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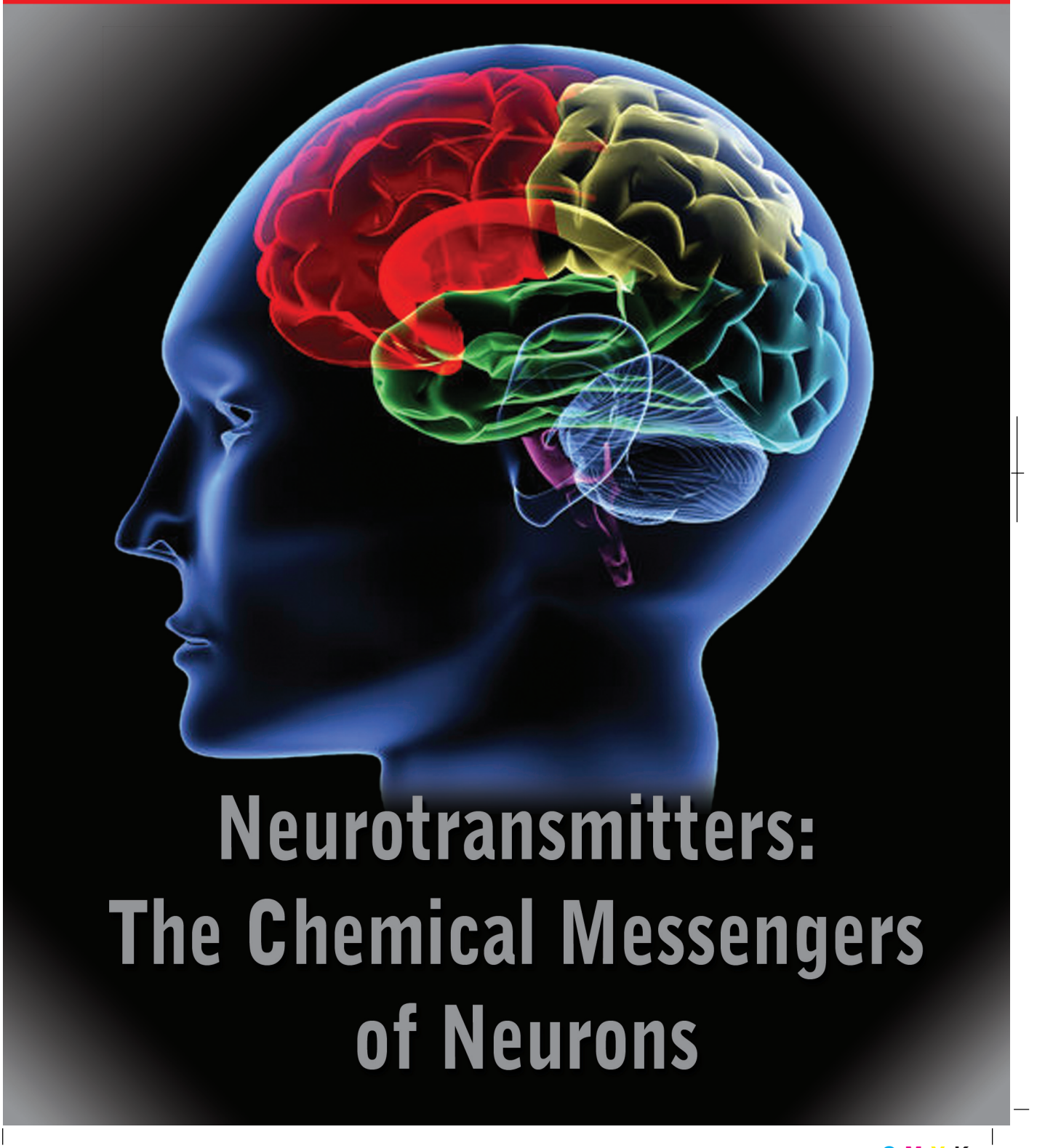

Neurotransmitters: The Chemical Messengers of Neurons

C M Y K

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SCIENCE INDIA
Sastra Bhavan, B4, 4th Floor, Mather Square
Town Railway Station Road, Kochi - 682 018
Ph: 0484 - 2393242, 2393256 Fax: 2393256
E-mail: scienceindia2010@gmail.com
www.scienceindia.in

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Editorial

Neurotransmitters are the brain chemicals that communicate information throughout our brain and body. They relay signals between nerve cells, called "neurons." The brain uses neurotransmitters to tell your heart to beat, your lungs to breathe, and your stomach to digest. They can also affect mood, sleep, concentration, weight, and can cause adverse symptoms when they are out of balance. Neurotransmitter levels can be depleted in many ways. As a matter of fact, it is estimated that 86% of Americans have sub-optimal neurotransmitter levels. Stress, poor diet, neurotoxins, genetic pre-disposition, drugs (prescription and recreational), alcohol and caffeine usage can cause these levels to be out of optimal range.

Neurotransmitters play a major role in every day life and functioning. Scientists do not yet know exactly how many neurotransmitters exist, but more than 100 chemical messengers have been identified.

When neurotransmitters are affected by disease or drugs, there can be a number of different adverse effects on the body. Diseases such as Alzheimer's and Parkinson's are associated with deficits in certain neurotransmitters.

Neurotransmitters can be classified by function. Excitatory neurotransmitters have excitatory effects on the neuron; they increase the likelihood that the neuron will fire an action potential. Some of the major excitatory neurotransmitters include epinephrine and norepinephrine. Inhibitory neurotransmitters have inhibitory effects on the neuron; they decrease the likelihood that the neuron will fire an action potential. Some of the major inhibitory neurotransmitters include serotonin and GABA.

Some neurotransmitters, such as acetylcholine and dopamine, can have both excitatory and inhibitory effects depending upon the type of receptors that are present.

The Cover Story of this issue is "Neurotransmitters: The Chemical Messengers of Neurons".

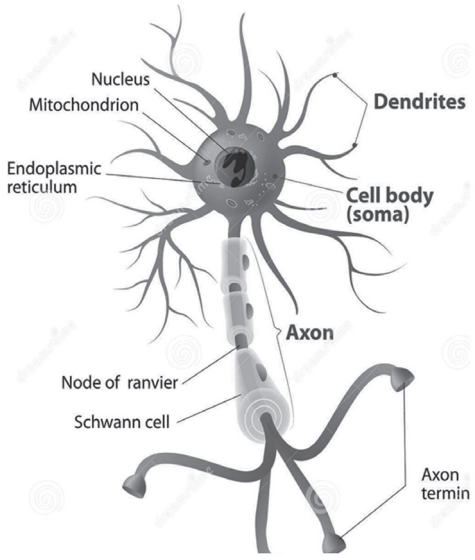
Team Science India

Neurotransmitters: The Chemical Messengers of Neurons

Prof. K.K. Mishra

Neurotransmitters are the chemical messengers responsible for communication between individual neurons. They have always been of great interest to neuroscientists. Neurotransmitters regulate the entire biological activities in human beings including even our mood, motivation and day to day behaviour. The present article is an attempt to give a generalized account of the chemistry of some important neurotransmitters.

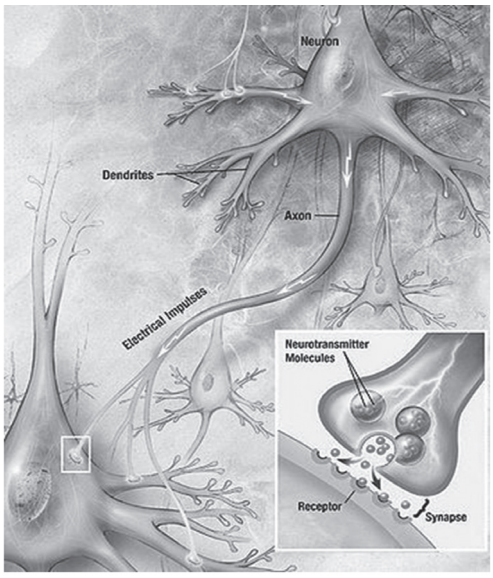
For a human being to think, act or merely to exist, the cells of the body must communicate with one another. They do so by means of two systems. One is hormonal system in which certain chemicals are released by endocrine glands directly into circulation and they convey the message to respective target cells. The other system of communication is nervous system in which electrical signals are generated in the form of nerve impulse which is usually associated with the rapid response to external stimuli. These two systems of communication in the body are not in isolation but they are very much integrated and inter-dependent in their functions. The nervous system is divided into the central nervous system (CNS) consisting of brain and spinal cord, and the peripheral nervous system (PNS) that includes all other nervous tissues. The CNS is further grouped into the ascending (to the brain) and descending (from the brain) pathways of neurons. Likewise, PNS is divided into afferent (Sensory) neurons which direct their information to CNS and efferent (Motor) neurons which direct their information away from CNS. The elementary structural unit of nervous system is the neuron, a nerve cell. The figure below shows the morphological



features of a typical neuron. A neuron possesses a cell body with numerous ramifications called dendrites, an axon and terminal fibres. The propagation of nerve impulse involves an alteration in the permeability of membrane that results in the free diffusion of Na^+ - K^+ ions. The impulse travels from dendrites to cell body and then down to terminal fibres *via*. axon. This impulse is relayed through the synapse – the specialized contact zone where one neuron communicates with another neuron.

The molecules that make the nervous system functionally dynamic are neurotransmitters. By definition a neurotransmitter is a chemical substance that is released synaptically by one neuron and subsequently affects another cell in a specific way.

Florey in 1962 coined the term neurotransmitter for a chemical which mediated synaptic transmission. According to Kendal and Schularz (1981), for a substance to be classified as a true neurotransmitter, four criteria must be satisfied. The chemical substance must be produced by the neuron, it must be released by the neuron in considerable amount to exert an effect on neighbouring neurons; exogenous application in appropriate amount must mimic the action of endogenously released compound; and a mechanism must exist to eliminate the neurotransmitter from the target tissue.



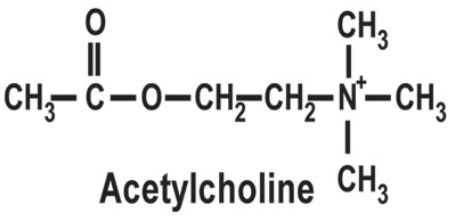
Communication between neurons

MONOAMINE TRANSMITTERS

Acetylcholine, histamine, serotonin, dopamine and norepinephrine are called as monoamine neurotransmitters since they all possess a single amino group in their structures.

Acetylcholine

Acetylcholine was the first substance to be identified as a neurotransmitter by Otto Loewi from Germany in 1921. He demonstrated the release of acetylcholine from the vagus nerve in a frog through a well set experiment. Stimulation of the nerve stopped the heartbeat. Loewi perfused the region with a physiological solution, removed the solution and employed it to another frog heart. The second heart also stopped beating. Subsequently, acetylcholine was extracted



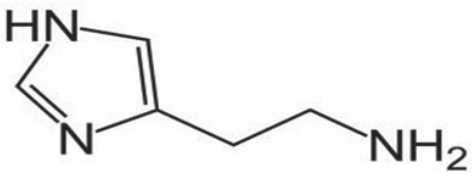
Acetylcholine

from the solution and identified as a chemical mediator. The synthesis of acetylcholine occurs in the cell body of the neuron. The enzyme choline acetyltransferase catalyzes the reaction between acetyl CoA and choline.

Acetylcholine is a transmitter of motor neurons in the spinal cord and is the transmitter at all of the nerve skeletal muscle junctions in vertebrates. Systems that use acetylcholine as a neurotransmitter are called cholinergic systems. Acetylcholine released from pre-synaptic membrane is poured into the synaptic cleft. Its action on post-synaptic membrane involves binding with a receptor protein and an alteration in the permeability of membrane occurs. A number of researchers have reported that patients with Alzheimer's disease have significantly lower concentration of enzyme choline acetyltransferase in their brains. To date, two types of acetylcholine receptors have been identified such as nicotinic receptors and muscarinic receptors, after their respective agonists. Biochemical response to these two receptors is quite different. One of the biochemical responses is the elevation of cyclic guanosine triphosphate (cGTP) as a result of increased guanylyl cyclase. The elimination of acetylcholine from post-synaptic neurons takes place by hydrolysis to choline and acetate by acetylcholine transferase enzyme.

Histamine

Histamine is synthesized from the essential amino acid L-histidine by a decarboxylation reaction. There are two

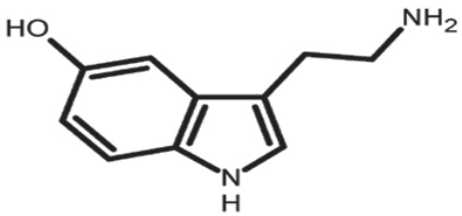


Histamine

kinds of histamine receptors designated as H_1 and H_2 receptors. Upon its binding to these receptors, adenylyl cyclase is activated and an increase in concentration of adenosine 3', 5'-cyclic monophosphate (cAMP) results in the intracellular fluid. Binding of histamine to H_1 receptor also results in increase in cyclic GTP levels. Histamine plays a central role in such neural responses as thirst, antidiuresis and hypothermia.

Serotonin

Serotonin is chemically 5-hydroxy tryptamine. It is a classical neurotransmitter which is synthesized from an amino acid called tryptophan. Insomnia, depression, psychosis are the result of serotonin function and related disturbances. Distributed in the various regions of the brain, it mediates the sensation of pain, right down through the spinal cord. Serotonin makes us aware of day and night and regulates sleep-wake mechanism.



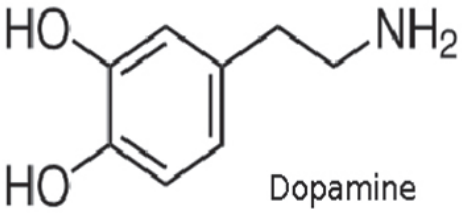
5-hydroxy tryptamine (Serotonin)

It is really a matter of great surprize that the most potent hallucinogen Lysergic acid

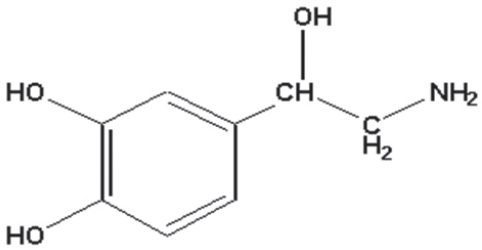
Diethylamide (LSD) derived from *Claviceps purpurea*, a fungus, has a good structural similarity with serotonin molecule. Three types of serotonin receptors have been identified. One is inhibitory, that is when serotonin binds to this receptors, inhibition of nerve impulse relay or related metabolic changes occurs. The second type of receptor called autoreceptor involves the mediation of the response of neuron to its own neuroreceptors. The third, an excitatory receptor is the type which causes propagation of an impulse. Serotonin is eliminated from the synaptic cleft, by degradation into 5-hydroxyindole acetic acid in the presence of the enzyme monoamine oxidase.

Catecholamines

Catecholamines are a group of compounds having a common catechol structure. Dopamine and norepinephrine are referred to as catecholamines. The first definite evidence for neurochemical transmission for catecholamines was observed by Otto Loewi. However, it was not until 1946 when Ulf Von Euler succeeded in identifying and isolating norepinephrine as neurotransmitter in sympathetic nervous system. Dopamine and norepinephrine are synthesized through a common pathway. Tyrosine is converted into L 3', 4'–dihydroxy phenylalanine (L-DOPA) by tyrosine



Dopamine

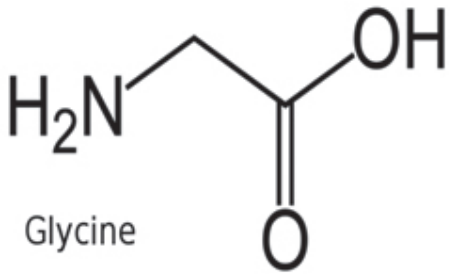


Norepinephrine

hydroxylase. This is the rate determining step in the synthesis of catecholamines. Dopamine plays a cardinal role in the elicitation of certain behaviour such as locomotor activity, hunger and satiety together with thermoregulation. Dopaminergic systems have been related to Parkinsonism and Schizophrenia. The regions of CNS affected by these disorders contain high concentrations of dopamine neurons and are found in the brainstem, midbrain and hypothalamus. The two major types of receptors for norepinephrine are the alpha and beta adrenergic receptors. Alpha adrenergic receptor-mediated responses are found in smooth muscle contraction and beta adrenergic receptors play roles in such responses as ionotopism in heart tissue. Binding of the norepinephrine with receptor has been shown to affect cAMP metabolism in post-synaptic cell. Catecholamines are eliminated by getting metabolized in the presence of enzyme monoamine oxidase.

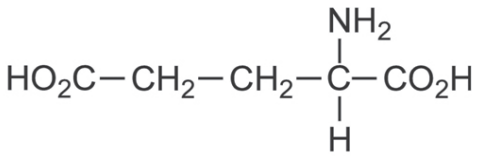
AMINO ACID TRANSMITTERS

Glycine, L-glutamic acid and gamma-amino butyric acid (GABA) are well known examples of classical neurotransmitters. Glycine, chemically an amino acetic acid, is the simplest essential amino acid. It is



Glycine

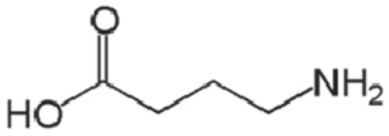
an inhibitory transmitter of the spinal cord inter-neurons. Comparatively, much is not known about glycine systems. Glycine may be formed from serine by methylation with tetrahydrofolate. L-glutamic acid and GABA are the major workhouse neurotransmitters of brain. It is known to be an excitatory neurotransmitter. Glutamic acid is one of the 20-22 proteinogenic amino acids and its codons are GAA and GAG. It is a non-essential amino acid with a side chain carboxylic acid functional group. The carboxylate anions and salts of glutamic acid are known as glutamates. It is the most common neurotransmitter in the central nervous system - as much as half of all neurons in the brain - and it plays an important role with regard to memory. Curiously, glutamate is actually toxic to neurons and an excess will prove fatal.



L - glutamic acid

Glutamate was discovered more than a century ago by Kikunae Ikeda of Tokyo Imperial University in 1907 while looking for flavour common to things like cheese, meat and mushrooms. He extracted an acid from seaweed, the glutamate. He went on to invent monosodium glutamate (MSG) which is used as a flavouring agent or taste enhancer in foods and beverages. But it took decades for Peter Usherwood to identify glutamate as a neurotransmitter in 1994.

Of amino acid transmitters, GABA is the most studied and fascinating neurotransmitter. Though its existence was reported in brain in 1950, a final confirmation of GABA being a legitimate neurotransmitter came only in 1970. It is formed from glutamic acid through a decarboxylation reaction. In patients of anxiety-neurosis and depression, the levels of GABA and its functional efficacy in CNS is reported to be diminished. The most widely employed anxiolytic drug Diazepam is supposed to be acting by enhancing the effectiveness of GABArgic system.



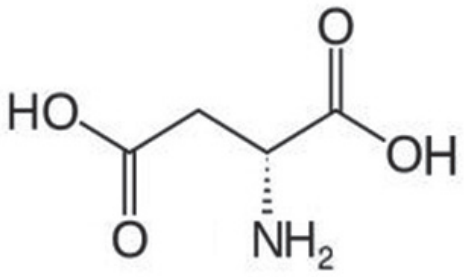
Gamma-aminobutyric acid (GABA)

RECENT RESEARCHES IN NEUROCHEMISTRY

In the past few decades, there has been an outburst of knowledge in neurochemistry. The identification of ATP, a form of cellular energy as a significant neurotransmitter and investigation of neuronal action of nitric oxide (NO) have opened new avenues for further extensive research in this field. The discovery that ATP is a neurotransmitter by Geoffrey Burnstock in 1980 was not only ignored but ridiculed also. But recent studies have finally provided requisite evidences to

prove that ATP is indeed a major neurotransmitter. One could hardly imagine a decade ago that NO is a highly significant regulator involved in higher organisms. The story began in the early 1980s in different areas of biochemical research. The most startling and relatively recent aspect of NO is its involvement in brain functions. The researchers are surprised at the unusual action of NO. Unlike other transmitters, it is toxic and is not stored in vesicles, rather produced on demand. Nitric oxide is synthesized from the semi-essential amino acid L-arginine by NO Synthase. The precise biosynthetic pathway is still not very clear but hydroxy arginine is an intermediate. Nitric oxide is a central and peripheral neuronal messenger. It is involved in classical anterograde neuronal signalling and has also unique properties as a retrograde transmitter. Within the CNS, nitric oxide is released in response to increase in intracellular Ca^{2+} that follow stimulation of glutamate receptors. Immuno-histochemical studies have shown that Ca^{2+} Calmodulin-dependent NO Synthase is distributed in discrete areas throughout the brain with high concentrations in cerebellum, hippocampus and olfactory lobe.

Of late a team of scientists has discovered that D-aspartic acid (D-Asp) is a novel neurotransmitter that could potentially be used in the fight against neurological diseases such as Parkinson's and Schizophrenia. D-Asp meets all of the criteria that characterize biological molecules which exhibit neurotransmitter activity: they are present in high



D-Aspartic Acid

concentrations in the synaptic vesicles of axon terminals; synthesis for this amino acid occurs in neurons by conversion of L-Asp to D-Asp *via*. D-aspartate racemase; depolarization of nerve endings with potassium ions evokes an immediate release of D-Asp in a Ca^{2+} dependent manner; specific receptors for D-Asp occur at the post-synaptic membrane; and stimulation of nerve endings with D-Asp triggers signal transduction by increasing the second messenger cAMP. D-Asp plays an important role in the initial phases of central nervous system development in vertebrates and invertebrates. In humans, mice and chicken, large quantities of this molecule are produced in the brain during embryonic development.

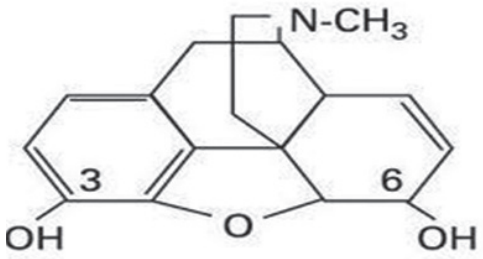
After birth, D-Asp falls to minute levels and remains constant throughout the adult stage life. Evidence suggests that the molecule is involved in the learning process and memory function in rats and enhances the cognitive capabilities of animals in a range of experiments. According to Professor Jordi García-Fernàndez, "Basic research leads to advances in applied work by describing new functional mechanisms that explain

the complex biological machinery of the nervous system". This study is of particular interest in the field of dementia, as it describes a novel neurotransmitter with a potential use in the treatment of certain neurological diseases such as Parkinson's disease and Schizophrenia.

Endorphin

In 1973, Solomon Snyder and Candace Pert of Johns Hopkins University discovered endorphin. Endorphin is short for "endogenous morphine." It is structurally very similar to the opioids (opium, morphine, heroin, etc.) in their abilities to produce a feeling of well-being and has similar functions. It is involved in pain reduction and pleasure, and the opioid drugs work by attaching to endorphin's receptor sites. They are produced by the brain during exercise, excitement, consumption of certain foods, love and orgasm.

β -Endorphin is an endogenous opioid neuropeptide found in the neurons of both the central and peripheral nervous system. β-Endorphin is a peptide, 31 amino acids long. It is found in neurons of the hypothalamus, as well as the pituitary gland. β-Endorphin was discovered by Li and Chung in 1976. It is one of the five endorphins found in humans, the others are- alpha endorphin, gamma endorphin, alpha neoendorphin and beta neoendorphin. It is used as an analgesic in the body to numb for dull pains. That is the reason why humans start to feel better immediately after an acute physical trauma even though the symptoms are still present. It is because of body's own



Morphine

response to trauma in order to control the sensation of pain. The reason the pain dulls is because it binds to and activates opioid receptors. Beta endorphin is a very potent analgesic, and is approximately 18-33 times more powerful than morphine, a natural pain killer.

The search for novel neurotransmitters is far from over. There are several potential candidates in queue waiting to compete and qualify. Researchers suggest that it is very likely that there are many weird chemicals which are neurotransmitters of future.

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Prof. K.K. Mishra
Homi Bhabha Centre for Science Education
Tata Institute of Fundamental Research
Mumbai – 400 088
E Mail: kkm@hbcse.tifr.res.in

Curry leaf - For enhancing shelf life of banana chips

N.S. Sonia, Dr. C. Mini and Dr. P.R. Geethalekshmi

Processing of green mature bananas mainly Nendran variety to banana chips is a small scale food business of Kerala. It is an integral part of traditional Kerala meal, 'Sadya' and are consumed as a snack food by all age groups. Banana chips are prepared by deep fat frying the slices. Deep fat frying seals the food surface by immersing food pieces in hot oil so that all flavours and juices are retained inside. Frying causes changes in physical and chemical properties including starch gelatinisation, protein denaturation, water vapourisation and crust formation. It has a crispy, unique taste and flavour. During the frying process, oil gets absorbed into the product and its oxidation leads to increase in rancidity, a condition marked by unpleasant odour or flavor and decrease in the shelf life.

Antioxidants

Oxidation is a chemical reaction that transfers electrons from a substance to an oxidizing agent, thereby producing free radicals, which start chain reactions that damage cells. Antioxidants play an important role in preventing undesirable changes in flavor and nutritional quality of foods. Antioxidants have been added to frying media to improve the shelf life of deep fried snack food products. The protection of foods from oxygen is the basic principle upon which antioxidant protective technologies are based. Antioxidants are the substances that are able to prevent or inhibit oxidation processes in human body as well as in food products. Antioxidants terminate these chain reactions by removing free radical intermediates and inhibit other oxidation reactions by being oxidized themselves.

Both synthetic and natural antioxidants can serve these functions. Synthetic antioxidants such as butylated hydroxyl anisole (BHA), butylated hydroxy toluene (BHT) and propyl gallate (PG) are widely used as food additives, but their application has been reassessed because of possible toxic or carcinogenic

components formed during their degradation. So a recent area of interest in antioxidant research is concerned with finding effective replacements for the conventional synthetic antioxidants from among various natural plant extracts which are seen to possess antioxidant properties.

Spices as potential antioxidants

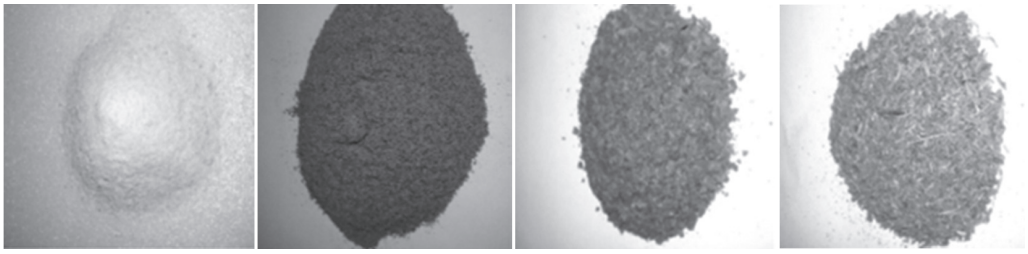
Spices and herbs are aromatic and pungent food ingredients with significant antioxidant activities. Flavours and seasonings are important considerations for snacks and herbs and could be used as both flavouring and functional ingredients in snack foods. Curcumin, the yellow colour principle present in turmeric (*Curcuma domestica*) and Capsaicin in Capsicum are powerful antioxidants which prevent oxidation of oils and fats. Organosulphur compounds in garlic like s-allyl cysteine and s-allyl mercapto cysteine have potent antioxidant activity. Pepper oil can exhibit antioxidant activity during frying when used alone or in combination with Capsaicin or Alpha-tocopherol. Coriander extracts contain phenolics and caroteinoids which exhibit a considerable antioxidant action.

Antioxidant protein compounds isolated from curry leaf was effective in scavenging free radicals at 150-fold lesser

concentration compared to BHA and Tocopherol (400 μM). Two antioxidant compounds namely Mahanimbine and Koenigine were isolated from curry leaf.

Evaluating curry leaf as antioxidant

A study was conducted at College of Agriculture, Kerala Agricultural University, Vellayani to find out the effect of addition of spices on the reduction of rancidity and enhancement shelf life of banana chips. Nendran banana chips were prepared in unrefined coconut oil at 165 °C with an oil-slice ratio of 2:1 by adding 0.7% salt and 0.15% turmeric as 20% aqueous solution at the end of frying. Spices like garlic, black pepper, curry leaf and coriander leaves were collected from Instructional Farm, College of Agriculture, Vellayani, cleaned, oven dried, powdered and incorporated into chips by adding directly to oil at smoke point, before addition of the banana slices. The prepared chips were analyzed for

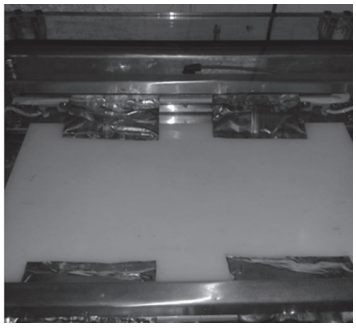


Garlic Black Pepper Curry leaf Corinder leaves

Oven - dried and powdered spices

LDPE pouches

Laminated pouches



Nitrogen packaging

Packaging systems

physical, chemical and sensory quality parameters.

Banana chips prepared by addition of 0.02% oven - dried curry leaf powder into frying oil had low moisture content (5.30%), oil uptake (31.40%), shrinkage (20.95%), FFA value (3.02 mg KOH/g), peroxide value (6.50 meq.O_2/kg), high integrity (85.90%) and iodine value (6.73). Chips with highest physical and chemical quality attributes were supported with high sensory scores too. Among the four spices evaluated oven - dried curry leaf treated chips was found to be superior.

The storage potential of curry leaf treated chips and untreated chips in different packaging materials are further tested by storing it in LDPE pouch, laminated pouch and nitrogen packaging in laminated pouch for three months under control conditions (28 ± 2 °C) and evaluated for moisture, colour, texture, chemical parameters and sensory quality parameters.

Curry leaf application and nitrogen packaging were found effective in retaining quality parameters. Chips prepared with 0.02% oven dried curry leaf powder and nitrogen packaging in laminated pouches showed low moisture (6.90%), FFA value (5.24 mg KOH/g), peroxide value (7.87 meq. O_2/ kg), highest iodine value (10.27), yellowness index (109.86) and crispness (5.12) at the end of 90 days of storage. Higher mean rank value for sensory quality parameters and highest antioxidant activity (12.61 ± 1.23 %) were also recorded by this treatment.

All stakeholders of banana chips processing and marketing chain encounters the problem of rancidity during storage of deep fat fried banana chips. Synthetic as well as natural antioxidants can be added to delay the onset of rancidity. The study was conducted with the aim of evaluating and comparing the effect of natural antioxidants in delaying rancidity of banana chips during storage. The study revealed that incorporation of 0.02% oven-dried curry leaf powder to frying oil at smoke point of 165 °C and nitrogen packaging in laminated pouches ensures shelf life of three months to Nendran banana chips.

N.S. Sonia, Dr. C. Mini and
Dr. P.R. Geethalekshmi
Department of Processing Technology
College of Agriculture
Vellayani, Thiruvananthapuram – 695 522
E Mail: coa2008soniya@gmail.com

Treutler's gecko (*Hemidactylus treutleri*) – Misidentified ?

B. Laxmi Narayana and G. Baburao

Treutler's gecko (*Hemidactylus treutleri* Mahony, 2009) has been recently discovered and described from Andhra Pradesh (now Telangana State), South India. In this article we are presenting the current status and distribution of the species in India based on our own studies and by literature review.

The genus *Hemidactylus* (Oken, 1817), belonging to the lizard family, order Squamata is composed of 100 species described till date in the world (Javed *et al.*, 2010). In India, *Hemidactylus* is represented by 26 species (Mizra and Sanap, 2014) of which 11 species have been reported from Andhra Pradesh (Venugopal, 2010). According to Srinivasulu and Das (2008) eight species are found in Telangana region wherein most of the *H.* gecko species have been recorded in the Eastern Ghats namely: (i) *Hemidactylus bowringii* (Gray, 1845), (ii) *H. brookii* (Gray, 1845), (iii) *H. flaviviridis* (Rüppell, 1835), (iv) *H. frenatus* (Duméril and Bibron, 1836), (v) *H. giganteus* (Stoliczka, 1871), (vi) *H. leschenaultii* (Duméril and Bibron, 1836), (vii) *H. reticulatus* (Beddome, 1870), and (viii) *H. triedrus* (Daudin, 1802). In recent years six species of *Hemidactylus* have been described in India, of which two species are from Maharashtra *H. aaronbaueri* (Giri, 2008); *H. gujaratensis* (Giri *et al.*, 2009), one species from Gujarat *H. sataraensis* (Giri and Bauer, 2008), one species from Andhra Pradesh *H. treutleri* (Mahony, 2009), one species from Karnataka *H. graniticolus* (Agarwal *et al.*, 2011) and one species from Tamil Nadu *H. acanthopholis* (Mizra and Sanap, 2014). *H. treutleri* is a nocturnal gecko which is also active during day time. It was

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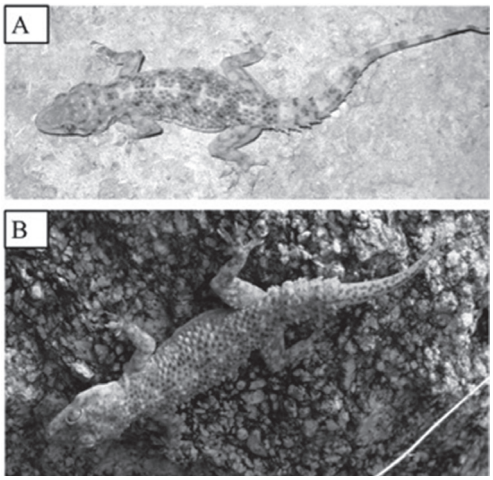
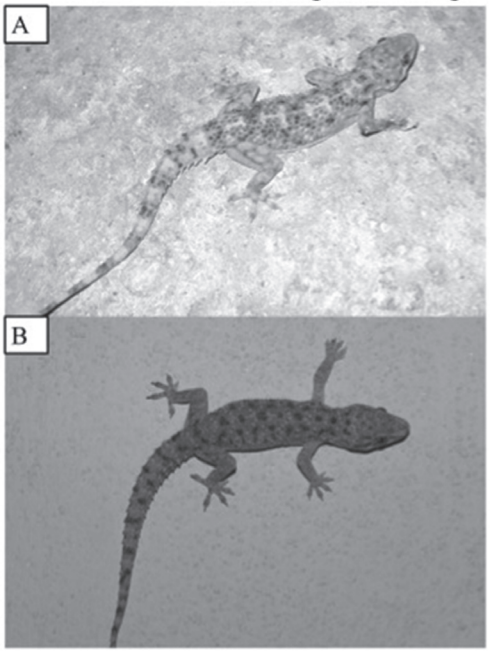
recorded from many locations in the districts of Guntur, Krishna, Prakasam, Kurnool and Anantapur in Andhra Pradesh, Nalgonda, Medak, Karimnagar, Adilabad and Mahbubnagar in Telangana and Parelakhemundi, Gajapati District, Odisha and Raichur District, Karnataka (Srinivasulu *et. al*., 2014).

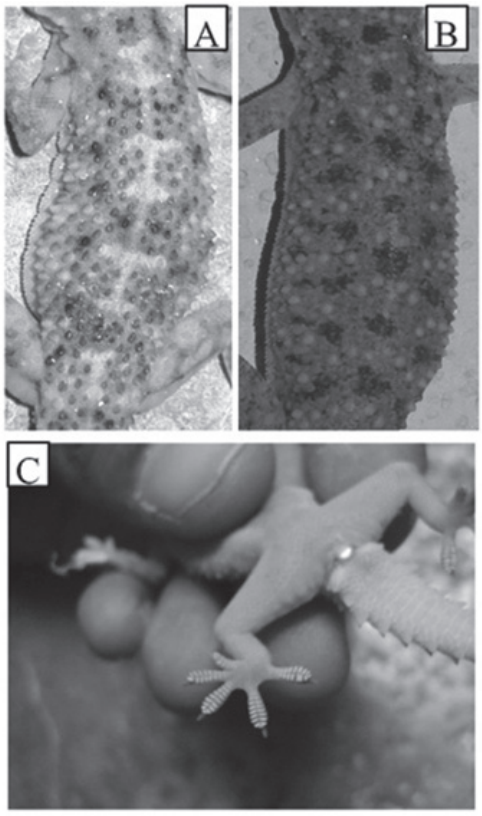


A typical colouration of *Hemidactylus treutleri* (A) Adult male from Yellareddy Pally village and (B) Sub-adult male from Peddagattu village

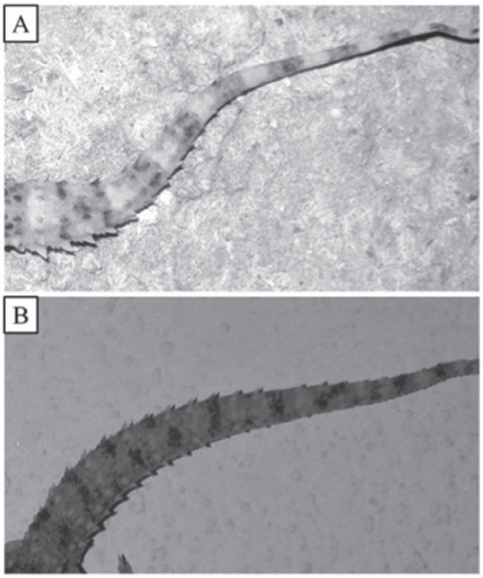


Morphological similarities of (A) *Hemidactylus treutleri* and (B) *H. brookii*

Hemidactylus treutleri was discovered and described by Mahony, 2009 in the Golconda fort at Hyderabad (17°22'57.83"N, 78°24'6.99"E). The species is a Least Concern Species (IUCN Redlist, 2013). Since Mohany, 2009 a total of 24 new localities have been reported, one individual was recorded from Rishi valley (13°37'59.94"N, 78°27'26.67"E) of Tirupathi foothills, Andhra Pradesh (Sreekar *et al*., 2010) and two localities from Telangana state. In Telangana three individuals were sighted at Yellareddy Pally village (18°34'8.28"N, 78°18'11.10"E), Nizamabad district (Baburao and Krishna Kumar, 2014) and Narayana *et al*. (2014)



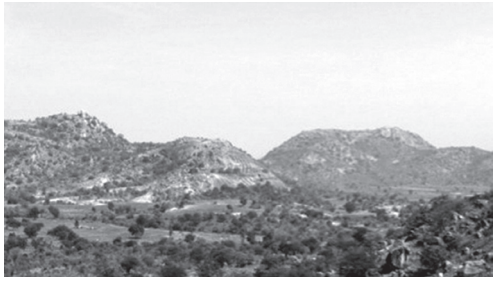
(A) *Hemidactylus treutleri* (I-shaped marks on the dorsal surface of the body), (B) *H. brookii* (X-shaped marks on the dorsal surface of the body) and (C) *H. treutleri* (post-cloacal opening in adult male)



(A) *Hemidactylus treutleri* (presence of large spines on the tail) and (B) *H. brookii* (presence of small spines on the tail)

reported one individual from Peddagattu village (16°36'23.86"N, 79°14'14.19"E), Nalgonda district. *H. treutleri* was constantly misidentified as *H. brookii* due to morphological similarities. Systematic taxonomic examination revealed that it differs from *H.* cf. *brookii* (Mahony, 2009; 2011).

The species was identified using the diagnosed key characters as stated by Mahony (2009) and Sreekar *et al*. (2010). Key identification characters of the species were the presence of large spines on the tail and large keeled tubercles on the dorsal-lateral side of the body and presence of granular body and I-shaped marks on the dorsal surface of the body.



Habitat of *Hemidactylus treutleri*

This species prefers habitats like rocky surfaces, rocky scrub jungles and dry deciduous forests.

The present article reveals the current distribution status of this species in Telangana and Andhra Pradesh, Odisha and Karnataka states which clearly indicates that species distribution commonly occur in reported states and also its range was extended from Central Telangana to Southern Andhra Pradesh and also to Northern Telangana. Srinivasulu *et. al*., 2014 stated that the most new records are roughly contiguous with one another, forming relatively compact distribution, except the Odisha record which needs further studies to ascertain whether it is a disjunct population. It occurs at elevations between 350 and 720 msl. The distance between each sighting from the first sighting (Golconda Fort, Hyderabad) is 432 km to Rishi Valley (Sreekar *et al*., 2010), 138 km to Yellareddy Pally (Baburao and Krishna Kumar, 2014) and 116 km to Peddagutta in Nalgonda (Narayana *et al*., 2014). After that Kumar and Srinivasulu (2014) reported 20 new additional site records from Telangana, Andhra Pradesh, Odisha and Karnataka.

List of known locations of Treutler's Gecko (*Hemidactylus treutleri* Mahony, 2009) in Peninsular India (Ref: Kumar and Srinivasulu, 2014).

There are many other places in these states having similar habitat types which is prefered by the gecko. The presence of same habitat types in other places give an idea, that the species could also occur in other parts of these states. However, the present reported areas are not yet well documented for Hemidactylus treutleri population. Further studies are needed to ascertain the population, distribution, demographic details, threats, ecology and behaviour of the species.

Andhra Pradesh

1. Dornala, Prakasam District 15.92N, 79.09E
2. Guntur District 16.29N, 80.43E
3. Jaggayapet, Krishna District 16.86N, 80.08E
4. Kurnool, Kurnool District 15.76N, 78.18E
5. Macherla, Guntur District 16.47N, 79.44E
6. Nandikotkur, Kurnool District 15.85N, 78.26E
7. Rishi Valley, Chittoor District 13.63N, 78.45E

Karnataka

8. Raichur Fort, Raichur District 16.20N, 77.36E
9. Urugutta, Raichur District 16.15N, 77.36E

Odisha

10. Parelakhemundi, Gajapati District 18.77N, 84.09E

Telangana

11. Bibinagar, Nalgonda District 17.47N, 78.78E
12. Dakkalgutta, Nizamabad District 18.56N, 78.30E
13. Devarkonda, Nalgonda District 16.69N, 78.92E
14. Elgandal Fort, Karimnagar District 18.42N, 79.04E
15. Gadwal, Mahbubnagar District 16.23N, 77.
16. Golkonda Fort, Hyderabad District 17.40N, 78.46E
17. Jadcherla, Mahbubnagar District 16.77N, 78.13E
18. Jagatiyal, Karimnagar District 18.79N, 78.91E
19. Medak, Medak District 18.05N, 78.26E
20. Nalgonda, Nalgonda District 17.05N, 79.26E
21. Peddagattu, Nalgonda District 16.60N, 79.23E
22. Shanigaram, Karimnagar District 18.17N, 79.02E
23. Siddipet, Medak District 18.10N, 78.84E
24. Utnoor, Adilabad District 19.37N, 78.78E

There are many other places in these states having similar habitat types which is prefered by the gecko. The presence of same habitat types in other places give an idea, that the species could also occur in other parts of these states. However, the present reported areas are not yet well documented for *Hemidactylus treutleri* population. Further studies are needed to ascertain the population, distribution, demographic details, threats, ecology and behaviour of the species.

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B. Laxmi Narayana
All India Network Project on Vertebrate Pest Management
PJTS Agricultural University
Rajendranagar – 500 030
Hyderabad, Telangana
E Mail: narayana.laxmi8@gmail.com

G. Baburao
Division of Ornithology
Salim Ali Centre for Ornithology and Natural History
Anaikatty P.O.
Coimbatore - 641 108

Science Fiction of the Month

In a Thousand Years

by Hans Christian Andersen

Editor's Notes

This 1853 story is packed with brilliant extrapolation:

First, Andersen recognized the continuing advance of progress, accurately predicting the construction of a tunnel beneath the English Channel, routine airline flights across the Atlantic, and instantaneous communication between the continents (His biggest mistake was believing that all this would take a thousand years).

Second, he grasped the impact that technology would have on society. The pace of our lives has accelerated dramatically since 1853; people really do take whirlwind one-week tours of Europe! And, as the brevity of "In a Thousand Years" itself suggests, we enjoy reading short-short science fiction stories.

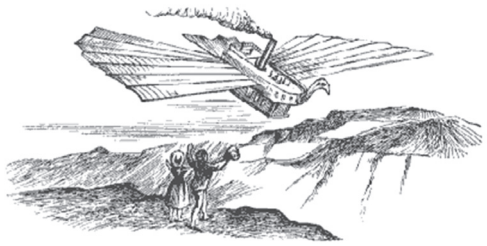
The illustration by A.W. Bayes is from *Stories for the Household* (1889), an extensive collection of Andersen's tales.

Yes, in a thousand years people will fly on the wings of steam through the air, over the ocean! The young inhabitants of America will become visitors of old Europe. They will come over to see the monuments and the great cities, which will then be in ruins, just as we in our time make pilgrimages to the tottering splendors of Southern Asia. In a thousand years they will come!

The Thames, the Danube, and the Rhine still roll their course, Mont Blanc stands firm with its snowcapped summit, and the Northern Lights gleam over the lands of the North; but generation after generation has become dust, whole rows of the mighty of the moment are forgotten, like those who already slumber under the hill on which the rich trader whose ground it is has built a bench, on which he can sit and look out across his waving cornfields.

"To Europe!" cry the young sons of America; "to the land of our ancestors, the glorious land of monuments and fancy—to Europe!"

The ship of the air comes. It is crowded with passengers, for the transit is quicker than by sea. The electro-magnetic wire under the ocean has already telegraphed the number of the aerial caravan. Europe is in sight: it is the coast of Ireland that they see, but the passengers are still asleep;



they will not be called till they are exactly over England. There they will first step on European shore, in the land of Shakespeare as the educated call it; in the land of politics, the land of machines, as it is called by others.

Here they stay a whole day. That is all the time the busy race can devote to the whole of England and Scotland. Then the journey is continued through the tunnel under the English Channel, to France, the land of Charlemagne and Napoleon. Moliere is named; the learned men talk of the classic school of remote antiquity; there is rejoicing and shouting for the names of heroes, poets, and men of science, whom our time does not know, but who will be born after our time in Paris, the center of Europe, and elsewhere.

The air steamboat flies over the country whence Columbus went forth, where Cortez was born, and where Calderon sang dramas in sounding verse. Beautiful dark-eyed women live still in the blooming valleys, and the oldest songs speak of the Cid and the Alhambra.

Then through the air, over the sea, to Italy, where once lay old, everlasting Rome. It has vanished! The Campagnalies desert: a single ruined wall is shown as the remains of St. Peter's, but there is a doubt if this ruin be genuine.

Next to Greece, to sleep a night in the grand hotel at the top of Mount Olympus, to say that they have been there; and the journey is continued to the Bosphorus, to rest there a few hours, and see the place where Byzantium lay; and where the legend tells that the harem stood in the time of the Turks, poor fishermen are now spreading their nets.

Over the remains of mighty cities on the broad Danube, cities which we in our time know not, the travelers pass; but here and there, on the rich sites of those that time shall bring forth, the caravan sometimes descends, and departs thence again.

Down below lies Germany, that was once covered with a close net of railways and canals, the region where Luther spoke, where Goethe sang, and Mozart once held the sceptre of harmony. Great names shine there, in science and in art, names that are unknown to us. One day devoted to seeing Germany, and one for the North, the country of Oersted and Linnaeus, and for Norway, the land of the old heroes and the young Normans. Iceland is visited on the journey home: the geysers burn no more, Hecla is an extinct volcano, but the rocky island is still fixed in the midst of the foaming sea, a continual monument of legend and poetry.

"There is really a great deal to be seen in Europe," says the young American, "and we have seen it in a week, according to the directions of the great taveler" (and here he mentions the name of one of his contemporaries) "in his celebrated work, *How to See all Europe in a Week*."

Are We Losing Scientific Temper?

Biju Dharmapalan

"It is science alone that can solve the problems of hunger and poverty, of insanitation and illiteracy, of superstition and deadening of custom and tradition, of vast resources running to waste, or a rich country inhabited by starving poor… Who indeed could afford to ignore science today? At every turn we have to seek its aid… The future belongs to science and those who make friends with science." - Jawaharlal Nehru (Independent India's first Prime Minister)

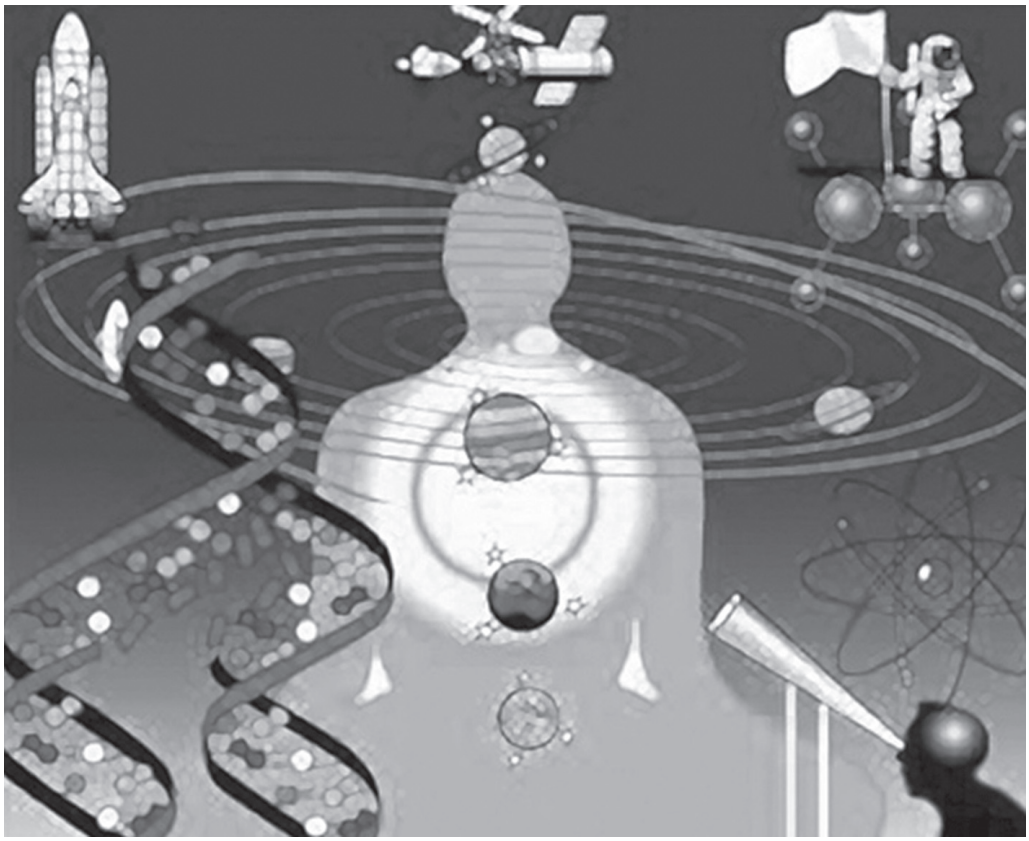
India is the first country in the world to have scientific temper instilled in her constitution. It is interesting to know the phrase 'Scientific Temper' with its current attributes being first articulated by Pandit Jawaharlal Nehru in his famous book Discovery of India (1946) wherein he said: "The scientific approach and temper are, or should be, a way of life, a process of thinking, a method of acting and associating with our fellowmen". Nehru relentlessly expanded the notion of scientific temper and strived to convince political and scientific leaderships to inculcate scientific temper among citizens. True to the democratic spirit the successive governments also followed the value for the betterment of society and today we have reached a stage wherein we would be able to create space colonies and is in the verge of redefining even the principles of evolution.

Yet in this era of scientific explosion, are we Indians losing scientific temper? Scientific temper is needed for the healthy development of the society. It is a way of life where people live incorporating the scientific principles in life. The spirit of inquiry and the acceptance of the right to question and be questioned are fundamental in scientific temper. It considers knowledge as open ended and ever-evolving. Scientific temper is incompatible with theological and metaphysical beliefs. While science is universal, religions and their dogmas are divisive. Scientific temper cannot flourish in a grossly egalitarian society where 50 per cent of the population lives below the poverty line and almost 70 per cent of our people, especially women, are functionally illiterate. Social justice, widespread education and unrestricted communication are the pre-requisites for the spread of scientific temper and, therefore, optimizing the results of science and technology.

In the history of science, it had faced lot of criticism from the religious groups in different parts of the globe for being against religious believes. But most of time religion had to accept the scientific concepts because of its genuineness. Science had also faced and is facing

criticism from the society when it tried to dispel certain myths and superstitions prevalent in the society. Behind every myths and superstitions there is a person who has vested interest to disorient the society so that they can gain material benefits. Many myths and superstitions are so embedded with the society that these get absorbed into the blood of humans right from his birth and nobody is ready to question this even in this scientific age. Even our scientific community fall prey to this. It is said that behind every successful scientific event including our prestigious Mars mission there were some superstitions involved in it.

Even though Government of India celebrated National Science Day with the focal theme "Fostering Scientific Temper" the way our society is moving ahead shows that citizens have hardly fostered scientific temper. There is hardly any difference between literate and illiterate in this. Scanning the news paper reports we could see that even highly educated people gets cheated by dubious persons selling things for want of bringing prosperity. There is a large market demand for lucky bamboo plant (even though it is not bamboo) and laughing Buddha among our people. There was a time when people in Kerala brought a plant nicknamed by nursery people as Passion of Christ (*Euphorb*ia sp.) for want of prosperity. Recently somebody wrote an irresponsible article in a regional newspaper saying that the presence of the



plant itself would cause cancer among humans. The impact of the news was so high that even local bodies, who rarely care for even dog menace or waste disposal problem, acted in haste to destroy the plant in their locality. No one was ready to check the scientific veracity of this news. How come mere presence of a plant causes cancer? No one is ready to ask questions or willing to answer.

Now-a-day's all jewelery shops provides special schemes for 'Akshaya Tritiya'. People gets carried away by the advertisement of these jewelers saying that if you buy gold on that particular day it would bring prosperity. Whether all people who buy gold on that day prosper is a matter of dispute, but all jewelers prosper because of this.

Even in the case of cosmetics our young men and women buy products based on the advertisements they receive. No one checks for the ingredients of these products. In the advertisement of one cosmetic it is mentioned that protein passes through the skin and it keeps them young. Even educated science graduates get carried away by the advertisement in their endeavor to keep young and glowing. Saffron flower based products have huge market demand because of the vast medicinal properties. But no one checks whether the saffron flower based products available in our market contains actual saffron or not. People even don't have the sense to think how saffron flower based products could be sold at cheap price when their international prices are higher. Similar is the case with hundreds of hair dyes available in the market, most of the costly brand says that it is ammonia free, but no one will highlight the presence of highly toxic PPD or its derivatives.

Even in this scientific era people don't check for through the ingredients of food products or the composition of drugs. No one is concerned whether any toxic chemical is present in Ready To Eat foods or in bottled drinks. Even though there was a quick outburst about the presence of harmful ingredients in Maggi, there is no genuineness in Government's efforts. There are thousands of restaurants in India which provide sub-standard food products containing harmful ingredients. Yet it is not considered as a serious offence. At the most they will be asked to pay penalty which many will pay happily and continue the offence till it is caught again. People consume food products knowing that it contains harmful ingredients. Nobody even checks for proper labeling of ingredients.

Many products that advertise cure against diabetes or cancer are available in market and people consume them without analyzing their veracity. People consume medicines provided by the doctor without knowing either the trade name or generic name of the medicine. In many cases hospitals supply drugs that are banned by law. Yet people don't question it.

Another area of major concern is usage of public address system during festival seasons by various religious groups. Even though the horn-shaped loudspeakers are banned by law the organizers prefer it as it causes more noise that would bring the

To create scientific temper among the citizens we should start inculcating the spirit in the minds of our youngsters from the child hood itself.

attention of public about the function. As per the Noise Pollution (Regulation and Control) Rules - 2000, and Environment (Protection) Act - 1986, the noise level at the boundary of a public place, where loudspeaker or public address system or any other noise source is being used shall not exceed 10 dB above the ambient noise standards for the area or 75 dB, whichever is lower. In most of festivals irrespective of religions the organizers use sound that is higher than this. Even though laws are in enforcement and there is scientific evidence of noise pollution causing harmful health effects, society never questions it for the fear of retaliation.

Similarly we speak about uses of biodiversity and need to conserve it, but when it comes to religious belief our people forget about biodiversity conservation or other environmental issues. No one questions destruction of biodiversity for creating religious amenities. Most of the biodiversity is lost due to tourism and religion-related activities. Even the coastal regulation rules have been amended making way for the construction of religious structures. There are many in our society who based on religious texts argue that whatever God created is only for human consumption and it won't deplete.

To create scientific temper among the citizens we should start inculcating the spirit in the minds of our youngsters from the child hood itself. In order to create that we need to create a society where freedom of expression is promoted, which unfortunately is lacking due to varied reasons. For this they should be encouraged to ask questions. But unfortunately our society and teaching community, especially in the school education system does not support the questioning attitude of by students. Scientific temper is killed at the primary school level itself or even before that by parents when the child asks them how he or she was borne. We need to develop a scientific society where questioning and discussions are promoted. Remember most of the civilization evolved due to such healthy environment. Colonization of space is soon going to be a reality and human race may have to rewrite even the religious believes. In such a society if one has to survive then science would be indispensible and science would survive only if society accepts it. It is imperative that our academicians and scientists evolve a policy to promote scientific temper through education.

Biju Dharmapalan
Head of Department
School of Biosciences
Mar Athanasios College for Advanced Studies
Tiruvalla (MACFAST), Kerala – 689 101
E Mail: biju@macfast.org /
biju_dharmapalan@yahoo.co.uk

In search of Pi

Part – I

Prof. Joseph Thomas and Prof. Liza George

Editors Note: With this issue we begin a series of articles entitled, "In search of Pi" written by two eminent Mathematicians. Prof. Joseph Thomas, M. Sc, M. Phil, B. Ed. is currently The Principal, The Baker Vidyapeedh, Kottayam. He was formerly Associate Professor in Mathematics at Henry Baker College, Melukavu. He is an author of science articles for children in different publications and has published research papers in Qualitative Higher Education.

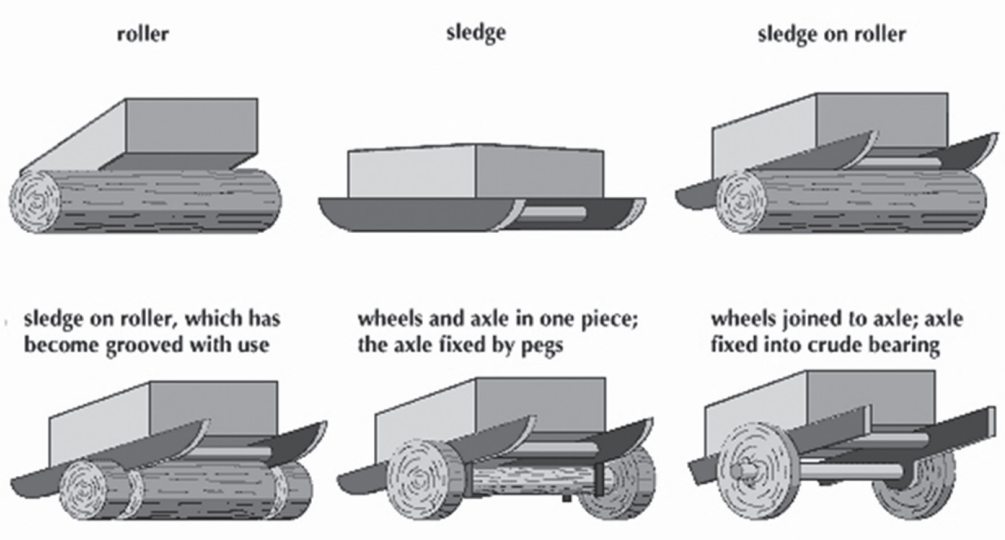
Prof. Liza George, M. Sc, B. Ed. is currently with the Department of Physics, Henry Baker College, Melukavu.

Prof. Liza poses in front of the π spiral exhibited in Mathamaticum, The interactive Mathematical Museum, Giezen, Germany.

π on the Wheels

Wheel is considered to be one of the most important, may be ranked among the first three or four great inventions of humankind. Man first used round logs as wheels to move heavy things. Attracted by the easiness in handling heavy things he began to think of more sophisticated and convenient wheels. As a result he made different types of wheels depending upon his knowledge, environment and available resources (http://history-world.org/wheel.htm). Wheels are used in carts as well as in sophisticated and complex modern engines.

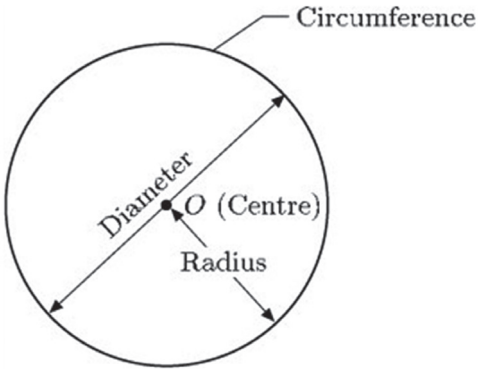
Think that you are going to make a wheel, how large it should be? The answer depends upon the purpose of the wheel



you make. You cannot use a big wheel in a small place and a small wheel to move a big thing. So the size of the wheel is of great importance and the size depends on the distance from any point on the rim of the wheel to the farthest point on the rim. Therefore, depending upon the requirement you have to make a study about the wheels before you start making your wheel.

Wheels being an inseparable part of human development. Many studies are made about its shape and properties from time immemorial.

The shape of a wheel is circular; the usefulness of the wheel depends upon its size, so studies on the size of the wheel or that of the representing circle is of great importance. In the study of circles, the size of the wheel can be replaced by the circumference of the circle usually represented by the letter 'C'. There are two elements related to circles, the centre usually denoted by 'O' and diameter of the circle usually denoted by 'd'. Diameter is the length of the line segments that joins any two farthest points on the circle and the centre is the midpoint of the diameter. Moreover, d/2 is called radius and denoted by 'r'.

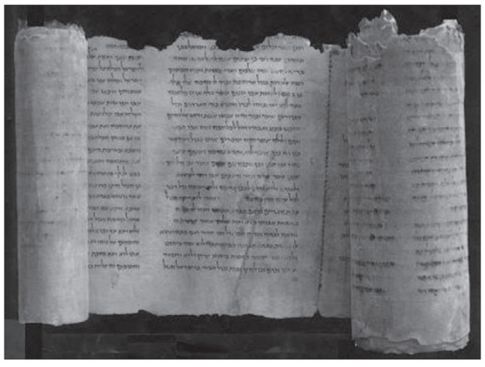


From the above discussions, it is clear that the size of the wheel represented by the circumference (C) of the corresponding circle becomes large or small as the diameter (d) becomes large or small. The circumference of a circle thus depends on its diameter and hence the ratio between 'C' and 'd' plays a vital role in the study of circles. For the sake of convenience, let us call this ratio π (pi).

Many studies were made (from time immemorial), are in the process of making and will make about this ratio. This article is a humble attempt to look into some of these studies already made and thereby create an interest in the reader to conduct further studies.

'π' in the Bible

One of the oldest references about this ratio can be seen in Bible. Though there are other older references, we choose Bible, considering the easy availability of the book. There are two passages regarding 'π' in Bible, one in 1 Kings 7:23 and the other in 2 Chronicles 4:2, see these passages in English as well as in Hebrew, the language in which it is written originally in about 550 B.C.



כג וַיַּעַשׂ אֶת-הַיָּם, מוּצָק: עֲשֶׂר בָּאַמָּה
סָבִיב עָגֹל שְׂפָתוֹ-אֶל מִשְׂפָתוֹ בָּאַמָּה
וְחָמֵשׁ, בָּאַמָּה שְׁלֹשִׁים (וְקָו) יָסֹב, קוֹמָתוֹ
סָבִיב אֹתוֹ.

1 Kings 7: 23

1 Kings 7: 23

ב עֲשֶׂר: מוּצָק, הַיָּם-אֶת וַיַּעַשׂ
סָבִיב עָגוֹל שְׂפָתוֹ-אֶל מִשְׂפָתוֹ בָּאַמָּה,
שְׁלֹשִׁים וְקָו, קוֹמָתוֹ בָּאַמָּה וְחָמֵשׁ
סָבִיב אֹתוֹ יָסֹב, בָּאַמָּה.

2 Chronicles 4: 2

2 Chronicles 4: 2

23. And he made the molten sea of ten cubits from brim to brim, round in compass, and the height thereof was five cubits; and a line of thirty cubits did compass it round about.

2. Also he made the molten sea of ten cubits from brim to brim, round in compass, and the height thereof was five cubits; and a line of thirty cubits did compass it round about.

Both the passages clearly say π = circumference / diameter =3. Elijah of Vilna was a Jewish rabbi and a Bible scholar. He made a different interpretation about these passages, according to him

100	ק	10	י	1	א
200	ר	20	כ,ך	2	ב
300	ש	30	ל	3	ג
400	ת	40	מ,ם	4	ד
		50	נ,ן	5	ה
		60	ס	6	ו
		70	ע	7	ז
		80	פ,ף	8	ח
		90	צ,ץ	9	ט

the words used for "a line of" in both passages differs as shown below (also see the highlighted part in the above Hebrew passages).

קוה is used in the first passage and וְקָ is used in the second passage. Conventionally each Hebrew alphabet is coded with numbers as in the table given below. Decoding these words, we get 100+6+5=111 from the first passage and 6+100 = 106 from the second passage.

Considering the ratio between these two numbers, 111/106 = 1.0472 as a correction factor of the value of $\pi = 3$, we get the corrected value of π as:

3 X 1.0472 = 3.1416. Wow! We are very close to the value of π that we studied in primary classes, ie, 3.14.

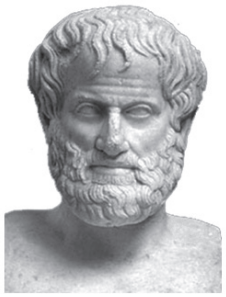
See how certain facts are hidden in old scripts!

Another mysterious number

The most mysterious number in Bible is 666, the number of Anti Christ described in Rev. 13:18.

Out of the 1.24 trillion decimal digits (excluding 3) of the value of π that super computers have already calculated*, sum of the first 144 (an ancient magical number**) decimal digits is 666. See the table below.

What kind of Number π is?



Aristotle was a great thinker of all times who lived in 4th century B.C. He made an intelligent guess that the circumference of a circle cannot be calculated from its diameter accurately.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	Grand Total of the first 144 digits after the decimal point of the approximate value of π correct to 1.24 trillion decimal places
I	1	3	7	3	4	0	0	7	8	6	5	
II	4	2	9	9	9	6	3	9	2	0	3	
III	1	3	5	9	4	2	4	8	3	9	5	
IV	5	8	0	3	4	8	8	2	0	5	9	
V	9	4	2	7	5	6	2	1	6	5		
VI	2	6	8	5	9	2	5	4	6	0		
VII	6	2	8	1	2	0	3	8	4	5		
VIII	5	6	4	0	3	8	4	0	7	8		
IX	3	4	1	5	0	9	2	8	0	2		
X	5	3	9	8	7	9	1	6	9	2		
XI	8	3	7	2	8	8	1	5	3	3		
XII	9	8	1	0	1	6	7	1	8	1		
XIII	7	3	6	9	6	2	0	3	4	7		
XIV	9	2	9	7	4	8	6	2	4	2		
TOTAL	74	57	76	68	66	74	46	64	64	55	22	666

* We will discuss this later.

** in ancient days 144 was considered to be a magical number

Otherwise, the ratio C/d = π cannot be determined correctly.

Hard work of men of great intellectual capacity and staunch determination for millennia to determine the nature of this number π, succeeded in 1794 AD, after about 2000 years when the great French Mathematician Legendre proved Aristotle's guess true.

Legendre proved that π is an irrational number. An irrational number is a number, which is not rational.

A rational number is one, which can be expressed as a ratio of two integers of which the denominator is not zero.

Let us see some examples of rational numbers.

Take 0, 0 = 0/5, it is a ratio and hence 0 is a rational number not an irrational number.

Legendre

Take 5, 5 = 5/1, again rational.

Take 3/2, 3/2= 1.5 which is rational.

Take 1/3, 1/3 = 0.333333333 …, though the ratio is non-ending the next possible digit is predictable and hence rational.

Another example is 11/7. 11 /7 = 1.571428571428571428…, though decimal digits are non-ending we can predict the next possible digit and hence rational.

Hard work of men of great intellectual capacity and staunch determination for millennia to determine the nature of this number p, succeeded in 1794 AD, after about 2000 years when the great French Mathematician Legendre proved Aristotle's guess true.

Legendre proved that p is an irrational number. An irrational number is a number, which is not rational.

However, π is not such a number. We can calculate the value of π correct to any number of decimal points but cannot predict what comes next. Hence it is irrational.

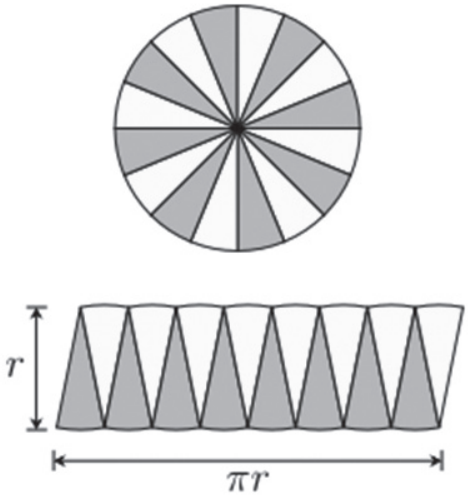
Then you may ask why we took the value of π as 22/7 or as its decimal representation 3.142857142857 142857…, which we have corrected to three or four decimal places, as it is required. Really, it is not the exact value but an approximate value of π for practical purposes.

Moreover, Legendre proved that π is a 'Transcendental' number. A transcendental number is one whose value cannot be determined by the four algebraic operations, namely addition, subtraction, multiplication, division or by the process of finding roots.

Hence, π is not only irrational but also transcendental too.

Area of a Circle – A practical approach

You may have studied the formula for finding out the area of a circle that "The Area of a circle of radius r is : $A=\pi r^2$. However, the proof for this formula is beyond the scope of this article, we will try to see how this formula works.



Take a cardboard, cut out a circular disc of moderate size, say with radius 'r', from it, draw sectors as shown in figure. Arrange these sectors as a parallelogram as shown in figure below.

Certainly, the area of the circle is same as the area of the parallelogram as the cardboard used.

Using the formulae we know, the circumference of the circle, $C = 2\pi r$, make the two longer sides of the parallelogram and the radius 'r' makes its height.

Hence, the length of one side of the parallelogram is

$2\pi r/2 = \pi r$.

Thus, the area of the parallelogram is

length x breadth = $\pi r \times r = \pi r^2$.

Remember that the area of the parallelogram is same as the area of the circle, and hence, the area of the circle of radius r is πr^2. However, this is not a proper mathematical proof yet it helps you experience the thrill of finding area of a circle.

- To be continued

Prof. Joseph Thomas
Principal
The Baker Vidyapeedh
Kottayam – 686 001
E Mail: sofroys@gmail.com

Prof. Liza George
Department of Physics
Henry Baker College
Melukavu

Major commercial fishes of India - The Indian Mackerel

Dr. K.K. Prajith and Ramchandra Khileri

Introduction

The Indian mackerel (*Rastrelliger kanagurta*) is a species of mackerel in the Scombroid family. It is commonly found in the Indian and West Pacific oceans, and their surrounding seas. It is an important food fish and is commonly used in South and South-East Asian cuisine. This occurs in areas where surface water temperatures are at least below 17 °C in coastal bays, harbours, and deep lagoons, usually in some turbid plankton-rich waters. They form schools in coastal waters. The well being of the marine fishing industry of India is determined to a large extent by the sustaining yields from the mackerel fishery. About 80 to 90% of the mackerel catches come from the west coast.

Scientific classification

Rastrelliger kanagurta locally known as *Ayala , Ayila* (Malayalam*), Ailai , Augalai, Kumla, Kanangeluthi* (Tamil), *Bangada (*Canarese*), Kaula gedar (*Marathi*), Kanagurta, Kannangadathaa* (Telugu), *Karan-kita* (Oriya), *Oibia gedar* (Sindhi), *Bangadi* (Hindi) and *Malbari bangada* (Gujarati). Besides *R. kanagurta*, two more species of mackerel

Indian mackerel (*Rastrelliger kanagurta*)

are found in Indian waters *viz. R. faughni* (Island mackerel) and *R. brachysoma* (Short mackerel).

Distribution

The Indian mackerel is found in warm shallow waters along the coasts of the Indian and Western Pacific oceans. In the inshore waters up to about 25 m the species is well known to occur all along the east and the west coasts of India from Kathiawar in the north-western coast to Kolkata in the north-eastern coast. It is also recorded from many other places under the Union Territory *viz*. the Andaman-Nicobar Islands and the Laccadive group

of Islands. The trawlers operating from Veraval, Bombay, Karwar, Mangalore, Cochin and Kolkata have obtained the species from the deeper regions of the continental shelf. It often enters the estuaries and backwaters. It has been recorded from the Kali River estuary near Karwar, Netravati estuary near Mangalore and from the Cochin backwaters of Kerala.

Distinguishing characters

The body is moderately deep, its depth at margin of gill covers 4.3-5.2 times in fork length. Head longer than body depth. Maxilla partly concealed, covered by the lachrymal bone, but extending to about hind margin of eye. Colour: narrow dark longitudinal bands on upper part of body (golden in fresh specimens) and a black spot on body near lower margin of pectoral fin; dorsal fins yellowish with black tips, caudal and pectoral fins yellowish; other fins dusky.

Fishery

In India, the landings of Indian mackerel in 2013 showed slight improvement from 1.7 lakh t in 2012 to 2.0 lakh t, still below the 2.8 lakh t mark in 2011. Indian mackerel landings in Gujarat during 2013 were 4,301 t recording a decline over the previous year by 21%. It formed 1.8% of the total pelagic resources landed during the year. In Maharashtra *R. kanagurta* contributed 2.5% (9,262 t) to the total fish landings in the State. Catch of mackerel declined by 53.9% as compared to 2012. The contribution of mackerel in Karnataka was 11.7% and in Goa it was 15.6% against their total catch in 2013. Indian mackerel landings in Kerala was 45,289 t during 2013. In Andhra Pradesh the total landing of mackerels in 2013 was 0.34 lakh t (22.9%)

Food and Feeding

Juveniles of the species feed on phytoplankton mainly on diatoms and small zooplankton such as cladocerans, ostracods, larval polychaetes, etc. With growth they gradually change their dietary habits, a process that is reflected in the relative shortening of their intestine. Hence, adult Indian mackerel prey primarily on macroplankton such as larval shrimps and fish.

Reproduction

Study shows that at the time of first spawning, mackerel are about two years old and measuring 200 - 220 mm in total length. The intensive spawning of mackerel starts by April/May. The spawning continues till around July. Young ones are recruited to the fishery by August when they are about three months old. They swarm in large shoals in the upper mixed layer to feed on the abundant plankton bloom caused by upwelling. By around December they start maturing. They become mature and start spawning by February. The breeding intensity increases and reaches a peak by May, the age at first spawning being around one year. They grow to a size of around 230 mm by the end of first year of their life. The Indian mackerel normally grows to a maximum size of 285 mm and weighs 270 gm, though an unusually large specimen of 480 mm was recorded from the Karnataka-Goa area.

Migration and shoaling behaviour

The mackerel of different size groups move in separate shoals. They move in semicircular or arrow head formations and their speed is about 8-10 miles per hour. They scatter, when pursued by seer fish, but when the shoals are chased by sharks or porpoises, the mackerel submerge with the head downwards into a compact mass. When the mackerel dive a patch of muddy water is seen at the surface which is due to churning of water by a large mass of fish.

Exploitation (Craft and Gear)

The Indian mackerel are harvested using a verity of nets. In Konkan region, north Kanara and South Kanara, the major gears in operation are shore seine (*Rampani*), gillnet (*Pattabale*) and cast net (*Pag*). The types of fishing boats are *Pandi, Hodi* and *Dhoni* with or without out - triggers. In Kerala boat seines (*Odam vala, Paithua vala*, *Ayilakollivala, Thattumvala, Nonvala*), shore seines (*Karavala*) and gillnets (*Ayilachalavala*) are operated with the help of dugout canoes. In Tamil Nadu, masula boats, Tuticorin type of boats, canoes and catamarans are chiefly used for operating different types of shore seines, boat seines, bag nets and gillnets. In Andhra Pradesh and Odisha more or less similar types of gear are used as in Tamil Nadu, with masula boats, plank built boats and catamarans.

Utilization

In India 20% of the catch is salt cured or pickled and approximately 5% are canned. A negligible portion of the salt cured mackerel is exported to Sri Lanka and Far East, while canned mackerel is entirely sold within the country. The remaining 75% are consumed in fresh form in the country. Sometimes unsold mackerel are beach dried and then converted into manure for use in coconut, coffee and tea plantations.

The importance of mackerel fish meal as cattle and poultry feed is well known. It has easily digestible proteins, vitamins and minerals and is obtained by pressing the cooked fish and sundrying the same. It is also prepared by beach drying of fish in the open sun without being cooked. In both the cases it is then powdered, sieved and stored in tins. Canning of mackerel was attempted by the Tamil Nadu Govt. which proved to be a commercial failure due to lack of regular supply of fish, high cost of cans and ground nut oil.

Scombroid fish such as tuna, mackerel and bonito that contain high levels of free histamine in their muscle are often implicated in Scombroid poisoning incidents. Scombroid poisoning is usually a mild illness with a variety of symptoms including rash, urticaria, nausea, vomiting and diarrhoea, flushing and tingling and itching of the skin. Severity of the symptoms can vary considerably with the amount of histamine ingested and the individual's sensitivity to histamine.

Dr. K.K. Prajith and Ramchandra Khileri
ICAR-Central Institute of Fisheries Technology
Veraval Research Centre
Matsya Bhavan, Bhidia
Veraval, Gujarat – 362 269
E Mail: prajithkk@gmail.com

THE ANATOMY OF AN EARTHQUAKE

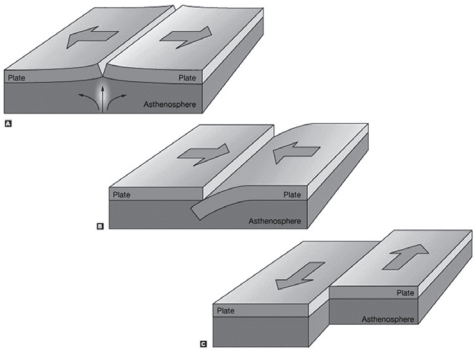
A very frightening and destructive phenomena of nature!!!

Dr. Shaweta Mohan and Dr. Gaurav Agnihotri

An earthquake is a sudden, rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface. The earth is formed of several layers which have very different physical and chemical properties. The outer layer, which averages about 70 kilometers in thickness, consists of about a dozen large, irregularly shaped plates that slide over, under and past each other on top of the partly molten inner layer. Most earthquakes occur at the boundaries where the plates meet. Due to the heating and cooling of the rock below these plates, the resulting convection causes the adjacently overlying plates to move, and, under great stress, deform. The rates of plate movements range from about 2 to 12 centimeters per year. Sometimes the movement is gradual. At other times, the plates are locked together, unable to release the accumulating energy. When the accumulated energy grows strong enough, the plates break free. If the accumulated stress exceeds the strength of the rocks making up these brittle zones, the rocks can break suddenly, releasing the stored energy as "seismic waves" that radiate out from the "source" in all directions and cause the ground to shake, resulting in an earthquake.

Measuring the size of an earthquake

The vibrations produced by earthquakes are detected, recorded and measured by instruments called seismographs. The zig-zag line recorded by a seismograph, called a "seismogram," reflects the changing intensity of the vibrations by responding to the motion of the ground surface beneath the instrument. From the data expressed in seismograms, scientists can determine the time, the epicenter, the focal depth, and the type of faulting of an earthquake and



can estimate the amount of energy released.

The *Richter Magnitude Scale* was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is not commonly used anymore, as it has been replaced by another scale called the Moment Magnitude Scale which is a more accurate measure of the earthquake size. The Moment Magnitude Scale, abbreviated M_W, is preferred because it works over a wider range of earthquake sizes and is applicable globally. Another way to measure the strength of an earthquake is to use the Mercalli Scale. Invented by Giuseppe Mercalli in 1902, this scale uses the observations of the people who experienced the earthquake to estimate its intensity.

Seismic zone map of India

On the basis of the intensities or the destructiveness of the earthquakes, a map of India has been published by the Meteorological Department in collaboration of the Indian Standard Institution. The map shows the five seismic zones based on modified Mercalli Scale such as:

Zone I - Intensity V or below (instrumental, feeble, slight, moderate rather strong).

This zone comprises some areas of Punjab and Haryana, plains of Uttar Pradesh, coastal plains of Maharashtra and Kerala, certain parts of the plains of Bihar and West Bengal, certain areas in Rajasthan and major part of Gujarat except Kutch.

Zone II - Intensity VI (Strong).

This zone includes southern Punjab and Haryana, certain parts of the plains of Uttar Pradesh, eastern Rajasthan, coastal areas of Odisha and Tamil Nadu.

Zone III - Intensity VII (Very Strong).

This zone covers southern and south-eastern parts of Rajasthan, larger parts of Madhya Pradesh, Maharashtra, Karnataka, Jharkhand and northern and north-western part of Odisha.

Zone IV - Intensity VIII (destructive)

This zone represents areas where there is high damage risk by destructive earthquakes. It comprises the state of Jammu and Kashmir, Himachal Pradesh, northern part of Punjab and Haryana, Delhi, eastern Uttar Pradesh, Tarai and Bhabar regions, the Himalayan areas of Uttaranchal, Bihar and Sikkim.

Zone V - Intensity more than VIII (disastrous, catastrophic)

It represents areas of the most destructive and catastrophic earthquakes where there is extremely high damage risk. The following areas fall into this zone: certain parts of Jammu and Kashmir, parts of Himachal Pradesh, Uttaranchal,

Monghyr and Darbhanga districts of Bihar, northern part of India and Kutch region of Gujarat.

Safety measures to be taken during an earthquake

- If you are inside a building: Stay where you are until the shaking stops. Do not run outside. Do not get in a doorway as this does not provide protection from falling or flying objects, and you may not be able to remain standing.
- Drop down onto your hands and knees so that the earthquake doesn't knock you down. Drop to the ground (before the earthquake drops you!).
- Cover your head and neck with your arms to protect yourself from falling debris.
- If you are in danger from falling objects, and you can move safely, crawl for additional cover under a sturdy desk or table.
- Stay away from glass, windows, outside doors and walls, and anything that could fall, such as light fixtures or furniture.
- If you are in bed, stay there and cover your head and neck with a pillow. At night, hazards and debris are difficult to see and avoid; attempts to move in the dark may result in more injuries than remaining in bed.

Because earthquakes happen without warning, being prepared in advance is critical to minimize damages and loss. Check your home for structural damage or cracks on a regular basis. Scientists are constantly estimating the locations and likelihoods of future damaging earthquakes. Sites of greatest hazard are being identified, and definite progress is being made in designing structures that will withstand the effects of earthquakes. Scientific understanding of earthquakes is of vital importance to the nation. With a greater understanding of the causes and effects of earthquakes, we may be able to reduce damage and loss of life from this destructive phenomenon.

Dr. Shaweta Mohan
Head of Physics Department
BBK DAV College for Women
Lawrence Road
Amritsar, Punjab – 143 001

Dr. Gaurav Agnihotri
Associate Professor
Department of Anatomy
Government Medical College
Amritsar,
Punjab – 143 001
E Mail: anatomygaurav@rediffmail.com

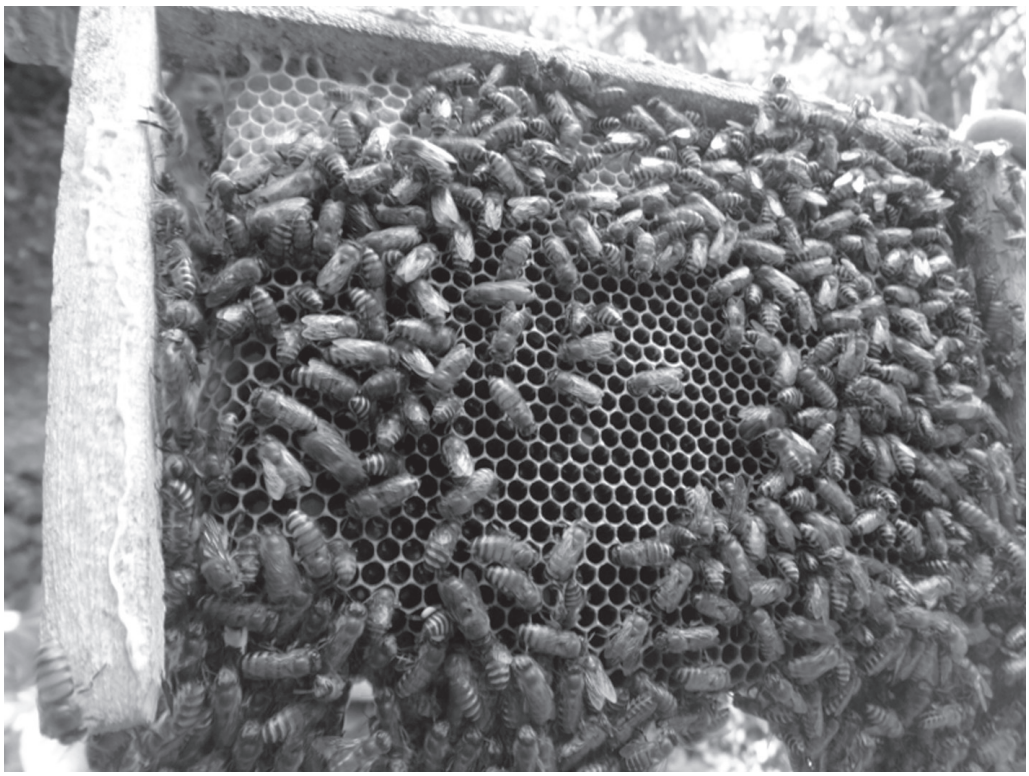
Give Honeybees a Chance !!!.....

K.G.R. Ajitha Nath

Laying the foundation stone of Indian Agriculture Research Institute (IARI) at Barhi in Hazaribag, Prime Minister Narendra Modi in his speech asked farmers to "select at least one district in every state to take up apiculture. Apiculture is an essential component in integrated farming and also increases the production of honey to meet the greater demand in the world market over".

This statement is definitely true because honeybees are an integral part of our ecosystem. They are the keystone pollinators to crop plants as well as wild plants. Majority of our agricultural pollination (approximately 80%) are provided by these gentle creatures on earth. Recent reports highlight the fact that lack of pollinators has caused a reduction in agriculture production.

Pollination is the first step in the formation of fruit/seed in plants. It involves the transfer of pollen from male part of flower (anther) to the female part



Honeybees provide one third of what we eat. If bees disappear from earth we will be no longer available because they would have consumed most of our insect pollinated plants. Actually, the world's food supply is dependent on honeybee pollination directly or indirectly. In other words, honeybees ensure food security to our world.

of the flower (stigma). Approximately 25,000 different types of honeybees are responsible for pollinating our agricultural world. Honey bees visit the same flowers of a particular species at one trip, thereby attain high quality of pollination. Without honey bees, pollination would not take place and crops would not develop. Okra, onion, cashew, mustard, cabbage, coconut, lemon, coffee, sunflower, rubber, cotton, tamarind etc. are some of the crops pollinated by honeybees. Pollination also affects dairy industry since alpha-alpha - the main ingredient in live stock feed - is dependent on honey bees for their pollination.

Honeybees provide one third of what we eat. If bees disappear from earth we will be no longer available because they would have consumed most of our insect pollinated plants. Actually, the world's food supply is dependent on honeybee pollination directly or indirectly. In other words, honeybees ensure food security to our world.

In addition to these, honeybees provide humankind with many valuable products like honey, bee wax, propolis, pollen, royal jelly, bee venom etc. It also helps in maintaining a good, attractive and aesthetic environment by promoting better floral growth.

Now a days, the number of apiculturists are decreasing day by day due to the loss of colonies. Indiscriminate and increasing use of insecticides, deforestation, climate change, global warming etc. have shortened the life span of honeybees and have thus reduced the number of colonies available for production of honey. Reduction in number of honeybees effectively reduces the rate of successful pollination, which in turn reduces agricultural and horticultural production. As a result, shortage of food materials and a consequent increase in the price of food will follow.

We never recognize the value of honeybees and the laborious task involved in producing honey and allied products, none of which have been substituted by any other means. We can study so many

Honeybees pollinating coconut flowers

things from honeybees one way or other. Honeybees do their own jobs and they are busy with their work also. The fruits of the toils of this social insect plays a great role in maintaining and managing our ecosystem.

Beekeeping is a comparatively small industry, but it plays a significant role within the agricultural area. Outcomes of beekeeping are: 1) Enhancement of crop productivity through pollination, 2) Generation of large income for unemployed youth, which can be started with minimal funds and an income generating hobby for school and college students, 3) Generation of an additional employment and income for those already in employment, 4) Enjoyment for the mankind, and 5) Helping in rural development and encouraging small village industry.

To follow Prime Minster's words, let us culture honeybees by maintaining one apiary in each home or at least encourage farmers for beekeeping. Let us make honeybees our model - do a small job and make a better world.

Both bees and plants can't live without each other. In fact we can't live without bees. So give honeybees a chance: "Save the Honeybees, Save the Earth".

I conclude quoting Albert Einstein's words: "If the bees disappeared off the surface of the globe, then man would have only four years of life left. No more bees, No more pollination, No more plants, No more animals, No more man".

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K.G.R. Ajitha Nath
Research Scholar
Department of Biotechnology
Kerala University
Karyavattom Campus
Thiruvananthapuram – 695 581
E Mail: kgr.ajithanath@gmail.com

The Challenges of Mathematics

Prof. D. Chatterjee

The progress of human civilization largely depends on the advancement of science and technology which advance on the wheels of mathematics. Ever since the dawn of civilization, mathematics has played a vital role in the transformation of our society. But what propelled mathematics to flourish? The obvious answer is challenging problems fed by all branches of sciences and social sciences but mainly by physics, chemistry, biology and economics. Mathematics of all ages took these problems as challenges and endeavoured to solve them as a result of which new theories evolved, new techniques were developed and new concepts were coined. Thus the solutions to these problems enriched mathematics, often science also. Some of these problems were revolutionary also in the sense that they changed the mathematical paradigm, extending the horizons of mathematics and finally giving precise interpretations of the physical and social phenomena. Many of such problems are still unsolved and attempts to solve them have given us new methods and often new theories. Mathematicians took several years to solve them, some problem even took several centuries.

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Euclid

The challenges that changed the world

Some of the outstanding problems whose solutions brought about a phenomenal change in mathematics are the following:

(a) In Euclid's Geometry the following three problems posed great difficulty to mathematicians of several centuries:

(i) Trisection of an arbitrary angle with ruler and compass only

(ii) Drawing a square equal in area to a circle using ruler and compass

(iii) Constructing a cube whose volume is double the volume of another cube.

These problems evolved in early first millennium A.D. and took nearly ten centuries to find their solution till Galois gave a formal solution in the negative.

(b) In Number Theory the following two problems perturbed almost all mathematicians of several centurie:

Goldbach

(i) Goldbach's Conjecture: Every even natural number greater than 2 is expressible as the sum of two prime numbers.

Mathematician Goldbach posed this problem in the year 1742 but surprisingly none has been able to prove this as yet.

(ii) Fermat's Conjecture or Fermat's Last Theorem: For positive integers x, y and z, the equation $x^n + y^n = z^n$ has a solution only in the case n = 2, but it has no solution for n > 2 (n ºN). Ever since Pierre de Fermat posed this problem in 1637, no one has been able to prove this. Only in 1996, Andrew Wiles gave a proof of this almost after 358 years. Interestingly the greatest mathematicians of this period tried this problem but could not crack.

(c) In Graph theory too, there are some problems which baffled the efforts of many. One such problem is:

(i) Hamilton's Problem: Is it possible to find a path through the edges of a dodecahedron, which starting from a vertex passes through every other vertex exactly once returns to the starting vertex?

The problem has not yet been solved though many outstanding mathematicians tried this ever since Hamilton proposed this problem in 1859.

(ii) The Four Colour Problem: Are four colours sufficient to colour any map so that no two adjoining

Fermat

countries get the same colour?

This is an over-simplified version of the actual problem. The actual problem could not be presented here as that requires some precise notions of graph theory, yet it is given here to give an idea about the problem and its apparent simplicity.

The problem was raised in a class room in October, 1852 by a student when his teacher was discussing colouring of a map. His question was – What is the minimum number of colours one require to colour any map so that no two adjoining countries get the same colour? The teacher after thinking for a while said – Five, but I don't know whether four will suffice. It took more than 300 years to get the correct answer. In the year 1976 an American Mathematician Hawken and a German Mathematician Apple worked together and using the latest generation computer came out with the solution that four colours suffice. They divided all maps into several categories and tested each category by a computer programme as to the requirement of colours complying with the condition. Almost all great mathematicians of the 19th and 20th centuries tried this problem sometime in their life but to no success until computers came forward to help us for a solution. Incidentally it may be mentioned that there is no proof as yet which does not use computer.

In Mechanics, a problem that has sizzled the Mathematical world for several centuries is the three body problem posed by d'Alembert in 1747 and modified by Clairaut in in 1749. Henry Poincare gave a partial solution to the problem in 1987, but the complete solution of the problem is yet unknown.

The Three Body Problem: Given an initial set of data specifying the position, mass and velocities of three bodies at a point of time, is it possible to determine the motion of the three bodies in accordance with the laws of classical mechanics ?

The above are not the only problems that played an everlasting influence on the advancement of mathematics. There are indeed plenty of unsolved, i.e., open problems many of which can be found in the Scottish Book, The Problem Book of Ulam. Apart from these, the great

mathematicians like Paul Erdos, Nagy, Riesz, Schwarz, Tate, Noether and Hilbert are great sources of beautiful problems.

How to take challenges

A mathematician is the one who is ready to take challenges. It is not always necessary that he should know everything of mathematics but must know the basics, have aggressive attitude, must be venturesome and analytical and have an urge to learn new concepts and new techniques and do experiments. One who has a Ph.D. or D.Sc. degree in Mathematics need not be called a mathematician unless he has the above qualities. So how to prepare oneself for being a true mathematician?

DO's:

(a) Try each problem from a standard text

(b) Try to be ahead of the class

(c) Try to solve a problem by as many methods as possible

(d) Try to convert a problem from one form to another and then solve. For example, convert an algebraic problem to a geometric problem, a trigonometric problem to an algebraic problem etc.

(e) Always try to draw diagrams, if possible.

(f) For inspiration and broadening of foundational knowledge, read books like:

(1) Prelude to Mathematics – W.W. Sawyer

(2) Search for Pattern – W. W. Sawyer

(3) The development of Mathematics – E.T. Bell

(4) Men of Mathematics – E.T. Bell

(5) One, two, three and infinity – George Gamow

(6) Mathematics and Logic – Ulam and Kac

(7) Three Hundred Years of Mathematics – J.L. Coolidge

(8) Fallacies, Paradoxes and Puzzles of Mathematics – D. Chatterjee

(9) Mathematics can be fun – Y. Perelman

(10) A primer of Real Functions – Boas, Jr.

(11) Srinivas Ramanujan – P.K. Srinivasan (Ed.)

(12) A Pure Mathematician's Apology – Hardy

DON'T's

(1) Don't memorise proofs and solutions without understanding the sequence of logical reasoning.

(2) Don't give a problem if you cannot solve it in the first attempt. Try many times until you get a solution.

Rewards you may get

It is true that there is no Nobel Prize in Mathematics but there some prizes in Mathematics which are equivalent to, if not more honourable than, the Nobel Prize. One should remember great

mathematicians never care for any reward. They do Mathematics because they love it. The joy and excitement are the best rewards.

The following three awards are considered equivalent to the Nobel Prize:

(1) Field Medal, awarded by International Mathematical Union since 1936.

(2) Abel's Prize, awarded by the Government of Norway since 2001

(3) Wolf's Prize, awarded by Wolf Foundation, Israel since 1978.

Other prestigious prizes almost equivalent to the Nobel Prize are:

(1) Poincare Prize, awarded by Daniel Lagolritzer Foundation since 1997

(2) De Morgan's Medal, awarded by London Mathematical Society since 1884

(3) Sylvester's Medal, awarded by Royal Society, London since 1901

(4) Cole Prize, awarded by American Mathematical Society since 1928.

The only mathematician who won three prizes in his career is Professor John Thompson. He got Field's Medal in 1970, Wolf's Prize in 1992 and Abel's Prize in 2008. It is a matter of great honour for India that three Indians received three such prizes. They are:

(a) Prof. (Dr.) Manjul Bhargava, Field Medal winner in 2014.

(b) Prof. S.R.S. Varadhan, winner of Abel's Prize in 2007, a former student of Indian Statistical Institute, Kolkata

(c) Prof. Nalini Anantharaman, winner of Poincare Prize, born and brought up in Paris, France.

Conclusion

To be great in any field is certainly not easy. This is more true in Science. It requires great effort, complete dedication, resolute determination and a dream that propels to destination or goal. For this one must have dream first, the dream will then dictate goals and the goals will prescribe efforts to be made.

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Prof. D. Chatterjee
B/18 Govt. Housing Estate
Dr. Sundarimohan Avenue
Kolkata – 700 014
E Mail: dipchat@rediffmail.com

German scientists prove there is life after death

Dr. A.R.S. Menon

A team of psychologists and medical doctors associated with the Technische Universität of Berlin, have announced that they had proven by clinical experimentation, the existence of some form of life after death. This astonishing announcement is based on the conclusions of a study using a new type of medically supervised near-death experiences, that allow patients to be clinically dead for almost 20 minutes before being brought back to life.

This controversial process that was repeated on 944 volunteers over the last four years, necessitates a complex mixture of drugs including epinephrine and dimethyl tryptamine, destined to allow the body to survive the state of clinical death and the re-animation process without damage. The body of the subject was then put into a temporary comatic state induced by a mixture of other drugs

Near-death experiences have been hypothesized in various medical journals in the past, as having the characteristics of hallucinations, but Dr. Ackermann and his team, on the contrary, consider them as evidence for the existence of the afterlife and of a form of dualism between mind and body.

which had to be filtered by ozone from his blood during the re-animation process 18 minutes later.

The extremely long duration of the experience was only recently made possible by the development of a new cardiopulmonary recitation (CPR) machine called the Auto Pulse. This type of equipment has already been used over the last few years, to re-animate people who had been dead for somewhere between 40 minutes to an hour.

The team of scientists led by Dr. Berthold Ackermann, has monitored the operations and have compiled the testimonies of the subjects. Although there are some slight variations from one individual to another, all of the subjects have some memories of their period of clinical death and a vast majority of them described some very similar sensations.

Most common memories include a feeling of detachment from the body, feelings of levitation, total serenity, security, warmth, the experience of absolute dissolution, and the presence of an overwhelming light.

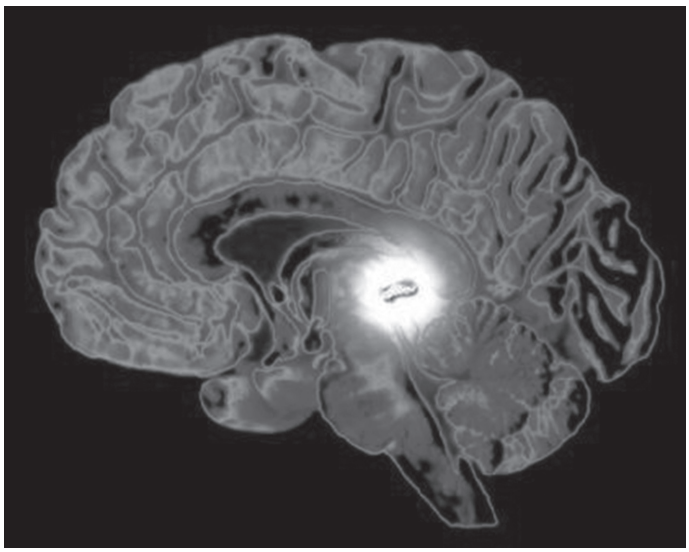
The scientists say that they are well aware that many of their conclusions could shock a lot of people, like the fact that the religious beliefs of the various subjects seems to have held no incidence at all, on the sensations and experiences that they described at the end of the experiment. Indeed, the volunteers counted in their ranks some members of a variety of Christian churches, Muslims, Jews, Hindus and atheists.

"I know our results could disturb the beliefs of many people" says Dr. Ackermann. "But in a way, we have just answered one of the greatest questions in the history of mankind, so I hope these people will be able to forgive us. Yes, there is life after death and it looks like this applies to everyone."

Mystery of Death Solved: DMT is the Key

We now know what happens at death

Resting comfortably in the recessed center of your brain, encased snugly within the corpus colossum, wrapped tightly between the dual-hemispheres of spongy nerve bundles, encased in the quarter-inch-thick armor-plating of skull, finally surrounded by your main and expressive organs with which you face the world, exists a tiny gland, long considered vestigial (serving little to no function), that holds the key to our interpretation



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of existence as we know it. I'm speaking of the pineal gland. This minute spec, roughly the size of a grain of rice, is more heavily protected than even the heart with its literal cage of protection, because if something happens to your heart you die, but if something happens to your pineal, you can't go to heaven.

Never heard of it?

This pineal gland has influences on both melatonin and pinoline, but our interest is in the gland's role in the creation of dimethyl triptamine, or DMT. This chemical, DMT, may well be the reason we, as a species, are capable of sentience itself.

I'm not a chemist; break it down

First, DMT is a narcotic, Schedule 1. It's scheduled as a highly illegal substance all over the planet, largely because DMT is one of the most potent psychedelics known to man. Intensely powerful. Yet, every day your pineal produces this stuff.

Secondly, DMT is the chemical that elicits dreams. That's right. Each night as you drift to slumber-land, not only are you tripping on a psychedelic, but you're also premeditatedly committing a federal offence; possession or consumption of DMT could land you a felony charge.

And third, this illegal gateway to dreamland is released in massive amounts at the moment of death. When I say massive, if a water glass of DMT evokes a dream, at death, an equivalent river excretes into your system. Any druggies reading this?

How have I not heard of this before?

Well, the pineal's significance is neither a new idea, nor an unfounded one. Spanning the expanse of human civilization runs an undercurrent of worshipful adoration to the almighty pineal, more widely known as the inner eye, all-seeing eye, or the like – considered the body's gateway to the soul.

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Egypt had its Eye of Horus (now emblazoned on the US dollar bill). Hindu culture has its 'pottu' (the familiar forehead dot). Even the ancient art of yoga recognizes the brow chakra, or ajna, as blossoming at the pineal, or third eye. That's only to name a few.

The hell you say! The truth behind the cult of the pineal has gone largely unnoticed collectively, though the symbols themselves have been downright ubiquitous. Tibetan Buddhists, as well,

Tibetan Buddhists, as well, have long carried a belief that the soul enters the fetus precisely 49 days after conception. Likely, reading this, you are not a Tibetan Buddhist – their numbers fall less than 20 million – and whether you subscribe to an eternal soul or not isn't the point, because day 49 is the moment the pineal is formed in a fledgling brain.

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Great, so what does all this have to do with death?

Well, on an experiential level, shrooms distort perception, coke smacks you withdraw energy, ecstasy grants superpower orgasms (ladies), and most notably, weed slows time – time distortion seems to go hand in hand with most psychedelics as well – so time passage then is totally subjective. Ask Einstein.

Meanwhile, among DMT smokers, out of the macrocosm of potential experiences, two major themes emerge nearly universally:

1) A stretching of time – they experience the hectic 6 or 7 minutes as a near eternity or lifetime.
2) They experience religious incarnations with a tilt toward whatever sect the subject is affiliated with.

Here's the clincher: After death, while this massive psychedelic dose courses through the brain, there is this mysterious several minutes where the brain still functions. With our new perspective, however, we at last understand what these minutes are...

These few minutes after death, subjectively, are experienced as an eternity, engrossed in the DMT universe. Also, the trip itself is a highly personal experience dictated by the deepest realms of the subconscious.

Therefore, whatever at your deepest core you expect to happen when you die… Congratulations, that's what'll happen… Every religion was right.

Mystery solved. Peace on earth.

If you're resourceful, you can find this stuff and try it. The bigger question now is: Do you really want to know where you'll be spending eternity?

Dr. A.R.S. Menon
ICAR-Central Institute of Fisheries Technology
Matsyapuri P.O.
Cochin – 682 029
E Mail: arsmenon@gmail.com