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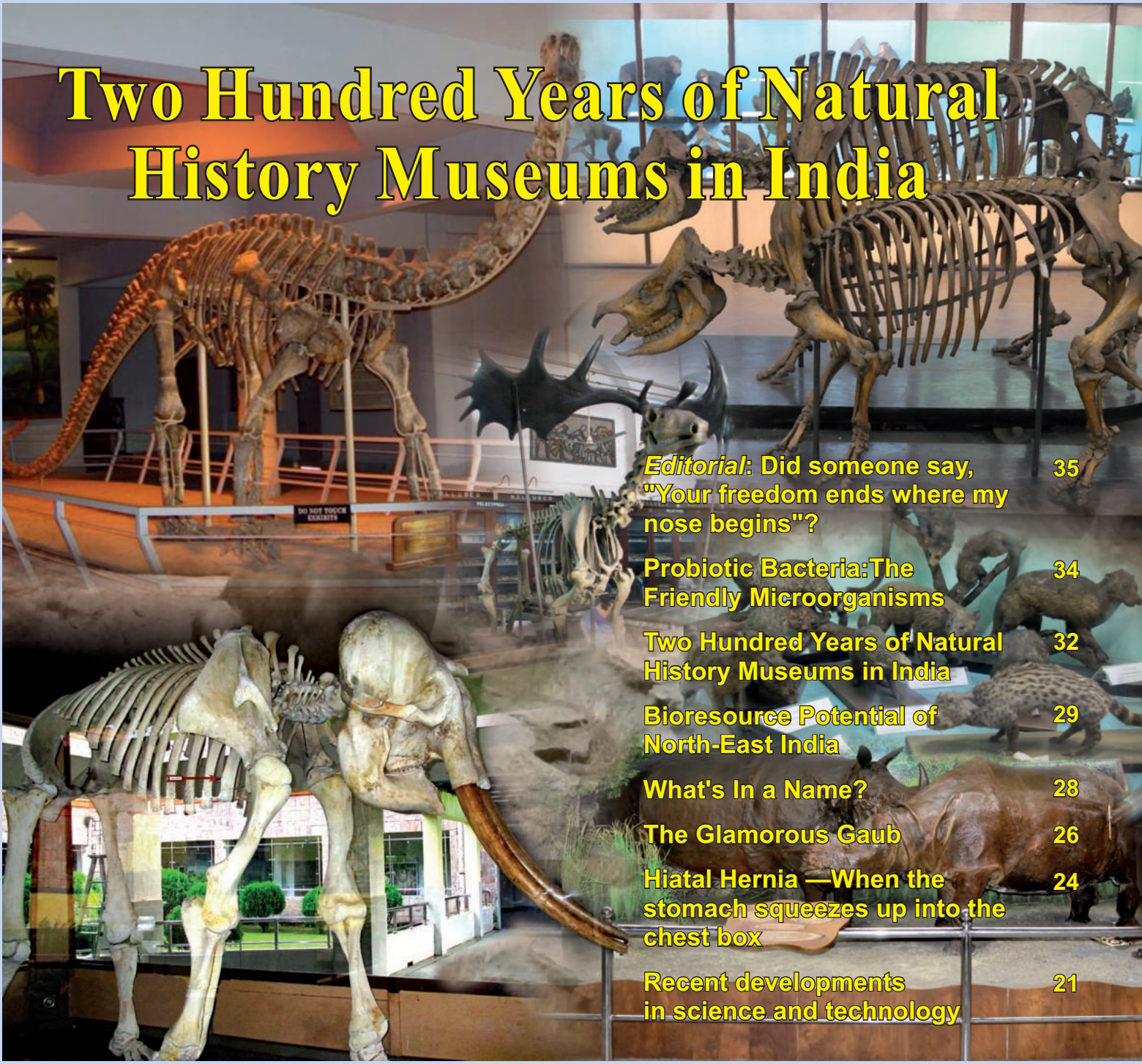

Two Hundred Years of Natural History Museums in India

... think scientifically, act scientifically... think scientifically, act scientifically... think scientifically, act...

Did someone say, "Your freedom ends where my nose begins"?

Dr. R. Gopichandran

Please visit the sites* for an understanding of the origins and applications of this adage. I will however go ahead by building on the unique value it confers to knowing one's own limits and respecting the freedom fellow citizens have; especially when we interact in the public domain. The text that follows is actually a soliloquy. Meant for me to re-align myself with my environs. It may be loud despite its lowest decibel through design. This recognition of one's limits and not invading into other's territory, to my mind is the primordial expression of scientific temper. Basis courtesies, you see. Subtle beliefs and their origins and manifestations are much higher up in the order of complexity. A scientifically tempered society should be expected to reveal and demonstrate this core value of mutual respect for each other.

Countless times in markets, airports, workplaces and many other common spaces, I am either hit or rudely overtaken by a fellow citizen. She/he somehow does not seem to take note of my presence. I seem to become all too transparent. They cannot see me standing in front of them. I wonder if I have slowed down and therefore am not able to move out of their way. Or is it because they are too fast, progressive and can therefore be entitled to be callous? Am I wrong in expecting my fellow citizens to follow a simple line while boarding planes? Or am I to believe they are too rationalistic to care for me or emotionalise about my comfort? Should I too care a damn for my fellow travellers; become opaque so that they don't see through me?

People often also scream their heads off. I seem to become too transparent for such obstreperous fellow citizens. This can happen with fellow passengers in a II AC train compartment, places of worship or an airplane. C'mon, am I not entitled to some quiet moments at least while travelling (metaphorically the journey of life), especially when I am in the midst of only cacophony, rest of the time.

Am I supposed to suffocate in the presence of my smell marauders or expect them to be scientific enough to let me breathe freely? Fellow travellers in airplanes or buses do not care about the blitzkrieg they launch on my odoriferous concavities (Johnsonian expressions!!!!) and related smell sensibilities. They do not brush or wash enough and stink away even as many chew on tobacco. C'mon, I thought bathing to not stink, not spitting or refraining from munching away on aromatics, or smoking in common places (!!!!!) were basic courtesies I can expect from fellow citizens. I had to actually almost plead with a fellow traveller in recent past about the stress he created by exposing me to the volatiles/odours within the confines of a plane. He was actually chewing some tobacco or paan-masala; drowned in the joy he derived. I was again too transparent for him to take note. These are just about the minimalistic invasions I am exposed to, from the eyes and nose perspectives. The microbes that invade me are less of hypocrites because we know each other's nature. Many of them are actually harmful but respect my immunity. Some others actually synthesise vitamins inside me and therefore I am compelled to acknowledge microbes as more friendly.

Another bizarre onslaught is when we discuss objectives and methods of science communication. The content and the communicator are often trivialised. It is either a case of my very poor knowledge levels or self-claimed !!!! excellence of (many, many and not all!!!) people I speak with. I often tell myself that I should not be negatively aggressive during such discussions. This means I actually ask myself if I have listened to all that is really said. I do not want to construct vacuities based on all that is not said. I also do not prejudge them for their values or relegate them as unscientific. Am I wrong in expecting the same positive countenance from the people I engage with? My politeness is too transparent because of which they are probably not able to perceive it. I can give them the benefit of doubt on that count. This is lebensraum of the subtler kind. Oh my, is being transparent the densest thing to happen? Often there are no dialogues. Abrupt snorting is the way of life.

Courtesies to my mind are expressions of basic human values. People can express such values in their daily lives only if they are awake to sensitivities around them. Being scientific is being aware, in the know of things and about responsibilities of basic good behaviour at least in common spaces. C'mon, how can I imagine (some) people around me are not aware of these fundamentals. We are at our courteous best silly!!!!!!!! On the other hand, I shudder to imagine, they are rude despite their wisdom. Is this sheer lackadaisical attitude? If yes, can I imagine they will never condescend to behave well; especially where my nose begins; so to say? I am sure the wise people who created this adage are turning in their graves reading this editorial.

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http://quoteinvestigator.com/2011/10/15/liberty-fist-nose/; http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1763331/pdf/v058p00830.pdf & http://blog.eternalvigilance.me/2013/11/your-freedom-ends-where-my-property-rights-begin/

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Probiotic Bacteria: The Friendly Microorganisms

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Probiotics

The literal meaning of 'probiotic' is 'for life'. Probiotics are described as 'healthy', 'friendly' or 'beneficial' microorganisms which, when consumed in adequate amounts, confer a health benefit to the host. The concept of probiotics was introduced by the Russian zoologist Elie Metchnikoff, who in 1907 suggested that "the dependence of the intestinal microbes on the food makes it possible to adopt measures to modify the flora in our bodies and to replace the harmful microbes by useful microbes".

Lactic acid bacteria as probiotic

Lactic acid bacteria (LAB) are 'generally regarded as safe' (GRAS) because they do not cause any health risk to the host. A number LAB strains are known as probiotics which includes various species of *Lactobacillus*, *Streptococcus*, *Bifidobacterium, Enterococcus, Pediococcus, Lactococcus, and Leuconostoc.* LAB are non-motile, gram-positive bacteria and occur in variety of habitats such as human and animal mucosal membranes, on plants or material of plant origin, in sewage and fermenting or spoiling food.

Why probiotics?

The widespread and indiscriminate use of antibiotics for the management of various bacterial infections has resulted into the multi-drug resistance of common pathogenic microorganisms to several traditional antibiotics and this has led to an increasing concentration towards the usage of probiotic bacteria for treatment and management of various infections of digestive tract in adults, children as well as in animals. Probiotics are of great significance for their role in gut health and immunological aid and today a number of probiotic products such as yoghurt, acidophilus milk, bulgaricus milk, bifidus milk, butter milk, *kefir*, cheeses, sour cream, probiotic *dahi*, etc., are available in the world market.

Health benefits of probiotics

Probiotics are being used by consumers and in clinical practice widely across the globe and their health benefits are being investigated extensively. Probiotics eliminate unwanted harmful microbial flora from gut, improves immunity, strengthens gut barrier function, produces β-galactosidase enzyme in lactose intolerant individuals and are also known to reduce cholesterol.

Mechanism of action of probiotics

The probiotic property of a microorganism is strain specific. Probiotics provide gut health to the host by modulating the profile of intestinal microbiota. The probiotics survive variably in different anatomical parts of the gut. The composition of gut microflora can be manipulated through probiotic supplementation. The change in the gut microflora is seen a few days after the start of probiotics consumption in adequate amounts. The mode of action includes:

(1) Direct antagonism of harmful pathogenic gram-positive and gram-negative microorganisms by a variety of antimicrobial substances such as bacteriocins (proteinaceous toxins produced by bacteria to inhibit the growth of similar or closely related bacterial strains) such as antibacterial peptides (ABPs), lactic acid, diacetyl, hydrogen peroxide, etc. These substances cause a reduction in number of viable pathogens by inhibiting their growth and also affect bacterial metabolism and toxin production. Probiotic LAB, by producing lactic acid, reduces the intestinal luminal pH which leads to the reduction of many pathogens and enhances the absorption of mineral ions in the intestine. The reduction in pH of the intestine is also the result of production of short-chain fatty acids such as acetates, propionates and butyrates. Probiotics also enhance the production of defensive molecules such as mucins. The intestinal microbiota provides protection against a variety of pathogens including *Escherichia coli*, *Salmonella*, *Shigella*, *Pseudomonas*, certain forms of *Clostridia*, as well as yeasts such as *Candida albicans*.

(2) Competitive exclusion of pathogens from adhesion sites on epithelial layer of microvilli of small intestine (ileum).

(3) Competition for the dietary ingredients as growth substrates necessary for pathogen survival.

(4) Improving barrier functions by promoting tight contact between epithelial cells of gut mucosa.

(5) Production of exopolysaccharides, vitamins, etc., for other commensal bacteria. Bioconversion of sugars to inhibitory substances.

(6) Immunomodulation by activation

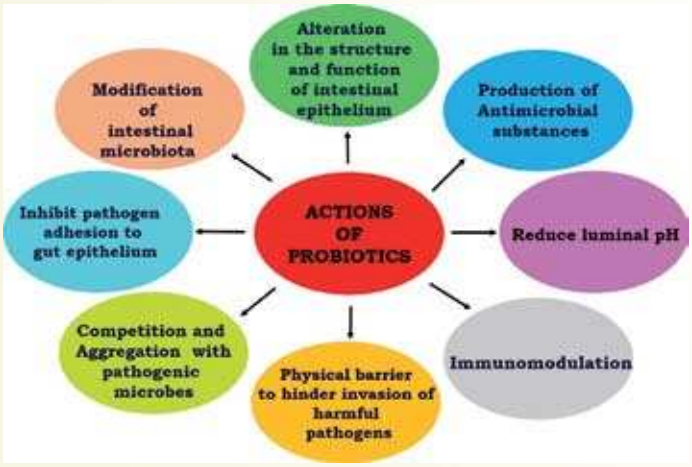
LAB Probiotic species

Lactobacillus	*Bifidobacterium*	*Streptococcus*	*Enterococcus*	Others
L. plantarum	*B. longum*	*S. diacetylactis*	*E. faecalis*	*Lactococcus lactis* ssp. *lactis*
L. rhamnosus	*B. bifidus*	*S. salivarius*	*E. faecium*	*Lactococcus lactis* ssp. *cremoris*
L. fermentum	*B. lactis*	*S. cremoris*		*Leuconostoc dextranicum*
L. brevis	*B. infantis*	*S. intermedius*		*Pediococcus acidilactici*
L. acidophilus	*B. bifidus*	*S. salivarius* ssp. *thermophilus*		
L. casei	*B. Adolescentis*			
L. bulgaricus	*B. breve*			
L. amylovorus				
L. reuteri				
L. gallinarum				
L. delbreuckii				

LAB probiotic species which are currently being used

and regulation of gut-associated and systemic immune system responses. Enhancement of signalling in host cells to reduce inflammatory responses. Reduction in production of inflammatory substances and stimulation of production of anti-inflammatory cytokines.

Most probiotic strains can be destroyed by acidic effect of gastric juice in the stomach and to overcome this problem a number of microencapsulation techniques are being developed.



Action of probiotics

Probiotic consumption

It has been observed that most probiotics temporarily colonise the lower intestine, but exert their effects as they metabolise and grow during their passage through the gut and therefore it must be consumed regularly to maintain their bio-theraputic effectiveness.

Probiotic dosage differs from person to person because the composition of intestinal microflora is quite different between individuals and hence the appropriate probiotics dosage has to be determined individually. The higher the imbalance in the microbiota of gut, the higher dosage is required for measurable positive health benefits. The probiotics usage may be the most natural and safe for keeping the balance of the intestinal ecosystem. When the consumption is stopped the number of probiotic microorganisms quickly falls.

Various clinical uses of probiotics

Intestinal infections in new-born and children

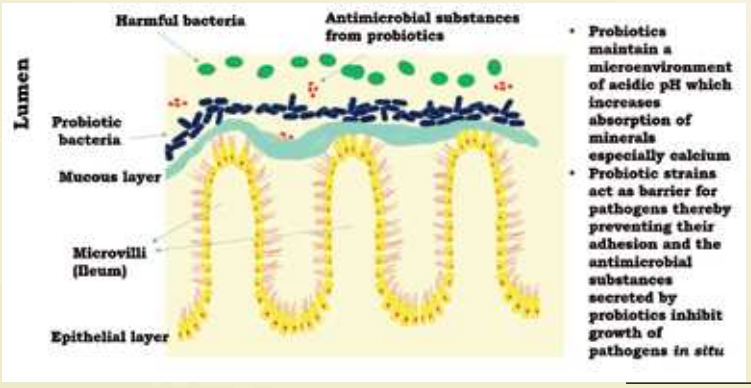
Probiotics are being applied in case of intestinal infections in the new-born and children such as diarrhoea which is a prime cause of morbidity and mortality. Necrotizing enterocolitis is a devastating intestinal disorder that a pre-term infant may face within a neonatal intensive care unit. The colonisation or infection of the intestine by pathogens such as *Klebsiella*, *Escherichia*, *Salmonella*, *Shigella*, *Clostridium*, *Campylobacter*, *Pseudomonas*, *Staphylococcus aureus*, *Streptococcus*, *Enterococcus*, and coagulase-negative staphylococci increases the risk of necrotizing enterocolitis. The incidence of necrotizing enterocolitis has been reported to fall if probiotics such as lactobacilli and bifidobacteria, colonise the intestine, or if breast milk rather than formula is used.

Lactose intolerance

Probiotic strains with an ability to produce β-galactosidase enzyme may help lactose-intolerant individuals to tolerate more lactose.

Enteropathogens and Helicobacter pylori

There are *in vitro* evidences that certain probiotic strains can inhibit the growth and adhesion of a range of enteropathogens. *Helicobacter pylori* is responsible for type B gastritis and peptic ulcers and may be a risk factor for gastric cancer. The *in vitro* as well as *in vivo* findings have indicated that certain LAB strains can inhibit the pathogen's growth and decrease the urease enzyme activity necessary for it to survive in the acidic environment of the stomach.



Mechanism of probiotic action

Inflammatory bowel disease

Inflammatory bowel diseases may be caused or aggravated by imbalances in the gut microbiota. Studies suggest that the use of a number of LAB probiotic strains in combination rather than a single strain can improve the conditions.

Cholesterol reduction

Probiotic strains are known to break down bile in the gut and thus inhibit its reabsorption where it enters as cholesterol in the blood and thereby reducing serum cholesterol levels.

Cancer

The lactobacilli and bifidobacteria reduce the risk of cancer by decreasing the glucouronidase and carcinogen levels.

Mucosal immunity

Probiotics lactobacilli are able to cross the intestinal mucous layer and can penetrate the gut wall either through epithelial layer or Peyer's patches (the numerous areas of lymphoid tissue in the wall of the small intestine that are involved in the development of immunity to antigens present there). Subsequently the microbial components interact with the immune cells and induce the production of cytokines, chemokines and other innate effectors.

Oral health

Pathogens cause a variety of oral and dental health problems including halitosis, gingivitis, and tooth decay. The good bacteria in mouth compete with these pathogens for space and inhibit their growth by producing antimicrobial substances.

Women's reproductive and bladder health

The incidence of urinary tract infections, yeast vaginitis, and bacterial vaginosis is estimated to affect one

Continued on page 22

Two Hundred Years of Natural History Museums in India

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Introduction

The first two natural history museums of the world were established in Europe during 18th century. The Italian 'Imperial and Royal Museum of Physics and Natural History', founded in 1775, in the city of Florence, was the first public museum to display natural history specimens comprehensively. The next such museum was the 'National Museum of Natural History', established in Paris in 1793.

Indian Museum, Calcutta in late 19th century

In India the first museum was established in Calcutta (now Kolkata) in 1814. Named as Oriental Museum of the Asiatic Society of Bengal, this museum had various natural history objects on display from the very beginning. The museum was later named Indian Museum.

The term 'Natural History' is used for scientific study of all objects of the natural world, covering major subject areas such as zoology, botany, geology and their allied fields like palaeontology and physical anthropology. Collections of natural history provide us information of biodiversity on Earth.

According to the International Council of Museums (ICOM), Natural History Museums are institutions that collect, display and research materials, collected or extracted from the natural world. The multifaceted purpose of such a museum is to: (i) build or store natural history collections, (ii) conduct research and interpret the results, (iii) support the purpose of science and biological conservation, (iv) enhance public understanding and appreciation of the natural world, and (v) collaborate with the public in deriving their own meaning from the natural heritage they encounter in the museum and in nature.

Natural History Museums by the numbers in India

During last two hundred years (1814-2013) sixty natural history museums or natural history galleries have been set up in various parts of India. Distribution of the institutions in seventeen states is as follows: Uttar Pradesh (14), Maharashtra (6), Tamil Nadu (6), Gujarat (4), Karnataka (3), Kerala (3), Uttarakhand (3), West Bengal (3), Assam (2), Bihar (2), Madhya Pradesh (2), Odisha (2), Punjab (2), Rajasthan (2), Telangana (2), Chhattisgarh (1), Manipur (1). Only two Union Territories of Chandigarh and New Delhi, are having natural history museums, one in each place.

In India 20 natural history galleries were set up as part of general museums, that also have galleries on art, archaeology, anthropology, numismatics, crafts, paintings and so on. The departments of zoology, botany, geology, etc. of many universities and colleges also have natural history museums and they are 23 in number. There are 17 fully dedicated natural history museums, but their size and collection vary widely.

General Museums with Natural History Galleries

The Oriental Museum of Asiatic Society of Bengal (later named Indian Museum) was established in Calcutta in 1814, with two major sections – one of archaeological and ethnological materials and the other of zoological and geological specimens. With the establishment of this museum, collection and display of natural history specimens began in India.

The next significant natural history display was in Government Museum and National Art Gallery, Madras (now Chennai), which was opened in 1851. The

Skeleton of crocodile in Indian Museum

Table 1. Growth of Natural History Museums or Galleries in India

Eight quarters of 25 years each	1814-1838	1839-1863	1864-1888	1889-1913	1914-1938	1939-1963	1964-1988	1989-2013	Total
General Museums with Natural History Galleries	1	4	3	1	3	5	2	1	20
Natural History Museums in Universities and Colleges	-	-	2	5	5	8	3	-	23
Dedicated Natural History Museums	-	-	2	2	-	1	6	6	17
Total	**1**	**4**	**7**	**8**	**8**	**14**	**11**	**7**	**60**

Specimens of lions in Baroda Museum and Picture Gallery, Vadodara

Museum of Natural History, Economic Geology, Industry and Art was established in Mumbai in 1855. Two general museums, set up in 1863, namely, State Museum, Lucknow and Central Museum, Nagpur also had added natural history galleries. Government Museum, Bangalore (now Bengaluru) established in 1865 too has important natural history sections. Three more museums – Mahant Ghasidas Memorial Museum, Raipur (1875), Watson Museum, Rajkot (1888), and Baroda Museum and Picture Gallery, Vadodara (1894), had set up galleries on natural history in the 19th century. The next eleven natural history galleries, set up as part of general museums in the country, were at Patna Museum (1917), Prince of Wales Museum of Western India, Mumbai (1921), Municipal Museum, Gwalior (1922), Museum of Antiquities, Jamnagar (1946), Prabhas Patan Museum (1951), Government Museum, Faizabad (1954), Bundelkhand Chhatrasal Museum, Banda (1955), Chandradhari Museum, Darbhanga (1957), Salipur Museum (1975), Government Museum, Vellore (1985) and B M Birla Science Centre, Hyderabad (2000).

Natural History Museums in Universities and Colleges

Since late 19th century many Indian universities and colleges realised the importance of natural history collections in innovative undergraduate science education. As a result, departmental natural history museums were set up. Maharaj's College in Ernakulam had first such facility, a Zoology Museum in 1874. The museum is still in operation. Only four more were there in that century, Natural History Museum at St. Joseph's College, Tiruchirapalli (1881), Museum of the School of Plant Morphology at Meerut College (1892), Botany Museum of Christ Church Colllege, Kanpur (1896) and Central College Museum, Bengaluru (1898). However, eighteen more departmental museums, spread all over the country, were established during the 20th century. These are known as, Museum of the Forest Research Institute, Dehradun (1906), Zoological Museum (1906) and Agahrkar Museum (1923), both in Allahabad University, Botany and Zoology Museum, I T college, Lucknow (1921), Zoology Museum, Annamalai University, Annamalai Nagar (1929), Museum of Plant Fossils, Lucknow (1929), Botany and Zoology Museum, Madras Christian College (1937), Geological Sciences Museum, Guwahati University (1950), Geological Museum, Lucknow University (1951), Botany Museum, T D College, Jaunpur (1956), Museum of the Botanical Survey of India, Dehradun (1956), Zoological Museum, D A V College, Muzaffarnagar (1958), Geology and Geophysics Museum, University of Roorkee (1960), Botany Museum, Punjab University, Chandigarh (1960), Zoology Museum, Punjab University, Chandigarh (1960), University Museum of Science and Culture, Aligarh Muslim University (1964), Shri Jainarain College, Lucknow (1973), and Geology Museum, Indian Statistical Institute, Kolkata (1977).

Timber Gallery in Forest Research Institute, Dehradun

Dedicated Natural History Museums

There are seventeen dedicated natural history museum in India. The first such museum was established by the Bombay Natural History Society in Bombay (now Mumbai) in 1883. Only after two years a natural history museum was opened in 1885 at Thrissur under the Kerala State Museum and Zoological Garden. The Gass Forest Museum, a natural history museum, was established in 1902 in Coimbatore. Next was the Bengal Natural History Museum set up in Darjeeling, West Bengal in 1903. However, no more dedicated natural history museum was established before India's independence. In 1961 a unique Museum of Arthropods was set up in Pune. A very large natural history museum was opened in Thiruvananthapuram in 1964. Two natural history museums attached to the nearest zoological gardens were established in Ahmedabad (1974) and Hyderabad (1979). So far, only two natural history museums have been established in the northeast – they are Assam Forest Museum, Guwahati (1983) and Biological Museum, Imphal (1989). Five natural history museums with thematic galleries and extensive educational activities were established in New Delhi (1978), Mysore (1995), Bhopal (1997), Bhubaneswar (2004), and Sawai Madhopur (2014). A government natural history museum was established in Chandigarh in 2001 and another such private museum was opened at Thar in Rajasthan (2007).

Highlights of some Natural History Museums

I. Early Natural History Museums in Mumbai

The first museum in the western part of India was opened in Mumbai in 1855. It was named the Central Museum of Natural History, Economic Geology, Industry and Arts. It was set up at the Town Barracks in Colaba area of the city and the Secretary of Bombay Geographical Society, Dr George Buist was appointed as the Secretary and Curator of the Museum. At that time, the museum was just a treasure house of decorative and industrial arts. But in 1857, when India declared its first rebellion for independence, British troops were stationed at the Town Barracks. This led to the shifting of the Central Museum to a different place. Right after the 1857 war died out, British Crown took over the governance of India. A group of intellectuals of Bombay, both of British and Indian origin decided to establish the Central Museum at a new and prominent location in the city and dedicate the museum to Queen Victoria. Sir Henry Frere, Governor of Bombay laid the foundation stone of this Museum on November 19, 1862. Funds were collected

from the public as well as the Government and the museum came to existence in 1872. Since it was built in the honour of the British Queen, it was named Victoria and Albert Museum and was opened to the public on 2nd May 1872

In 1883, eight residents of Bombay decided to form a Society for the study of natural history. They named it Bombay Natural History Society (BNHS) and held regular meetings in the Victoria and Albert Museum. Soon, the Society filled up with many members and collections began to be made. Thus they needed a new place, and ample space to exhibit these collections. Secretary of the society, Mr. H. M. Phipson came to the rescue and in 1886 the entire body was shifted to 6, Apollo Street which is currently known as Shaheed Bhagat Singh Road. When collections at 6, Apollo Street

Town Barracks in Colaba area of Bombay

began to grow, the need to have a proper museum was felt. After several years, the exhibits were shifted in 1921, to set up a permanent gallery on natural history in the Prince of Wales Museum, in Bombay.

II. Natural History Museum, Thiruvananthpuram

Back in 1885, the Napier Museum in Thiruvananthapuram had a substantial collection of natural history specimens. It initially had started with the personal collection of General William Cullen, a British Army Officer with the Madras Artillery Regiment. As years went by, the stock got richer and it was decided to expand the building. The foundation stone for the new Natural History Museum was laid on 22nd January, 1958 by the then Governor of Kerala, Dr. B. Ramakrishna Rao. It took about six years and the construction of the modern two storied building that we see today was completed in 1964.

Specimens of Indian rhinoceros in Natural History Museum, Thiruvananthapuram

There are some 2500 specimens and exhibits in the museum, displayed in galleries on Skeleton, Birds, Mammals, Vertebrates, Invertebrates, Ethnology and Palaeontology. The museum also has a huge collection of specimens to facilitate research in ornithology. Two Indian rhinoceros specimens are on display at the Entrance Hall of the museum. 'Maniyan', the male and 'Rita', the female had arrived in Thiruvananthapuram in 1956 and 2003, respectively, from Assam State Zoo cum Botanical Garden.

III. National and Regional Natural History Museums

India in 1978 had celebrated the World Environment Day on the 5th June befittingly by opening the National Museum of Natural History (NMNH) in New Delhi. The museum owes its beginning to Smt Indira Gandhi, Prime Minister, who in 1972 on the occasion of the 25th Anniversary of India's Independence, decided to establish a museum of natural history, primarily to depict the rich biodiversity of the country, and to promote environmental awareness among the masses through exhibits and activities. The NMNH is functioning under the aegis of Ministry of Environment, Forest and Climate Change, Govt. of India. Unfortunately, a massive fire had gutted out a major part of the NMNH in the early hours of 26th April, 2016.

In 1974, Dr S.M. Nair, an MSc and PhD, both in Museology from M.S. University of Baroda, was appointed as the Head of the project by Union Ministry of Environment and Forests. He was solely responsible for conceptualization of the museum. Dr Nair was assisted by his able colleagues like, Dr D.P. Singh, Shri S.K.Saraswat, Dr B. Venugopal. The museum opened its doors to the public in FICCI building on Barakhamba Road with a gallery on 'An Introduction to Natural History'. The initial expenditure amounted to rupees 70 lakh. During next 34 years NMNH added four more thematic galleries, namely, 'Nature's Network – Ecology', 'Conservation', 'Cell – the Basic Unit of Life' and 'Intangible Natural Heritage'.

The NMNH New Delhi has established four natural history museums in four zones of the country between 1995 and 2014. These are Regional Museum of Natural History in Mysore (1995), RMNH Bhopal (1997), RMNH Bhubaneswar (2004) and Rajiv Gandhi Regional Museum of Natural History in Sawai Madhopur (2014).

These four regional natural history museums collectively have permanent galleries on varied topics like, Biodiversity, Ecology, Life through Ages, Marine Creatures, Nature's Network, etc. These museums also conduct specially designed programs for school students and their teachers.

Skeleton of Baleen Whale in RMNH Bhubaneswar

It is evident from the forgoing paragraphs that there is large accumulation of natural history objects in our country and perhaps only a fraction of it is on display in museums for public viewing and study of respective academic institutions. It is necessary to digitize such collections and make that available to researchers from any part of the country, because such treasure would enable scholars to explore the relationships among environmental conditions and biodiversity.

Dr Jayanta Sthanapati, former Deputy Director General of National Council of Science Museums, is currently engaged in writing the 'History of Science Museums and Planetariums in India', a research project sponsored by the Indian National Science Academy. He holds PhD (Physics) and PhD (History) degrees.

Bioresource Potential of North-East India

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The North-Eastern region of India with its astounding biodiversity is one of the major natural hotspots in the country. The contiguous states of Arunachal Pradesh, Assam, Meghalaya, Manipur, Mizoram, Nagaland and Tripura, also known as the Seven Sister states in North-Eastern India, have been known for their water resources, land resources and bio-resources, much of which is yet to be explored. The rich flora and fauna of this region has the extraordinary potential to contribute major bio-products, therapeutics, food products, etc., which are in great demand. With an ideal geographic location, appropriate climatic condition and plenty of rainfall, the land resource is extremely fertile and can support a vast biodiversity including a lot of rare and medicinally important plants. Water bodies too support a large aquatic biodiversity including many algae, diatoms, reptiles, snakes, fishes, river dolphins, etc. Several extremophiles and thermo-tolerant plants are already reported from this region. There is no doubt that core-level scientific research on these bio-resources can benefit us in multi-dimensional ways in the near future. People of the North-East are in need of urgent attention from the government to help them in tapping the untapped resources and in exploring the potential research areas

into many threatening issues like climate change, lethal diseases, decreasing agricultural outputs, etc. Biotechnology research can help in reaping the benefits from the region's natural resources and can also provide an excellent opportunity for budding young scientists of the region. Already known for contributing remarkable bio-products by giving us many life-changing opportunities with its broad spectrum of applicability in biosciences, biotechnology offers the best option to explore and exploit the region's natural resources.

One of the most remarkable bio-resources from the North-East region, particularly Assam, is fresh water microalgae.

The region has a profusion of rivers, ponds, *beels*, wetlands, agricultural lands, etc., which are ideal habitats for algae. Algal blooms in Assam can be seen very easily and it is very unfortunate that in this era of biotechnology, no proper scientific research on algae is available in the region for product development and commercial applicability. There has to be proper characterisation of all bio-resources including algae and the genetic information in terms of DNA sequences should be made available to the scientific community through digital database.

There are many micro-algal species reported from this region, which are known to have biofuel properties and it is worthwhile to mention that algae can grow 50 times faster than terrestrial plants and are known to have 30-70% (sometimes more) oil content in terms of dry cell weight. Algal fuel has the potential to replace petroleum fuels and have the ability to reduce pollution as biofuels have almost zero emission. The impact of climate change and global warming can be remarkably abated by utilising these tiny natural treasures from this region.

Hard-core biotechnology research in algal fuel may help reduce petroleum fuel use in public transport systems in the region, thereby reducing air pollution to a great extent. It is very unfortunate that till date no separate algal biotechnology research unit/centre or division has been established in this algae-dominated region. More research on algal biotechnology, especially on production of algal biofuels, can go a long way in fighting climate change. For this there has to be a proper road map and vision for biotechnology research in the North-Eastern region of India to exploit its massive natural resources. Life science research need to be made an integral part of curriculum and young researchers need to be encouraged to work on important algal species and other bio-resources available in the region. Government need to take urgent initiatives to set up international level research stations in the region, so that students may get a research-based platform at the early stage of their academic life.

Compared to the significant bio-resources available in the region, research and development in the field is still in its infant stage. Many forests, water bodies in this region are yet to be explored. Algae are just a drop in the ocean, which may be the research focus of this region, because they have the potential for global research contribution in terms of climate change and biofuels. Algae have the potential to solve problems of global warming and petroleum fuel emissions. The

mammoth scope of scientific research in this region and the natural resources available here if utilised properly, may attract many industries and foreign companies to invest in large scale in near future.

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What's In a Name?

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> "What's in a name? That which we call a rose
> By any other name would smell as sweet."
>
> — Juliet

This is a well known and often used famous quote from Shakespeare's *Romio and Juliet*. Romeo Montague and Juliet Capulet met and fell in love in Shakespeare's lyrical tale of two struggling lovers as they belong to the two warring families. Here Juliet tells Romeo that a name is a superfluous and meaningless convention, and that she loves the person who is called "Montague", not the Montague 'name' nor the Montague 'family'. Romeo, out of his passion for Juliet, rejects his family name and baptised as Juliet's lover. However, the story below will show how a name gravely matters to scientists while naming a new particle that we know as 'meson' and later baptised as 'muon'.

Cosmic rays are high-speed energetic particles. These possess the highest known energies of individual particles in the universe. The energy spectrum of primary cosmic rays extends from 1 GeV (10^9 eV) to above 10^{20} eV. The Scottish physicist and meteorologist C.T.R. Wilson (1869-1959) who wanted to understand the formation of clouds under laboratory conditions suspected the existence of high-energy radiation outside our atmosphere. About a decade later, the Austrian scientist V.F. Hess (1883-1964) experimentally observed that with increase of altitude the intensity of ionising radiation increases in a dramatic way which he called "Höhenstrahlung" (high-altitude radiation) or "Ultra-Gammastrahlung" (ultra-gamma radiation). It was the American physicist Robert A. Millikan (1868-1953) who was initially sceptical about the existence of such rays, but later introduced the term 'cosmic rays' for the high-energy radiation. In 1929, German physicists Walther Bothe (1891-1957) and W. Kolhöster (1887-1946) found that cosmic rays are not photons, but consist of charged particles. With the discovery of atomic nucleus, physicists tried to understand the forces which keep a nucleus or rather its constituent particles protons and neutrons bound together. In order to explain the interaction between protons and neutrons German physicist Werner Heisenberg and Italian physicist Enrico Fermi proposed theories, but the energy calculated based on their assumptions was too small to account for the binding energy of the nucleus (the energy required to keep the particles together).

Charles Thomson Rees Wilson

Robert A. Millikan

A Japanese physicist Hideki Yukawa (1907-1981) proposed nuclear force field similar to the electromagnetic force field and with his simple assumptions found a new type of quanta having a mass more than 200 times the mass of the electron. On 17 November 1935 Yukawa read a paper which was later published in the *Proceedings of the Physico-Mathematical Society of Japan* in which Yukawa wrote:

"Now such interaction between the elementary particles can be described by means of a field of force, just as the interaction between the charged particles is described by the electromagnetic field. … In the quantum theory this field [field of force] should be accompanied by a new sort of quantum, just as the electromagnetic field is accompanied by the photon. In this paper the possible nature of this field and the quantum accompanying it will be discussed briefly and also their bearing on the nuclear structure will be considered."

By taking a particular wavelength, Yukawa calculated the mass of the new quanta as 200 times that of the electron mass (i.e., about 100 MeV). Yukawa was skeptical about the correctness of his theory, as he noted: "As such a quantum with large mass and positive or negative charge has never been found by experiment, the above theory seems to be on a wrong line." Nonetheless, a particle with a heavy mass was discovered in 1936 and was named 'mesotron', with the understanding that the mass of the particle is 'intermediate' between the mass of electron and proton (with mass 1836 times the mass of the electron). 'Mesos' in Greek means 'intermediate'. According to the Wikipedia article on mesons, it was Heisenberg who pointed out to Yukawa that there is no "tr" in the Greek word "mesos", thus Yukawa renamed the 'mesotron' as 'meson'. Interestingly, Yukawa did not use the term 'mesotron' in any of his publications till one published in 1939. However, controversy grew over whether to name the particle 'mesotron' or 'meson', which can be looked upon as a conflict between American scientists versus the others.

Hideki Yukawa

Millikan was a strong advocator of naming the particle as 'mesotron'. The name was first proposed in print in a letter published in *Nature* dated 30 September 1938 by C.D. Anderson (1905-1991) and S. H. Neddermeyer (1907-1988). On 7 December 1938, Millikan wrote a letter to the *Physical Review*.

"After reading Professor Bohr's address at the British Association in last September in which he tentatively suggested the name 'yukon' for the newly discovered particle, I wrote to him incidentally mentioning the fact that Anderson and Neddermeyer had suggested the name 'mesotron' (intermediate particle) as the most appropriate name. I have just received Bohr's reply to this letter in which he says "I take pleasure in telling you that everyone at a small conference on cosmic

ray problems including Auger, Blackett, Heisenberg and Rossi, which we have just held in Copenhagen, was in complete agreement with Anderson's proposal of the name 'mesotron' for the penetrating cosmic ray particle."

While compiling the '*Proceedings of the Chicago Conference on Cosmic Ray Physics*', it was found that the new particle was called by various names by different authors. The matter became so contentious that it had to be finally put on vote, and the name 'mesotron' was settled for, as is evident from the foreword to the *Proceedings* written by A.H. Compton (1892-1962). Compton wrote:

A.H. Compton

"An editorial problem has arisen with regard to the designation of the particle of mass intermediate between the electron and the proton. In the original papers and discussions (at the conference) no less than six names were used. A vote indicated equal choice between *meson* and *mesotron* with no considerable support for *mesoton, barytron, yukon*, and *heavy electron*. Except where the authors have indicated a distinct preference to the contrary, we have chosen the term mesotron."

However, the naming controversy was still haunting the scientists. It is known that the Indian physicist Homi J. Bhabha (1909-1966), British physicist Maurice H.L. Pryce (1913-2003) and others at a meeting in E. Bretscher's house in Cambridge agreed henceforth to use the word 'meson'. It is to be noted in this connection that Bhabha in the meantime had received international recognition as one of the leading scientists in cosmic ray research for his detailed study on the meson lifetime and its consequences for cosmic ray phenomena. Bhabha sent a paper for publication in *Nature* under the title "The fundamental length introduced by the theory of the mesotron (meson)", keeping the option open in changing the name if required. While sending the paper on 17 December, 1938 Bhabha wrote to Bohr that he had called the new particle meson. Dirac and other physicists in Cambridge found 'meson' better than 'mesotron'. But if he (Bohr) did not agree with the name meson, Bhabha was willing to change the name to mesotron and that the change could be made in the proof. The paper was published in *Nature* in February 1939 with no change in the title. In the footnote Bhabha included his argument against the word mesotron as follows: "It is felt that 'tr' in this word is redundant, since it does not belong to the Greek root 'meso' for middle, the 'tr' in neutron or electron belong, of course, to the roots, "neutr" and "electra". … It would therefore be more logical and also shorter to call the new particle a meson instead of mesotron." In the letter of 17 December 1938, Bhabha had informed Bohr about the footnote and the paper was published on 8 February 1939. This leaves no doubt that Bhabha played a significant role in settling the naming issue in favour of 'meson'.

Homi J. Bhabha

But it did not last long because Millikan came back into the picture about six years later, when he wrote to the Soviet physicist A. Alichanow on 14 February, 1945 that he was "particularly pleased to find you, contrary to the British and Indian scientists, writing 'mesotron' and not 'meson'". On 5 November, 1946, he reported the following to the American physicist Robert Brode at the University of California, Berkley in connection with the "history of the word 'mesotron'".

"I have no idea who started the use of 'meson'. A couple of years ago I wrote to Bethe, about the only man in this country who was using 'meson', and asked him if he did not think it would not be desirable if we got together and tried to get some common usage."

Hans Bethe (1906-2005), in the meantime, suggested that "it might be well to keep the name 'mesotron' for the experimental thing and 'meson' for the theoretical. Millikan found it neither wise nor practical. He also reported in his letter to Borde that he "spoke to (W.F.G) Swann about this recently in Philadelphia and he feels very vigorously about it that the use of 'meson' is a very unfortunate one, not only because it violates all historical and etymological properties but is also so close in name to a word that has come in French to be used as a word for a house of ill fame, that he will not tolerate its use at all."

Hans Bethe

In 1946, M. Conversi, E. Pancini and O. Piccioni showed that the "mesotron" which was discovered by Neddermeyer and Anderson, and by J.C. Street and E.C. Stevenson "was not the particle predicted by Yukawa as the mother of nuclear forces, but was instead almost completely unreactive in a nuclear sense". The controversy died down after the discovery of π-meson and its subsequent decay to μ-meson, the latter one is the controversial mesotron which is now known as muon.

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The Glamorous Gaub

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Gaub is a very common tropical tree species that produces sweet-smelling, delicious fruits. The pulp of this less-known fruit and the resin from the tree are generally used to make the fishing nets durable under water as well as for caulking of boats. Gaub fruits have been used in various ethnomedicinal and ayurvedic treatments in India from long ago.

The gaub tree is quite common in the Indian Subcontinent. Older trees can reach a height of up to 35 metres. Ripe fruits are round with a diameter of 4 to 7 cm and have a yellow colour. The fruit is not so well-known to city dwellers as it is in the villages. Particularly, the sticky pulp of the fruit is extensively used by the local fishermen to coat fishing nets to make them durable under water. A sticky substance discharged from the tree is used for sealing country boats. Unripe fruits of the gaub tree contain tannins and are used for curing nets and leather. Leaves and fruits can be used as a natural dye to dye cloth black. The ripe fruit of the tree are relished not only by animals and birds, but by human beings as well. This delicious fruit has an implicit taste and grown-ups cannot easily forget the first nostalgic bite and the flavour that he or she savoured in the teens.

Gaub is the fruit of a dicotyledonous tree of the same name. Outside India, this tree is known by several names such as 'Indian Persimmon', 'Wild Mangostein', 'Malabar Ebony', etc., in addition to the common name. 'Gaub' with alternative name 'Desi Gaub' is botanically known as *Diospyros peregrina* (Gaertn.) Gurke. It belongs to the family Ebenaceae. Gaub is known under different names in different languages in India. In Sanskrit this tree is known as '*Tinduka*' whereas in Hindi, Bengali and Odiya it is known as '*Gab*'. In Kannada it is known as '*Holitupare*', in Malayalam, it is '*Panancha*', in Marathi, it is '*Temburi*', in Tamil, it is '*Tumbika*', and in Telugu, it is known as '*Bandadamara*'. The desi gaub is a native of tropical Africa and distributed throughout India, Bangladesh, Myanmar, Malaysia and other South-East Asian countries, and is also found in Australia. The tree occurs in village groves throughout the country, usually growing by the banks of rivers, or canals and in moist places.

Fig. 1. A mature gaub (Diospyros peregrina) tree in the fruiting season (Photo: Dipanjan Ghosh).

Another species known as '*Bilaiti Gaub*' (*Diospyros discolor* Willd.) is a medium-sized tree growing to a height of 20 metres. This particular species is native to the Philippines and also very common throughout India. The fruit of Bilaiti gaub is known as Mabolo, Butter Gruit, Velvet Apple or Camogan ebony. The fruit is very attractive for its beautiful reddish skin colour as well as for the taste. The surface of the fruit is covered by powdery velvet structure and the texture of the flesh is sandy.

Botanical trivia

Gaub is a long-lived, very slow-growing, evergreen tree with a spreading crown (Fig. 1). It can grow up to 10-15 m in height with a trunk girth up to 70 cm. The outer bark is black, smooth, and the inner bark turn bluish on exposure to sunlight. Leaves are simple, alternate, distichous, and oblong to lanceolate in shape; leaf lamina 16-19 cm long and 5-7 cm wide, glossy and dark green in colour. Leaf margins are entire, venation strongly reticulate on both surfaces and midrib canaliculated.

The gaub tree flowers between March to May and simultaneously fruiting also starts. Flowers (Fig. 2) are unisexual, small, dioecious, regular, ebractiate and tetramerous. Male flowers with 25 – 55 free stamens and are in short pedunculate, rusty pubescent, 3-7 flowered axillary cymes. Female flowers are solitary, sub sessile, hypogynous, monocarpellary, larger than male flowers; peduncles stout and pubescent.

Fig. 2. Flowers of gaub – a. male flowers and b. female flower (Photo: Dipanjan Ghosh).

Fig. 3. The extracts of unripe fruit are generally applied to make fishing nets durable under water as well as for caulking of country boats (Photo: Dipanjan Ghosh).

Gaub fruit is a berry, about 4-6 cm across. Unripe fruits (Fig. 3) are green-to-reddish velvety in colour. Ripening takes 4-5 months' time. Green fruits turn yellowish when ripe and are covered with deciduous red or brownish hairs. Each fruit contains 4-8 smooth elliptical, reddish brown, compressed seeds, embedded in a glutinous yellowish-brown pulp, turning black when exposed to sunlight.

Fig. 4. Ripe fruits of gaub – a. from various angles and b. a single fruit with persistent calyx (Photo: Dipanjan Ghosh)

Fruit value

Ripe fruits (Fig. 4) are edible. Harvesting of fruits at the right time ensures better fruit quality. The pulp is sweet smelling and delicious. The usual practice is to eat only the pulp. Although this fruit is not very familiar to common people, it is generally used as a table fruit. Tribal consume the fruits raw (Fig. 5) and it is also sold in local markets. Fruits are nutritionally rich, containing (per 100 g of edible portion): calories 113, water 69.6 g, carbohydrates 26.6 g, fat 0.1 g, protein 1.4 g, dietary fibres l.5 g, and minerals 0.8 g (including high calcium, potassium and phosphorus content). Ripe fruit also has high glucose content. Immature fruits are astringent, acrid, bitter and greasy. Moreover, the fruit pulp contains certain secondary metabolites such as hexacosane, hexacosanol, β-sitosterol, monohydroxy ketone, lupeol, and salicylic acid. Seeds contain betulinic acid and oil.

Gaub benefits

Gaub has occupied a pivotal position in the Indian traditional system of medicine. Rural and aboriginal people of our country commonly use this plant to treat various disorders for years. In ethnomedicinal practice, ripe fruits of gaub are used as tonic and aphrodisiac. Unripe fruits are used for the treatment of diarrhoea, dysentery, cholera, asthma, cough, ulcer of mouth and wounds. It is also said to be a good remedy in poisoning, especially in snake bite.

According to Ayurveda, the plant is considered anti-inflammatory in nature. Bark, fruit, seed and seed oil are mainly used in the Ayurvedic system of medicine to cure diseases like diabetes, urinary tract disorders and non-healing wounds. The bark is applied externally to treat abscesses and boils. It improves skin complexion and quality; helps relieve diarrhoea and heal burning wounds, speeds up the healing process of bone fracture and so on. The seed powder is used to stop excess blood flow in case of injuries and haemorrhages.

Besides medicinal uses, gaub has other uses too. The hard and termite-resistant wood of the tree is used for furniture and wood carvings. The wood is very tough and suitable for making of *dhenki* (traditional wooden agricultural machinery) and textile shuttles. Also the chopped and steamed tender leaves of the gaub tree are mixed with grated coconut to prepare a palatable recipe famous in rural areas of Bengal.

Conclusion

Like other uses, this less known fruit tree has perpetual importance as nutriment, at least for marginal people. Especially these days, when the so called urbane people are in desperate search of some unconventional and new foods, it is high time to be acquainted with fruits of Gaub. The herbal remedy based on Gaub has also been found to possess positive impacts.

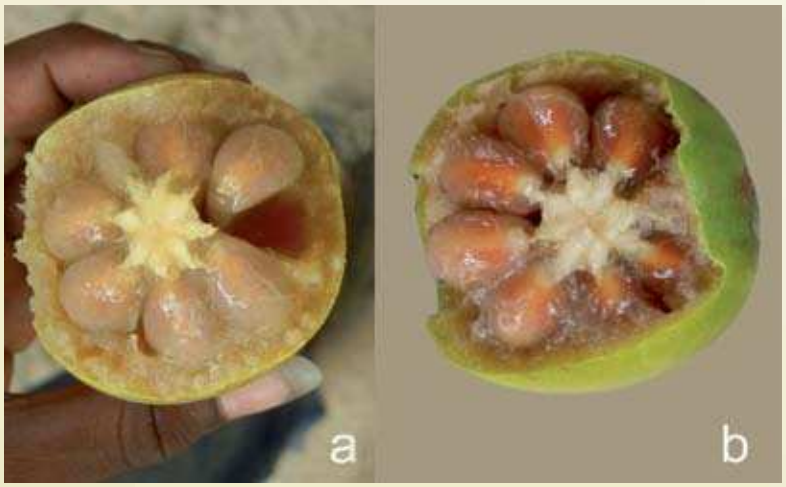

Fig. 5. Pulp and seeds inside a ripe fruit – a. freshly cut fruit and b. gradual darkening of pulp after a while (Photo: Dipanjan Ghosh).

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Hiatal Hernia — When the stomach squeezes up into the chest box

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The food pipe connects the mouth and throat to the stomach. Given the name of oesophagus, it courses through the chest cavity and enters the abdominal cavity through a small opening (hiatus) in the diaphragm. The diaphragm is a muscle layer which separates the chest box from the abdomen box.

A hiatal hernia occurs when a part of the stomach pushes upward or protrudes through the oesophageal hiatus in the diaphragm to rest within the chest cavity.

The big cause

Normally, the space where the oesophagus passes through the diaphragm is sealed by the phreno-oesophageal membrane, a thin membrane of tissue connecting the oesophagus with the diaphragm where the oesophagus passes through the diaphragm, so that the chest cavity and abdominal cavity are separated from each other.

Since the oesophagus shortens and lengthens with each swallow, essentially squeezing food into the stomach, this membrane needs to be elastic to allow the oesophagus to move up and down. Normal physiology allows the gastroesophageal junction, where the oesophagus and stomach meet, to move back and forth from just below to just above the diaphragm. However, at rest the gastroesophageal junction is normally located below the diaphragm and lies in the abdominal cavity.

Over time, as we catch up in years, the phreno-oesophageal membrane may, however, weaken. When that happens, a part of the stomach may protrude through the membrane and remain above the diaphragm permanently.

Culpable factors

A number of reasons may contribute to the development of a hiatal hernia. For instance, conditions that decrease the abdominal muscle tone and increase the pressure within the abdominal cavity are the biggest culprits; however, a hiatal hernia may be precipitated by a host of factors:

Birth defect

Being born with an unusually large oesophageal opening (hiatus) in the diaphragm can lead to a hiatal hernia. This kind of hiatal hernia may develop at any age and may also be seen in a new-born.

Pregnancy

Since pregnancy lowers the abdominal muscle tone and increases the pressure within the abdominal cavity, repeated pregnancies may also be partly accountable for the occurrence of a hiatus hernia.

Chronic constipation

People who have constipation and strain to have a bowel movement, increase the intra-abdominal pressure when they strain, and this may weaken the phreno-oesophageal membrane (the membrane by which the oesophagus is attached to the diaphragm), leading to a hiatal hernia.

Obesity

People who are obese are at an increased risk for developing a hiatal hernia because of the lowering of the abdominal muscle tone and increased pressure within the abdominal cavity.

Ageing

The phrenoesophageal membrane also may weaken and lose its elasticity as a part of the normal ageing. People past the age of 50 thus are at an increased risk of developing a hiatal hernia.

Types of hiatal hernias

A hiatal hernia can broadly be of two types: a sliding hiatal hernia; and a para-oesophageal hernia. In some people, a mix of two types also can occur.

Sliding hiatal hernia

The most common type of hiatal hernia is a sliding hiatal hernia. In this condition, the gastroesophageal junction and a portion of the stomach slides upward into the space in the chest between the lungs where the oesophagus travels and where the heart is housed. The hernia is more prominent during inspiration when the diaphragm contracts and descends towards the abdominal cavity and when the oesophagus shortens during swallowing.

Sliding hiatal hernias account for 95 per cent of all hiatal hernias and, because a hiatal hernia by itself causes no symptoms, it is unknown how frequently this condition exists in the general population.

Para-oesophageal hiatal hernia

In a para-oesophageal hernia, the opening in the phreno-oesophageal membrane is large, and a greater portion of the stomach protrudes

into the chest alongside the oesophagus and stays there, but the gastroesophageal junction remains below the diaphragm. This is due to ligaments that keep parts of the stomach attached to other organs within the abdomen.

Should a para-oesophageal hernia occur, parts of the stomach rotate upward to assume their position above the diaphragm.

Mixed hiatal hernia

In a combination of events, should the defect in the diaphragm be large, the gastroesophageal junction and more of the stomach can protrude and become displaced into the chest causing both a para-oesophageal and a sliding hiatal hernia.

Signs and symptoms

Often, a hiatal hernia causes no symptoms. Many are found incidentally when a person has a chest X-ray or abdominal X-rays (including upper gastrointestinal series, where the patient swallows barium) or a CT scan. It also is found incidentally during upper gastrointestinal endoscopy.

Most often if symptoms occur, they are due to gastroesophageal reflux disease (GERD) where the digestive juice containing acid from the stomach moves up into the oesophagus. The stomach is a mixing apparatus that allows food and digestive juices to mix together to begin the digestive process. It is provided with a protective lining that

prevents acid from eating away at the stomach muscle and causing inflammation.

Unfortunately, the oesophagus does not have a similar protective lining. In the situation of a sliding hiatal hernia, acid is allowed to reflux back into the oesophagus causing inflammation of the lining of the oesophagus and the symptoms of GERD.

These symptoms may include the following:

- heartburn: chest pain or burning,
- water brash, the rapid appearance of a large amount of saliva in the mouth that is stimulated by the refluxing acid
- retching
- burping

Symptoms usually are worse after meals. These symptoms may be made worse when lying flat and may resolve with sitting up or walking.

In some patients, reflux into the lower oesophagus sets off nervous reflexes that can cause a cough or even spasm of the small airways within the lungs, setting off an asthma-like condition. A few patients may reflux acid droplets into the back of their throat. This acid can be inhaled or aspirated into the lung causing coughing spasms, asthma, or repeated infections of the lung including pneumonia and bronchitis. This may occur in individuals of all ages, from infants to the elderly.

Most para-oesophageal hiatal hernias have no symptoms of reflux because the gastroesophageal junction remains below the diaphragm, but because of the way the stomach has rotated into the chest, there is the possibility of a gastric volvulus (abnormal twisting of the intestines), where the stomach twists upon itself. Fortunately, para-oesophageal hernias are relatively uncommon. However, volvulus is a surgical emergency and causes difficult, painful swallowing, chest pain, and vomiting.

Diagnosis

Most often, a hiatal hernia is found incidentally with gastrointestinal X-rays, upper gastrointestinal endoscopy, and sometimes CT scan, since by itself, it causes no symptoms. Only when there are associated symptoms of GERD will the patient usually seek medical care. With symptoms of GERD, it is likely that a hiatal hernia is present since most patients with GERD have hiatal hernias.

Most often, the diagnosis is confirmed by a barium swallow examination, where a radiologist uses fluoroscopy to observe in real time as the swallowed barium outlines the oesophagus, and upper part of the stomach.

An upper gastrointestinal endoscopy is a procedure performed under sedation or short anaesthesia by a gastroenterologist to look at the lining of the oesophagus, stomach, and duodenum. A hiatal hernia may be diagnosed easily in this manner and more importantly, the physician may be able to see complications of GERD from the reflux of acid. Endoscopy is used to diagnose scarring with narrowing of the oesophagus and precancerous conditions like Barrett's oesophagus. Biopsies or small tissue samples may be taken and examined under a microscope.

Self-care measures

Several small steps in the daily routine can help relieve the signs and symptoms of GERD as they help prevent the acid reflux into the oesophagus.

Partake of small frequent meals

Instead of eating two or three larger meals a day, if you opt for small frequent meals, it is likely to reduce the burden of acid reflux into the oesophagus.

Stay shy of foods that trigger acid reflux

Some foods are known to trigger acid reflux. These include spicy, greasy foods, onions, tomatoes and citrus fruits and chocolates. You should avoid all such foods that trigger heartburn symptoms.

Eat at least two to three hours before bedtime.

Say no to alcohol and smoking

Avoid alcohol. Stop smoking. Both are known to increase the acid reflux.

Lose weight

If you're overweight or obese, try and lose weight. Tone up your abdominal muscles.

Sleep in style

Elevate the head of your bed. When you go to sleep, elevating the head end of the bed about 15 centimetres with a few bricks placed underneath the posts can be most useful. This allows you to befriend gravity which prevents acid from refluxing into the oesophagus.

The treatment

The treatment for hiatal hernia is really treatment for GERD and minimising acid reflux. This includes decreasing acid secretion in the stomach, avoiding substances that are irritating to the stomach lining, and mechanical means to keep the remaining acid in the stomach where it belongs.

Medications

Antacids

Antacids that neutralise stomach acid. Over-the-counter antacids, such as Gelusil, Maalox, Mylanta, Rolaids and Tums, may provide quick relief.

Medications to reduce acid production

H-2-receptor blocker medications act by decreasing the acid secretion in the stomach. They include cimetidine, ranitidine, and famotidine.

Proton pump inhibitor medications are powerful molecules which decrease the acid production in the stomach. The commonly used proton pump inhibitors are pantoprazole, lansoprazole, omeprazole, rabeprazole and esomeprazole.

Surgery

The current medications have reduced the necessity of surgery for sliding hiatal hernias. Surgery is often only recommended for people who have failed aggressive drug treatment or who have developed complications of GERD like strictures, ulcers, and bleeding or those with repeated pneumonia from aspiration.

Patients with para-oesophageal hernias often have no symptoms, and surgery is required only if the hernias become incarcerated and become stuck in the diaphragmatic hiatus or rotate to cause a volvulus. While this is more commonly seen in older people, para-oesophageal hernias also may occur as a congenital condition in neonates and infants.

Most often, the surgery is done as a minimally invasive procedure using a laparoscope. While there are different techniques, the results are similar and the best option is usually the one the surgeon feels most comfortable performing in a specific situation.

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Probiotic Bacteria: The Friendly Microorganisms (continued from page 33)

billion women every year. The prevention or resolution of bacterial vaginosis is particularly important for women at risk of human immunodeficiency virus (HIV) infection. The vaginal microflora is often abnormal during the menstrual cycle and post-menopause. When a woman develops a symptomatic infection, the pathogenic microflora increases several-fold which may lead to bladder infection.

It is recognised that the application of probiotics can go beyond consumption of foods. It has been reported that about 70% of pre-menopausal, healthy women harbour lactobacilli capable of producing hydrogen peroxide. Certain *Lactobacillus* strains are able to colonise the vagina following vaginal suppository use and reduce the risk of urinary tract infection, yeast vaginitis, and bacterial vaginosis. The probiotics characterised for the vaginal health must be resistant to spermicides.

Side effects of probiotics

There are very rare cases of bloating, diarrhoea, abdominal pain as side effects of probiotic consumption. In persons with compromised immune system problems like skin rash, fever, bloody stools, etc., have been seen. Sometimes probiotics interact with immunosuppressive drugs leading to life threating conditions. So people taking such drugs should avoid it.

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Recent Developments in Science and Technology

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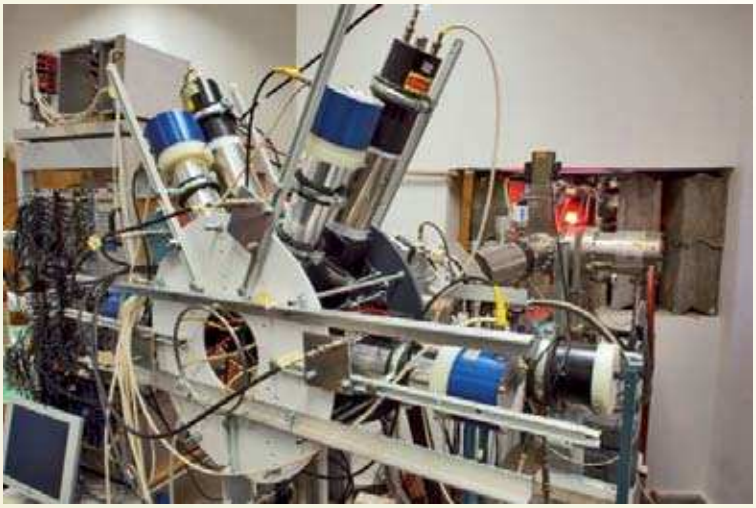
Possibility of a fifth fundamental force

Till now physicists have known of four fundamental forces, namely (i) gravity, (ii) electromagnetism, (iii) the strong nuclear force, and (iv) the weak nuclear force. Gravity and electromagnetism operate on a scale that we can readily recognise, while the strong and weak forces act on the atomic level to keep atoms together or to break them apart. Most of physics can be understood with these forces, but there are anomalies – hints that our understanding of nature is missing something. Hungarian researchers recently spotted something strange after firing protons at a lithium-7 atom, causing a brand new super-light boson to pop out that could be a carrier of a fifth force. If confirmed by further experiments, this discovery of a possible fifth force would completely change our understanding of the universe, with consequences for the unification of forces and dark matter.



Physicists at the Institute for Nuclear Research in Debrecen, Hungary, say this apparatus has found evidence for a new particle only 34 times heavier than the electron.

The discovery came while researchers of University of California, Irvine (UCI) in USA were analysing a previous study by experimental nuclear physicists from the Hungarian Academy of Sciences who were looking for "dark photons" – a proposed electromagnetic force carrier for dark matter, similar to the way that regular photons carry the electromagnetic force for normal matter. The Hungarian researchers were not able to claim that it was a new force; they "simply saw an excess of events that indicated a new particle, but it was not clear to them whether it was a matter particle or a force-carrying particle".

The UCI group studied the Hungarian researchers' data as well as all other previous experiments in this area and came to the conclusion that the evidence strongly disfavours both matter particles and dark photons. They proposed a new theory that synthesises all existing data and determined that the discovery could indicate a fifth fundamental force. They proposed that the particle may actually be a kind of still unknown boson, which they call 'protophobic X boson' rather than a dark photon. There is no other boson known that has this same characteristic. According to the researchers, "while the normal electric force acts on electrons and protons, this newfound boson interacts only with electrons and neutrons – and at an extremely limited range" (*Physical Review Letters*, 12 August 2016 | arXiv:1608.03591).

Over the past decade, physicists have been looking for new forces because of the inability of the standard model of particle physics to explain dark matter – an invisible substance thought to make up approximately 27% of the mass of the Universe. Theorists have proposed various exotic-matter particles and force-carriers, including "dark photons", by analogy to conventional photons that carry the electromagnetic force. According to Jonathan Feng, Professor of Physics and Astronomy who led the UCI study, "The particle is not very heavy, and laboratories have had the energies required to make it since the '50s and '60s, but the reason it has been hard to find is that its interactions are very feeble. However, because the new particle is so light, there are many experimental groups working in small labs around the world that can follow up the initial claims, now that they know where to look".

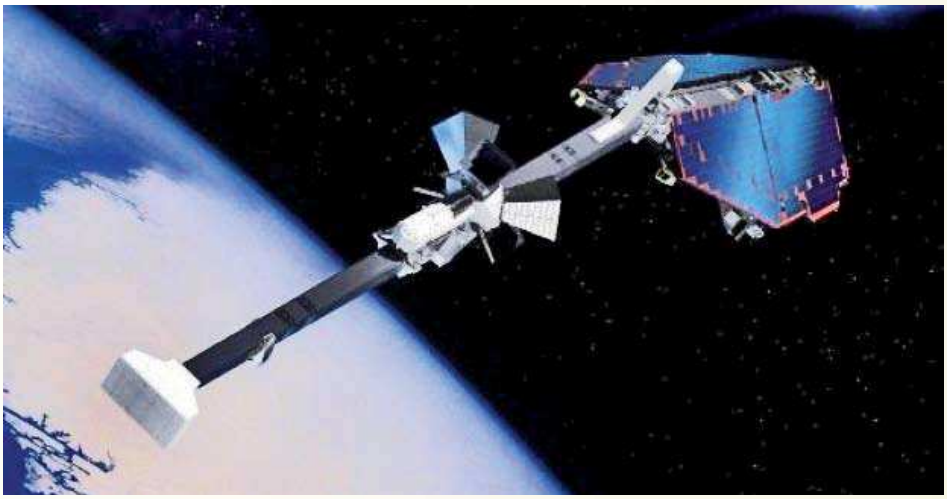
Like many scientific breakthroughs, this one opens entirely new fields of inquiry. Feng further speculates about the possibility that this potential fifth force might be joined to the electromagnetic and strong and weak nuclear forces as "manifestations of one grander, more fundamental force".

China launches world's first quantum satellite

In the age of relentless cyberattacks and global electronic surveillance, nations and citizens are looking for any means to secure their communications. To achieve this objective, the Chinese have launched the world's first quantum communications satellite that can achieve totally secure communication links between space and Earth. Officially known as the *QU*antum *E*xperiments at *S*pace *S*cale (*QUESS*), the mission has been renamed *Mozi* after an ancient Chinese philosopher. The 600-kg satellite carries an encryption technology that, if successful, could revolutionise hack-proof communications. It has been placed in a 500-km orbit with an orbital period of 90 minutes.

Quantum technology offers unique possibilities not available with currently available technologies. One such possibility is quantum communications – novel communication protocols using quantum entanglement, which allow efficient communication and computation beyond the capabilities of their classical counterpart. The basic idea of quantum entanglement is that two particles can be intimately linked to each other even if separated by billions of light-years of space; a change induced in one will affect the other.

Traditional communications satellites



Mozi, The first satellite of the QUantum Experiments at Space Scale (QUESS), launched by China.

use radio waves for communication. But a quantum communication satellite uses a crystal that produces a pair of entangled photons whose properties remain entwined even as one is transmitted over a large distance. Messages could be sent by manipulating these properties. Quantum physicists have recently advanced the use of photons to communicate securely over short distances on Earth.

The satellite will be used to beam communications from space to Earth with quantum technology, using photons, or particles of light. This type of communication could prove to be the most secure in the world, invulnerable to hacking. The Chinese researchers hope to use the satellite and quantum communications to establish secure transmissions between two ground sites. In theory, the satellite can provide the connection between them. The first major link in China would be between Beijing and Shanghai, and might open this year. The satellite, if successful, would vastly expand the range of totally hack-proof communication.

A team led by Jian-Wei Pan of the University of Science and Technology of China in Hefei will conduct their own experiments with *Mozi*, using photons to test quantum entanglement – in which the quantum properties of two particles are linked even when separated – over a large distance of thousands of kilometres. The team will also test quantum key distribution, a form of secure communication in which the laws of quantum mechanics prevent unauthorised access to the transmitted message. If successful, more similar satellites would be placed in orbit to create a super-secure communications network, potentially linking people anywhere in the world.

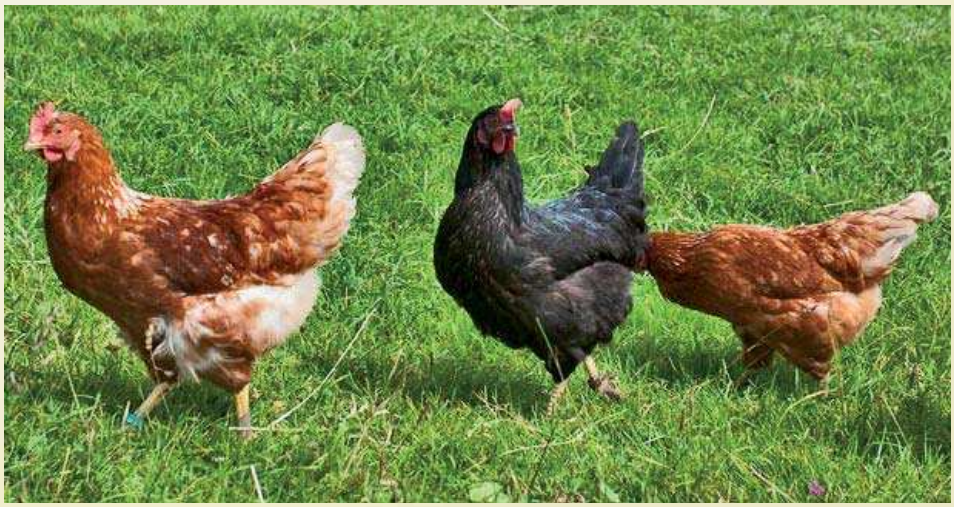
Chicken odour as mosquito repellent

Malaria is a serious health problem in many developing countries including India. According to the World Health Organisation, in 2015, there were roughly 214 million malaria cases and an estimated 4,38,000 malaria deaths worldwide although in India, malaria cases have shown a sharp decline since 2000. Sub-Saharan Africa continues to carry a disproportionately high share of the global malaria burden. In 2015, the region was home to 89% of malaria cases and 91% of malaria deaths, including 3,05,000 African children who died before their fifth birthdays.

Malaria is caused by Plasmodium parasites that are spread to people through the bites of infected female Anopheles mosquitoes. Although increased malaria prevention and control measures are dramatically reducing the malaria deaths in many places, the problem still persists, especially with the growing resistance of the malaria parasite to artemisinin – till now the only effective anti-malarial drug. Scientists are looking for new ways to tame the disease and a recent discovery gives new hope.

Swedish researchers have recently made a surprising discovery in field studies in Ethiopia, that Anopheles mosquitoes are repelled by the odour of chickens, potentially offering another cheap protection method against malaria. Most mosquitoes – including certain species of the Anopheles genus that carry the malaria parasite – like to bite humans. They transmit the disease through a blood meal. They are also known to occasionally bite cattle, goats and sheep for blood meal. But they are selective feeders. Mosquitoes don't like the taste of chicken blood, so poultry rarely gets bitten.

For the study, the researchers set up traps to capture the most common mosquito in the area, *Anopheles arabiensis*, in 11 houses in Addis Ababa. Then they tested the blood inside the mosquitoes, and found blood from humans and all sorts of animals. But they found almost no blood from chickens (*Malaria Journal*, 20 July 2016 | DOI: 10.1186/s12936-016-1386-3). According to Rickard Ignell, a professor at the Swedish



Chicken odour repels malaria-carrying mosquitoes.

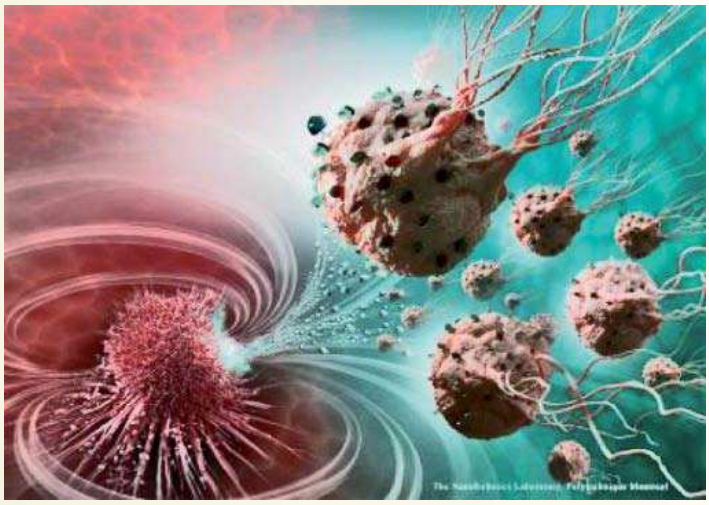
University of Agricultural Sciences and the corresponding author, "We were surprised to find that malaria mosquitoes are repelled by the odours emitted by chickens. This study shows for the first time that malaria mosquitoes actively avoid feeding on certain animal species, and that this behaviour is regulated through odour cues."

The researchers collected hair, wool and feathers from potential host and non-host species to analyse the odour compounds present in them and identified certain compounds that were only present in chicken feathers. The researchers say the compounds are cheap and some are already available. The researchers are planning to see whether the chicken odour, contained in some sort of wax that can be burned like a candle, also repels mosquitoes outside the home "once they get a whiff of poultry". Future research could explore what concentrations of these chicken compounds repel mosquitoes best. Another alternative could be sleeping next to live chicken. Although the method may sound bizarre, it could save the lives some of the 3.2 billion people at risk of malaria globally, especially in rural areas.

Administering anti-cancer drugs using nanorobots

Cancer is one of the most dreaded diseases that afflict mankind. According to the World Health Organisation, cancer figures among the leading causes of morbidity and mortality worldwide, with approximately 14 million new cases and 8.2 million cancer related deaths in 2012. The number of new cases is expected to rise by about 70% over the next two decades.

Currently, cancer treatment as we know it is problematic because it targets a large area. Chemo and radiation therapies are effective, but they are like setting off a bomb – they not only destroy cancerous cells, but in the process also damage the healthy ones surrounding it often critically affecting health. This is why these therapies are sometimes as harmful as the cancer itself. Researchers have been looking for alternative treatments that can wipe out the cancerous cells, but without creating additional medical issues and they may have found one.



The nanorobotic agents are actually composed of more than 100 million flagellated bacteria and loaded with drugs that move by taking the most direct path between the drug's injection point and the area of the body to cure. (Credit: Montréal Nanorobotics Laboratory)

Researchers from Polytechnique Montréal, Université de Montréal and McGill University in Canada have recently achieved a spectacular breakthrough in developing new nanorobotic agents that can navigate through the bloodstream to administer a drug with precision by specifically targeting the active cancerous cells of tumours. This method of drug delivery ensures the optimal targeting of a tumour and avoids damaging surrounding healthy tissues and organs. As a result, a much lower dosage of drug, which is not toxic for the human organism, could be used.

Cancer cells usually grow very fast, depleting oxygen quickly. Oxygen-depleted regions in the tumour are generally resistant to therapies. Although nanocarriers have been used in the past to deliver drugs to cancer cells, the efficiencies have been very low. The Canadian researchers have designed nanorobotic agents that look for and target oxygen-depleted cancer cells. Sylvain Martel, Director of the Polytechnique Montréal Nanorobotics Laboratory who led the research explained: "These legions of nanorobotic agents are actually composed of more than 100 million flagellated bacteria – and therefore self-propelled – and loaded with drugs that move by taking the most direct path between the drug's injection point and the area of the body to cure". The researchers used a special kind of bacteria called magnetotactic bacteria that orient along the Earth's magnetic field and can be guided using external an magnetic field. When they enter a tumour, the bacteria can detect the oxygen-depleted tumour areas and deliver the drug to them. The research was done on mice, which were successfully administered nanorobotic agents into cancerous tumours of the colon (*Nature Nanotechnology*, 15 August 2016 | doi:10.1038/nnano.2016.137).

According to the researchers, chemotherapy, which is so toxic for the entire human body, could make use of these natural nanorobots to move drugs directly to the targeted area, eliminating the harmful side effects while also boosting its therapeutic effectiveness.

Biman Basu is a former editor of the popular science monthly Science Reporter, published by CSIR, He is a winner of the 1994 'NCSTC National Award for Science Popularisation'. He is the author of more than 45 popular science books.