is better to have some mathematical tool rather than none. More research is necessary to get realistic values to make effective use of the equation.

Dr. S.K. Gurtu, Jaipur

RESURRECTING LOST SPECIES

The article **De-extinction – Resurrecting Lost Species** published in the March 2014 issue was informative and interesting. I would like to add to it.

Hard work by scientists for de-extinction of biological wealth is an extraordinary and praiseworthy effort, but it is very difficult to reduce the pace of extinction of organisms. The biological wealth of our planet has been depleting fast, the process of de-extinction cannot overcome it. Extinction of species is a natural process but it is estimated to be hundreds to thousand times faster than pre-human times. Certainly the accusing finger clearly points to humans for the current loss of biological wealth.

Environmental scientists warn that if the present trends of extinction of species continue then nearly half of the species of earth would need de-extinction.

Dr. K.K. Ambasta, New Delhi

END OF FOREIGN DEPENDENCY

I am a Product Manager by profession in a pharma company in Pune, Maharashtra. I was completely awestruck and surprised by the fact that we still do not have our own GPS in place (Editorial, **A Step Closer to an Indian GPS**, May 2014). It is sad to know we are still at the mercy of foreign GPS which we cannot use in extreme hostile conditions as happened during the Kargil battle. This leaves a big hole in our national security.

I am happy that the situation is going to change soon because of ISRO's sheer

determination and expertise which they have demonstrated quite successfully in recent times (whether it was the Mars Orbiter Mission or the indigenously designed and manufactured cryogenic engine). It really feels great to learn that we are shedding the feathers of dependency and emerging on our own. It will not only provide better surveillance facility but also help military personnel to map and cut the delay in response time. The successful launch and operational capability of the remaining satellites of the IRNSS programme will be the key element in defining India's success in technology indigenization.

Nonetheless, quite an editorial, I liked it.

Mradul Buddekar, Pune, Maharashtra

PROMOTING IDEAS

The cover story on the **Open Source Drug Discovery (OSDD)** programme by Dr. Geetha Vani Rayasam and Dr. Tanjore S. Balganes (April 2014) is extremely well-written. It really is a great step towards taking the public closer to science. If a similar thing could be done for electronics/machines then it might be even more beneficial. If such a website were to be launched where we can test the capability of any machine simply by uploading the blueprint then I think it might be very helpful because there are many ideas all over the nation which get lost simply due to lack of resources and time.

Hitaishi Barai, West Bengal

WRITE YOUR VIEWS

If you have any comments about any article published in *Science Reporter*, or have some information to share, do write to us at:

Editor, *Science Reporter*
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Resources (NISCAIR)

Council of Scientific & Industrial
Research (CSIR)

Dr KS Krishnan Marg,
New Delhi-110012

Or email : sr@niscair.res.in



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EDITOR

HASAN JAWAID KHAN

ASSOCIATE EDITOR

DR. VINEETA SINGHAL

LAYOUT & DESIGN

NEERU SHARMA

PRODUCTION OFFICERS

SUPRIYA GUPTA

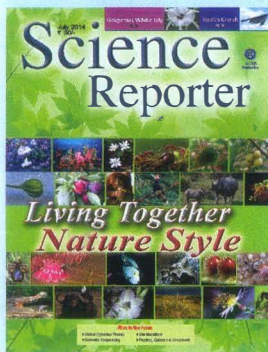
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COVER DESIGN

NEERU SHARMA

SCIENTISTS NEED TO COMMUNICATE SCIENCE

Communicating science to the civil society rolls out innumerable benefits. These range from creating an understanding about new scientific ideas, concepts and projects and promoting large-scale engagement with science among the people to pulling them away from irrational and unscientific beliefs. Most importantly, science communication inspires and motivates the young to think scientifically and take up scientific careers so as to give the country its next generation of scientists.

It is accepted wisdom today that scientific knowledge needs to be shared with the civil society to bring about more acceptance of scientific endeavours. And in this regard, the scientific community can be a big player. With their grasp of the complexities of science and with a little understanding of the nuances of communication scientists are perhaps in the best position to reach out to the public. Scientists have compelling and interesting stories to tell. But in India there is still reluctance within the scientific community to don the mantle of a communicator.

There are several reasons why scientists should reach out to the public about their work, especially in today's context. Today, more than ever, science intersects with crucial policy decisions whether it is the adoption of genetically modified food, establishment of nuclear reactors for generating power, investing in space exploration, building big dams or taking action to ward off the imminent consequences of climate change. With half-baked information, and often mischievous information, fed to them through untrustworthy sources, the public can hardly be expected to be supportive of such scientific projects whose successful implementation is likely to decide the fate of the nation's progress. Besides, scientists also need to understand that interacting with the public can throw up new challenges and open new frontiers of engagement with scientific problems.

Scientists, as also science communicators, also have another constituency to address – that of the lawmakers and the policy makers and administrators. Crucial projects implemented without adhering to sound scientific principles and without any understanding of future consequences can only lead to environmental disasters and further human misery. The devastation and deaths in the Uttarakhand disaster can be cited in this respect.

But why is it that not many scientists in India are actively taking up science communication when it has so many benefits to offer? Perhaps being too absorbed in their research work scientists either do not have the time for it, or there may be a reluctance to deal with the media for fear of trivializing their work. For some, the lack of communication skills could be a major bother.

For science communication to be actively adopted among the scientific community, some measures can be taken. For instance, in the Stony Brook University in New York, students seeking a Masters degree in Marine Science are now required to take communications courses. Similarly, if scientists were required to demonstrate an ability in communicating their work to the public, a cultural shift could be expected.

There is a need to bring scientists in touch with media so that they develop an understanding of how media stories targeted towards the public need to be structured. Institutions also need to support their scientists in communicating science and accord recognition in some form to those who do.

Hasan Jawaid Khan

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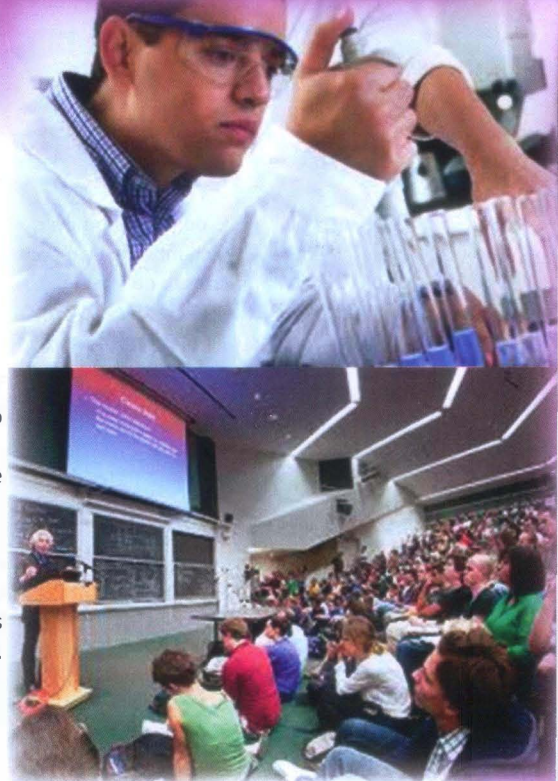
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PATIENCE LINKED TO BODY CHARACTERISTICS

WOULD you wait if you were promised more to eat? Well, a chimpanzee will wait more than two minutes to eat six grapes, but a black lemur would rather eat two grapes now than wait any longer than 15 seconds for a bigger serving.



A paper published in the *Proceedings of the Royal Society B* explores the evolutionary reasons why some primate species wait for a bigger reward, while others are more likely to grab what they can get immediately.

"Natural selection has shaped levels of patience to deal with the types of problems that animals face in the wild," said author Jeffrey R. Stevens, a comparative psychologist at the University of Nebraska-Lincoln and the study's lead author. "Those problems are species-specific, so levels of patience are also species-specific."

Studying 13 primate species, from massive gorillas to tiny marmosets, Stevens compared species' characteristics with their capacity for patience, self-control or delayed gratification. He found the species with bigger body mass, bigger brains, longer lifespans and larger home ranges also tend to wait longer for a bigger reward.

Chimpanzees, which typically weigh about 85 pounds, live nearly 60 years and range about 35 square miles, waited for a reward for about two minutes, the longest of any of the primate species studied. Cotton-top tamarins, which weigh less than a pound and live about 23 years,

waited about eight seconds before opting for a smaller, immediate reward.

"In humans, the ability to wait for delayed rewards correlates with higher performance in cognitive measures such

as IQ, academic success, standardized test scores and working memory capacity," he wrote. "The cognitive ability hypothesis predicts that species with higher levels of cognition should wait longer than those with lower levels."

But Stevens found no correlation between patience levels and an animal's relative brain size compared to its body size, the measure he used to quantify cognitive ability.

Researchers also have argued that animals in complex social groups have reduced impulsivity and more patience to adapt to the social hierarchies of dominance and submission. But Stevens did not find correlations between species' social group sizes and their patience levels.

Stevens said he believes metabolic rates may be the driving factor connecting patience with body mass and related physical characteristics. Smaller animals tend to have higher metabolic rates. "You need fuel and you need it at a certain rate," he said. "The faster you need it, the shorter time you will wait."

The research offers interesting avenues to study what factors might influence human patience.

(Courtesy:
www.sciencedaily.com)

CAN YOU GET AIDS FROM A MOSQUITO?

ONE of the great myths about HIV transmission is that mosquitoes or other bloodsucking insects can infect you. There is no scientific evidence to support this claim. The National Centers for Disease Control (CDC), USA has demonstrated that mosquito transmission of AIDS is highly unlikely.

Let's say a mosquito initiates the cycle by feeding on an HIV-positive carrier and ingests the virus particles with the blood meal. For the virus to be passed on, it would have to survive inside the mosquito, preferably increase in numbers, and then migrate to the mosquito's salivary glands. The infected mosquito would then search for its second uninfected host and transfer the HIV from its salivary glands during the course of the bite. This is the how malaria, yellow fever, dengue, and the encephalitis viruses spread easily by most mosquito-borne parasites.

When a disease is transferred by mosquitoes from one person to another, it is necessary that the agent of infection must remain alive inside the mosquito until the transfer is completed. If the parasite is digested by the mosquito the transmission cycle is terminated and the parasite cannot be passed on to the next person.

Malaria parasites survive inside mosquitoes for 9-12 days and actually

Studies have shown that the AIDS virus is regarded as a food by the mosquito and is digested along with the blood meal due to which mosquitoes that ingest AIDS-infected blood digest that blood within 1-2 days and completely destroy any virus particles that could produce new infection.

BULLYING DELETERIOUS FOR HEALTH OF VICTIMS

BULLIED children may experience chronic, systemic inflammation that persists into adulthood, while bullies may actually reap health benefits of increasing their social status through bullying, according to researchers at Duke Medicine.

The study, conducted in collaboration with the University of Warwick, the University of North Carolina at Chapel Hill and Emory University, is published online in *the Proceedings of the National Academy of Sciences* the week of 12 May 2014.

"Our findings look at the biological consequences of bullying, and by studying a marker of inflammation, provide a potential mechanism for how this social interaction can affect later health functioning," said William E. Copeland, associate professor of psychiatry and behavioral sciences at Duke University School of Medicine and the study's lead author.

Earlier studies have suggested that victims of childhood bullying suffer social and emotional consequences into adulthood, including increases in anxiety and depression. Yet, bullied children also report health problems, such as pain and illness susceptibility, which may extend beyond psychological outcomes.

Copeland and his colleagues used data from the Great Smoky Mountains Study, a robust, population-based study that has gathered information on 1,420 individuals for more than 20 years. Individuals were randomly selected to participate in the prospective study, and therefore were not at a higher risk of mental illness or being bullied.

Participants were interviewed throughout childhood, adolescence and young adulthood, and among other topics, were asked about their experiences with bullying. The researchers also collected small blood samples to look at biological factors. Using the blood samples, the researchers measured C-reactive protein (CRP), a marker of low-grade inflammation and a risk factor for health problems including metabolic syndrome and cardiovascular disease. CRP levels are also related to psychosocial factors.

Three groups of participants were analyzed: victims of bullying, those who were both bullies and victims, and those who were purely bullies. Although CRP levels rose for all groups as they entered adulthood, victims of childhood bullying had much higher CRP levels as adults than the other groups. In fact, the CRP levels increased with the number of times the individuals were bullied.

Young adults who had been both bullies and victims as children had CRP levels similar to those not involved in bullying, while bullies had the lowest CRP – even lower than those uninvolved in bullying.

The researchers concluded that it was necessary to reduce bullying as well as promote physical and emotional health and lessen the risk for diseases associated with inflammation in victims of bullying.

(Courtesy: www.sciencedaily.com)



go through a series of necessary life stages during that period. Encephalitis virus

particles survive for 10-25 days inside a mosquito and replicate enormously during the incubation period.

Studies have shown that the AIDS virus is regarded as a food by the mosquito and is digested along with the blood meal due to which mosquitoes that ingest AIDS-infected blood digest that blood within 1-2 days and completely destroy any virus particles that could potentially produce a new infection. HIV requires specialist cells found only in humans in order to multiply. HIV is treated as food and digested. Since the virus is unable to survive to reproduce and invade the salivary glands, the mechanism that most mosquito-borne parasites use to get from one host to the next is not possible with AIDS.

The structure of the mosquito's mouth parts does not operate like a hypodermic needle. So, the tube which is injected in the first person with saliva is separate from the canal which the mosquito uses to suck blood

from the same person and that is why only blood can flow into the mosquito and only saliva is injected; blood is not flushed out of the same canal.

Besides, the mosquito does not take enough units of HIV from the infected person to spread the infection. Even if it were possible for a mosquito to transfer AIDS from an infected person to an uninfected person, then the uninfected person would have to be bitten by about twenty million mosquitoes who had previously been feeding on an infected person in order to receive one unit of AIDS. Therefore, accidentally swallowing a mosquito also does not put one at risk of contracting HIV, because there is not enough HIV positive blood within the mosquito for a person to pass the disease.

Contributed by Habeeba Ahmad Kabeer* and Sallanat Parveen. Address:* Limnology Research Laboratory, Department of Zoology, A.M.U., Aligarh-202002, (U.P.); Email: habeebakabir@yahoo.com

'CHAGEM-POMBA': A LUSCIOUS MANIPURI CUISINE

MANIPUR in the far northeast India is the land of ethnic diversity, culture and traditional cuisines. The traditional cuisines are of very unique type with least oil and greatly different from the rest of the world.

Among the traditional cuisines, 'Chagem-pomba' is one such item which is prepared with a large number of vegetables and fermented soybean. This food item is preferred by children and old-age people due to its soft nature and peculiar flavour.

The item is mainly rice-based along with shoot of 'paknon' (*Foeniculum vulgare*) and fermented soybean. Besides, tender leaf of mustard, leaf of *Neptunia oleracea*, tender pods or seeds of tree bean, locally called 'yongchak' (*Parkia roxburghii*), few leaves of eryngo (*Eryngium foetidum*), etc. are added as per taste choice and availability. These plants have high nutritional value and supplement the dietary nutritional requirements of the people, especially the rural poor population.

The recipe is simple. A hundred grams of broken rice, 2 g fresh leaves/shoots of 'paknon', few shoots of *Neptunia oleracea*, 2 leaves of mustard, 1 tender pod or 4-5 seeds (chopped) of *Parkia roxburghii* and a few leaves of eryngo are put together along with 200 ml of water in an earthen pot. The bottom of the pot is lined with the leaf of banana or turmeric which enhances the

These plants have high nutritional value and supplement the dietary nutritional requirements of the people, especially the rural poor population.



EASIER TO FORGET WHEN YOU FORGIVE

"FORGIVE and forget" – is there merely a philosophical ring to this common saying or is there some scientific truth behind it? A study from researchers at the University of St. Andrews in Scotland shows that the details of a wrong are more easily forgotten when that wrong has been forgiven.

The findings have been published in *Psychological Science*, a journal of the *Association for Psychological Science*.

"It is well established that learning to forgive others can have positive benefits for an individual's physical and mental health," says Saima Noreen, lead author of the study. "The ability to forget upsetting memories may provide an effective coping strategy that enables people to move on with their lives."

From the perspective of cognitive science, overcoming strong negative emotions toward the person who did us wrong and quashing impulses for retribution or vengeance -- processes that are critical to forgiveness -- may be seen as a function of executive control. And research suggests that this executive control is also involved in our ability to forget something when we are motivated to forget it.

Noreen's study suggests that forgiveness may facilitate intentional forgetting by helping individuals to suppress details about the wrong perpetrated against them. So, while true forgiveness may be difficult to accomplish, the findings suggest that once the wrong has been forgiven forgetting may become easier as a result.

"This research is only coming into fruition, and it's likely that the relationship between forgiveness and forgetting is bi-directional and far more complex over longer periods of time," Noreen says. "We hope that, in time, new fields of enquiry may combine forgetting- and forgiveness-based interventions that might, in turn, give rise to powerful therapeutic tools that will enable people to "forgive and forget" more effectively."

(Courtesy: www.sciencedaily.com)

flavour of the dish. Common salt, chilli, turmeric powder, fresh ginger paste and few leaves of onion are added. The mixture is boiled for 10 minutes and then 10 g of fermented soybean is added. It is boiled till a greenish sticky consistency is observed.

Then it is ready to serve with major meals or as snacks.

Contributed by Dr. H. Birkumar Singh, Scientist-in-Charge, CSIR-North-East Institute of Science & Technology Laboratory, Lamphelpat-795004, Imphal, Manipur.



**Forgiveness
is not something
we do for others
We do it for ourselves
- to get well and
move forward**

AND NOW COMES A1/A2 MILK!



MILK of cows is very nutritious and beneficial for human beings because it has body-building proteins, bone-forming minerals and health-giving vitamins and energy-giving lactose and fat. The proteins present in milk are considered as complete proteins of high quality, i.e. they contain all essential amino acids in fairly large quantities.

Six different types of proteins are present in milk out of which four are casein proteins (α , β , γ and κ -casein) and two are whey proteins (β -lactoglobulin and α -lactalbumin). Casein protein is peculiar because it is present only in milk and exists in the form of calcium caseinate-phosphate complex.

β -casein proteins exist in milk in three forms – A1 and A2 and B. Milk high in β -casein A1 is referred to as 'A1 milk' while milk high in β -casein A2 is called 'A2 milk'. Originally all milk was A2, but due to a genetic mutation at some point, the A1 form appeared and, gradually, became the prevalent form of β -casein.

Recent research has shown that *Bos indicus* cows (Indian cows) are potential sources of BCM 7 (Beta Casomorphine 7)-free A2 milk which is considered good milk, compared to *Bos taurus* cows (exotic cows), which produce A1 milk.

A genetic test developed by the A2 Milk Company based in Australia determines whether a cow produces the A2 or A1 type protein in its milk. This is done through a DNA test of a cow's tail hair. The test allows the A2 Milk Company to give licenses to milk producers once these producers prove their cows produce A2 β -casein protein in their milk. Now, more and more A1 companies are beginning to test their bulls to establish whether they carry the desirable A2 gene.

A1 milk has been implicated as a potential etiological factor in Type 1

Changing the dairy herds to more A2 producing cows on commercial basis may significantly improve public health.

The Government of India has already taken steps to identify the breeds having A2 gene.



diabetes mellitus (DM-1), Ischaemic heart disease (IHD), Schizophrenia, Autism and A1 milk protein intolerance. But A2 milk has not been associated with these diseases. Symptoms of A1 milk protein intolerance can be similar to those of lactose intolerance, including digestive issues such as bloating, abdominal pain, nausea, diarrhea and constipation.

Human trials are needed before it can be said with confidence that the A1/A2 composition of milk is important in human health.

Changing the dairy herds to more A2 producing cows on commercial basis may significantly improve public health.

The Government of India has already taken steps to identify the breeds having A2 gene. Preliminary studies have confirmed the hypothesis that Indian breeds of cows produce the safe A2 type milk. The National Dairy Research Institute, Karnal recently fixed A2 casein allele in Deoni cattle and also reported that Malnad Gidda (new registered cattle breeds) predominantly (151 out of 154) have casein allele.



Research is already going on for fast DNA detection tools to identify A1/A2 milk producing cows in India.

Contributed by Dr. Chandan Kumar, PhD Scholar at National Dairy Research Institute. Address: Room No. 151, Krishna Hostel, NDRI Karnal, Haryana-132001; Email: vetchandan@gmail.com



Nature's Living

THE Egyptian Plover bird and the crocodile share an unusual relationship. The bird gets into the crocodile's mouth, picks out the tiny bits of food stuck in his teeth and eats them. This cleans the crocodile's teeth and keeps his mouth fresh and free from infections while the Plover gets her food!

Similarly, Egrets ride on the backs of large mammals like zebras, buffaloes, elephants and horses, picking parasites from their fur or skin to feed themselves, which, in turn, frees these animals of

nasty pests kicked up on to their backs while walking.

Then there are jellyfish that nurture within their bodies gardens of algae. The plants feed the jellyfish with food that they manufacture from the sun. During the day the jellyfish keep themselves positioned in such a manner that the gardens inside them get the strongest light and at night they descend to fertilise their plants with muck from the bottom of the lake. The algae spend their entire lives in this pampered mobile home.

The living world on planet earth is fascinatingly diverse and amazingly complex. Even though all living beings differ

in their characteristics, they are all interdependent and interact with each other directly or indirectly as shown in the above examples.

Let us see take a look at some more mutualistic interactions of distantly related species and unrelated species and see how this helps both parties to survive and flourish.

Insects as Pollinators

Plant mutualistic relationships with animals are very important as they play a vital role in ecological systems; both benefit by increasing their reproductive output. Some relationships between plants and insects are so mutualistic that one cannot live without the others. Evolutionary biologists have studied and confirmed that explosion of flowering plants in the evolutionary history is closely linked with the diversification of insect pollinators.

Pollination is the transfer of pollen from an anther (the male reproductive organ) to a stigma (the receptive part of



An Egret picks up parasites from the buffalo's back



The Plover bird cleans out the crocodile's teeth

The wonderful diversity of life on the earth is maintained ever since the earth formed not by combat alone but by networking and cooperation as well. There are numerous instances of cooperation and survival in the plant and animal world, which could be great lessons for humans as well.

Lessons on Together!

the female reproductive organ), either of the same flower (self pollination) or of a different flower of the same species (cross pollination). Cross pollination involves the services of pollinating agents to effect transfer of the pollen. Out of all the pollinating agents or the pollinators, the insects are unique and the best.

A remarkable relationship of interaction between plant and insect is shown by the yucca flowers and the yucca moths. For more than 40 million years

there has been a relationship between yucca plants and yucca moths. It is a particularly important and an interesting one because neither the yucca nor the moth can survive without the other. The moth's larvae depend on the seeds of the yucca plant for food, and the yucca plant can only be pollinated by the yucca moth.

Indeed, approximately 80 percent of all flowering plant species are pollinated by animals, including vertebrates and mammals – but the main pollinators are

insects. Pollination is responsible for providing us with a wide variety of food, mainly horticultural crops.

In fact, pollinators such as bees, birds and bats affect 35 percent of the world's crop production, increasing outputs of 87 of the leading food crops worldwide, as well as many plant-derived medicines. At least one-third of the world's agricultural crops depend upon pollination – a service provided by insects and other animals. Bees are the most dominant taxa when it comes to pollination and they are crucial to more than four hundred crops.

Pollination is an essential service that is the result of intricate relationships between plants and animals, and the reduction or loss of either affects the survival of both. Diversity in insects will induce diversity of plants. However, effective pollination requires resources, such as refuges of pristine natural vegetation. Where these are reduced or lost, pollinators are becoming scarce and adaptive management practices will be required to sustain food production.

A yucca flower and its yucca moth partners (left); Yucca growing in the wild (right)





From left: An ant carries a seed to its colony using the elaiosome (with a treat back home to share); Elaiosome of bloodroot seeds – something that is hard-to-miss for the ants; Ants drag bloodroot (*Sanguinaria canadensis*) seeds by their elaiosome; Blood roots planted by the ants

Insects as Distributors, Germinators and Breeders

Travelling is so important for every living organism to survive and adapt. Actively moving animals such as humans tend to regard plants as immobile organisms, leading stationary lives leisurely rooted to the ground.

In order to survive and extend the generations or the dominion of their species plants must try to claim space for themselves. To do this plants have to travel at some stage in their lives. Some succeed by producing extraordinary stems like blackberry and some by annexing land from other less robust and aggressive species. And in some plants seeds are distributed with the help of air such as the anisoptera's helicopter seeds or the six-inch-long gliding seeds of alsomitra. Coconut palm dispatches its seed inside a hard shell via water (seas, oceans or rivers).

Some plants adopt ingenious methods for the dispersal of their seeds to reduce competition or to find favourable places to grow. One of the most successful methods is that of the production of seeds that instead of hurting their carriers reward them.

Plants have learned through long natural selection events that the key to ant cooperation is their stomachs. So some plants take the help of ants to disperse their seeds and pave the way for those seeds to germinate. The plants attach a treat to their seeds, called an elaiosome (oily edible seed covering). Ants are greatly attracted by the elaiosome. These treats are rich in nutrients.

Ants collect such seeds and carry them down to their underground nests. There they gnaw off the elaiosome. The

seeds without their elaiosome now are of no interest to the ants and are abandoned. So the seed sits well protected in a dark, relatively humid and nutrient rich chamber some inches below the soil surface – ideal conditions underground where they can germinate, safely out of the clutches of potential consumers or destroyers. Had they been not transported underground by the ants within the few hours after being shed, all of them would have been eaten up by mice and other rodents.

Plant-fungi Interaction

Many fungi are notorious as pathogens that can damage the plants. However, there are some examples of beneficial mutual relationships such as between mycorrhizae and lichens.

In the symbiotic relationship between the roots of the vascular plant and the fungus called mycorrhiza there is a bi-directional movement of nutrients where carbon flows to the fungus and inorganic nutrients move to the plant, thereby providing a critical linkage between the plant, root, and soil. The fungal hyphae (long, branching filamentous structure of a fungus) help increase the area for the absorption of soil nutrients including water.



Umbilicaria esculenta (right)

Lichens, on the other hand, are composite organisms consisting of a fungus (the mycobiont) and a photosynthetic partner (the photobiont or phycobiont) growing together in a symbiotic relationship. While the fungal partners provide shelter to the algae the algal partners diligently manufacture food for both by photosynthesis.

Plant-Herbivore Relationship

Green plants are also called producers. They are the first group of organisms that convert solar energy into chemical form of energy by means of photosynthesis. Many plants and animals show amazingly bizarre behavior to accommodate each other. Let us see some interesting examples.

It will be wrong to assume that agriculture is known to humans only. We are not the first animals to invent the concept. Ants have been farming fungi within their tunnels for tens of millions of years. Ants also keep aphids in captivity in order to "milk" them of sugary secretions. Leaf cutters are an ideal example of how adept ants are at farming fungi.

Four different castes of worker ants work together to bring back leaf fragments and integrate them into huge fungal gardens. Certain bacteria with antifungal and antibacterial properties grow within the metapleural glands of the ants. The worker ants use these bacteria to "prune and weed" dangerous or unproductive organisms out of their gardens.

Older (more expendable) worker ants carry waste products from the hive to a waste pile where they stir the hive wastes together to aid in decomposition. The waste-management job



Milking of the aphids by an ant

brings the danger of fungal or bacterial contamination and contaminated ants are exiled to certain death in order to keep the gardens safe. Additionally dead ants from within the hive are carefully placed around the waste pile to protect the hive from their decomposition. In this relationship what benefits do the aphids gain? The aphids are well protected by the ants in the fungal gardens maintained by the ants. They gain well protected shelters and a readymade supply of food.

Acacia and acacia ants also show an excitingly interesting example of mutualism. Some African acacia trees and their corresponding acacia ant partners live so closely that one cannot live without the others in certain seasons. Here the acacia attract and house the ants by developing special chambers called nectarines where they secrete the nectars. These highly energetic sugary nectars are welcome food for the ants.

The ants, surprisingly, in return serve as the protective soldiers for the acacia trees whenever herbivores try to attack the acacia tree. They may even drop from the branches of their host trees on the bodies of the attacking herbivores giving them mind blowing pains. It has been shown that the acacia plant could not survive if the ant communities on them are killed by insecticides or due to heavy predation by the herbivores.

Free Hitchhikers: Sticking with the Animals

Seed dispersal in many plants including the herbs is accomplished by recruiting animal help, by sticking to fur, paws, feathers, boots and clothing. The ways seeds can stick, cling (and even burrow) are simply amazing and effective. Even

though Archimedes discovered and implemented the concept of the screw, needle-and-thread grass did it a million years before.

The prickly heads of plants like burdock, the Enchanter's Nightshade, are noted for easily catching on to fur and clothing (being the inspiration for Velcro), thus providing an excellent mechanism for seed dispersal.

Some plants fine-tune themselves so surprisingly in interesting ways to orient the behavior of many animals useful to them. Some tropical figs turn pale yellow for they seek the help of night-flying fruit-bats and need to be easily visible in the dark. Apples and fruits like strawberries turn from green to red, plums and figs turn purple when



The mirror orchid imitates the female of its bee partner with a blue patch that resembles the sheen of the bee's wings

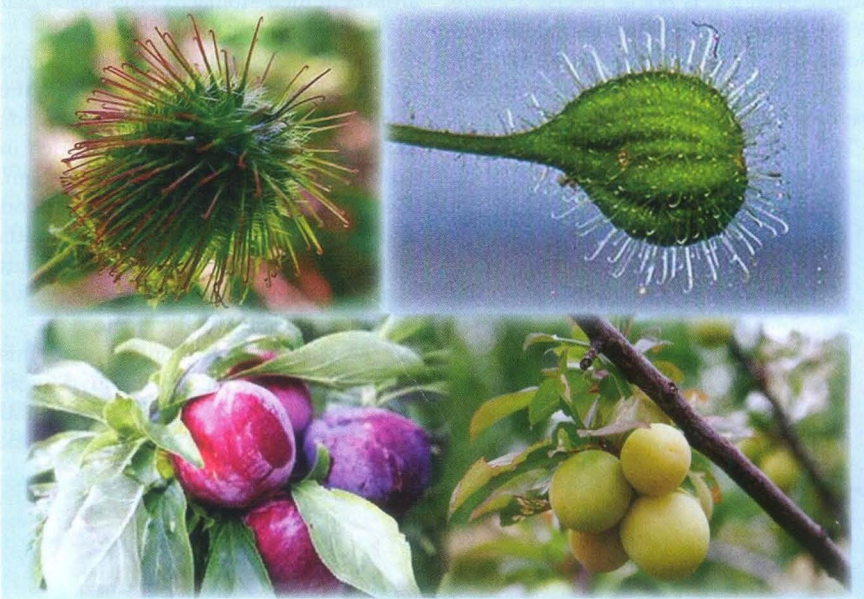


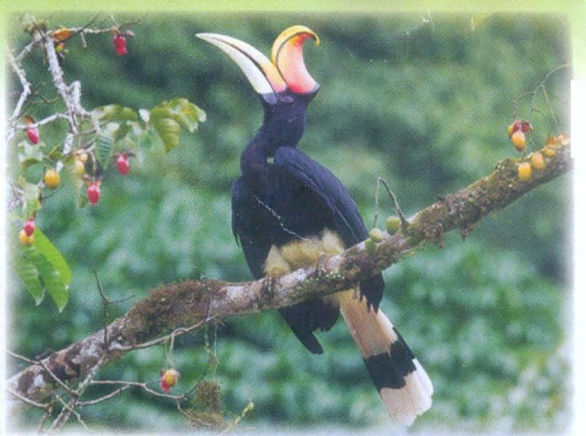
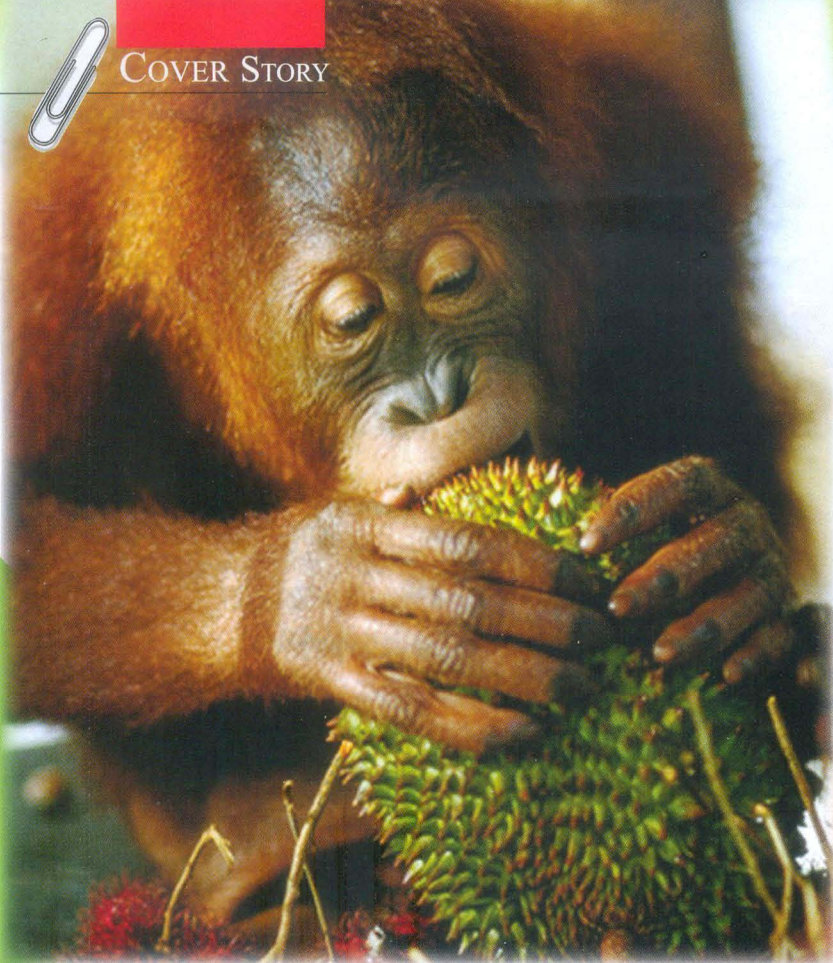
the seeds of such plants are fully developed signaling the fact that the seeds are ready for transport. Here the different colours act as stimulus to the seed dispensers.

The animal carriers understand these stimulating signals well. Monkeys feeding in a tropical jungle tree that is only just coming into fruit are selective in choosing which fruit to eat, inspecting each fruit closely and lifting it up to their nostrils for a quick sniff before risking a bite.

Seeds are extremely complex structures and it takes a plant enormous time and energy to construct them. The entire strategy would be spoiled if a carrier ate the fruit before the seeds it contains

Clockwise from top left: Burdock seed hooks are incredibly effective in attaching to the furs of animals; The hooked seed of Enchanters' Nightshade; Unripened plums try to take the colour of the leaves; Fully ripened plums are purple in colour against the green background of leaves





Clockwise from left:
An orangutan feasting on a durian;
A rhinoceros hornbill collecting fruits in a forest;
The great rhinoceros – dedicated transporters of the trewia seeds

were properly developed. Hence the sap in the fruit's flesh is acid and unpleasantly sour while it is developing. However, once the seeds are fully developed the sap becomes delectably sweet and the fruit sincerely signals the fact that the seeds are now ready for transport by changing colour.

Smell of the fruit reaches a significantly wider public than a visual signal, even if it is not as precise a guide to an exact location. The durian tree of south-east Asia takes such an advertising technique to extremes. Its ripe fruit can be detected by its smell from half a mile

away. Orangutans pluck the fruits while they are still on the tree. After swallowing the fruits they carry the seeds inside their stomachs and guts. When ejected at a considerable distance away the seeds germinate and grow into new plants.

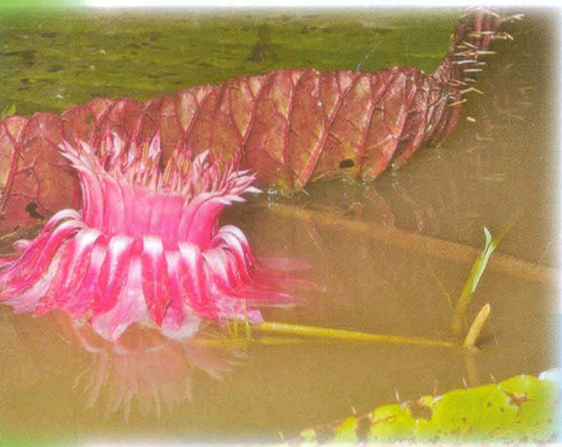
Many birds are able to remove the nutritious flesh from around a fruit inside their crop and then regurgitate the seed for it saves the bird from having to carry around in their stomachs large loads that have no nutritional value.

Some seeds require passage through an animal's gut. A species of acacia in the plains of East Africa encloses its seeds in small twisted pods. These are rich in proteins and hence animals relish them. Seeds that remain uneaten on the ground seldom germinate. However, those seeds that are swallowed with the pods and then pass through an animal's digestive system nearly always germinate.

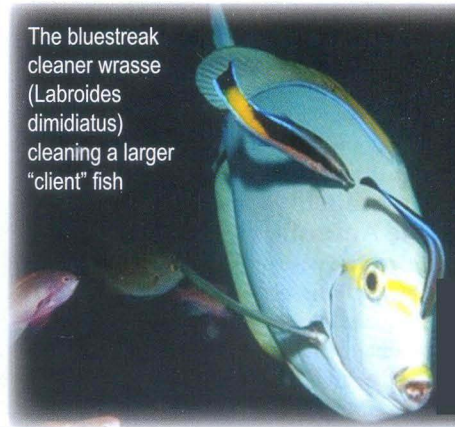
It was earlier thought that this was because stewing in digestive juices weakened the covering of the seeds and made it possible for the infant plant

within to break out. The truth goes like this. Within a few hours of the acacia tree shedding its pods, large numbers of small beetles fly in, pierce the pods with their sharp ovipositors and inject their eggs within. The eggs hatch rapidly and the tiny grubs then proceed to feed on the acacia's seeds unless the pods are eaten by animals such as elephants.

While the elephant grinds the pods with its teeth, many seeds remained unharmed and are swallowed with the mash. In the stomach all the beetle eggs are killed by the digestive juices. So the seeds finally return to the outside world with the animal's droppings saved from



Amazon's water lily flower after pollination by certain beetles changes to pink colour from white (left)



The bluestreak cleaner wrasse (*Labroides dimidiatus*) cleaning a larger "client" fish

There are jellyfish that nurture within their bodies gardens of algae. The plants feed the jellyfish with food that they manufacture from the sun.



the harm that the beetles could have caused.

Some animals drop their dung on special middens, for instance, the great Indian rhinoceros. This may seem to be a disadvantage for a seed which would be better served by more widespread distribution. This is not necessarily the case.

The trewia tree is a kind of euphorbia whose fruits are large, brown and hard like potatoes. They are not covered with soft succulent flesh that might tempt monkeys or birds and at the same time too big to be swallowed by a small mammal. The rhinos, however, love them and regularly deposit them on the mud banks of rivers by way of their droppings. This is exactly what the trewia need, for the young trewia plant will only grow properly in open locations where there is strong light.

Nowadays the India rhinos are becoming rarer. If they disappear altogether, then the trewia would also lose its carrier and might no longer line the river banks of southern Nepal as it does today. More plants than we know about may well have disappeared from the Earth because they have lost their dedicated transporters.

Plants reward all kinds of animals – mammals, birds, reptiles and insects for carrying their pollens. Often plants go to extreme lengths to attract animals by developing attractive colourations and morphological changes. However, some plants go to such an extent that they start secreting smells that mimic the chemical sex pheromones of insects!

The Amazon's water-lily, like its leaves, is outside. It opens for the first time in the evening. The multiple petals of this lily are purely white and consequently very conspicuous in the dark, thus drawing attention to itself with a rich perfume that a particular species of beetle finds irresistible. They fly and settle on the flowers in large numbers. The

flower has in its centre a circle of small knobs that are full of delightful sugar and starch and the beetles feed on them in an irresistible manner.

During this feasting session the flower's petals slowly close over them and hold them captive for the whole night. As they continue to feed in their flowery prison, the lily's anthers ripen and begin to shed pollen. The flower keeps holding its captives throughout the next day. When night falls for the second time, it opens once again.

Now the flower has turned pink. The beetles are now already smeared with pollen on their bodies which are sticky with the remains of their banquet. The beetles will now fly away to find another food laden lily flower. Indeed, an ingenious way of reaching their pollen far and wide.

One of the significantly important plant-animal interactions in tropical forests that has consequence to conservation and maintenance of biodiversity pertains to keystone tree species and its associated fauna. Removal of these keystone species is predicted to have a cascading affect on species loss due to the induced loss of interaction.

India has been identified as a repository of global hotspot of biodiversity. These hotspots act as hot beds of activity. The loss of habitats substantially reduce biodiversity in the biodiversity hotspots as it no longer sustains interdependencies.

We all are also so familiar with the symbiotic relationships between the nitrogen-fixing bacteria and the leguminous trees' roots. This beautiful relationship is so important for the replenishment of soil fertility.

The bluestreak cleaner wrasse (*Labroides dimidiatus*) is one of several species of cleaner wrasse found on coral reefs in the Indian Ocean and much of the oceans of the world. It eats parasites and dead tissue off larger fishes' skin in a mutual relationship that provides food and protection for the wrasse, and considerable health benefits for the other fish. Client fishes allow the cleaner

access to their body surfaces, gills and sometimes mouths. This relationship is so important for the well being of the bigger fishes that on removal of the cleaner fishes they become weak and parasitized or shift from the areas devoid of the cleaner fishes towards the ones that have them.

Corals are marine invertebrates including the important reef builders that inhabit tropical oceans and secrete calcium carbonate to form a hard skeleton. Some corals can catch small fish and plankton, using stinging cells on their tentacles. However, most corals obtain the majority of their energy and nutrients from photosynthetic unicellular algae called zooxanthellae that live within the coral's tissue. Such corals require sunlight and grow in clear, shallow water, typically at depths shallower than 60 metres.

Organisms are able to cope with extremes in their environment through certain physiological adjustments while others do so behaviorally (migrating temporarily to a less stressful habitat) or by entering to a cooperative arrangement with other organisms. This is also called adaptation. Many adaptations have evolved over a long evolutionary time and are genetically fixed.

The mutually responsive networking in lichens, coral colonies, the leafcutter ants and the aphids, the acacia ants and the acacia – are all giving us a lesson in cooperation. But are we learning our lessons from the cooperative societies of the animals or the interactions of different organisms?

Human-induced changes are killing off species of plants and animals, depleting the earth's biodiversity. And, as we have seen, all organisms are linked to one another in more ways than one. So, loss of a species sets off a chain reaction.

Let us remind ourselves – Life did not take over the planet by combat but by networking.

Mr Mayanglambam Ojit Kumar Singh is Assistant Professor in Zoology and Life Sciences, Ramjas College, University of Delhi; Email: ojit102005@yahoo.co.in

Cyber Law

Global Trends in 2014

In the year 2014, Cyberlaws may have to tackle several issues ranging from increased thrust in cost-effective interception surveillance to providing far more protection and preservation of individual stakeholder's online privacy in the digital and the mobile ecosystem and also protection from increasing cyber attacks.

THE advent of the Internet, the mobile and the digital ecosystems have ushered all of us in a new irreversible era in our lives. A digital platform has been added which runs our lives, more or less, in terms of keeping in touch with friends and relatives, communicating with business peers and clients, seeking and providing services, digging out information, and even providing e-governance.

The year 2013 has seen numerous events unfold in the field of cyberspace. So there is a need for appreciating the constantly emerging new cyberlaw trends in the new paradigms that we are living in.

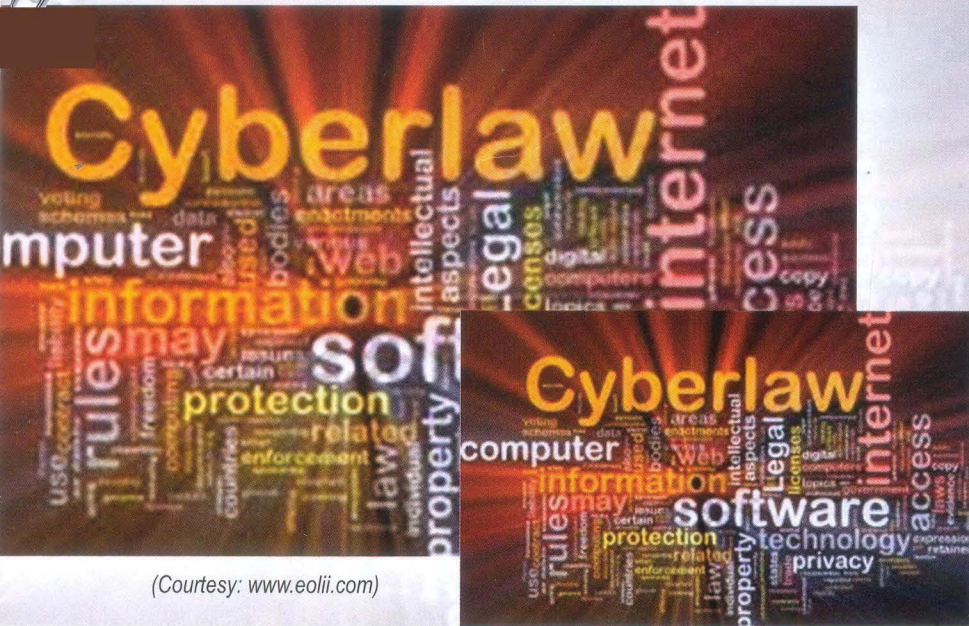
The author is no soothsayer and as such it is impossible to predict accurately as to what will be the relevant trends that will impact cyberlaw development in 2014. However, based on the existing realities of 2013, given the way our technology is moving, it is possible to look at and identify certain emerging important cyberlaw trends that are likely to have significant impact upon on the growth of cyber legal jurisprudence across the world in 2014.

The biggest cyberlaw trend in 2014 would be the enhanced frequency and instances of interception, surveillance and monitoring across the world. The recent Snowden revelations regarding the US surveillance programme PRISM have exhibited how networks and computer systems of legal entities outside a particular jurisdiction have been

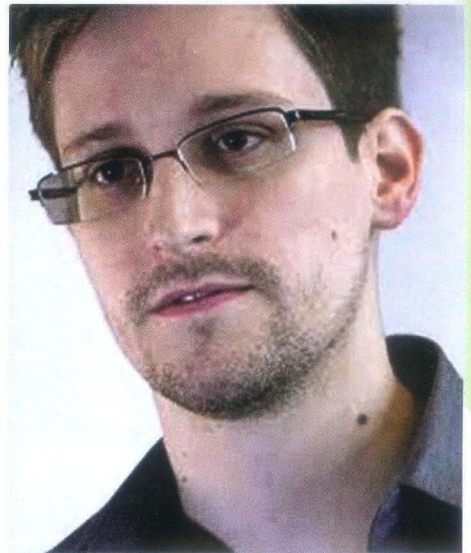
subjected to surveillance without the knowledge of such legal entities.

This being the case, 2014 is likely to witness an increased thrust in cost-effective interception surveillance, monitoring and decryption under the gazing eyes of other sovereign nations. Many countries are likely to put in place stringent regulatory regimes which will aim to prevent/curb the unauthorized access to their network and further make such acts as penal offences. However, the challenge will be to ensure as to how continued interception, monitoring and surveillance is to be regulated in a manner so as to give a semblance of respect to the rights and obligations of individual users of computer systems and digital ecosystems.

It will also be important to check the interception and surveillance being



(Courtesy: www.eolii.com)



Edward Snowden, who came to international attention after disclosing to several media outlets thousands of classified documents

The biggest cyberlaw trend in 2014 would be the enhanced frequency and instances of interception, surveillance and monitoring across the world.

carried out outside the territorial boundaries of countries and effectively regulate them within a legal framework.

Connected with this trend is the increased need for providing far more protection and preservation of individual stakeholder’s online privacy in the digital and the mobile ecosystem.

Given the Snowden revelations, the fragmentation of the Internet is likely to be accelerated as different countries are coming up with their own secure national networks, thereby by-passing the dangers of surveillance and monitoring from foreign shores. In such a scenario, the fragmentation of the Internet is further likely to bring forward various legal, policy and regulatory issues, which are likely to be addressed during the year 2014.

Fragmentation of the Internet and interception, monitoring and surveillance are likely to bring in active focus the issue of the interplay of the online sovereignty of nations vis-à-vis activities of interception, monitoring and surveillance in cyberspace. Questions like where would the online sovereignty of nations begin and end are important issues that will have to be addressed. 2014 would be an interesting year to see how this important trend unfolds with the passage of time.

Another significantly important cyberlaw trend of the year 2014 is likely to be the increased thrust on cyber security policy issues. Nations are expected to come up with national legislative measures to further protect and preserve cyber security. Given the fact that the

dark Internet has already established itself as a formidable force, and cyber crimes as services are now being provided on networks, clearly protection and preservation of the cyber security of a country’s national networks as also its critical information infrastructure are going to be topmost priorities in 2014.

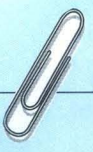
Cyber crime reports have revealed that 2014 will experience more cyber attacks and corporations will have to conduct more boardroom scrutiny to manage their data supply chains (<http://www.siasat.com/english/news/2014-experience-more-cyber-crimes-report>). As such, 2014 will see an increase in the demand for providing effective remedy in order to protect victims from cyber criminal attacks and offences.

The International Telecommunication Union (February 2013) estimates that there are 6.8 billion mobile subscriptions worldwide. That is equivalent to 96 percent of the world population (7.1 billion according to the ITU) (<http://mobithinking.com/mobile-marketing-tools/latest-mobile-stats/a>). Kaspersky in their security bulletin for 2013 stated that the mobile world is one of the fastest-developing IT security areas (Kaspersky Security Bulletin 2013).

As mobile crime continues to grow at a rapid pace in the year 2014, the relevant stakeholders will call upon the

There is no denying the fact that all the aforesaid trends are important significant factors, which will have a bearing on the growth and further evolution of the international Cyberlaw ecosystem in the year 2014.





DIGITAL COIN

THE latest mode of money transaction is Bitcoin. Bitcoin or Crypto currency is a form of digital currency, created and held electronically. No one controls it. Bitcoins are not printed.

A software developer Satoshi Nakamoto proposed Bitcoin in 2009 as an electronic payment system based on mathematical proof. The idea was to produce a currency independent of any central authority, transferable electronically, more or less instantly, with very low transaction fees.

Bitcoin is different from normal currencies. It can be used to buy things electronically. In that sense, it is like conventional dollars, euros, or yen, which are also traded digitally. However, Bitcoin's important characteristics are that it is decentralized, easy to set up, anonymous in nature, completely transparent, transaction fees are minuscule, transaction is faster, non-repudiable, easy storage, hassle-free payment.

No single institution controls the Bitcoin network which puts some people at ease. At the moment, the largest full trading exchanges accessible to everyone are Mt. Gox (Japan), Bitstamp (US), BTC-e (Bulgaria), and Kraken (US). The world's largest Bitcoin exchange is BTC China.

Bitcoin Issue Rights do not rest with central banks – rather it is created

digitally, by a community of people that anyone can join. Bitcoins are 'mined', using computing power in a distributed network. This network also processes transactions made with the virtual currency, effectively making Bitcoin its own payment network.

As per the Bitcoin protocol – the rules that make Bitcoin work – only 21 million Bitcoins can ever be created by miners. Bitcoin circulation is based on mathematics. Around the world, people are using software programs that follow a mathematical formula to produce Bitcoins. The mathematical formula is freely available by using open source software.

Bitcoin circulation takes place through the exchange platform that is distributed across thousands of computers, peer-to-peer style. In order to expand the total supply of Bitcoins, users also run complex algorithms on this peer-to-peer network to solve cryptographic puzzles. Each time a puzzle is solved additional Bitcoins get credited to the accounts of those who solved the puzzle. That is how the "money supply," as it were, expands in the Bitcoin market.

However, each new puzzle gets incrementally harder to crack. The system is designed in such a way that it can limit the growth of the supply of Bitcoins. The overall supply of Bitcoin in the system therefore grows at a slow and pre-ordained rate. There are currently 10.8 million

The resurgent interest in privacy is likely to be another trend of 2014. Google's chief internet evangelist Vint Cerf has stated that "privacy may actually be an anomaly" (<http://motherboard.vice.com/blog/googles-top-execs->



Logo of Bitcoin

(Source: http://en.wikipedia.org/wiki/File:Bitcoin_logo.svg)

Bitcoins in the system, and this will cap out at 21 million coins in just over 125 years.

Unlike bank accounts, the Bitcoin accounts are called 'wallets' which are available in two ways – a software wallet stored on the hard drive of any computer, or an online web-based service. The popular Coinbase is a wallet service that trades dollars for Bitcoins, and has web and mobile (Android) apps. Blockchain.info is another popular online wallet option but it has only mobile solution available for both Android and iOS.

Other sites for wallet services are:

- MultiBit, a secure, lightweight, international Bitcoin wallet for Windows,

are-saying-the-opposite-things-about-privacy). The author has already, in one his tweets stated in the context of cyberspace that "Privacy is on its death bed, counting its last breaths...in a cold technology environment..." (<http://lnkd.in/dUViBSk>).

As technology will only erode the basic essentials of the concept of privacy in the digital ecosystem, the year 2014 is likely to see more calls from different stakeholders as well as the governments of the world to protect and preserve as also strengthen the legal regimes to help protect not just data privacy but also personal privacy of the relevant stakeholders.

As social media continues to grow, it is likely to bring forward various policy and regulatory aspects which countries of the world would increasingly be required

governments of the world to effectively strengthen their cyber legal systems and regimes to cover and regulate the newly emerging mobile threats and mobile crimes.

As mobile crime continues to grow at a rapid pace in the year 2014, the relevant stakeholders will call upon the governments of the world to effectively strengthen their cyber legal systems to regulate mobile crimes.





Typical Bitcoin wallet
(Source: <http://thestatelessman.com/2013/06/03/using-bitcoin/>)

The popular Coinbase is a wallet service that trades dollars for Bitcoins, and has web and mobile (Android) apps. Blockchain.info is another popular online wallet option but it has only mobile solution available for both Android and iOS.



year 2014, thereby forcing the relevant stakeholders to look at appropriate legal frameworks which can effectively regulate certain activities.

MacOS and Linux. No blockchain download required.

- Armory (Alpha), an open-source wallet-management platform for the Bitcoin network.
- Electrum, a lightweight Bitcoin client, based on a client-server protocol. No blockchain download required.

In India there are about 2,000 active Bitcoin users. With an exchange within India once again, Buy Sell Bitcoin, the ability to purchase with cash (rupees deposited at HDFC or Axis bank), makes buying Bitcoins possible without having to transfer funds internationally or suffering excessive fees.

to deal with. Countries are likely to be called upon to revisit their existing cyber legal regimes in order to address the issues of social media. Various countries in different parts of the world have tried and are continuing to address the same in their own respective manner.

Cloud computing will be another growing trend in the year 2014. Cloud has already become a significant buzzword in our lives. While cloud has tremendous advantages, there are a large number of regulatory challenges pertaining to large-scale adoption of cloud computing as a popular technology. The year 2014 is likely to see significant development in the jurisprudence around cloud computing.

As the world moves towards mobility where more and more people own more than one mobile communication device,

The huge demand for Bitcoins in India has largely been from speculators hoping to gain from the rising value of the currency. There have been an estimated 29,400 downloads of Bitcoin wallets from Indian IP addresses.

The Reserve Bank of India has stated that it does not immediately intend to regulate Bitcoin and has not yet formulated regulations to govern trading or profits generated from Bitcoins.

Contributed by Mr Bibhuti Narayan Biswal is Principal, Sri Sathya Sai Vidyaniketan, Ganeshvad Sisodra, Near TATA SSL, N.H.-8, Navsari-396463, Gujarat; Email: chem_iway@sify.com

there is an increase in the number of personal devices being carried to work. BYOD, bring your own device, is indeed a magical phenomenon which helps companies to minimize expenditure in the infrastructure. However, the security, confidentiality and veracity of data as also jurisdiction are important legal challenges that have to be appropriately addressed by the cyber legal regimes in order to enable large and mass scale adoption of BYOD.

The growth of Bitcoins and other virtual currency(s) is yet another trend to watch out for in 2014. In its Security bulletin 2013, Kaspersky has predicted that attacks on Bitcoin pools, exchanges and Bitcoin users will become one of the most high-profile topics of 2014. Bitcoin crimes are likely to emerge as an important significant phenomenon in the

The advent and adoption of the data analytics at a mass scale requires that appropriate attention is given to issues concerning big data like authenticity, veracity of the data, data collection, data archiving, data retention jurisdiction, privacy, confidentiality and other data collection related issues. The year 2014 will call for creating appropriate legal and regulatory framework in this regard.

The above are important Cyberlaw trends in 2014 in the opinion of the author, given his work in Cyberlaw and given the nature of the existing ground realities and events that have occurred in 2013. It can be possible that some of these trends may or may not see the light of the day in totality or in the manner so envisaged.

However, there is no denying the fact that all the aforesaid trends are important significant factors, which will have a bearing on the growth and further evolution of the international Cyberlaw ecosystem in the year 2014.

Mr Pavan Duggal is Asia's leading Cyberlaw expert and authority and Advocate, Supreme Court of India. Pavan is the President of Cyberlaw Asia, Asia's pioneering organization committed to the passing of dynamic Cyberlaws in the Asian continent and also the President of Cyberlaws. Net, which is Internet's first ever-unique Cyberlaw consultancy. Pavan is also a member of the WIPO Arbitration and Mediation Center Panel of Neutrals. He has been associated with the Ministry of Communication and Information Technology, Government of India on Cyberlaw and Electronic Governance legal issues. Address: S-307, LGF, Greater Kailash-1, New Delhi-110048; Email: pavan@pavanduggal.net, pduggal@vsnl.com and pduggal@gmail.com.

4126 and *still* counting.....

The recent accelerated advances in genomic sequencing have helped to explain some inexplicable life phenomena and characteristics of organisms. Genomic sequencing has provided us with a clearer picture of the genetic basis of traits intrinsic to certain organisms.

YOU might be wondering what the number in the title signifies. Well, it is the number of organisms whose genomes have been sequenced till date. While quite a few important organisms have already been sequenced, there are still many more left! Nature is ever so bountiful, and the fascinating world of biology never ceases to amaze mankind. But before we move on to the details of genome sequencing, let's first define what a genome is.

Genome is the total genetic information of an organism. The genes (made up of DNA) within our nucleus are what control our cellular functions by coding for proteins. And these proteins function as the molecular workhorses to determine the unique characteristics of cells, organs and individuals. Genomics

is a branch of biology that studies the structure and function of genomes of organisms, which determine their unique phenotype (physical characteristics).

The genome reveals many amazing facets in biology. For example, what makes us human? Are apes really our ancestors? Do all of us really come from Africa? Why is there so much water in watermelon? How are some species able to thrive in harsh and unfavorable environments? What makes certain animals resistant to pain and cancer? How are mere insects like fire ants able to maintain a rigid social structure? How does a songbird sing? What makes some of us so aggressive?

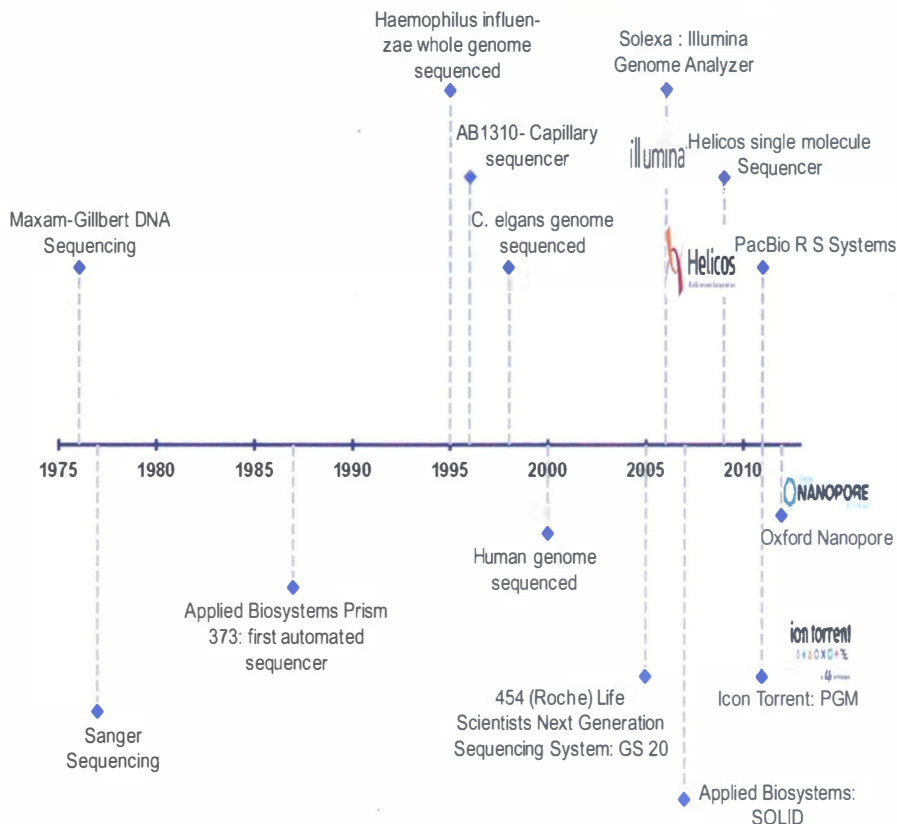
The answer to all these questions lies in understanding simple codes represented by the nucleotide bases: A, T, G and C. However, these genetic codes are indiscernible without their own "readers", which are, DNA sequencing technologies. Sequencing is the process by which the arrangement of the nucleotides can be identified for a given stretch of

nucleic acid. Sequencing genomes helps reveal the order of the nucleotides of a strand of DNA and hence helps us identify the genes present in the organism.

The real beauty of genomics lies in the fact that the language of the genetic code is universal, that is, genes in all organisms are composed of the four nucleotides A, T, G and C, akin to everyone conversing in a common language. If the same language was spoken all over the world then it would be much easier for people to share views and ideas. Similarly, the language in which genomes are "written" is identical in all organisms. This helps us make sense of these sequences.

The year 1977 was the first time a finished genome sequence was published. Frederick Sanger finished sequencing the entire genome of bacteriophage OX174, using a method of incorporation of chain-terminating di-deoxynucleotides by DNA polymerase. This method came to be named after its inventor, as Sanger sequencing. This name was synonymous with gene sequencing for over two

Landmarks in DNA Sequencing Technology



Frederick Sanger finished sequencing the entire genome of bacteriophage OX174, using a method of incorporation of chain-terminating di-deoxynucleotides by DNA polymerase.

decades and the most widely used sequencing method in the 20th century.

A decade later, planning for the human genome sequencing began. The Human Genome Project was an international scientific research effort to decode the sequence of the human genome and identify all genes that it possibly contains. The task commenced in 1990 and was completed in 2007.

With the advent of the 21st century, when the first draft of the Reference Human Genome was published, the genomic revolution kicked started, spawning many Massively Parallel Sequencing technologies that enabled revolutionary advances in our understanding of health and disease.

In the following paragraphs, we intend to take you through an exciting journey through four interesting cases, wherein the whole genome sequencing of organisms has helped unravel hitherto poorly understood biological phenomena.

Resilient Genomes

Can you tolerate 500,000 rad of ionizing radiation? Well, the *Deinococcus radiodurans* can.

You wouldn't expect any organism to withstand 500,000 rad of ionizing radiation. However, the *Deinococcus radiodurans* is not only able to survive that, but also cold, dehydration, vacuum and acid. It is one of the most resilient bacteria known to humans. Genome sequencing has helped us to identify several genes involved in compensatory mechanisms that allow it to be extremely resilient to radiation.

Deinococcus radiodurans thrives in rocky granite of antarctica's dry valleys. It is known for its DNA repair mechanisms and its ability to tolerate extreme ionizing radiation.



Radiation causes double strand breaks in DNA. Without an efficient genome repair machinery the organism cannot survive. The analysis of the genome of the *D. radiodurans* identified many genes involved in DNA repair systems, for example, the UV endonuclease, nine DNA glycosylases and MUI1 and MUI2 genes. Many repeat sequences have been identified in the genome of the *D. radiodurans*. These repeat elements may help to regulate DNA degradation. DNA degradation is essential for DNA repair in *D. radiodurans* after double strand breaks have occurred.

Radiation also causes oxidative damage to the cells i.e. oxygen radicals bind to some base pairs on the DNA and cellular proteins and destroy their structures. *D. radiodurans* expresses genes coding for caspase enzymes that scavenge these oxygen radicals,

SEQUENCING ACHIEVEMENTS AT IGIB

The year 2000 marked the advent of genome sequencing projects in India. The CSIR-Institute of Genomics and Integrative Biology (CSIR-IGIB, New Delhi) has been at the frontier of genomics research ever since. IGIB is a part of the Indian Genome Variation Consortium, the objective of which is to sequence several ethnic Indian populations, map all known variations and discover informative polymorphisms associated with a wide range of diseases.

IGIB scientists have also successfully sequenced the genome of the zebra-fish. This has proven to be a wonderful resource as the zebra fish is used as a model organism for research in labs across the world. IGIB scientists are also currently involved in elucidating and analyzing genomes of microbes. Genomes of *Idiomarina* and *Rheinheimera* are the discernable bacterial genomes that scientists have successfully sequenced.

thus mitigating the resulting damage. Moreover, *D. radiodurans* has the ability to prevent the reincorporation of damaged nucleotides into its genome by transporting them out of the cell. Two homologs of UvrA genes, present in the *D. radiodurans* genome, are hypothesized to be involved in this export activity.

There are some genes that are thought to allow the *D. radiodurans* to import large amounts of peptides and amino acids from out of the cell to help in cell recovery. Moreover, some genes presumed to be involved in synthesis of nucleotides were also detected.

The Naked Mole rat is resistant to pain and cancer! How is it possible?

The Naked Mole rat has posed an enigmatic puzzle for biologists over the past half century. This largely subterranean inhabitant has certain phenotypic characteristics that are remarkable for living organisms. It shows resistance to spontaneous cancer, longevity (with an average lifespan of 30 years – very long for rats), negligible senescence (its cells can continuously divide) and high reproductive capacity.

With its natural habitat being deep burrows underground, unsurprisingly,



the Naked Mole rat has adapted itself to dispense with senses that are of little or no use to it in its daily environment, for instance vision and taste. Most of these rats are blind or have very poor vision.

Over the past couple of decades, numerous experiments have shown that these organisms display remarkable resistance to certain types of pain, have greatly reduced metabolic rates, produce very trace amounts of heat and have greatly altered circadian rhythms (internal biological clock). However, it wasn't until the entire genome and transcriptome (entire body of genes that are transcribed to form RNAs, at any given time, and hence are expressed) sequencing was carried out, that the underlying mechanisms driving these extreme adaptations were elucidated.

Genome sequencing of this species has revealed that its loss of taste and vision and high fecundity is attributed to the loss of functional genes commonly involved in the said processes. This process is called Pseudogenization, wherein some genes over the course of time, acquire certain mutations in their sequences that impair their ability to be transcribed (to form RNAs) and hence are unable to express themselves.

Previous experiments have shown that the skin and cutaneous tissues lacked neuropeptide Substance P, a messenger peptide that is critical to the pain-signaling pathway in mammals. Genome sequence analysis revealed that the gene coding for this peptide carried a mutation in its promoter sequence, thereby preventing its expression and blocking

the pain-signaling pathway in these rats. A promoter sequence is a region on the DNA that precedes the coding region of a gene. It affects the level to which genes are expressed in a cell by affecting the level of transcription of the DNA to form RNA. Transcription factors (proteins which bind to DNA and help in Transcription) bind to the promoter sequence of a gene and start the process of transcription.

Its unique resistance to cancer has been explained by the presence of two different tumor suppressor proteins involved in the process of Contact Inhibition (a process that limits cell growth and division that lead to the formation of a tumor). The Naked Mole rat possesses two proteins involved in contact inhibition, wherein the presence of an additional protein with a redundant function serves to compensate for a loss of function in the first.

Another interesting trait exhibited by the Naked Mole rat is its ability to tolerate severe hypoxic conditions (dearth of oxygen in the environment). While this would severely incapacitate normal rats, the Naked Mole rat thrives under such adverse conditions primarily due to the stable expression level of a protein, HIF-1 (a transcription factor activated during hypoxia that expresses essential genes). Gene sequencing has revealed that this constant level of expression is due to a mutation carried in VHL protein (its interactive partner).

Mystery of Mimicry and Migration

The ultimate conmen! How can butterflies program themselves to look like each other?

All butterflies are lovely to look at and easy to notice but only some are tasty to eat (from the point of view of their predators). Certain species of butterflies (like the Monarch butterfly *Danaus plexippus*) tend to taste very bitter and are toxic to their predators due to accumulation of secondary metabolites (from plants) like cardiac glycosides. The predators eventually learn to avoid these insects by memorizing their wing patterns, and specifically prey on the palatable butterfly species by using their wing patterns to mark them out.

Heterocephalus glaber or the naked mole rat is a hairless, subterranean organism thriving in deep dark burrows, and is known for its longevity and resistance to cancer.



Heliconius butterflies, thriving in the western hemisphere, are epitomes of Mullerian mimicry.

Over generations, the palatable butterflies have remarkably programmed their genomes to 'mimic' the wing patterns of the toxic butterflies so that the predators would be misled into believing them to be bitter and avoid preying on them all together.

This phenomenon of wing-color pattern mimicry, most commonly seen in butterflies, has posed an intriguing enigma to lepidopterists for decades. Existing texts commonly describe two forms of mimicry: Batesian phenomenon by which one palatable species mimics another harmful/poisonous species of butterfly in order to avoid its predator, such as, wasps, dragonflies, snakes, rats, lizards etc.) and Mullerian (phenomenon in which two or more poisonous species share a common predator and hence have come to mimic each others' wing patterns).

The natural question that arises is: How does one species of butterfly perfectly mirror the wing pattern of another? To explain the dynamics and logistics of this phenomenon, scientists earlier proposed the theory of Adaptive Introgression, a process by which a particular gene belonging to one gene pool (one species) flows to another species by means of repeated backcrossing (mating) with the parent species.

It was not until the Heliconius Sequencing Consortium embarked upon sequencing three subspecies of the Heliconius family (*H. melpomene*, *H. timareta*, *H. elevates*) that the theory was found to be more pervasive than previously assumed. They found that all genes governing wing pattern

Don't be fooled by its small size and beautiful wing patterns. The monarch butterfly is known for its ability to travel 4000 km, from central North American lands to the overwintering grounds in Mexico (left)



formation cluster/group together to form a 'supergene' – a group of genes that behave like a single gene and are always inherited together. They further discovered that butterflies exchange this cluster of genes freely among various subspecies (by mating with each other frequently over their lifetime), thereby allowing one to mimic the wing pattern of the other.

How can a tiny insect travel 4000 km in adverse conditions and live to tell the tale?

Another aspect that caught the attention of lepidopterists was the phenomenon of long-distance migration in certain species of butterflies, such as the Monarch Butterfly. Each year, during the fall season, millions of eastern North American monarch butterflies undergo a long-distance migration, traveling up to 4,000 km to reach their 'overwintering grounds' in Mexico.

How are such tiny insects capable of traversing several miles of flight through adverse weather conditions? What are the genetic and molecular mechanisms involved in long-distance migration? How do they protect themselves from being devoured by predators during their flight?

The answers are not yet completely known. However, between the study of all signaling mechanisms involved and the availability of complete genomic and transcriptomic profiles of the migratory Monarch, most of the puzzle pieces are now in place. While it was already known that the Juvenile Hormone biosynthesis pathway and the central processing of visual cues by the sun compass structure in the brain are vital processes to the survival of Lepidoptera (and most other insects), there are a few variations found between the non-migratory and migratory butterflies.

Sequencing the Monarch genome revealed that small non-coding RNAs (mostly microRNAs that control gene expression) play a crucial role in preparing the Monarch metabolism for long-distance migration. Researchers found that very small non coding RNAs called microRNAs, which control the expression of a large number of genes, were associated with accumulation of fat deposits, temperature regulation and muscle activity that are controlled differently in migratory butterflies, thereby enabling this function.

Besides, Monarchs are protected from harmful predators as they contain a bitter cardiac glycoside – ouabain – that renders them unpalatable and toxic to predators. Ouabain severely inhibits the function of the Na⁺/K⁺-ATPase enzyme (central to energy metabolism in most organisms) thereby killing the predator that feeds upon it. How, then, does the Monarch protect its own enzyme from this toxin? Sequencing the entire coding region of the gene revealed a mutation that is carried over to the protein preventing the binding of ouabain, thus rendering it resistant to such inhibition.

Eusociality

How do strict norms pertaining to colony structure exist in fire ants?

You may often look at fire ants as pests in your backyard, but these ants (*Solenopsis invicta*) show remarkable behavioral qualities that have shed a lot of light in the field of biology.

Fire ants show intraspecific variability (variation within the same species) in social organizations, a striking phenomenon in living organisms. It has long been known that fire ants show alternate colony behavior. Some colonies are monogamous, i.e. only have one queen, while others can tolerate more than one queen, or are polygamous.



Solenopsis invicta, fire ants, show intraspecific variability in social organizations, a very remarkable behavioural phenomenon (left)



Taeniopygia guttata, zebra finch, possess the ability to sing, a complex behavioural trait (left)

The real beauty of genomics lies in the fact that the language of the genetic code is universal, that is, genes in all organisms are composed of the four nucleotides A, T, G and C, akin to everyone conversing in a common language.

Why should the same species of insect display varied preferences in formation of colonies? Genome sequencing (performed for male offspring from monogamous and polygamous colonies) has led to the discovery of a certain allele (alleles are defined as multiple forms of the same gene) of the gene Gp-9 that causes this intraspecific variability in fire ants. In other words, the alleles of the gene determine whether workers tolerate a single fertile queen or several fertile queens in their colony.

Workers from colonies containing only one version of the GP9 gene (Gp-9 BB) are homozygous and only accept a single Gp-9 BB queen, whereas colonies containing multiple versions of the gene are heterozygous (have both Gp-9BB and Gp-9Bb) and will accept several (but only Gp-9Bb) queens. Interestingly, if a heterozygous Bb worker detects a homozygous BB queen by sensing the absence of surface chemicals that are related to the b allele, it kills her by biting to ensure the presence of only Bb queens in its colony. This is how the presence of a single allele determines the social structure of colonies in fire ants.

Researchers who sequenced the Gp-9 gene found that it codes for odorant-

binding protein (OBP), which is similar to the gene coding for pheromones in moths. Pheromones help in chemical recognition of individuals in many insects. Gp-9's close relation to the gene coding for pheromone suggests that the gene too has a role in chemical recognition of individuals in ants.

How have some birds mastered the chords?

Behavior is a complex trait. This means it is determined in part by the genes that one has inherited from ancestors. It is also subjected to modifications, as a learning response to environmental cues. The relative contributions of your genes and environment ultimately produce the observable trait (your phenotype) which scientists can study. And as a twist in the story, it varies extensively across different scales of observations: populations, societies, individuals, even cells.

The ability to sing gives a special place to song birds in ecosystems as well as neurobiological studies. Thriving in the temperate zone, the zebra finch (*Taeniopygia guttata*) is a typical songbird. It is a passerine bird, just like crows and sparrows; however unlike them, it can "sing" i.e., communicate through learned vocalizations.

Genome sequencing and genetic analysis have led to the discovery that genome of the songbird specifically responds to song, in that the expression of certain genes is greatly altered as a direct result of singing or song exposure. Studies have shown that the zebra finch forebrain contains a discrete neural circuit with several dedicated centers, which act as the "song control" nuclei. This develops only in males, the sex that can sing. Gene expression is enhanced in male song control nuclei while singing.

An interesting finding obtained from the comparative analysis was that the zebra finch genome does not follow the mechanism of dosage compensation exhibited by other avians, leading to

speculations that these chromosomal differences could play a role in male singing behavior. (Dosage compensation is the process by which one of the copies of genes is inactivated and only the remaining copy is expressed at a given time.)

Moreover, several neural ion transport genes have been identified that are hypothesized to aid in 'singing'. Additionally, researchers found multiple copies of genes coding for zinc finger proteins (transcription factors that affect the expression of other genes) that are associated with synapse formation and neuronal signaling in the brain. (Synapse is the seat of memory and synaptic plasticity means the change in strength of synaptic signaling with time and usage.)

The phenomenon of song in the songbirds, while being aesthetically pleasing, also plays an evolutionarily role in songbird reproduction. Female songbirds exhibit a strong mating preference toward the best singing males.

While the actual mechanism involved in the response to song is yet to be completely understood, whole genome sequencing of the songbird has helped reveal the origin and importance of singing in these species and brought the research community one step closer to dissecting the mechanisms involved by narrowing the focus toward certain genes that directly respond to song.

In the years to come, genomic sequencing is bound to come up with much more interesting information about trait peculiarities of various organisms. And the count of organisms whose genomes will be sequenced will surely keep rising.

Amruta Vasudevan is a Summer Research Fellow of the Indian Academy of Sciences and is working in the field of genomic variations and their role in genetic susceptibility to diseases and Ayur-Genomics, under the guidance of Dr. Mitali Mukerji, Scientist G, Genomics & Molecular Medicine Unit, CSIR-Institute of Genomics and Integrative Biology (IGIB). Address: 3rd floor, Discovery Genomics, CSIR-IGIB, Near Sukhdev Vihar Bus Depot, Mathura Road, New Delhi-110020;

Mr Aniket Bhattacharya is a PhD student (JRF) in the Genomics & Molecular Medicine Unit, CSIR-IGIB, New Delhi

Model Organisms: Living Laboratories



The use of model organisms in biological science has come a long way. A huge wealth of biological data has been amassed using these model systems.

DURING the past few decades, model organisms have helped scientists make several epoch making discoveries. The role of model organisms in medicine was evident when dog was used to decipher the cause and consequence of Type I diabetes mellitus and its recovery using the pancreatic extract insulin.

Way back in 1921, the discovery of insulin was initiated by the University of Toronto based young surgeon, Frederick Banting who along with his assistant Charles Best first tried to reverse the symptoms of diabetes in a dog upon removal of its pancreas. In a follow-up experiment they tied off the pancreas in another dog, then removed it and obtained an extract, which they injected into the first dog. It recovered, albeit only for a day (because it required daily insulin injections, the active component of pancreatic juice to combat diabetes). Later, insulin was purified by James Collip. Banting shared the 1922 Nobel Prize with John Macleod.

There are several such instances in which animals have been used as models in biological research such as advances in medical technology, including open

heart surgery, cardiac pacemakers, heart transplants, coronary bypass surgery and so on. Model organisms have also been used in the classroom to help students learn important concepts in various disciplines of biology. For example, *Escherichia coli*, *Saccharomyces cerevisiae*, *Drosophila* and many other lower eukaryotes have been widely used as model organisms in introductory biology courses to teach microbiology and genetics.

The idea of using model organisms for biological studies was first initiated by Gregor Mendel in the mid 19th century who used cross pollinating pea plants to understand the genetic inheritance pattern. Today scientists rely on a number of model organisms from single cell bacteria and yeast to fruit fly and nematodes, all the way up to mammals such as mice and rats.

What is a Biological Model?

Model organisms are the workhorses of biological science and play a role in deciphering the real mystery of life. These organisms are usually fast-growing non-human species with simple genome and are inexpensive, easy to maintain and breed in a laboratory setting. The main criteria to be satisfied by an ideal model organism includes: 1) short life cycles, 2) small adult size, 3) ready availability, and 4) tractability.

Now, what is the rationale for using model organisms? Humans share with the animals many vital functions such as breathing, digestion, movement, sight, hearing and reproduction. As a biological entity any human being is thus comparable to other organisms because all the living beings on earth are made up of cells having similar genetic information. Therefore, in most cases the structure and function of different body proteins are evolutionarily conserved across a wide variety of species and so are the metabolic and developmental pathways.

Human beings cannot be used as experimental objects because of health-associated risks and other ethical issues. However, different aspects of human biology could be unravelled using different experimental model organisms which best fit the specific question to be answered.

Animal welfare activists throughout the world are vociferous against the use of animal experimentation and have questioned the unethical and inhumane experiments conducted on animals.

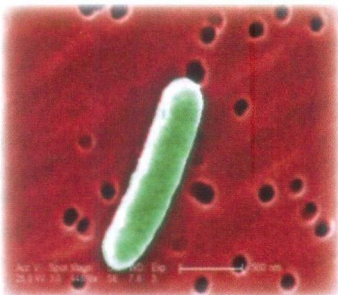


A balance should be struck so as to minimise the use of animals using different non-animal models and lower animals. In case of any dire necessity of animal experimentation, the research should be conducted only within the ethical framework ensuring the use of animal in a humane manner as far as possible thus minimising pain, distress and discomfort to the animals.

Since long the prokaryotes and lower eukaryotes have been used to understand different basic biological processes. Animals are mostly used as natural candidates for biomedical research because they share many of the illnesses with humans. For example, rabbits suffer from atherosclerosis (hardening of the arteries); dogs suffer from cancer, diabetes, cataracts, ulcers and bleeding disorders such as haemophilia; cats suffer from some of the visual impairments similar to humans.

Animals are also used extensively as models in different preclinical toxicity studies for testing the efficacy of drugs. Let's take a look at some of the real heroes of biology: the model organisms.

Escherichia coli: Some of the *E. coli* strains constitute the normal bacterial flora in our guts while other strains are capable of causing diarrhoea in humans. In the late 1800s, *E. coli* was discovered by the German paediatrician and bacteriologist, Theodor Escherich and since then it



is being used to understand many of life's essential processes because of its rapid growth rate (30 min/generation), simple nutritional requirements and well established genetics. It is easy to manipulate *E. coli* using recombinant DNA technology and is currently the most widely used organism in studying molecular genetics.

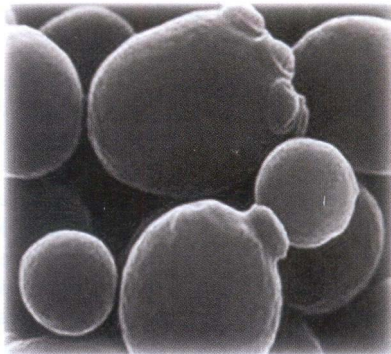
Dictyostelium discoideum (Slime Mold): *Dictyostelium discoideum* is a soil-borne amoeba and is commonly referred to as slime mold. The cellular slime mold

undergoes a transition from single-celled amoebae to a multicellular organism as a natural part of its life cycle. Several



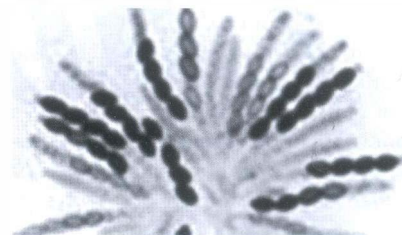
D. discoideum genes are homologous to human genes and the simplicity of its life cycle makes *D. discoideum* a valuable model organism to study genetic, cellular, and biochemical processes in other organisms.

Saccharomyces cerevisiae: *Saccharomyces cerevisiae* (budding yeast or



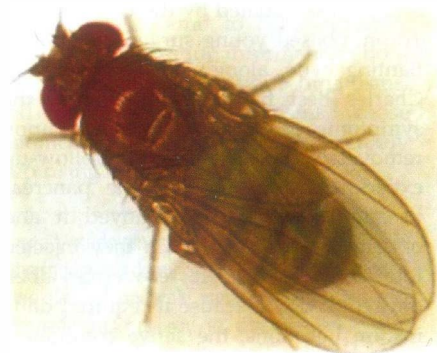
baker's yeast) is the most widely used eukaryotic model system. It grows quickly and is relatively cheap to maintain. Almost 30% of the genes implicated in human diseases have orthologs (genes in different species that evolved from a common ancestral gene by speciation) in yeast. Therefore, it is being used as a model to study different biological processes such as aging, regulation of gene expression, signal transduction, cell cycle, metabolism, apoptosis (programmed cell death), neurodegenerative disorders and so on.

Neurospora crassa (Bread Mold): Since the landmark discovery (one gene-one enzyme model) of Beadle and Tatum using the model system *Neurospora*, in 1941, this orange bread mold is being



used as a simple model organism for genetic and biochemical studies and has been instrumental in our understanding of several basic and fundamental aspects of biology.

Drosophila melanogaster: *Drosophila*, the fruit fly, is a small invertebrate which was first successfully used by Thomas Hunt Morgan at Columbia University and he was awarded the Nobel Prize in 1933 for the discovery of white eyed mutation in 1910. Since then *Drosophila* has been used as a model organism for the study of several diseases, including Parkinson's disease, Alzheimer's and various types of cancer.



Surprisingly, *Drosophila* shares highly homologous gene sequences with humans, making it one of the most preferred organisms for genetic studies. It is easy to maintain, grows quickly from embryo to adult within 12 days thus generating a number of offspring. It is

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relatively straightforward to disrupt fruit fly genes and introduce foreign ones. The usage of fruit fly as a model organism dates back almost a century and has been widely used in genetic, developmental and behavioural studies, and more recently as a tool to study human diseases and to screen compounds for therapeutic use.

***Caenorhabditis elegans*:** Sydney Brenner was the first to introduce *Caenorhabditis elegans* as a model organism in 1974 for pursuing research in developmental biology and neurology. It is a very small soil nematode (1 mm length), transparent for ease of manipulation and observation; it grows very easily in large numbers (10,000 worms/petri plate) and is very cheap to breed.

C. elegans reproduces with a short life cycle of about 3 days under optimum condition, about the same time needed for genetic crosses in yeast. Its life span is around 2 to 3 weeks under suitable culture condition. Compared to the use of other model organisms, such as mice, the shorter life cycle of *C. elegans* reduces the experimental time and facilitates biological study.

Studies with this model organism have unveiled different scientific mysteries such as programmed cell death (Nobel Prize in 2002, awarded to Sydney Brenner and associates) and RNA interference process (Nobel Prize in 2006, awarded to Andrew Fire and Craig C. Mello).

***Arabidopsis thaliana*:** Friedrich Laibach is the founder of experimental *Arabidopsis* research. *Arabidopsis thaliana* is the most common eukaryotic model organism for studying plants. It possesses a relatively small, genetically



In case of any dire necessity of animal experimentation, the research should be conducted only within the ethical framework ensuring the use of animal in a humane manner as far as possible thus minimising pain, distress and discomfort to the animals.

tractable genome that can be manipulated through genetic engineering more easily and rapidly than any other plant genome. Some of its notable advantages are that it reproduces relatively quickly, produces numerous progeny through self pollination, requires limited space, and is easily grown in a greenhouse or indoor growth chamber with simple growth requirements like light, air, water and a few minerals to complete its life cycle. Therefore, it is being used as a model system for several decades to understand the genetics and molecular biology of flowering plants.

***Xenopus laevis*:** *Xenopus* is a genus of highly aquatic frogs native to Sub-Saharan Africa. *Xenopus* is a bizarre looking frog



that was introduced as a model system in the 1950s. The eggs and embryos of *X. laevis* can be produced in large numbers by means of a simple hormone injection and, like other amphibian embryos, can be easily manipulated. Much of the early uses of *X. laevis* in the 1930s and 1940s were confined to physiological research. More recently it has gained the primary focus of model system in molecular biology.

***Puffer fish (Fugu rubripes)*:** Pufferfish is a great delicacy in Japan that has occupied an important niche in biological science as a genetic model system. Its genome sequence was published in 2002. It has the shortest genome so far identified – just 400 million base pairs. Even though men and fish diverged from



their common ancestor over 450 million years ago, the *Fugu* genome contains roughly the same number of genes as its human counterpart, which is eight times larger. The compactness of the pufferfish genome simplifies the detection and analysis of genes and their regulatory elements. The *Fugu* project was initiated in 1989 in Cambridge, UK, by a small research group led by molecular biologist Sydney Brenner.

***Mouse (Mus musculus)*:** Mouse, most familiar as an agricultural and household pest, has immense potential as the foremost genetically tractable model organism for understanding human biology and disease. It bears a lot of similarity with humankind in terms of physiology, tissue structure and organization. In effect, this creature has to combat many of the common diseases we suffer. This kinship is also reflected in the 99% resemblance of the mouse and the human genome. Probably no two mammals have shared such a closer relationship, even though their





Human beings cannot be used as experimental objects because of health-associated risks and other ethical issues. However, different aspects of human biology could be unravelled using different experimental model organisms which best fit the specific question to be answered.

evolutionary lineages diverged more than 96 million years ago. The added feature of this model system is its low maintenance cost and its reproduction time as low as nine weeks. Different disease models in mice can be created by manipulating the mouse genome, and these models can be used to test the efficacy of new drugs in different preclinical trials.

Nude mouse: A nude mouse is a laboratory mouse with a genetic mutation that causes a deteriorated or absent thymus, resulting in a non-functional immune system due to a greatly reduced number of T cells. This defect is manifested in its outward appearance such as lack of body hair, hence is name "nude mouse". It is also known as NIH-III as it was developed at the NIH (National Institutes of Health, Bethesda). The nude mouse is valuable to research because it can receive different types of tissue and tumor grafts, as it mounts no rejection response. These xenografts (tissue or organs from one species transplanted into or grafted onto an organism of another



species) are commonly used in cancer research to test different drugs.

Zebrafish (*Danio rerio*): The zebrafish (*Danio rerio*) is a small tropical fresh-water fish found in northern India, northern Pakistan, Nepal, and Bhutan. This aquarium showpiece has occupied an important place in the catalogue of model organisms due to its small size and ease of culture. It is widely used for the study of embryonic development and gene function because their embryos develop outside the mother's body and remain transparent until most of the organs have fully developed.

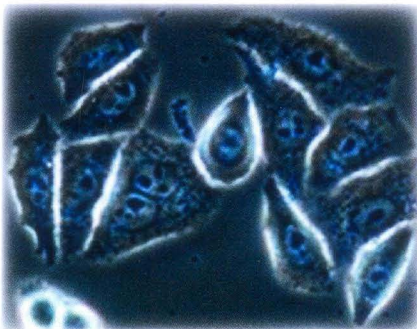
'Casper' is a mutant form of Zebrafish developed in 2008 at the Boston Children's Hospital that is ghostly transparent. This transparency allows any abnormality in the cells to be visualised



and tracked through the developing body. Thus, zebrafish permit scientists to follow the formation of tissues and organs in microscopic detail as the organism grows.

This small fish may be the key to understanding how vertebrates, including human beings, develop. The zebrafish genome is 1700 million base pairs in length, about half the size of the human genome. Many human developmental and disease genes have counterparts in the zebrafish. A number of zebrafish mutants so far generated are good models of human diseases and can therefore be used to test candidate drugs.

HeLa cells: HeLa cell is an immortal cultured cell line used in many scientific researches. This mammalian cell culture model is often used to study the ageing process due to the difficulty associated with high throughput lifespan analysis on different mammals. It is the oldest of all the cell lines and was derived from cervical cancer cells from a cancer patient Henrietta Lacks who died of cancer on 4 October 1951. This cell line is remarkably durable and prolific and the ease of use makes HeLa a genetically tractable, high-throughput platform.



Ethical Issues

The experimental use of lower animals such as microorganisms, plants, reptiles, and amphibians does not raise any ethical issues. However, the use of higher animals in scientific and medical research has been a subject of heated debate for many years.

In 1964, CPCSEA (the Committee for the Purpose of Control and Supervision of Experiments on Animals), a statutory body was formed by the Indian Parliament under the Prevention of Cruelty to Animals Act 1960. It was again revived in 1998, under the chairpersonship of Ms Maneka Gandhi. This committee is composed of members of the scientific community, regulatory authorities and animal activists and proactively trains and guides scientific and non-scientific personnel on different issues of laboratory animal welfare.

Animal welfare activists throughout the world are vociferous against the use of animal experimentation and have questioned the unethical and inhumane experiments conducted on animals. It must be emphasised that use of animals in research cannot be abandoned in the interest of both human and animal welfare.

So a balance should be struck so as to minimise the use of animals using different non-animal models and lower animals. In case of any dire necessity of animal experimentation, the research should be conducted only within the ethical framework ensuring the use of animal in a humane manner as far as possible thus minimising pain, distress and discomfort to the animals.

The use of model organisms in biological science has come a long way. A huge wealth of biological data has been amassed using these model systems. Consequently, the model organisms that were once developed for a specific domain of basic biological studies are now being used with greater success for a wider spectrum of studies involving preclinical studies, health, disease related studies and so on.

Dr. Saswati Sengupta, CCMB Housing Complex (V/12), HMT Nagar, Hyderabad-500076; Email: saswatis.biologics@gmail.com



CSIR-NISCAIR Announces a Five-Day Course

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Course dates:

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Course venue:

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Course contents:

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Basics of popular writing for magazines and newspapers

Basics of research communication

Creation of information resources, e.g. encyclopedic publications

Publishing and Copyright

Use of modern IT tools in science communication

Role of graphic arts in popular science communication

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For more details, contact:

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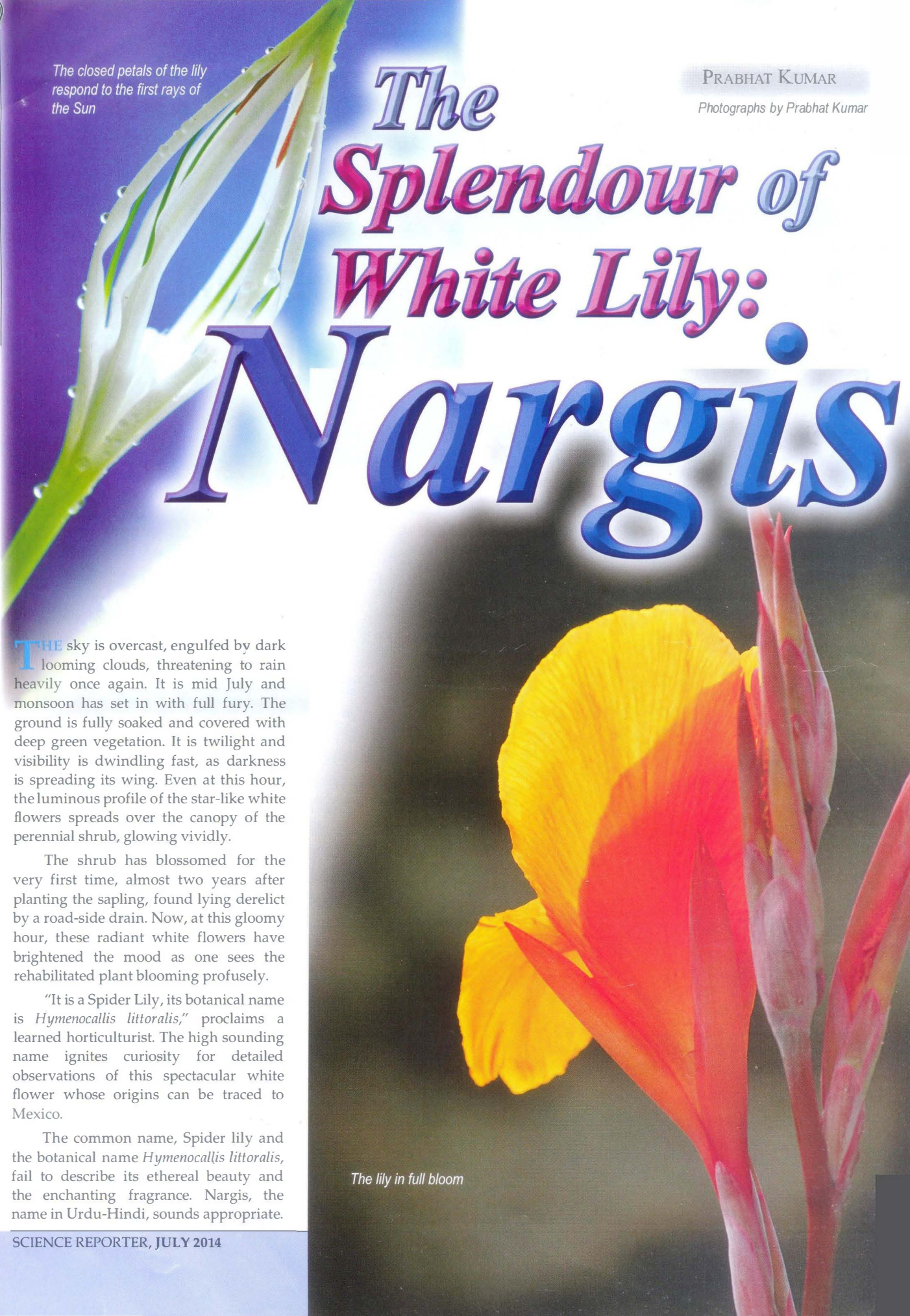
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The closed petals of the lily
respond to the first rays of
the Sun

FEATURE ARTICLE



The
Splendour of
White Lily:
Nargis

PRABHAT KUMAR

Photographs by Prabhat Kumar

THE sky is overcast, engulfed by dark looming clouds, threatening to rain heavily once again. It is mid July and monsoon has set in with full fury. The ground is fully soaked and covered with deep green vegetation. It is twilight and visibility is dwindling fast, as darkness is spreading its wing. Even at this hour, the luminous profile of the star-like white flowers spreads over the canopy of the perennial shrub, glowing vividly.

The shrub has blossomed for the very first time, almost two years after planting the sapling, found lying derelict by a road-side drain. Now, at this gloomy hour, these radiant white flowers have brightened the mood as one sees the rehabilitated plant blooming profusely.

"It is a Spider Lily, its botanical name is *Hymenocallis littoralis*," proclaims a learned horticulturist. The high sounding name ignites curiosity for detailed observations of this spectacular white flower whose origins can be traced to Mexico.

The common name, Spider lily and the botanical name *Hymenocallis littoralis*, fail to describe its ethereal beauty and the enchanting fragrance. Nargis, the name in Urdu-Hindi, sounds appropriate.

The lily in full bloom



The Spider lily is an ethereal beauty with an enchanting fragrance. Here's an interesting account of the goings on as the flowers of the lily open up answering the calls of the first rays of the sun.



The Pansy butterfly – one of the first visitors



*Anticlockwise from left:
The bee alights on the flower oblivious of its future;
The waiting Crab spider grabs the bee in its pincer-like fangs;
Oblivious of the game of life and death being played around it, the Pansy butterfly continues to suck the nectar of the lily*



Poets eloquently have sung in couplets, bringing out the unsurpassed charm, unblemished purity and tenderness of this elegant flower.

The Spider lily bush loves moisture in soil and humidity in air for luxuriant growth and flowers. This condition is provided during the rainy season. Water fronts and drain sides are their favourite hot spots if sun shine is available for



The Jewel bug alights on the flower in a profusion of colours;



Ants are the next to arrive on the lily;



And suddenly the flower is crowded by ants

In true bugs such as the Jewel bug, the body or thorax is enlarged forming a shield over the two pairs of wings, having bright metallic covering with a variety of patterns over it. This covering does not divide in the middle and thus does not split open in flight, like in beetles.

The spectacle being performed inside the cup of the funnel-shaped flower on the subject of life and death is a natural drama. Flowers have demonstrated that they are acting as a nano-ecosystem, part of the hierarchy of the larger mega-ecosystems.

three to four hours. For decoration, it is an excellent cut flower. It can be grown in pots also. It remains in dormant stage for about nine months through October to mid June.

It is a treat to see the flowers open in a sudden burst, one by one, within fifteen minutes at sun-set hour. First, an elongated bulbous form of closed petals joined at the tip starts bulging slowly at the mid portion and then, in a split second, the six petals are thrown open downward.

It is a thrilling phenomenon to witness at dusk, just before 6 pm in the months of July-August. The petal-burst is fast. Also, it is difficult to capture it in a photograph by a still camera. As the flower opens up, a bewitching fragrance is instantly released which was till now sealed inside the neck of the flower. This light aroma spreads far and wide with the breeze. It is a way of sending floral invitations to interested parties.

Although ephemeral in nature, this fragrance has reached the target. Both nocturnal and diurnal insects start to flock over the freshly opened flowery restaurant. The invitees are a mixed lot including carnivores also.

The Crab spider is one such, who has gate crashed even before the opening of the petals. It has placed itself cleverly to ambush victims by camouflaging itself so dexterously that it remains unseen, merging its white body with the white colour of the flower. With pincer-like front pair of legs, the terminator grabs and kills a bee by injecting a potent venom into the body of the victim. The Crab spider will suck the juice out of the body of its prey leaving the skeleton bone dry. It is astonishing to see the small spider kill relatively a far bigger bee within a few seconds. This spider does not spin a web nor does it warp the victim in silken shroud. It is a predator of the first order.

A beautiful butterfly – a species called Pansy – has also arrived as an honoured guest. Wasting no time, it uncurls the long proboscis to its full length to reach the nectar stored deep down and starts drinking contentedly but with dignity. It is totally oblivious of the episode of the spider and the bee. The proboscis of the butterfly is a wonderful instrument, an appendage attached to its mouth for drinking liquids as we do from a straw pipe. This hollow tube can be coiled back and folded inside the mouth.



Caterpillars are voracious eaters of plant tissue



By evening a few half-eaten bulbs are left

It is not that there is only one freshly opened bloom, at least four more had opened almost simultaneously the previous evening. Hence vacant tables are available for many more invitees.

On one flower, a stately guest has just landed. It is a lone occupant, a beetle (?) draped in polka dot attire as is evident from its outer cover known as sheath. The beetle surveys the surroundings leisurely as if admiring the ambience provided by the Spider lily. It appears that the beetle is enjoying the warmth of morning sun. It is not in a hurry neither it is displaying any activity over the flower petals.

Beetles form the largest group of insects in the world. The sheath – armour-like covering – is unique to the beetle. It protects the delicate wings lying underneath. The sheath is a tough, shining and colourful element of its body.

The world of insects is wide and varied. Even experts find it difficult to differentiate between certain beetles and bugs. So let us first focus on the distinguishing features of beetles and bugs before passing our verdict: beetle or bug? The entomologist's criteria for identification will help.

Beetles have one pair of wings with wing sheaths having a parting in the middle. The sheath gets lifted to facilitate the wings to come out before flying. In true bugs such as the Jewel bug, the body or thorax is enlarged forming a shield over the two pairs of wings, having bright metallic covering with a variety of patterns over it. This covering does not divide in the middle and thus does not split open in flight, like in beetles.

Now concentrate on another picture of our guest photographed on a cactus. There is no parting over its thorax or body. Conclusively, the insect mentioned

earlier is not a beetle but a Jewel bug! Jewel bugs (*Crysochoris stollii*) are amongst the most colourful of all insects, rivaling beetles and butterflies. These bugs are misidentified as beetles most of the time.

Flies also congregate over the top thin membrane of the flower, which provides a comfortable landing platform or table to the visitors. There are house flies of normal size and fruit flies of larger body mass, and varying colours. The flies constitute a major insect order next only to beetle. Incidentally, mosquito, the most hated insect, falls under the same order.

The flies are feasting hilariously. Some are blowing liquid bubbles through their mouths after sucking the nectar belly full. The bubble blowing activities go on for quite a long time, displaying their playful mood and giving opportunity for good shots. The nectar has cast an intoxicating spell on these creatures. They do not find the clicking sound of the shutter disturbing and refuse to fly out, throwing all caution to the wind – a very unlikely behaviour.

Meanwhile, the cunning but cruel Crab spider has pounced upon a fly, killing it instantly, as the fangs inject a lethal dose in the head directly. In animal world there is no mercy.

Ants are different from others. They have assembled in groups, displaying a strong social bond which is their strength also. These ants are not vulnerable to attacks by predators as they themselves are marauders. And so the Crab spider is now sulking in one corner of the petal in a resigned disposition. If it dares to attack, the ants will make mince meat of the spider. But so inebriated are the ants with nectar that some dead ones are entrapped inside the neck of the flower containing nectar.

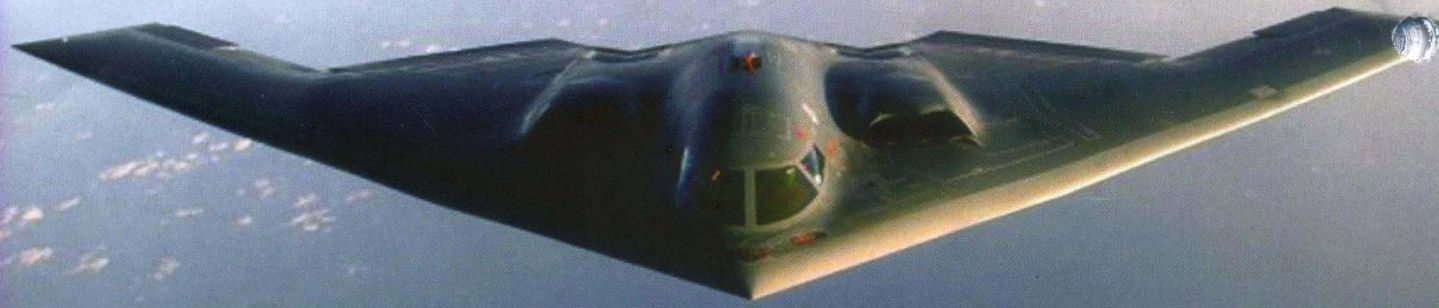
The story does not end at this point as it should. By mid August, caterpillars have emerged in battalion strength and they are voracious eaters of plant tissue. The Spider lily has generously supplied sweet complements – food – to most of the guests but caterpillars are devouring the entire stalks of the flowers before they have blossomed. The caterpillars have found a very delicate and delicious food of their liking. But the bush has produced so many stems, bearing flowering stalks, the supply is in abundance.

Next evening a few half eaten bulbs blossom but are deformed in shape. The gracious flowers have become hapless victims this time. Also, the flowering season has come to an end by the last week of August.

The spectacle being performed inside the cup of the funnel-shaped flower on the subject of life and death is a natural drama. The flowers have demonstrated that they are acting as a nano-ecosystem, part of the hierarchy of the larger mega-ecosystems. Seven insects, namely spider, butterfly, beetle, bug, fly, ant and caterpillar have participated in the drama – a sequence of eating and being eaten – in the back drop of a larger canvas of Food Chain/Web system. The all-encompassing ecosystem demonstrates this phenomenon in a wider perspective.

Needless to say, we save an entire ecosystem when we save a flower.

Mr Prabhat Kumar, a civil engineer by profession, has rendered more than 38 years of service in various government and PSU departments. He retired from Coal India Limited in 2005 from the post of Chief General Manager (environment and civil). Address: House no. 342/b, Road no. 4b, Ashoknagar, Ranchi-834002, Jharkhand



Stealth Aircraft

Striking with Stealth and Precision

ARNAB CHATTERJEE

WITH the advent of the First World War in the early 20th century, defense technology began advancing at a great pace. All countries involved in this devastating war started stepping up their technologies in order to outsmart and in turn defeat their enemies.

Aviation technology was also revolutionized as nations realized the potential of an aerial attack which has the capacity to devastate the morale of people and can easily inhibit the war effort by eliminating strategically important targets such as industrial parks. Consequently, detecting such enemy aircraft assumed importance as a defensive system.

After the First World War, many nations secretly started developing and researching on the radar and its potential use to serve as an early warning system before the actual attack took place. Research on radar technology rapidly continued throughout the war years and the British were the first to use radar as a defensive measure to detect incoming enemy aircraft during the Battle of Britain in 1940.

This rapid growth of radar technology was subsequently countered by stealth technology which could make aircraft virtually undetectable to radars. One of the first aircraft on which this technology was put to practice was the Horten Ho 229. The aircraft was a flying wing design and its employment of charcoal with the wood glue of the airplane made it absorb radio waves.

A stealth aircraft's primary job is to complete its mission undetected by its

enemy. Modern stealth aircraft employ various methods to reduce their radar and infrared signatures. Stealth bomber aircraft like the Northrop Grumman B-2 Spirit, which is capable of delivering nuclear weapons, become virtually invisible to radar detection by having a very negligible signature.

The primary factor in a stealth aircraft is its design. Stealth aircraft are designed to decrease their radar cross section so that the waves that are transmitted towards the aircraft are either absorbed or are largely deflected. A stealth aircraft avoids rounded aerodynamic surfaces which are unable to deflect radio waves transmitted perpendicularly on its surface thus compromising its position.

Stealth aircraft also absorb radar signatures by usage of RAM or Radar Absorbent Material. Although most Radar Absorbent Material are classified, the most common type of Radar Absorbent Material that was used in early stealth aircraft such as the Lockheed Martin F-117 Nighthawk and the Lockheed SR-71 Blackbird was "Iron Ball Paint". In this process, the aircraft's surface is painted with tiny metallic spheres coated with ferrite. When radar waves fall on this surface, they cause molecular oscillations in these spheres thus turning the incident radar energy into heat which is dissipated.

The design of a stealth aircraft has also to deal with protrusions that can compromise its stealth. Thus, all modern stealth aircraft mostly store their entire payload inside their wing or fuselage which is only compromised when it

discharges its weapon to attack its target. Aircraft engines are often set within the fuselage which reduces radar signature.

Of the earlier stealth aircraft, the Lockheed SR-71 Blackbird utilized composite materials in strategically important locations and had canted vertical stabilizers along with Radar Absorbent paint to significantly reduce its radar cross section although it mainly relied on its high cruising altitude and its supersonic speed.

Lockheed Martin F-117 Nighthawk was the first military stealth aircraft to come under service, but its radical design to counter radar waves made it aerodynamically unstable and thus it could not be controlled without fly-by-wire controls.

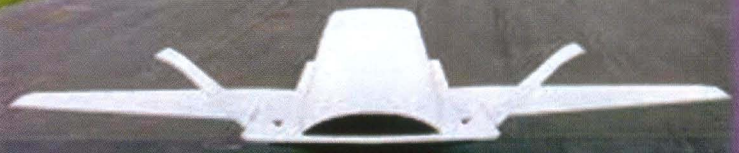
With the advent of thrust vectoring technology and advanced avionics, stealth fighter aircraft like the Lockheed Martin F-22 Raptor gained greater

B-2 Stealth Bomber





F-22 Raptor
(Courtesy: www.en.wikipedia.org)



Northrop experimental stealth aircraft

maneuverability along with stealth technology which gave them a greater edge over conventional fighter aircraft. The Raptor can also conduct small bombing missions virtually undetected, thus also claiming greater versatility over conventional fighter-bombers.

All stealth aircraft have a radical design as compared to other conventional aircraft. The Northrop Grumman B-2 Spirit is a flying wing design which uses split rudders as it has no distinct empennage. The Lockheed Martin F-35 Lightning II has also incorporated V/STOL capability (Vertical/Short Take Off and Landing) along with its stealth and thus has achieved even greater versatility as it needs very less space to operate from. Aircraft like the F-35 Lightning and F-22 Raptor use planform alignment, which involves using small number of surface orientations in the shape of its structure to avoid radar detection while corner reflections of radar waves are reduced by

Stealth aircraft also give military operators the element of surprise. The F-22 and F-35 can conduct strikes at supersonic speeds under the full cover of stealth minimising loss of human life.



F-117A Nighthawk

aircraft like F-117 Nighthawk by tilting their tail surface or as in case of the B-2 Spirit, a presence of a vertical stabilizer is completely eradicated.

Along with radar, aircraft were also detectable by infrared rays and thus to keep the title of being a stealth aircraft, engine exhausts of early stealth aircrafts were set in the fuselage like that of the B-2 Spirit. The exhaust is thereby cooled by the air following the surface of the wing. Also positioning fuel lines or tanks near the exhaust makes them act as heat absorbers thus reducing infrared signature.

Stealth aircraft have a great aerial advantage over conventional aircraft as they can penetrate deep into enemy territory without being detected and thus reduce life risk factor for the pilots. Also with the major involvement of computer systems in the cockpits of modern aircraft, a lot of work can be done easier and quicker thus making it possible for as little as four people to successfully complete a mission which would previously require more crew and support aircraft.

In spite of having an upper hand in modern aerial warfare, stealth aircraft do have a few limitations. They utilize a variety of composite and radar absorbent material to inhibit detection by infrared and radar. However, aircraft that have radar absorbent skin are comparatively sensitive than conventional aircraft skins.

Stealth aircraft also spend a long time on the assembly line before they are finally finished and are much more expensive than conventional military aircraft. Aerodynamic instabilities also often bothered aircraft like the F-117 Nighthawk and the B-2 Spirit which would have been highly instable to control without the constant

corrections by the digital fly-by-wire control system onboard the aircraft. They also lacked afterburners which were necessary to give them an extra boost of thrust for speed as it would make them susceptible to infrared detection by the heat emitted. However, with the utilization of modern design techniques, this has been avoided in newer stealth aircrafts like the F-22 Raptor and the F-35 Lightning which are now able to incorporate afterburners like conventional fighter aircrafts.

Stealth aircraft can also give away their position due to externally mounted payloads which cannot be stored internally inside the aircraft as their internal payload capacity is quite reduced due to design considerations.

Modern stealth aircraft, especially stealth fighter aircraft have overcome these shortcomings due to more advanced design techniques and avionic technologies. Stealth aircraft also give military operators the element of surprise. The F-22 and F-35 can conduct strikes at supersonic speeds under the full cover of stealth minimising loss of human life as systems on board can pinpoint targets and destroy them without causing damage to the surroundings. Pilots operating inside stealth aircraft feel a lot safer than while conducting missions on conventional aircraft as they can accomplish their mission undetected by the enemy.

Even though stealth aircraft are undoubtedly one of the greatest military aviation technologies that the world has come up with, we just hope we do not get to see them in action on real battlefields.

Arnab Chatterjee is a student and a NASA DashLink Researcher, which is a part of NASA's Aviation Safety Program under NASA's Aeronautics Research Mission Directorate. Address: C/o Amit Chatterjee, 32, Muktarpara, 1st Lane, Hatkhola, Chandannagar, West Bengal-712136; Email: rnb.chatterjee@gmail.com

Growth-Promoting Antibiotics

M.K. CHATTOPADHYAY

ANTIBIOTICS are one of the major gifts of modern science that have changed the history of the human civilization. The mortality and morbidity caused by infectious diseases in the pre-antibiotic era were substantially reduced following the discovery of antibiotics in the last century. Antibiotics have significantly improved the quality of our life.

Antibiotics are also known to speed up growth in animals. If small doses of antibiotics are added to the animal feed, the daily growth rate is improved by 1 to 10%. The meat obtained from the antibiotic-fed animals is also of better quality with more protein and less fat. Growth-promoting effects of antibiotics were first reported in the late 1940s, based on observations on chicken, pigs and other species, fed with the by-products of fermentative production of chlortetracycline. Today, it has become a global practice.

Needless to say, the approach makes business more profitable. Pigs fed with antibiotics require 10-15% of less feed to achieve the desired weight. Cost of feed contributes a major fraction (70%) of the total cost of animal production. That is why, addition of sub-therapeutic doses of antibiotics (including those therapeutically useful to humans and animals) to feed is a standard practice followed in animal farms and poultries all over the world.

More than 80% of the antibiotics sold in the US and at least 50% of the antibiotics manufactured in China are used in animals and a major portion of these antibiotics are used as growth promoters. Examples include Beta-

lactams (penicillins), lincosamides, macrolides, tetracyclines, bacitracin, flavophospholipol and virginiamycin.

The rationale for adding antibiotics to animal feed is evident from an estimate that reveals that if the use of antibiotics as growth promoters was banned, the production of feed animals (pigs, cattle) and birds (chicken) would have to be increased substantially to match the production that was achieved using antibiotics as growth promoters (Animal Health Institute of America, 1988).

Mechanism of Growth-promoting Effect

According to the National Office of Animal Health (a British organization consisting of members from the animal medicine industry in the UK and Northern Ireland) antibiotics used as growth promoters "help growing animals digest their food more efficiently, get maximum benefit from it and allow them to develop into strong and healthy individuals". The underlying mechanism behind the growth-promoting effects of antibiotics however is not clearly known.

Food materials contain bacteria, which destroy some of the nutrients of the food materials, inhibit absorption of nutrients from the intestine and produce toxin that inflicts adverse effects on the health of the animals. It is known that as much as 6% of the energy in the diet could

There is no doubt about the advantages that antibiotics as a feed additive offer and also about the problems they contribute to.

Antibiotics are often used in animal feed to promote growth. But indiscriminate use of antibiotics could lead to antibiotic resistance even in humans. There is, therefore, a need to look for suitable alternatives.

be lost due to microbial fermentation in the intestine of the pigs. The growth-promoting effect of antibiotics is believed to stem from their ability to suppress growth of the food-borne bacteria.

It is also postulated that in the unhygienic environment of the farms and poultries, animals and birds always harbour some latent infections, which trigger immune responses in their body. During immune response, a group of immunomodulators (chemicals which induce, enhance or suppress immune response) called cytokines is released. It is believed that cytokines might stimulate the release of catabolic hormones thus resulting in wastage of muscles.

Similarly, in animals with low-grade infections, a substantial portion of the nutrients, which could otherwise be used for growth, is used up by the immune system of the body. By suppressing the infections, antibiotics appear to spare the resources, leading to improved growth.

It is relevant to recall an interesting hypothesis, also called the Dirty Chicken Hypothesis, proposed by Dr. Noel W. Solomons of the Centre for Studies of Sensory Impairment, Aging and Metabolism (Guatemala) in 1993 (Nutrition Reviews, 51: 327-332). Based on the observation that poor growth of chickens in overcrowded poultries with



FEATURE

According to the National Office of Animal Health antibiotics used as growth promoters "help growing animals digest their food more efficiently, get maximum benefit from it and allow them to develop into strong and healthy individuals".



unhygienic conditions could be reversed by supplementation of antibiotics in their diet, he proposed that children who are brought up in unhygienic environment grow to small-sized adults with low body weight. Even though they are apparently healthy (bearing no symptom of illness) their immune system is always challenged with low-grade infections and they bear high level of some immunological indicators.

In analogy with the chickens reared in unhygienic poultries, a lot of nutrients are spent up in these children in keeping the infections under control. Hence they fail to grow as healthy adults.

Antibiotic Resistance

Resistance of microorganisms to antibiotics is a major problem that could undo the beneficial effects of antibiotics. The problem has assumed monumental proportions on a global scale leading to the apprehension of some scientists that we might be pushed back to the pre-antibiotic era with almost no antibiotics available to control the infections. The concern does not appear to be grossly over-blown in view of the reports of the emergence of bacterial strains resistant to methicillin and vancomycin, the two antibacterial antibiotics which were

believed to be invincible when they were introduced into clinical practice.

An enzyme, called New Delhi metallo-beta-lactamase-1 (NDM-1), produced by some bacteria that are believed to originate from the Indian subcontinent, has been found to make the producer organisms resistant to a broad range of therapeutically useful antibiotics. The emergence of multidrug-resistant *Mycobacterium tuberculosis*, the causative organism of tuberculosis, has raised serious concern all over the world.

Indiscriminate and imprudent use of antibiotics is believed to promote the emergence of antibiotic-resistant strains of bacteria. The postulation, called Antibiotic Paradox, has earned credence since increase in the frequency of resistance to an antibiotic has been found to have a close association with the increase in its use in many cases. The animal body is inhabited by a large number of harmless bacteria sensitive to antibiotics. The antibiotic-resistant bacteria, which occur in small number, are outnumbered and suppressed by the sensitive bacteria.

Antibiotics have to be used for prevention and clinical management of various types of infections in the livestock and birds in animal farms and poultries. Besides being used for therapeutic purpose, they are also used in a large scale as growth promoters. These antibiotics kill or suppress the sensitive bacteria in the animals. The resistant bugs get an opportunity to grow freely in absence of any challenge posed by the sensitive bacteria. Thus the food animals and birds become a reservoir of antibiotic-resistant bacteria. The antibiotic-defying organisms are excreted by them into the soil, washed by rain, carried to the ponds,

lakes and rivers and enter into the bodies of the aquatic animals (e.g. fishes) which we use as food.

Resistant bacteria are selected into the body of the fishes also because of widespread use of antibiotics in aquaculture. There is enough literature on the occurrence of antibiotic-resistant bacteria in meat, eggs, fishes and shell-foods. Thus, use of antibiotics in animals promotes emergence and dissemination of resistant bacteria.

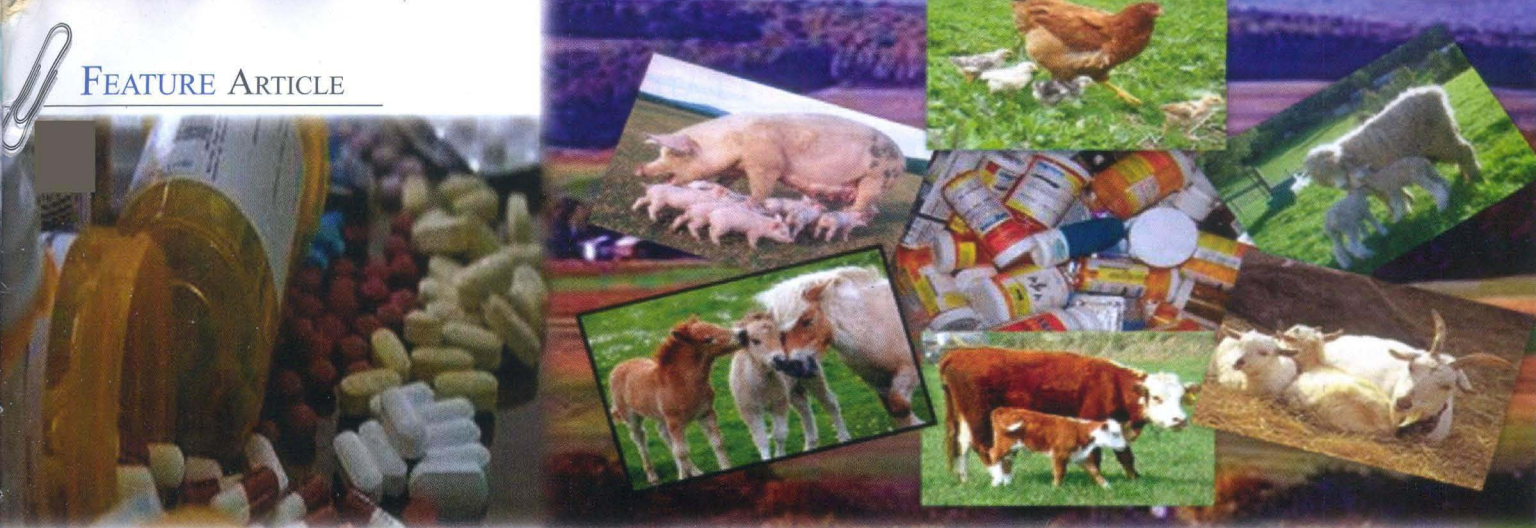
Even use of a non-therapeutic antibiotic as a growth promoter could promote the emergence of bacterial strains, resistant to a therapeutically useful antibiotic. For example, avoparcin is a glycopeptide antibiotic, not used in humans. But its use as a growth-promoting agent in animals and birds has been implicated behind the emergence of bacterial strains resistant to vancomycin, which is also a glycopeptide antibiotic.

Antibiotic-resistant bacteria are transmitted from animals to humans also by direct contact. Though many of them are harmless, they may lead to serious health hazards in persons with weak immunity. They also bear the potential to disseminate copies of the resistance conferring genes to the bacterial flora of humans by horizontal gene transfer. Thus use of antibiotics as feed additive is associated with far-reaching consequences.

Remedial Measures

1) Use of friendly bacteria: In view of the problem of antibiotic-resistance being furthered by the use of antibiotics as growth promoters, scientists are looking for non-antibiotic growth promoters like feed bacteria that colonize in the intestine





The underlying mechanism behind the growth-promoting effects of antibiotics however is not clearly known.

of the animals and prevent the growth of pathogenic bacteria. Bacteria used for this purpose are known as probiotics. Besides colonizing in the intestine and suppressing the pathogenic bacteria, they are also believed to stimulate the immune system. Some of them are known to have tumour-suppressing effect. However, the use of live bacteria is also associated with dangerous possibilities. Use of enzymes, which break down complex food materials and promote nutrition, appears to be a suitable alternative.

2) Use of safe antibiotics: Flavophospholipol, a glycolipid antibiotic, is not absorbed from the intestine of the animals. Besides improving the efficiency of feed conversion in the intestine, it also alters the microflora in the intestine in such a way that growth of the beneficial microorganisms (involved in the synthesis of vitamins, amino acids, and enzymes) is promoted. Flavophospholipol also accelerates the synthesis of volatile fatty acids, decreases the formation of ammonia and methane and promotes the degradation of cellulose. It does not induce cross-resistance to any antibiotic. It selectively inhibits the growth of some bacteria that play a significant role in transmission of antibiotic-resistance. Hence, it appears to be a safe alternative to the therapeutically important antibiotics used as growth-promoters.

Ionophores, fermentation products of microorganisms, disrupt the transmembrane ion concentrations required for proper functioning of the membrane and survival of the microorganisms. Hence they have antibiotic properties. Some of the ionophores (monensin, lasalocid, salinomycin, narasin) are used as growth promoters. The mechanism of microbial

resistance to ionophores is complex and specific. Hence use of ionophores is not likely to contribute to the problem of antibiotic-resistance.

3) Ban on the use of antibiotics: Since use of antibiotics as growth promoters is likely to promote the emergence of antibiotic-resistant bacteria, strictures on the addition of therapeutically useful antibiotics to the feed were imposed by a number of regulatory authorities all over the world from time to time.

In the UK, the Joint Committee on the use of Antibiotics in Animal Husbandry and Veterinary Medicine, chaired by Professor M.M. Swann, was appointed in July 1968 following an epidemic of the antibiotic-resistant food-borne pathogen *Salmonella typhimurium* in 1963-65. The report of the committee published in November 1969, recommended a ban on the use of some therapeutically useful antibiotics (chlortetracycline, oxytetracycline, penicillin, tylosin and the sulphonamides), as growth promoter. The recommendations were mostly accepted by the government. However no restriction was imposed on the use of such antibiotics for therapeutic and prophylactic purposes in animals.

Subsequently, in 1992, the Lamming Committee recommended reconsideration of the use of antibiotics for prophylactic purpose. Accordingly, the Veterinary Products Committee decided to discourage such use and to consider each case individually by merit. Similar prohibitive measures were adopted in some other countries of Europe. Use of all growth-promoting antibiotics was banned in Sweden (1986) and Switzerland (1999).

Use of avoparcin and virginiamycin was banned in Denmark in 1995 and

1998 respectively. A ban on the use of bacitracin, tylocin, spiramycin and virginiamycin was imposed by the European Union in 1999 and a total ban on the use of antibiotic as feed additive was completed with effect from 1 January 2006, when four substances (monensin sodium, salinomycin sodium, avilamycin and flavophospholipol) were removed from the EU Register of permitted feed additives.

In 1977, the US Food and Drug Administration (FDA) imposed a ban on some agricultural uses of antibiotics. But subsequently it had to remove the ban since the Congress passed resolutions forbidding the ban. Many poultry and meat producers in the US are not convinced that use of antibiotics in animals has any link to the occurrence of drug-resistant bacteria in humans.

Following the ban, a decrease in antibiotic-resistance was noticed in some cases. However, in absence of the protection obtained from the prophylactic use of antibiotics, an overall deterioration in animal health (indicated by diarrhoea, weight loss, mortality) was observed.

There is no doubt about the advantages that antibiotics as a feed additive offer and also about the problems they contribute to. It appears that search for suitable alternatives and periodic evaluation of the performance and side effects of the compounds which are in use are the only measures that we could adopt to contain the problem. Concerted efforts involving the government and private agencies are the need of the hour to deal with the issue.

Dr. M.K. Chattopadhyay is Senior Principal Scientist, Centre for Cellular and Molecular Biology (CCMB), CSIR, Uppal Road, Hyderabad 500007, A.P.; Email: mkc@ccmb.res.in

Inbreeding: Threat to Adivasi Population in Kerala?

T.P. MUHAMMED AZHARUDHEEN

THE adivasi population in the most literate and socially and economically leading state of India has been recently in the news for all the wrong reasons. There are many reports of infant mortality among the adivasi population, attributed mainly to malnutrition.

According to the 2001 Census of India, the Scheduled Tribe population in Kerala is 364189 (lunas 180169 and felunas 184020). Most of the tribal people of Kerala live in the forests and mountains of Western Ghats, bordering Karnataka and Tamil Nadu. Wayanad has the highest number of tribals (136062). Idukki (50973) and Palakkad (39665) districts are the next two that make up the lion's portion of the native tribal groups in the state. Paniyar (Paniya) is the biggest tribe among the 35 major tribes.

In contrast to other communities, the adivasi population is declining in the state. Poverty, deprivation and loss of rights over their own livelihood have affected the demographic transition of adivasis in Kerala negatively. A recent estimate of the different tribes of the adivasis in Kerala has shown that, in some tribes the population size has reached such an alarming level that they are at the verge of extinction (Table 1).

Many man-made, socio-economic reasons have been attributed to this sorry state of affairs. But one cause that is largely ignored or overlooked is the effect of reduced population size, which results in the mating of genetically related

individuals and the resulting genetic issues. So, what is happening in the tribal belts of Kerala is a result of both artificial selection, attributed mainly to the man-made issues, and the effect of natural selection attributed to the reduced population size. Both these forces are acting so synergistically that the adivasi population is declining at a rapid pace in Kerala and the trend is almost irreversible.

Artificial Selection at Work

A genotype is said to be fit when it contributes gametes to the total gametic pool in proportion to its frequency in the population. So, all the individuals contribute equal number of gametes to the gametic pool when all the individuals are equally fit ($F=1$) or selection is not operative.

But, when selection operates, fitness of some genotypes is reduced. This relative reduction in the fitness of a genotype, when the fitness of a normal genotype is equated to one, is called selection. Both natural and artificial selection can operate in a population.

In the case of the adivasi population in Kerala, the man-made artificial selection has been going on all through these years. Adivasis were the major victims of the birth control programme initiated during the emergency period. A large

proportion of the populations in different tribes were subjected to sterilization, primarily vasectomies. Encroachment of habitat (habitat invasion or lively hood invasion), introduction of alien culture, wrong development activities and programmes that lacked insight and efforts to 'uplift' them without proper understanding of their basic attributes all amount to a kind of artificial selection.

The effects of these artificial selections were manifested in the form of hunger, malnutrition, poverty, non-genetic diseases, etc., which eventually reduced the fitness of the individuals of the adivasi population and finally led to a decline in the population size over a period of time.

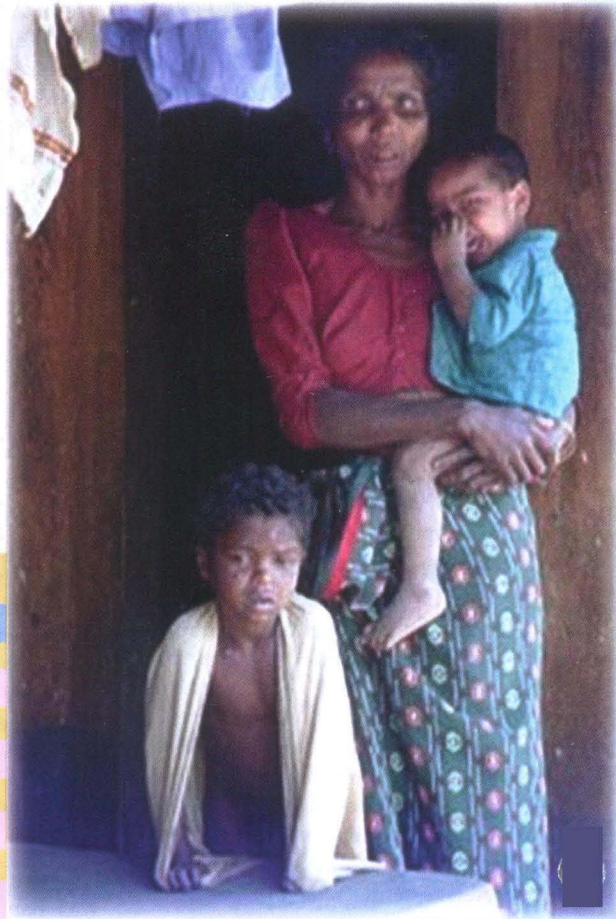


TABLE 1: POPULATION SIZE OF ADIVASI TRIBES THAT FACE THREAT OF EXTINCTION

Name of the Tribe	Population size	Name of the Tribe	Population size
Kondakapus	5	Koraga	<2000
Kochu Velan	36	Kurumbas	<2000
Maha Malasar	36	Palliyar	<2000
Koda	36	Malasar	<2000
Palliyar	155	Eravallan	<4000
Malakkuravan	547	Hillpulaya	<4000
Paliya	236	Kadar	<4000
Kudiya-Melakudi	751	Malai Pandaram	<4000

SHORT FEATURE

The effects of these artificial selections were manifested in the form of hunger, malnutrition, poverty, non-genetic diseases, etc., which eventually reduced the fitness of the individuals of the adivasi.

produced by two generations of inbreeding.

in simple terms, mating of genetically related individuals is called inbreeding. As a result of inbreeding, the resultant offspring may carry two genes at a locus that are replicates of one and the same gene in a previous generation (in the ancestor). The proportion of homozygotes goes on increasing in the population and the proportion of heterozygotes decreases in the population.

Therefore, the deadly recessive deleterious alleles which were masked by their dominant counter parts in the ancestor become homozygous in the inbred progeny leading to a reduction in the vigour of the genotype (Figure 1).

In Figure 1, the deadly recessive deleterious allele *a*, responsible for a disease, (e.g., sickle cell anaemia), is masked by the dominant allele in the heterozygous condition in the ancestor (generation 0). As long as random mating is ensured in the population, which is possible only when the population size is large, the recessive homozygous genotype, *aa* will never appear in the population. But as the population size decreases so that random mating of individuals is no longer possible, the sickle cell anaemic *aa* genotypes start appearing in the population. The frequency of such recessive homozygous genotypes is inversely proportional to the population size. This effect of unraveling of deleterious recessive alleles takes place in all the loci of the individual thus adversely affecting the fitness of the genotype.

The effect of inbreeding is similar in all organisms except those adapted to self fertilization (e.g., self pollinated crops like rice, wheat, etc). Mentally retarded children were a common scene among the Brahmin community in Kerala because of their tradition of marrying into close relatives and the tight knit nature of the society.

In a cross-pollinated crop like maize, the effect of inbreeding can be so drastic as to reduce the vigour in one or two rounds of inbreeding. In Figure 2, the plant at the far left is non-inbred, the plant second from left was produced by one generation of inbreeding, and the two plants on the right were

Even while maintaining a cattle breed or a variety in a cross-pollinated crop, a minimum population size, called the effective number, has to be ensured in order to avoid the deleterious effects of inbreeding. This is also an important issue in the conservation of endangered species; the dwindling tiger and lion population, and the possible inbreeding and the resultant genetic issues, are the biggest worries of population geneticists and conservationists.

But in some of the adivasi tribes in Kerala population size has reached such a level that inbreeding (mating of genetically related individuals) became unavoidable (Table 1). That is why some of the genetic disorders like sickle cell anaemia, which are almost unheard in other communities in the state, are increasingly being reported from the adivasi population. This process of natural selection was taking place silently all through these years.

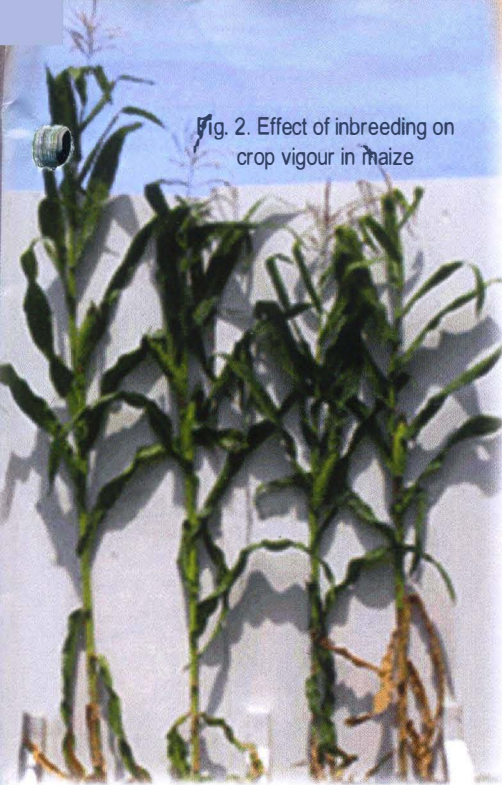
In every census after independence, some tribes present in the previous census seem to have disappeared from the population. For example, the Malayakandi and Vishavar tribes who were present in the 1961 census could not be found in the 1971 census. The same fate is awaiting Konda kapus, Kochu Velan, Maha Malasar and Koda tribes in the immediate future.

The fall in the adivasi population can no longer be stopped. Its downward spiral is no longer reversible. According to research, in order for a culture to maintain itself for more than 25 years, there must be a fertility rate of 2.11 children per family. With anything less, the culture will decline. Historically no culture ever reversed a 1.9 fertility rate. A rate of 1.3 is impossible to reverse.

So, with a declining population, it is just a matter of time when we will have to count the adivasis in Kerala along with the ever increasing number of extinct organisms.

Mr T.P. Muhammed Azharudheen is with the Division of Genetics, Indian Agricultural Research Institute, New Delhi-110012. Address: Room No 7, Hemant Hostel, Indian Agricultural Research Institute, New Delhi-110012; Email: tpazhar@gmail.com

Fig. 2. Effect of inbreeding on crop vigour in maize



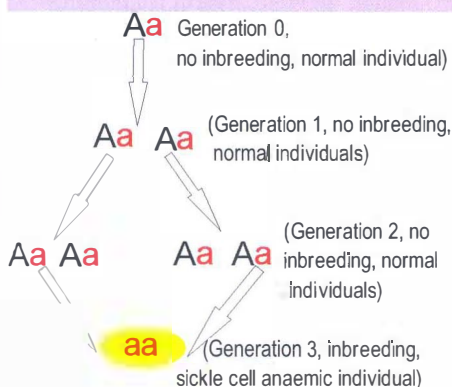
Natural Selection

Humans have played their part in eliminating a less fit (weaker and easily exploitable) section of the society. Now it is the turn of nature to act upon the population that is less fit in terms of evolutionary terms, which will accelerate the damage caused due to the man-made activities.

The degree of relationship between individuals in a population depends on the size of the population. Pairs mating at random are more closely related to each other in a small population than in a large one. As the size of the population decreases, a phenomenon called inbreeding starts occurring in the population.

Mating together of individuals that are related to each other by ancestry or,

Fig. 1. DEADLY DELETERIOUS RECESSIVE ALLELES BECOME HOMOZYGOUS DUE TO INBREEDING





Spending Time with Harini and Priyanka

M. ASHOKKUMAR, C. SAKTHIVEL, K. SUDHAKAR AND AJAY A. DESAI

HARINI is a 45-year-old wild elephant, residing in the Mudumalai tiger reserve. She spends most of her time in Kargudi (a place located in the middle of a tiger reserve) with her clan (several herds of elephants together make up a clan). She is one of the favourite elephants of Mr. Ajay Desai, who has been following these elephants for more than three decades.

We first saw Harini in the eastern part of the Mudumalai tiger reserve near village Anaikatty on 16 November 2006 and we were surprised to see her with a radio collar which was collared a decade before (1995). She was with her six-month-old calf along with an elephant herd moving towards a stream (Ketharhalla) probably to drink water after resting in the shade during the hot hours of the day.

That evening we went up to Anakatty village to check if there was any crop raid

by elephants, but there was no sign of elephant movement around the village. While coming back from Anakatty in a jeep we saw her again feeding near the road with her clan members. The clan is docile, they do mock charges when disturbed, and if undisturbed they graze within a few meters of your vehicle without doing any harm.

In March 2007, we spotted her while she was drinking water in a waterhole. We slowly moved with our tracker on to the other side by checking the wind direction. Elephants have poor eye sight, but they have very good olfactory (smell) capabilities. So, it is important to check the wind direction. We sat down on the other side of the waterhole.

There were Harini with two females, with their respective calves. While they drank the water by standing on the bank itself, the calf was too small to reach the water and just moved excitedly here and there. Then the females started spraying water on their body to cool themselves.

That night Harini came to Kargudi. A female elephant in the clan, Priyanka, broke the back door of our research station, while Harini was standing near the road. This is the second year that the female broke the door – it was trying to drink water from the water tank in the kitchen. The most interesting part was that though the elephants were operating in a vast area of 600 square kilometers, they remembered the key resources in their range, necessary for their survival. They have amazing fidelity to their range. Our team could find out exactly where they would be from the old movement record file of Harini and Priyanka.

At this point, we must introduce our boss elephant. He is around 40 years old and we call him Makhna. He operates in Mudumalai and the adjoining Gudalur forest. He is inevitable to become a crop raider because he has lost his part of the range to a tea plantation. He was a regular visitor to our research station, during our study period.

Harini (on the extreme right) and drinking water along with the herd in the cross cut road waterhole in Mudumalai Tiger Reserve (left)

Harini along with its calf and a juvenile male drinking water in the roadside in the Masinagudi-Theppakad road in Mudumalai Tiger Reserve (right)

Track of a bull elephant that crossed across the paddy field just planted in the settlements of Mudumalai Tiger Reserve (note there is no sign of feeding on the crops) (below right)

The most interesting part was that though the elephants were operating in a vast area of 600 square kilometers, they remembered the key resources in their range, necessary for their survival.

In the year 2004, he learnt to break the backyard door and drank the water from the bucket. Operating in a disturbed area, Makhna has high tolerance for human disturbance. One evening he stole Jack fruit from a shop in Thorapalli village. He just broke the kitchen shed of the shop in the centre of the village and made away with Jack fruit.

In 2013, we expected the elephant to visit our research station and amazingly it came in the same month and completely removed the kitchen roof just to eat a few seeds of Jack fruit left in the dust bin. Our presence in the station could marginally reduce the damage as he usually comes late in the night after finishing his regular crop raiding in the adjoining villages.

During our course of study we observed elephant herds were doing more damage in the moist deciduous forest area located in the middle of the Mudumalai Tiger Reserve, where the forest is fragmented and sandwiched with settlements inside the core area. But often they cross the swamps without feeding. But sometimes two herds come face to face leading to a conflict and damage to crops. In such a scenario sometimes even bursting of fire crackers, lighting torches and shouting could not cease the raid.

Priyanka's clan's major part of the range falls in Wayanad and Mudumalai. Her body condition and de-pigmented ears and trunks exhibit her prettiness. But her clan is one of the most furious



clans – they completely avoid human use areas. Though they move through the villages their presence inside the forest is difficult to detect. Following her is the most dangerous job as she and her clan members charge at any time. In Chokanalli (a village in the eastern part) local tribals avoid going inside the forest while Priyanka's clan forage around these areas.

Though these clans crossing the seven villages located in the eastern boundary of Mudumalai tiger reserve two times, they were never observed to raid the crops – they simply follow their way. This reminds us of the lines in a book *Week with Elephants*: "Though there

is availability of crops in the vicinity, elephants do not raid crops unless necessary or they learn to do so."

Thus, these elephants even after two decades are still following their way. It is our responsibility to save their corridor areas for peaceful co-existence of humans with elephants and other wild animals.

M. Ashokkumar is with the Center for Wildlife Studies, Kerala Veterinary and Animal Sciences University, Pookode-673576, Kerala; C. Sakthivel is with WWF-India, Western Ghats Landscape, Bhavanisagar, Tamil Nadu; K. Sudhakar, is with the Keystone Foundation, Kothagiri and Ajay A. Desai resides at B.C. 84 Camp, Belgaum, Karnataka 590001

Marathon of the “Genetically Modified”



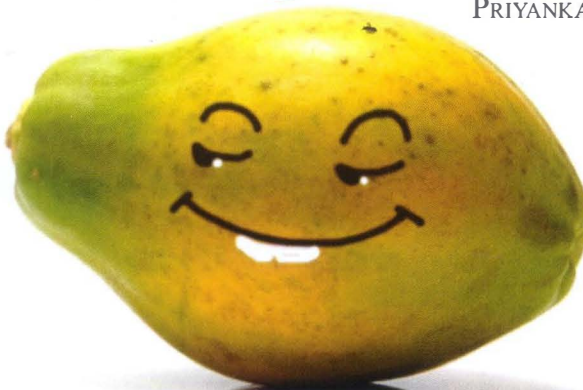
PRIYANKA HALDAR

“Eleven major Indian farmer unions urge Supreme Court to stop GM crop field trials”

“Objection against Bt cotton speculative and confusing says Indian Agriculture Minister”

“Resistance sprouts against Bt maize in Punjab (India)”

“Coming a cropper – Even Brazil and China have embraced GM crops, India must not dither”



THE above headlines in the leading newspapers of the country have forced us to help ourselves. Yes, we, the Genetically Modified plants are now going to spread awareness in the country of our potential benefits over the traditional crops. For this, the first move decided by us is to run a marathon under the aegis of the Universal Federation of GM crops, supported by renowned scientists from all over the world. The start point is a beautiful village in the southern part of Kolkata, West Bengal where the prime occupation of the villagers is farming.

And now the runners!!! I am the lead runner Brisky Brinjal. With me here are Peppy Papaya, Flavr Savr, Bunky Banana, Uncle Melon, Nutty Peas, Applex, Goldy Rice, and Corn-nel. The shot has just been fired and we have set out on one of the biggest challenges of our lives. All of us are holding flags with each of our benefits written on them. The farmers are giggling to their glory and fail to make an attempt to understand how much of scientific labour has gone behind making GMOs.

Just then Nutty Peas shouted, “Hey Sir, I have a fungus resistant gene inserted in me. You can try me out. No more of pesticides. Please take a sample.”

“Well done girl,” I said. This instilled some confidence in the others. We had crossed two kilometres to find a lush green potato field. “Hey, what are you guys up to? I am Picsky, the Potato,” shouted the potato crop from the field.

“I am Brisky, a genetically modified brinjal. All of us here are genetically modified.”

“What’s genetically modified,” asked Picsky.

“Scientists have modified our DNA in such a way that each of one of us has some or the other benefit, like improved shelf life, stress resistance, herbicide resistance or even pathogen resistance. For more details, why don’t you join the marathon Picsky? On-the-spot registrations are welcome.”

Picsky agreed and this was motivating enough for us. “Can I get resistant to Late blights?” Picsky asked.

“Yes of course. In fact, scientists are working on it,” Uncle Melon replied. Picsky now wanted to join our cause by taking us to some of the farmers. Looks like we are now getting down to serious business.

Just as we ran another two kilometres, Applex tumbled over the slippery roads next to the fresh water pond. He bruised himself. Picsky said, “Oops, be careful.

You will brown yourself.” Applex smiled, “I am a non-browning apple. I have a synthetic gene that sharply reduces production of polyphenol oxidase, an enzyme responsible for the browning.”

Picsky said, “Wow, so now we can have apple wedges, just like potato wedges in McDonalds.”

“But no oil, only healthy wedges, Picsky,” said Applex. Everybody agreed.

We now came across a bunch of school going kids. Flavr Savr handed each one of them a pamphlet about GMOs and a bottle of GMO tomato ketchup. She shouted as she ran, “If you want more, ask your parents to grow us.” Picsky tastes a little ketchup and finds a better taste. “GMOs are really astounding,” he said.

On the way, Picsky explained, “The landscapes here are a real beauty. The major cultivars here are rice and potato. The others grown are brinjal, papaya, cauliflower. And here is the Gram Panchayat, an official gathering of villagers.”

Just then a group of farmers came near us and read the information displayed on our flags. Goldy Rice started, “WHO survey says about 30% of the world population suffers from iron deficiency. To help you all come out of such health issues, scientists have modified me to



Yes, we, the Genetically Modified plants are now going to spread awareness in the country of our potential benefits over the traditional crops.

increase my iron content. In addition to that, I also can act as a great Vitamin A substitute. So why do you want to have medicines which have side effects for your iron and vitamin deficiencies when you can curb them by having merely rice with absolutely no side effects?"

Bunky Banana said, "Yeah, he is right. I too am injected with genes containing loads of iron and provitamin A. Am tasty and more over healthiest for a pregnant lady. Australian researchers and even the Department of Biotechnology India are trying hard to get me famous here. I request all you farmers to join them in their noble cause."

Corn-nel added, "Most farmers use a toxic chemical called Furadan to save their corn plants from insects. It kills leaf-eating insects, soil-inhabiting insects, wildlife, farm animals and you, if you drink it. So why do you guys want to use conventional methods of farming when you have non toxic genetically modified insect resistant corns?"

I too politely put forward my point to the farmers, "Sir, our country's population is increasing but at the same time our cultivable land is not. Also, the climate is changing fast. Hence, to meet the ever increasing demands of food crops in limited area and challenging climatic conditions, we must all resort to some smart and contemporary

methods of farming. We, the genetically modified crops are surely a solution to all your problems. We are sturdy, can bear extreme climatic conditions, we are drought resistant, we have higher nutritional values. Just give us a chance to prove our potential. I am sure none of us would disappoint you."

Picky too pleaded. The farmers nodded their heads and said they would love to try growing genetically modified crops. We continued the marathon to finally reach the finish point. We were surprised to find journalists, village women, kids, and researchers standing near the finish point, with constant recitals: "We want GMOs! We want GMOs!"

This was the moment that made all of us feel winners. We felt elated and energized enough to run a marathon once again! So sing along everybody...

*Kadam kadam badhaye ja
Khushi ke geet gaye ja,
Ye zindagi hai kaum ki,
Isliye tu GM crops ugaye ja...*

Ms Priyanka Haldar is a Masters in Biotechnology from the Bangalore University. She has a professional experience of almost six years as a researcher in various pharma and drug discovery industries. Address: Flat No.3, Raj Plaza, Anand Park, Dange Chowk, Thergaon phata, Pune-411033; Email: prynkhaladar@yahoo.com

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GAME NUMERO

Using all single digit numbers from 1 to 9, fill in the blank squares to form two 4-digit numbers, such that when the two numbers are added you get 11111 (eleven thousand one hundred and eleven). No digit is to be repeated. You may have to leave out any one number between 1 to 9.

1 1 1 1 1

What is the number that was left out?

Contributed by ASR Murthy, Sr Engg. Asst., Doordarshan Relay Centre, Devarakonda-508248, AP

There are three prizes of Rs 500/- each for three correct entries. In case of a large number of correct entries, the prize winners will be selected through a draw of lots. The decision of the Editor, *Science Reporter* will be final.

Send your entries to:

Puzzle Corner
Editor, *Science Reporter*

National Institute of Science Communication & Information Resources (NISCAIR)
Council of Scientific and Industrial Research (CSIR)
Dr KS Krishnan Marg, Pusa Campus
New Delhi-110012

**Last date for the
entries to reach us:
05-08-2014**

Name :

Address :

Pin code:

Age : Email: Sex:

Occupation : Student Housewife Teacher Professional Retired Other

Educational level : Primary Secondary Graduate Postgraduate

- Please fill up the questionnaire at the back
- You can send your answers on a photocopy of this page as well.



RADIOACTIVE SODOKU

Learning through games makes the process of memorizing elements easier. Radioactive elements are difficult to memorize for students. So it would be worthwhile to introduce radioactive elements through sudoku. Table 1 shows the list of elements, their symbols and their atomic numbers used in sudoku puzzle. Fill in the blanks so that each row, each column, and each of the nine 3x3 grids contain one instance of each of the elements listed in Table 1.

Table 1: List of elements

Element	Symbol	Atomic number
Technecium	Tc	43
Polonium	Po	84
Astatine	At	85
Radon	Rn	86
Francium	Fr	87
Radium	Ra	88
Thorium	Th	90
Uranium	U	92
Plutonium	Pu	94

			Th		U	Rn	
			At			Pu	Po
		Th	Pu		Rn		
Fr			Tc		Po		
At							Rn
		Pu			Po		Fr
			Po		Fr	Ra	
Ra	Po				Tc		
	Fr	Rn		At			

Contributed Ms Revathy Rajagopal, Department of Chemistry, Stella Maris College, 17 Cathedral Road, Chennai- 600086

BIOCHEMISTRY RIDDLES

- Fructose, mannose, sucrose are my family members, Every compound of my family contains rings of varied numbers. I'm the building block of carbohydrates. Name me.
- I'm the biochemical process used for ethanol production Yeast and Zymase are used to facilitate the reaction. In the process glucose undergoes disintegration, I'm neither dehydration nor saponification. Name the process.
- We are a class of naturally occurring organic compound of carbon, oxygen and hydrogen. We provide you clothes in the form of cotton, linen and rayon, We also help you to accomplish day-to-day function, Who are we?
- People refer to me as milk sugar, Chemists call me a reducing sugar. Identify me.
- I'm the most abundant organic molecule found in nature, People use me in industries like textile, plastic and paper, With different chemicals, I can form different products, But I'm unbreakable in human stomach. Identify me.
- We are high molecular mass complex biomolecules, On hydrolysis we form several amino acids. You can find me in milk, cheese, fish, meat, & pulses, I'm an integral part of human body structure and its vital function. Who am I?
- People call me building blocks of protein, I'm made up of carbon, hydrogen, oxygen, nitrogen. Everybody takes me in the name of valine, threonine, lysine in their diet, Kwashiorkor is caused due to lack of me in human diet. Who am I?
- I am a very popular vitamin, You can find me in turnip, milk, vegetables and kidney. Deficiency of mine causes diseases like Glossitis and dermatitis, Sometime I may cause fissuring at corners of mouth and lips. Name the vitamin.
- I am the nucleic acid and found in the cell nucleus, I exhibit the unique property of replication, Also responsible for hereditary character transmission. Who am I?
- Alexander Fleming discovered me first as penicillin, In market you can buy my neighbours like streptomycin, neomycin and ofloxacin. Who am I?

Contributed by Mr Bibhuti Narayan Biswal, Principal, Sri Sathya Sai Vidyani- ketan, Near Tata Ssl, N.H.No.-8, Ganeshvad Sisodra-396463, Dist. Navsari, Gujarat; Email: chem_iway@sify.com

Solutions to the puzzles published in the May 2014 issue

Prize Puzzle:

BASIC SCIENCES QUIZ

There was a mistake in the Prize Puzzle of the May issue. Therefore, the puzzle is being cancelled. We regret the inconvenience to our readers.

LANGUAGE NEWSPAPERS

English: 8 Hindi: 6
Bengali: 4 Urdu: 3
Telegu: 3

Total number of newspapers is 24.

SUDOKU

E	G	F	H	I	C	D	B	A
B	A	C	F	E	D	G	I	H
D	H	I	A	B	G	C	F	E
C	I	E	D	H	B	A	G	F
H	B	G	E	A	F	I	D	C
A	F	D	C	G	I	H	E	B
I	E	A	G	F	H	B	C	D
F	C	B	I	D	A	E	H	G
G	D	H	B	C	E	F	A	I



The male booby flashes his blue feet at possible mates. The bluer the feet the fitter and healthier he is likely to be, and so more attractive to mates.

Blue-Footed Booby

BLUE-footed boobies are possibly one of the world's most fearless birds! But it is this fearlessness and their utter clumsiness on land that makes them easy prey for other animals. How did they get this name?

When Spanish settlers first encountered blue-footed boobies, they found them very easy to hunt. The Spanish settlers named this bird "bobo" which in Spanish means 'stupid' or 'clown-like'. And they have large blue feet and are about the size of a goose.

Blue-footed boobies are found in Central America, on the Galapagos Islands,

the west coast of Mexico and northern South America. They weigh between 3 and 4 pounds, with the female being larger than the male. They can live to be more than 17 years old.

These birds are famous for their unusual courtship ritual. The male booby flashes his blue feet at possible mates. The bluer the feet the fitter and healthier he is likely to be, and so more attractive to mates. Another courting ritual is pointing their bills in the air, extending their wings and making strange whistling sounds.

The female lays 1-3 eggs in a shallow hollow in the ground. The Blue Footed Booby uses its webbed feet to keep the eggs warm. It takes about 41 days for the eggs to hatch. Until a chick is about a month old, they cannot control their body temperature so the chicks stay on the parent's feet to keep warm. The parents mark their nest with guano (bird droppings). If a chick strays outside, the parents won't let it back in and it will die.

Boobies leave their nesting grounds in the morning and head out to sea to look for shoals of fish such as anchovy and squid. They dive for food from up to 24 metres, hitting the water at incredible speed. Their bodies are well adapted for diving and they fold their wings right back moments before impact to make themselves ultra-streamlined. Blue-footed boobies sometimes hunt together. The first booby to spot a fish gives a whistle to call the rest of the group, who follows the first as it dives into the water to catch its fish! Does not sound so stupid after all?

The booby is legally protected in the Galapagos Islands, but elsewhere it is not a protected species. Estimates claim that there are 40,000 breeding pairs and half of them are on the Galapagos Islands.



B.K. SEN

Kadambini was the first native female medical practitioner of western medicine in India.

David Kopf, the American historian aptly wrote, "Ganguli's wife, Kadambini, was appropriately enough the most accomplished and liberated Brahma woman of her time."

Female Graduate of British Empire

Kadambini Ganguly

1861-1923

KADAMBINI Ganguly (née Bose) (1861-1923) is one of the first two female graduates of the British Empire. She also seems to be the first native female practitioner of western medicine in India.

Kadambini was born on 18 July 1861 in Bhagalpore in a Brahma family. Her father, Brajakishore Bose, was a headmaster of a local school. Kadambini's ancestral home was at Chandsi in Barisal district of Bengal (now in Bangladesh). Kadambini married in 1883 her teacher and mentor Dwarakanath Ganguli, a 39-year old widower. She had five children of her own, and three children from the earlier marriage of her husband. In all, she had to raise eight children. Among her children Jyotirmayee was a freedom fighter and Prabhat Chandra was a journalist.

Education and Professional Career

Kadambini initially received English education at the Brahma Eden Female School, Dacca; subsequently, at Hindu Mahila Vidyalyay, Ballygunj, Calcutta which was renamed as Banga Mahila Vidyalyay in 1876. In 1878 the school merged with Bethune School (f. 1849). At the Bethune School, Dwarakanath Ganguli, a staunch Brahma and an ardent supporter of women's emancipation movement, was her mentor.

When Kadambini became eligible for the Entrance Examination of the University of Calcutta (CU), the University at that time was not admitting female students following the practice of Oxford and Cambridge. At the same time another Christian Bengali student



Kadambini remained a very active medical practitioner till the last day of her life despite her high blood pressure. On 3rd October 1923, she visited a patient and conducted a critical operation. When she returned home, she was practically wilting. She breathed her last the same evening at the age of 63.

from Dehra Dun called Chandramukhi Basu also applied to CU for permission to appear at the Entrance Examination. Dwarakanath Ganguly fought practically tooth and nail for obtaining the required permission from CU and succeeded.

As a result Kadambini and another girl called Sarala appeared in the entrance test in 1877. In 1878 Kadambini cleared the test missing the first division by a single mark while Sarala could not appear for the test as she got married. Chandramukhi was declared by the Junior Board of Examiners to have attained the entrance standard in the examination of 1877.

Kadambini got admission at the College Class of Bethune School, and Chandramukhi at the Free Church of Scotland College. In 1880, both passed First Arts (FA) examination. Kadambini wanted to get admission at the Medical College, Bengal (The College was popularly known as Calcutta Medical College) but was denied as the door of the College was yet to open for female candidates. Eventually she took admission at Bethune College along with Chandramukhi and in 1882 both of them graduated from the University heralding a new era of women's education in the country. When the two Bengali women received their degrees in 1883, they became the first women graduates in the entire British Empire.

Till 1882, Calcutta Medical College (CMC) was not admitting any female student, though Madras Medical College had started admitting female students from 1875. Again Dwarakanath Ganguly fought for the admission of Kadambini at CMC and succeeded.

Thus Kadambini became the first woman to get admission at the CMC in 1884. The following year the government offered her a scholarship of Rs. 20 per month with retrospective effect. However, Kadambini's admission in medical college was intolerable to a section of Brahmos as well as Hindus. Even Kadambini's marriage to Dwarakanath, a widower, gave rise to bitter controversies and a section of the Brahmos did not recognize their marriage.

The professors at CMC were also not happy at her admission at the Medical College. With all these adversities she continued her study. It is said that one Bengali professor was dead against female education and failed Kadambini in the paper *Materia Medica* and *Comparative Anatomy*. This prevented her from getting the certificate of the first MB examination held in 1888. As a result, she got only the certificate of First LMS examination from CU. Before CMC came under the jurisdiction of CU, the Principal of the Medical College used to award the Graduate of Medical College of Bengal (GMCB) diploma to the successful students.

As Kadambini completed the medical course, the Principal of the Medical College, Dr. J.M. Coates, awarded her GMCB diploma that gave her the right to do private practice.

Somehow, Florence Nightangle came to know about Kadambini. On 20 February 1888, she wrote to a friend: "Do you know or could tell me anything about Mrs Ganguly, or give me any advice? ... (she) has already passed what is called the first licentiate in medicine and surgery examinations and is to go up for the final examination in March next. This young lady, Mrs. Ganguly, married! after she made up her mind to become a doctor! and has had one, if not two children since. But she was absent only thirteen days for her lying-in!! and did not miss, I believe, a single lecture!!"

Nightingale also wrote in the letter that she had been asked to recommend Kadambini to Lady Dufferin "for any posts about the female wards of Calcutta".

In 1888, Kadambini was appointed at the Lady Dufferin Women's Hospital, Calcutta on a decent salary of Rs. 300 per month. Soon she realized that she was being looked down upon by the British lady doctors as she did not have the MB degree. She started private practice but was not successful. At times she had to suffer humiliations.

Once she was called upon by a rich family to attend a teenage girl during her childbirth. After the delivery when the mother and child were doing well, Kadambini and her assistant were served food at the verandah as if they were maidservants. Moreover, they were asked to clean and wipe the place. At that time native people considered a lady doctor not more than a dai (an untrained midwife).

In 1891, the orthodox magazine *Bangabasi* projected her as a despised symbol of Brahmo womanhood and indirectly called her a 'whore'. Dr Nilratan Sarkar, Shibnath Shastri as well as Dwarakanath Ganguly took the matter seriously and went to court not only to defend Kadambini but also to support liberation of women from the strangulating forces of dreadful customs and evil prejudices of the then society. The court delivered a judgment in favour of Kadambini. Mahesh Chandra Pal, the editor of the journal *Bangabasi*, was slapped a fine of Rs. 100 and six months imprisonment.

It seems the prevailing circumstances practically forced Kadambini to take a momentous decision to go to England to acquire further medical degrees. In 1893, it was not at all easy for an Indian lady to travel to England, especially leaving behind a number of children. Her indomitable will, Dwarakanath's untiring efforts, unwavering support from Brahmo Samaj, and the gracious help of her cousin Monomohan Ghosh (a London-based barrister) saw Kadambini leaving for England all alone on 26th February 1893, leaving her children to the care of her elder sister.

She reached London on 23rd March 1893. On 13th April 1893, she filled up the form for appearing for triple diploma courses in medical sciences at the Scottish College at Edinburgh. She attended classes at the Royal College of Physicians and the Royal College of Surgeons. By virtue of her BA degree from CU and GMCB from CMC, she could complete the course within a very short time and was allowed to appear only for the last examination. She was awarded the Triple Diplomas of the Scottish College in July 1893. Among the 14 successful candidates of the year she was the only female candidate.

For the triple diplomas she appeared for the subjects medicine, therapeutics, surgery, surgical anatomy, midwifery and medical jurisprudence. The three diplomas she obtained are – Licentiate of the College of Physicians, Edinburgh (LRCP), Licentiate of the College of Surgeons, Glasgow (LRCS), and Licentiate of the Faculty of Physicians and Surgeons, Dublin (LFPS). She specialized in gynaecology and pediatrics as well.



She was hailed by Annie Besant for being a symbol signifying the uplift of India's womanhood. In the Calcutta session of Indian National Congress (1890) also Kadambini delivered a lecture in English. She organized the Women's Conference in Calcutta in 1906 in the aftermath of the partition of Bengal.

After her return from England with the Triple Diplomas, the situation turned in her favour as she was accepted for the post of a senior doctor at the Dufferin Hospital. Within a short period she started private practice that thrived so well that she had to resign her hospital job. During 1895-96 Kadambini took medical charge of the Queen mother of Nepal who was suffering for a long time. With Kadambini's creditable treatment the Queen mother recovered. After this incidence Kadambini used to be called by Royal families for medical treatment.

Another remarkable case of Kadambini's diagnosis and treatment deserves mention. A tumor was diagnosed in the abdomen of a girl by male doctors. Kadambini diagnosed it as a confirmed case of pregnancy and performed an operation for the safe delivery of the child.

Kadambini remained a very active medical practitioner till the last day of her life despite her high blood pressure. On 3rd October 1923, she visited a patient and conducted a critical operation. When she returned home, she was practically wilting. She breathed her last the same evening at the age of 63.

Other Activities

Kadambini combined her professional duty as a doctor with her social and political responsibilities. Dwaranath Ganguly had been agitating for women's participation in the annual sessions of the Indian National Congress. His efforts bore fruit in 1889 when Kadambini along with five other ladies were allowed to attend the Bombay session of the Indian National Congress. In the session Kadambini moved a vote of thanks.

She was hailed by Annie Besant for being a symbol signifying the uplift of India's womanhood. In the Calcutta session of Indian National Congress (1890) also Kadambini delivered a lecture in English. She organized the Women's Conference in Calcutta in 1906 in the aftermath of the partition of Bengal. In 1908, she

organized and presided over a meeting at Calcutta for expressing sympathy with Satyagraha workers of Transvaal, South Africa. At that time, she took initiative to form an association to collect money for helping the workers. She presided over the meeting of the Sadharan Brahma Samaj, held in Calcutta in 1914, in honour of Gandhi during his visit to Calcutta.

Labourers in the tea gardens of Assam were heavily exploited by their employers. Dwarakanath Ganguly condemned the exploitation and Kadambini fully supported her husband. In 1922, she went with the poet Kamini Roy to look into the conditions of women labourers employed in the Bihar and Orissa coal mines on behalf of an Enquiry Commission set up by the Government.

She was also famous for knitting yards of fine and beautiful lace.

Kadambini was a contemporary of Anandibai Joshee who completed her MB degree from Women's Medical College, Pennsylvania in 1886. She was appointed a resident physician of Albert Edward Hospital at Kohlapur. Before she could take charge, tuberculosis cut short her life in 1887.

Anne Jagannathan was the first Indian woman to complete certificate course in medical sciences from Madras Medical College in 1986-87. Thereafter, she headed for England to study medicine and was awarded Triple Qualification Board Diplomas from Scottish Colleges. She came back to India in 1892 and joined Cama Hospital for Women and Children in Bombay. Tuberculosis ended her career within just two years.

Of the three lady doctors, Kadambini started practising medicine in 1888. Anandibai passed away in 1887 before she could start her career. Anne started her medical career in 1892. Thus it may be said without hazarding a grave error that Kadambini was the first native female medical practitioner of western medicine in India.

David Kopf, the American historian aptly wrote, "Ganguli's wife, Kadambini, was appropriately enough the most accomplished and liberated Brahma woman of her time. From all accounts, their relationship was most unusual in being founded on mutual love, sensitivity and intelligence. Mrs. Ganguli's case was hardly typical even among the more emancipated Brahma and Christian women in contemporary Bengali society. Her ability to rise above circumstances and to realize her potential as a human being made her a prize attraction to Sadharan Brahmos dedicated ideologically to the liberation of Bengal's women."

Mr B.K. Sen is Member, Research Council, History of Science, Indian National Science Academy. Address: 80 Shivalik Apartments, Alaknanda, New Delhi-110019; Email: bksen1938@gmail.com

Computer Memory Quiz

HEMEN HAZARIKA

1. One 'Nibble' is a combination of:

- a) 2 bits
- b) 9 bits
- c) 4 bits
- d) 8 bits

2. Which number system is used as the base for any digital data storage?

- a) Binary
- b) Octal
- c) Hexadecimal
- d) Decimal

3. "Love.Life.Dreams" is the tagline of which storage device manufacturing company?

- a) Sandisk
- b) Kingston
- c) Moser Baer
- d) ADATA

4. The company that launched the first TeraByte hard disk.

- a) Hitachi
- b) Seagate
- c) Western Digital
- d) Toshiba

5. RAM Chip was invented by:

- a) Vinod Dham
- b) Rocky Brunjal
- c) Vinod Khosla
- d) Azim Premji

6. Storing data in Internet is termed as:

- a) Cloud Storage
- b) Net Storage
- c) Tank Storage
- d) Gas Storage

7. Data from which of the following memory is accessible the fastest?

- a) Hard disk
- b) CD
- c) Cache
- d) Blue ray disk

8. As the computer starts, it begins to access its memory BIOS, the software that boots up your computer. It is located in which type of memory:

- a) ROM
- b) RAM
- c) Virtual Memory
- d) Cache Memory

9. Gibibyte is a standard based binary multiple of the byte, a unit of digital information storage. 1 Gibibyte= 230 bytes = 1024 Mebibyte. Which is the correct relation between 1 Gigabyte (GB) and 1 Gibibyte (GiB)?

- a) 1GiB= 1.074GB
- b) 1GiB = 1GB
- c) 1GiB = 17.04 GB
- d) 1GiB = 1074 GB

10. Which of the following is not associated with computer memory?

- a) TechnoByte
- b) PicoByte
- c) Zettabyte
- d) Bit

11 Blue ray disk are named so because:

- a) They are blue in colour
- b) They emit blue radiations
- c) Blue laser is used to read from and record to a Blu-ray Disc
- d) They are robust

12. Circular divisions on the hard disk are called:

- a) Tracks
- b) Rounds
- c) Discs
- d) Cylinder

13. Which of the following is equal to 2GB?

- a) 1024 MB
- b) 2048 MB
- c) 200 MB
- d) 2000KB

14. How many bits are required to store a single character in "UNICODE" encoding system, which supports many local languages also?

- a) 8 bits
- b) 1 bit
- c) 2 bits
- d) 16 bits

15. Who said: "The desktop metaphor was invented because one, you were a stand-alone device, and two, you had to manage your own storage. That's a very big thing in a desktop world. And that may go away. You may not have to manage your own storage. You may not store much before too long."

- a) Bill Gates
- b) Steve Jobs
- c) Steve Ballmer
- d) Dr Engelbert

16. Platters, Magnetic heads and Actuator are associated with which Storage Device?

- a) Floppy Disk Drive
- b) Flash Drive
- c) Hard Disk Drive
- d) Compact Disk Drive

17. Which memory below is a temporary memory, which means Data does not remain permanent there?

- a) Hard Disk
- b) CD
- c) DVD
- d) Ram

18. If your computer lacks the random access memory (RAM) needed to run a program or operation, Windows uses another memory to compensate which combines your computer's RAM with temporary space on your hard disk. Which memory is being talked about?

- a) ROM
- b) Virtual Memory
- c) Corporate Memory
- d) Solid Memory

19. This memory is a special random access memory (RAM) that a computer microprocessor can access more quickly than it can access regular RAM. As the microprocessor processes data, it looks first in this memory and if it finds the data there, it does not have to do the more time-consuming reading of data from larger memory. What is this memory called?

- a) Special memory
- b) Reserved memory
- c) Cache memory
- d) Regular memory

ANSWERS:

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

Contributed by Hemen Hazarika, Amingaon Electrical Sub-Division, Amingaon, Guwahati, Assam-781031

Identical Twins

PRAFULLA K. MOHANTY

1. Which of the following are synonyms of identical twins?

- (a) Monozygotic or maternal or monoval (MZ)
- (b) Dizygotic or fraternal or biovular (DZ)
- (c) Conjoined
- (d) Parasitic

2. What category of twin is Siamese twin?

- (a) Identical
- (b) Non-identical
- (c) Parasite
- (d) None of these

3. Which of the following is the Siamese twin?

- (a) Chinese twins born in Siam joined from birth by a fleshy ligature
- (b) Twins born in England
- (c) Twins born in Holland
- (d) Twins which were separated successfully

4. What was the life time of the first Siamese twins?

- (a) 1801-1874
- (b) 1811-1874
- (c) 1821-1874
- (d) 1831-1874

5. What were the names of the first Siamese twins?

- (a) Chang and Feng
- (b) Chang and Eng Bunker
- (c) Eng and Meng
- (d) Chang and Meng

6. What are the sexes of the first Siamese twins?

- (a) Both male
- (b) Both female
- (c) One male and one female
- (d) Both intersex

7. What is the nature of sex of the identical twins?

- (a) Both may be male
- (b) Both may be female
- (c) One may be male and one may be female
- (d) Both may be male or female

8. Identical twins are

- (a) Similar to look at
- (b) Dissimilar to look at
- (c) Difficult to identify
- (d) Not Siamese twins

9. Monozygotic (MZ) twins arise by

- (a) The separation of two blastomeres
- (b) Two ova
- (c) One ovum and two sperms.
- (d) Two ova and two sperms

10. Identical twins are always

- (a) Discordant
- (b) Concordant
- (c) Mosaic
- (d) Sterile

11. In a pair of twins, if a character is either present or is absent in both the members, they are called concordant. Their phenotype will be

- (a) ++
- (b) --
- (c) ++ or --
- (d) + or +

12. To whom did Chang and Eng as Siamese twins marry?

- (a) Two brothers
- (b) Two sisters
- (c) Two different girls
- (d) One was married and another was unmarried

13. How many children Chang and Eng had?

- (a) Four
- (b) Ten
- (c) Twenty
- (d) Twenty one

14. Who from Chang and Eng died first due to stroke in his sleep?

- (a) Chang
- (b) Eng
- (c) Both at a time
- (d) Eng during separation

15. Who are the recorded twins born less than 30 minutes apart but on different days, different months and years (11.51 pm December 31, 2008 and 12.17am, January 01, 2009)?

- (a) Terrance and Tariq of Michigan
- (b) Justin and Jordan of USA
- (c) Peter and Paul Kingston of West Sussex, England
- (d) Lilia and Liana, USA

16. In which part of the world, a set of identical twin brothers married a pair of twin sisters in a military ceremony in Pechora in 2009?

- (a) Korea
- (b) Holland
- (c) Canada
- (d) Russia

17. When two individuals of a twin pair are alike with respect to a given characteristic, they are said to be

- (a) Discordant
- (b) Concordant
- (c) Chimeric
- (d) Mosaic

18. In identical twins, where the foetuses share a common chorion, the number of placenta is

- (a) One
- (b) Two
- (c) More than two
- (d) Two and fused

19. Twins usually occur in about 1.25 percent of pregnancies. Which part of the globe is popularly known as twin place where 2 per cent of children born are twins and half of them are genetically identical?

- (a) China
- (b) Brazil
- (c) Thailand
- (d) Vienna

ANSWERS

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

Contributed by Dr Prafulla K. Mohanty, Professor, Head and Dean, Faculty of Science, Post Graduate Department of Zoology, Utkal University, Vani Vihar, Bhubaneswar-751004, Odisha; Email: prafulla.mohanty3@gmail.com



Economic Plants for Greening Wasteland

KEDARESHWAR PRADHAN

1. Cashew is an ever green tropical tree with round crown and planted for afforestation on barren denuded areas, coastal saline sand, hilly slope and shifting cultivation areas as reclamation measure. It is a dollar earning crop of India and botanically known as:

- (a) *Buchanania latifolia*
- (b) *Feronia elephantum*
- (c) *Anacardium occidentale*
- (d) *Aegle marmelos*



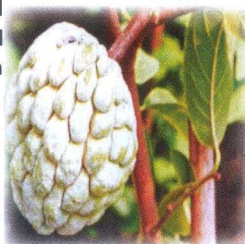
2. Tamarind (*Tamarindus indica*) a large evergreen tree with spreading crown and tolerant to saline and alkaline conditions and soil erosion, is a natural choice in afforestation for reclamation of wasteland. It belongs to which family?

- (a) Rutaceae
- (b) Leguminosae
- (c) Moraceae
- (d) Anacardiaceae



3. It is a deciduous tall woody shrub and one of the drought tolerant neglected fruit trees of India found growing on infertile soil of degraded lands. It is:

- (a) Custard apple
- (b) Pomegranate
- (c) Blackberry
- (d) Rose apple



4. It is a medium-size deciduous tree bearing strong axillary thorns. A very hardy tree and thrives well even in swampy, alkaline and stony soils. Soft pulp of its fruit is an excellent summer drink. It is

- (a) Mango
- (b) Orange
- (c) Jackfruit
- (d) Bael



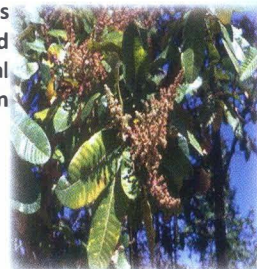
5. *Phyllanthus emblica* is seen in tropical and sub-tropical forests but scattered throughout India. Its fruits are largely used in Indian medicine and a popular drug ingredient of "Triphala" and chyawanprash. It is known in English as:

- (a) Indian gooseberry
- (b) Black berry
- (c) Mulberry
- (d) Strawberry



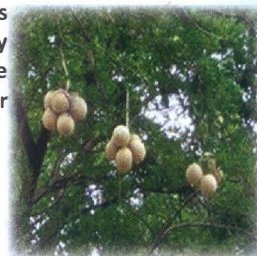
6. *Buchanania latifolia*, is an indigenous moderate size evergreen tree and commonly occurs in dry type of sal forest. It is known as piyal (chironji) in Hindi. What is its English name?

- (a) Wood apple
- (b) Star apple
- (c) Hamilton's mombin
- (d) Indian almond



7. It is a drought hardy deciduous medium size tree with thorny branches. It can come in arid climate and shows a marked preference for black cotton soils. It is known as:

- (a) Wood apple
- (b) Sugar apple
- (c) Aonla
- (d) Jamun



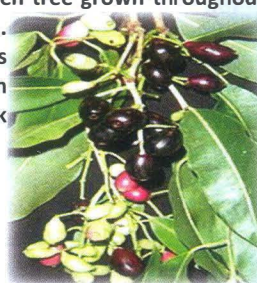
8. Indian almond is largely seen in hotter parts of India and is planted for avenue and shade in dry areas. It is botanically known as:

- (a) *Feronia elephantum*
- (b) *Aegle marmelos*
- (c) *Terminalia catappa*
- (d) *Morus alba*



9. *Syzygium cumini* is a large evergreen tree grown throughout India, commonly along water channels. Ripe fruits are largely eaten raw. Seeds are very useful in diabetes. It is an excellent species for stream bank protection. It is commonly known as:

- (a) Black berry
- (b) Straw berry
- (c) Mulberry
- (d) Goose berry



10. *Grewia subinaequalis* is a deciduous shrub with feathery leaves, not browsed by cattle, thrives well both in arid and sub humid tract and grown mostly as wasteland crop. Fresh ripe fruits or sherbet is very good for allaying the adverse effect of summer heat. It is known as:

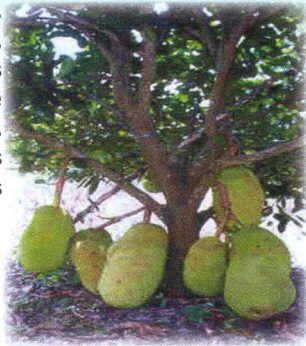
- (a) Falsa
- (b) Pomegranate
- (c) Mulberry
- (d) Indian gooseberry



FUNQUIZ

11. *Artocarpus heterophyllus*, indigenous to the Western Ghats, is a medium size evergreen tree. Its fruits have spinous rind and ripe fruit emits sweet pleasant smell. It flourishes in hilly tracts and is useful for bald hill utilization. It is commonly known as:

- (a) Guava
- (b) Jack fruit
- (c) Bread fruits
- (d) Fig



12. *Jujube (Zizyphus jujuba)*, indigenous to India, is a small spinous tree with spreading vine like branches. Neutral to slightly alkaline deep sandy soils seems to be ideal for it but can be grown in all wastelands including rocky lands. It is also known as:

- (a) Chinese date
- (b) Wild date-palm
- (c) Karonda
- (d) Star apple



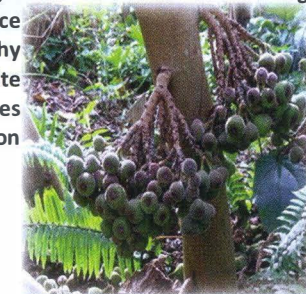
13. Pomegranate, an evergreen shrub with woody stem and profuse root suckers is indigenous to Iran. It thrives in hot dry region with irrigation and can tolerate alkaline and wet soils. It is botanically known as:

- (a) *Psidium guajava*
- (b) *Aegle marmelos*
- (c) *Punica granatum*
- (d) *Ficus reticulata*



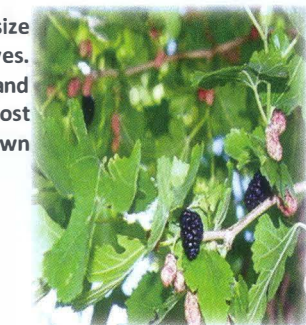
14. *Ficus carica*, a medium size, much branched tree having roundish crown. Its inflorescence is a hypanthodium and the fleshy receptacle grows into a composite fruit. Besides light soils it also does well in alkaline soils with application of lime. Commonly known as:

- (a) Banyan
- (b) Fig
- (c) Drumstick
- (d) Lemon



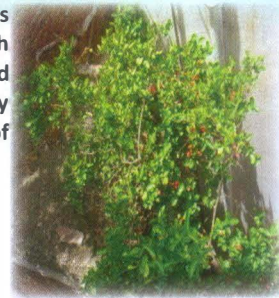
15. Mulberry is a medium size deciduous tree with profuse leaves. Ripe fruits are black in colour and tasty. It can stand drought and frost considerably. It is botanically known as:

- (a) *Morus alba*
- (b) *Morus optiva*
- (c) *Grewia subinaequalis*
- (d) None of the above



16. *Carissa carandas* is an indigenous and ever green thorny shrub with dark green foliage. It is not browsed by goats due to latex in it. Very hardy in nature and can grow in any type of soil. It is commonly known as:

- (a) Indian thorn
- (b) Chinese date
- (c) Christ's thorn
- (d) Elephant apple



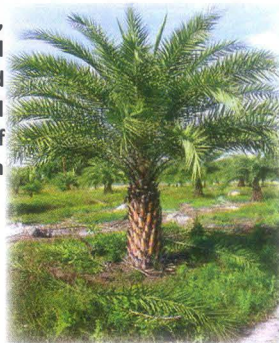
17. It is an indigenous typical fan-palm found in large number on coastal pockets of Eastern India and a very suitable and economic species to utilize poor sandy soils of coastal tract. It is commonly known as:

- (a) Palmyra palm
- (b) Bottle palm
- (c) Areca palm
- (d) Coconut palm



18. It is a tropical evergreen tree, comes up well in drier locations and in hill slopes and avoids ill drained sites. Its stem is unbranched and covered with hard persisting leaf bases which provide protective arm to it. It is commonly known as:

- (a) Fan palm
- (b) Wild date palm
- (c) Bottle palm
- (d) None of the above



19. India occupies prime position in tea production and export in the world. Tea is planted in bald sloping land of hills in high rainfall area and checks soil erosion. In which region of India tea plantations are raised in large scale?

- (a) Kashmir valley
- (b) Outer Himalayas
- (c) North Eastern hills
- (d) Nilgiri hills

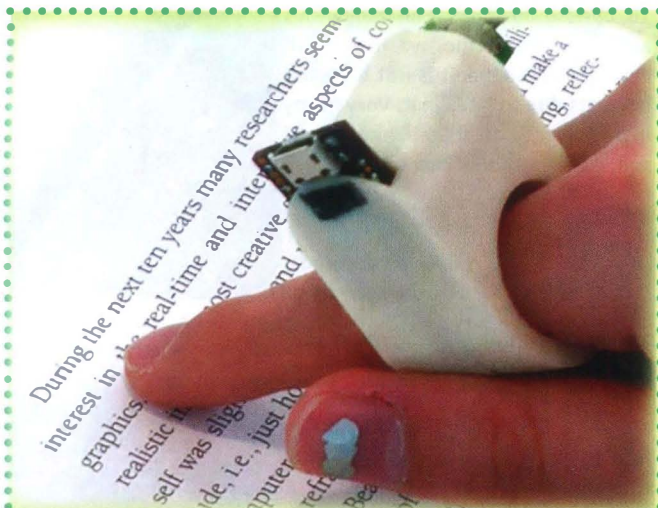
20. In India coffee is grown in the Western Ghat hills region on a large scale to check soil erosion. Since it is a shade loving plant, tall trees are planted in coffee plantations to give shade and called as "standard". Which is a good standard tree species that sheds lot of leaves and enriches the soil of coffee plantation on decomposition, besides providing shade?

- (a) Sal
- (b) Teak
- (c) Eucalyptus
- (d) Silver oak

Answers

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

Contributed Dr Kedaraswar Pradhan is District Consultant, National Food Security Mission, O/o Deputy Director of Agriculture, Kandhamal, Odisha



FINGER READER

Researchers have come up with a prototype device that will read lines of text as the user runs a finger over the page. The Finger Reader is a small device that fits over the knuckle of the index finger. It contains a camera which "reads" the text on the page and then says it aloud for the reader. The Finger Reader doesn't just read the words on the page; it indicates (via haptic cues) when the user has reached the end of a line, then when they reach the beginning of the next line. The device also indicates when the reader's finger is drifting from the line of text and provides cues to move the finger higher or lower on the page.



HEADBAND PREVENTS MIGRAINES

Migraine sufferers know that the pain of a migraine is unlike anything else. It isn't just a headache; it's a full-body experience of major pain that can last for days. The headband will finally provide relief. On the inside of the headband, a self-adhesive electrode attaches to the forehead. A weak electrical charge, powered by a battery, is then fed through the device to deliver transcutaneous electrical nerve stimulation (TENS), a technique that has proven effective in treating certain types of muscle pain. The device is approved for adults 18 and over, who can wear the device for up to 20 minutes a day.



BRICKS GROWN WITH BACTERIA

A biotech company has come up with a way to 'grow' bricks from naturally abundant materials like bacteria. Bacteria, which provide a precise environment to form in combination with a nutrient, nitrogen and calcium source allow for the formation of natural cement in ambient temperatures, taking less than five days to produce a pre-cast material. The beauty of this technology is that instead of building materials being created in super-heated environments like kilns, where carbon emissions are heavily released, they're grown in ambient temperatures.

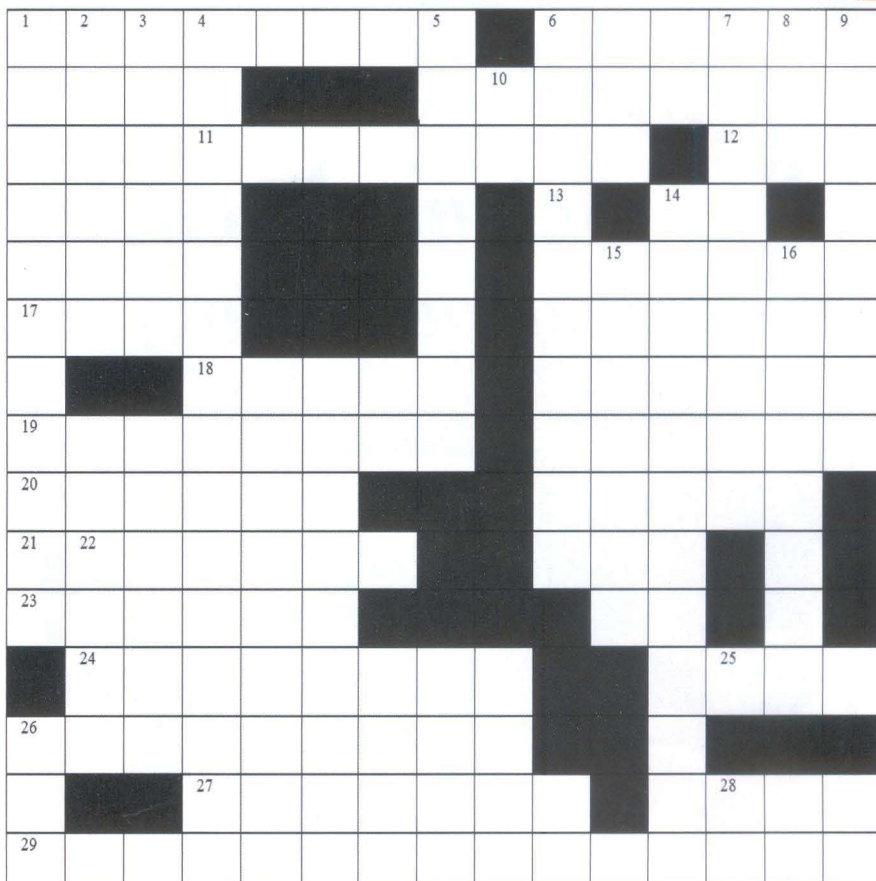


INSECT FARM

Consuming insects has gone from a completely objectionable concept to a feasible curiosity as a sustainable food source. A prototype has already been introduced and now a new home insect growing/harvesting apparatus has been proposed. While this device bred grasshoppers, Farm 432 uses the black soldier fly. The black soldier fly larvae are one of the most efficient protein converters in insects, containing up to 42% of protein, a lot of calcium and amino acids. The unit first matures a batch of larva, then allows the flies to mate. Farm 432 is almost completely self-sustainable; while most of the resulting larva is used for consumption, some is returned to repeat the process.

ACROSS

1. Lightest element that plays a role in acid-base balance (8)
6. Interstitial fluid that acts as intermediate between blood and tissues (5)
10. Contraction of the heart (7)
11. Parkinson's disease is due to the loss of this neurotransmitter (8)
12. Product obtained from destructive distillation of coal, wood & petroleum (3)
17. Closed sac that may contain air and fluid (4)
18. Long, slender projection of a neuron (4)
19. Brine shrimp (7)
20. Chemical name of Vitamin B3 (6)
21. Isoforms of enzymes like Lactic dehydrogenase (7)
23. He formulated three laws of motion (6)
24. Neurological syndrome caused by mercury poisoning (8)
25. Biological oxygen demand (3)
26. A pigment commonly known as visual purple (9)
27. Monitor Lizard (7)
28. X-linked agammaglobulinemia (3)
29. Emission of light by living organism like fire fly (15)



Contributed by by Dr. K. Venkataraman,
AT-2, Porkudam apts, Bypass Road, Madurai-16

DOWN

1. Copper-containing blood pigment found in molluscs (11)
2. Fungus, used in bakery and fermentation industries (5)
3. Male honey-bee (6)
4. Book that documents endangered species of flora & fauna (3-4)
5. Phylum that includes roundworms (8)
7. Chemical element named as Kalium in Latin (9)
8. MHC in humans (3)
9. Thiamine deficiency disease (8)
13. A change in the observed frequency of a wave occurring when the source and observer are in motion to each other.
14. Practice of controlling the formation, growth and composition of forest (12)
15. Macrophage cells found in liver (7)
16. Stomach of cockroach and birds are referred by this name (7)
22. Scanning Electron Microscope (3)
26. Long, curved bones that form the cage in the thoracic region in vertebrates (3)

Solution June 2014 Crossword

