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Natural bioshield of coastal areas: The mangrove

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

Rational Behaviour

A little over 30 years back a group of academicians and intellectuals after several days of deliberations at Coonoor in Tamil Nadu, released a document on scientific temper in Indian society. The statement broadly emphasised the virtues of the scientific method as an antidote to the religious and superstitious dogmas prevailing in the society.

Scientific temper is incompatible with metaphysical beliefs. It cannot flourish in an unegalitarian society with high levels of illiteracy. Wide-spread education amongst other facets of development is a pre-requisite for the spread of scientific temper.

The statement was expected to usher a new movement for restructuring the society. The deliberations and discussions that followed were inadequate both with respect to the spread of scientific temper and refining the concept by developing tools/mechanism for its measurement.

The intervening period has no doubt witnessed efforts by the state with the coming up of the National Council for Science and Technology Communication (NCSTC) and later Vigyan Prasar under the Department of Science and Technology with the mandate of propagating scientific temper. Non-governmental organisations have encouraged peoples' science movements and along with NCSTC and Vigyan Prasar contributed in a larger measure to demystifying many myths and natural phenomena.

The ground situation by all accounts remains bleak with fatalism prevailing amongst large sections of the society. Many television channels have reinforced antiquarian beliefs.

Vigyan Prasar jointly with CSIR- National Institute of Science Communication and Information Resources (NISCAIR), New Delhi, organised a national consultation a few months back at Palampur, Himachal Pradesh to take stock of the situation and assess the need for larger platforms to deliberate on the issues. Many uncomfortable questions were raised during the discussions. While we move from 'industrial' to 'knowledge' economy, large sections of the community struggle with the issues of universal education. The entry of market forces in academia is not an unmixed blessing. Many social distortions appear to be getting reinforced even in this century.

Scientific temper is essentially the capacity of ordinary citizens to make decisions based on informed choices. It is not the depth or extent of knowledge in a specific field but rather the scientific method of enquiry which characterises scientific temper. Modern education, particularly of girls, will be a change agent. However, scientific information must transform into knowledge and bring about a change in attitude and the education system needs to further evolve. There are other policy issues that require deliberation.

Vigyan Prasar will actively pursue all facets of the debate and catalyse more platforms for experts to deliberate. A wider consultation is scheduled in January 2012 in New Delhi. Research on different facets of Public Understanding of Science is being catalysed in research groups. NCSTC is chalking its own initiative involving experts from universities and research laboratories. "Scientific temper with humanism" is a fundamental duty enshrined in our constitution through a specific amendment in 1976. Let each of us perform our duty well!

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Stereochemistry

The study of the static and dynamic aspects of the three-dimensional shapes of molecules

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"The subject of stereochemistry is as old as organic chemistry itself. The discovery of optical rotation by Biot antedates Wohler's famous urea synthesis, and the classical stereochemical research of Pasteur was contemporary with Kekule's equally classic work on molecular structure. Despite the venerability of the subject, there has been a marked resurgence of interest in it since the end of World War II."

Ernest L Eliel in *Stereochemistry of Carbon Compounds*, Tata Mcgraw-Hill Publishing Company Limited, 1962, New Delhi.

"Stereochemistry is a part of chemistry which is concerned with study of the spatial structure of molecules and of the influence of this structure on the physical and chemical properties of the compounds and on the direction and rate of their reactions. Stereochemistry deals primarily with organic compounds; of inorganic compounds, mainly complex and inner complex (chelate) compounds are studied. Until recently stereochemistry has been one of the most abstract theoretical areas of investigations. Now it has also assumed great practical importance."

V. M. Potapov in *Stereochemistry*, Mir Publishers, Moscow, 1976

Stereochemistry is the branch of chemistry which is concerned with molecular structure in three dimensions. It may be noted that in Greek *stereos* means "solid". Stereochemistry or the study of three-dimensional shapes combines geometry, topology and chemistry. One aspect of stereochemistry is stereoisomerism. Stereoisomers are the particular kind of isomers that are different from each other only in the way the atoms are arranged in space. The constitution of a molecule refers to the number and types of atoms and their bonding, including multiple bonds. Unlike stereoisomers, constitutional isomers are molecules with the same molecular formula but different bondings between the atoms; for example, 1-bromo-butane (BrH_2C-CH_2-CH_2-CH_3) and 2-bromobutane (H_3C-$CHBr$-CH_2-CH_3) where only the bonding between carbon and bromine are at different positions. Stereoisomers are molecules that have the same bonding between the atoms but differ in the arrangement of atoms in space, such as the two structural arrangements of 2-butene as shown in Fig. 1.

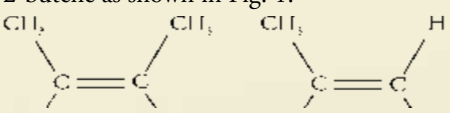

Fig. 1: Geometrical isomers of 2-Butene

Configuration refers to the relative position or order of the arrangement of atoms in space which characterises a particular stereoisomer and absolute configuration relates the configuration of a structure to an agreed upon stereochemical standard.

Sterechemistry deals primarily with organic compounds. However, some inorganic compounds, mainly complexes, also show stereoisomerism. There are three broad categories of stereoisomerism — conformational isomerism, optical isomerism, and geometrical isomerism.

Conformational isomerism

Different structural arrangements in space resulting from the rotation about single bonds are called conformational isomers, conformers or conformations. There are four distinct types of conformational isomers:

1. Linear alkane conformations.
2. Ring conformations like cyclohexane conformations.
3. Atropisomerism.
4. Folding of molecules.

Linear alkane conformations

Two extreme conformations of ethane resulting from rotation about carbon-carbon single bond are shown in Fig. 2.

Between the two extreme possibilities shown above there will be infinite number

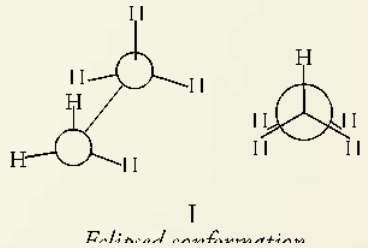

Fig. 2: Conformations of ethane

of intermediate conformations. The arrangement (I), in which the hydrogen atoms exactly oppose each other, is called the eclipsed conformation and the arrangement (II) is called the staggered conformation, in which the hydrogens are perfectly staggered. The intermediate conformations are called skew conformations. If there is no difference in energy among the different arrangements of a molecule then the molecule is not restricted to any particular arrangement. In case of ethane molecule the rotation about carbon-carbon single bond is not quite free. There is an energy barrier of about 3 kcal/mol. The staggered conformation has the minimum potential energy and the eclipsed conformation the maximum. Most of the ethane molecules are expected to spend most of the time in the most stable conformation, the staggered conformation. However, the energy barrier is not very high. Even at room temperature a collision with sufficient energy will result in rapid interconversion between different arrangements and practically it may be considered that there is free rotation about the carbon-carbon single bond.

In case of butane (CH_3-CH_2-CH_2-CH_3) there are several staggered conformations, as shown in Fig. 3.

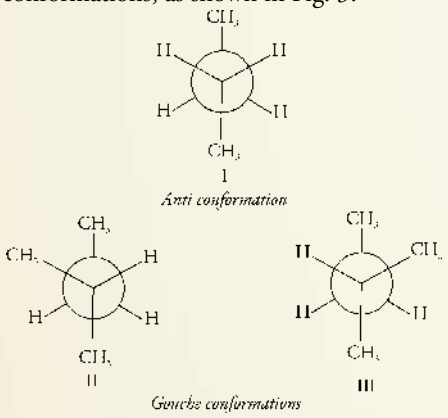

Fig. 3: Different conformations of n-Butene

The anti conformation has been found to be more stable than the gauche (by 0.8 kcal/mol).

Ring conformations

The study of ring conformations is one of the most important aspects of stereochemistry of cyclic compounds. Ring conformations are the shapes of the non-planar rings resulting from formal rotations about single carbon-carbon bonds. For example, in cyclohexane the most stable conformation is the chair conformation in which carbon atoms at 2, 3, 5, and 6 positions lie in a plane and the 1 and 4 carbon atoms lie on the opposite sides of the plane. The chair conformation is the most stable because there is not only no angle strain but also there is no bond opposition strain. It may be noted an organic molecule will be free of angle strain when the valence bonds of all the carbon atoms are at tetrahedral angle (109°28′). The other conformations of cyclohexane are boat, twist, and half-chair. The shapes of the different conformations of cyclohexane are shown in Fig. 4.

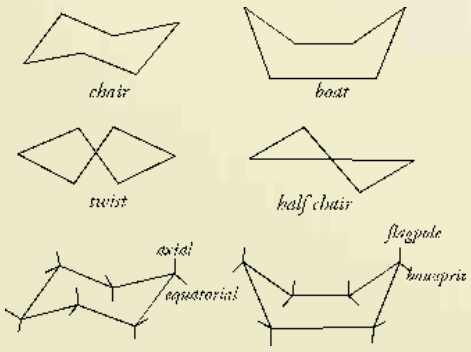

Fig. 4: Different conformations of Cyclohexane

Atropisomerism

Atropisomers are stereoisomers which are interconvertible by rotation about single bonds but the rotational barrier is high enough enabling the isomers to exist independently at room temperature. Atropisomers can be quite stable depending on the steric effects. In fact, atropisomers were the first conformational isomers to be identified.

Folding of molecules

Molecular folding in chemistry is a process by which a molecule assumes its shape and conformation. The most active area of interest in the folding of molecules is the process of protein folding; a protein assumes a particular shape determined by a specific sequence of its amino acids.

Jean-Baptiste Biot

Geometrical isomerism

Stereoisomers, which owe their existence to hindered rotation about double bonds, are called geometrical isomers. The configurations of the isomeric 2-butenes are shown Fig. 1.

The two configurations are differentiated in their names by the prefixes *cis-* and *trans-*. In *cis*-2-butene the two methyl groups are on the same side (in Latin 'cis' means 'on the same side'). In the *trans*-2-butene the methyl groups are on the opposite sides (in Greek 'trans' means 'across').

The rotation about any carbon-carbon double bond is hindered. However, such hindered rotation gives rise to geometrical isomerism only when there is a certain relationship among the groups attached to the doubly-bonded carbons.

Cis and *trans* isomers often have different physical properties. The *cis-trans* system for naming isomers cannot be implemented effectively when there are more than two different substituents on a double bond. In such cases E-Z nomenclature is used — Z (from the German "zusammen") means "together" and corresponds to the term "cis" and E (from the German "entgegen") meaning "opposite" and corresponds to "trans". Whether a particular molecular configuration is designated E or Z is determined by the Cahn-Ingold-Prelog priority rules where higher atomic numbers are given higher priority. The priority of each substituent for each of the two carbon atoms joined by the double bond needs to be determined. If both the higher-priority substituents are on the same side, the arrangement is Z and when they are on opposite sides, the arrangement is E.

Optical isomerism

The history of optical isomerism began in 1815 when French physicist Jean-Baptiste Biot (1774-1862) experimented with polarised light. Biot after passing polarised light through various solutions observed that certain solutions such as sugar have the ability to rotate polarised light. He also found that the degree of rotation is directly proportional to the concentration of the solution. Substances capable of rotating polarised light were called "optically active." However, at that time it was not known how certain compounds became optically active and others not. The significance of optical activity was also not known.

Louis Pasteur

It was the French chemist Louis Pasteur (1822-1895) who actually laid the foundation of stereochemistry in 1844, when he made a crucial observation while working on the salts of tartaric acid (2,3-dihydroxybutanedioic acid). On crystallising a solution of sodium ammonium tartrate, Pasteur found that there were two types of crystals present, which differed in the arrangements of the faces. Pasteur observed that the two types of crystals had identical properties except that they rotated plane-polarised light in different directions. One type of crystals rotated plane-polarised light to the right or clock-wise and the other rotated plane-polarised light by the same amount to the left or counter-clockwise. The symbols + and – are used to indicate rotations to the right and to the left, respectively.

It is important to understand the

concept of plane-polarised light. Certain properties of light are best understood when we consider light as a wave phenomenon. Light or an electromagnetic vibration of a range of different wavelengths, vibrate in many different planes at right angles to the direction of propagation of the light ray. Even monochromatic light, such as that emitted by a sodium lamp having discrete wavelength, vibrate in an infinite number of planes. In 1908, Etienne-Louis Malus (1775-1812), a French physicist, demonstrated that when light is reflected from opaque or transparent bodies at a certain angle it acquires certain special properties due to the fact that all the vibrations are confined to one plane, the plane of polarisation. Malus also demonstrated that the two rays produced by double refraction in crystalline calcium carbonate (Iceland spar) are polarised at planes perpendicular to each other. Such polarised light is called plane-polarised light. The most convenient way of turning ordinary light into a plane-polarised light is by passing it through a device such as Nicol prism. The amount of rotation of the plane-polarised light or the optical activity is measured by an instrument called the polarimeter.

Etienne-Louis Malus

Pasteur proposed that the forms of tartaric acid were mirror images to each other. This observation proved to be the cornerstone of stereochemistry. Pasteur later described his observations of sodium ammonium salts of tartaric acid in the following words: "...I carefully separated the crystals which were hemihedral to the right from those hemihedral to the left, and examined their solutions separately in the polarising apparatus. I then saw with no less surprise than pleasure that the crystals hemihedral to the right deviated to the plane of polarisation to the right, and that those hemihedral to the left deviated to the left."

Pasteur also observed that only one of the components could be utilised by microorganism for nutrition. Such observation led Pasteur to the conclusion that biological properties of chemical substances were not only dependent on the nature of atoms present in their molecules but also on the nature in which the atoms were arranged.

Pasteur's observation of two crystal structures made it obvious that this was possible because of two different molecular arrangements. But then one had to explain how molecules could exist in two mirror image forms. The explanation came from Joseph Achille Le Bel (1847-1930) and Jacobus Henricus van't Hoff (1852-1911). In 1874, Le Bell and van't Hoff, independently of each other, introduced the concept of tetrahedral carbon. They proposed that all the four valences of a carbon atom are directed towards the four corners of a regular tetrahedron and when a tetrahedral carbon atom is attached to four different substituents, the resulting molecule would lack symmetry. The asymmetry of the molecule is responsible for optical activity in such organic compounds.

Joseph Achille Le Bel

Van't Hoff published his findings in a 12-page pamphlet written in Dutch. The original title of this epochal pamphlet was "Voorstel tot Uitbreiding der Tegenwoordige in de Scheikunde gebruikte Structuurformules in de Ruimte, benevens een daarmee samenhangende Opmerking omtrent het Verband tusschen Optisch Actief Vermogen en chemische Constitutie van Organische Verbindingen (Proposal for the extension of current chemical structural formulas into space, together with related observation on the connection between optically active power and the chemical constitution of organic compounds). Considering the length of the pamphlet the title was rather long. The pamphlet was translated into French in 1875 as "La chimie dans l'espace" (Chemistry in Space). The German translation was brought out in 1877, which proved to be the most influential and controversial document. At the time of the publication of the pamphlet van't Hoff was barely 22.

Jacobus Henricus van 't Hoff, Jr.

Van't Hoff did not base his PhD thesis on his revolutionary work on stereochemistry because he thought his observations on the relation of optical activity to chemical constitution might not be received well by the examiners. That his apprehension was justified was evident by the fact that the well-known German chemist Hermann Kolbe (1818-1884) ridiculed his work. Kolbe wrote:

"I have recently published an article in *Journal fur praktische Chemie*…giving as one of the reasons for the contemporary decline of chemical research in Germany the lack of well-rounded as well as thorough chemical education. Many of our chemistry professors labour with this problem to the great disadvantage of our science. As a consequence of this, there is an overgrowth of the weed of the seemingly learned and ingenious but in reality trivial and stupefying natural philosophy. This natural philosophy, which had been put aside by exact science, is at present being dragged out by pseudoscientists from the junk-room which harbours such failings of the human mind, and is dressed up in modern fashion….

"Whoever considers this apprehension to be exaggerated should read, if he can manage it, the recently published pamphlet, *The arrangement of atoms in space*, by Messrs. Van't Hoff and Hermann, which teems with fantastic trifles. I would ignore this paper as so many others if it were not for renowned chemist who protected this nonsense and recommended it warmly as meritorious accomplishment.

"A J. H. van't Hoff, who is employed at the Veterinary School in Utrecht, appears to find exact chemical research not to his taste. He deems it more convenient to mount Pegasus (evidently loaned from the Veterinary School) and to proclaim in his "La chemie dans l'espace" how, to him on the chemical Parnassus which he ascended in his daring flight, the atoms appeared to be arranged in the Universe."

It was no doubt that Kolbe, while criticising van't Hoff, had shown great short-sightedness and intemperance. In

1878, van't Hoff was appointed as the first Professor of Chemistry, Mineralogy and Geology in the newly established University of Amsterdam. While accepting the appointment he delivered his inaugural lecture entitled "Imagination in Science". In this lecture he quoted Hermann's criticism as a counter example.

When two stereoisomers are non-superimposable mirror images of each other, they are called enantiomers. Stereoisomers that are not enantiomers are called diastereomers (see Fig.5). Both enantiomers and diastereomers are optically active; that is, they can rotate plane-polarised light. Any molecule that is non-superimposable with its mirror image is called chiral. It should be noted that all molecules having asymmetric carbon atom are not chiral and a

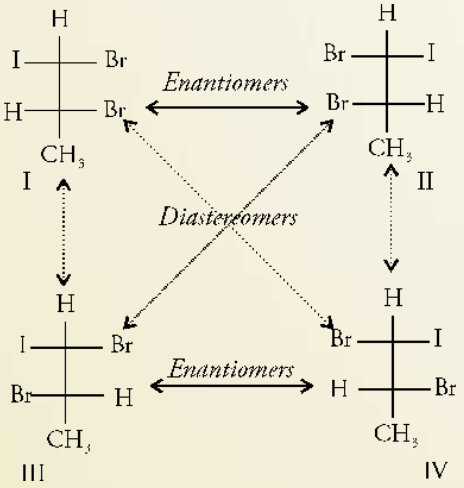

Fig. 5: Two dimensional representation of enantiomers and diastereomers

molecule can be chiral even without having an asymmetric carbon. A molecule becomes chiral if it has neither a plane nor a centre of symmetry. A carbon atom attached to four different groups is called asymmetric carbon atom. It is not necessary for a compound to have a tetrahedral structure to be a chiral compound.

Importance of stereochemistry

Initially stereochemistry used to be considered as an abstract theoretical area of investigation. However, in recent years stereochemistry has assumed great practical importance. The properties of both natural and synthetic polymers are substantially dependent on their spatial structures. The spatial three-dimensional structure exerts a great influence on the physiological properties of substances. Stereochemistry has found extensive applications in the chemistry and technology of polymeric materials, in biochemistry and molecular biology, in pharmacology and medicine. The properties of natural rubber are intimately associated with the definite geometrical configuration of its chain. Stereochemical methods of investigations have also helped to solve many theoretical problems in organic and inorganic chemistry.

We find inherent chirality in nature. The building blocks of life namely alpha-amino acids, nucleotides and carbohydrates are chiral and they appear in nature in enantiomerically pure forms. This means that any substances created by humankind to interact with nature or modify nature are supposed to interact with a chiral environment. Living organisms are capable of turning optically inactive substances into optically active ones.

The role of optically active substances in living organisms is so great that the presence of optically active substances in other planets or asteroids is considered to be one of the possible ways to detect extraterrestrial life.

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(The article is a popular presentation of some the important points on stereochemistry available in the existing literature. The idea is to persuade the younger generation to know more about sterechemistry. The author has given the sources consulted for writing this article. However, the sources on the Internet are numerous and so they have not been individually listed. The author is grateful to all those authors whose works have contributed to writing this article). ■

Natural bioshield of coastal areas: The mangrove

(A special feature to mark the UN "International Year of Forestry - 2011")

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Mangroves are a unique species of plants. They can grow where no other tree can survive. Botanists classify the major mangrove species into the family of Acanthaceae. This family has many genera which grow in brackish water, only one genus *Avicennia* has capacity to tolerate the brackish water more than any other genus of mangrove. Among *Avicennia* species the *Avicennia marina* can tolerate the highest level of salinity. This species can tolerate high salinity by excreting salts through its leaves and grows widely in sea-waters along the tropical coasts of Asia and Africa. The year 2011 has been declared by the United Nations as the International Year of Forestry - 2011, in addition to the International Year of Chemistry. The International Year of Forestry - 2011 is being celebrated globally to protect all kinds of forest trees including mangroves. An International conference on "Mangroves for Coastal Area Management was organized in M.S. Swaminathan Research Foundation (MSSRF) at its headquarters in Taramani Institutional Area, Chennai for four days from 7th August 2011 to 10th August 2011.

Prof. M.S. Swaminathan with children of the mangrove dependent communities. His dream is to leave a clean and green earth for the future generations.

Inaugurating this global meet the Union Minister of State for Environment and Forests Ms Jayanti Natarajan said that the integrated coastal zone management project is being implemented by the Ministry of Environment and Forests with the help of World Bank in Gujarat, Orissa and West Bengal. Under this Project the "Survey of India" is surveying the present status of Mangrove Forests alongwith the environmental situation of the coastal areas because the ecology of the Indian coastes is being ignored in the name of promoting tourism.

A National Centre for Sustainable management of coastal Areas has been established at the Anna University of Chennai which is working towards R & D in collaboration with a total of eleven institutions including M.S. Swaminathan Research Foundation. Ms Jayanti Natarajan said that this project has been included in the priority list of the projects of Ministry of Environment and Forests of the Government if India. She lamented that over the past 38 years, India has lost about 12 percent of the mangroves because of human pressure on coastal areas. She lauded the contribution of the MSSRF in rejuvenating mangrove forests and expanding their area with excellent Research and Development work during last 20 years under the guidance of Prof. M.S. Swaminathan. Under his leadership a survey was conducted of the mangrove trees in 23 coastal areas of nine countries in the world and three centres for conservation of genetic resources of the mangrove trees were created in South and South-East Asia and Oceania and one centre in west Africa and Central Africa. A training programme was organized at MSSRF Chennai for trainers of 12 countries from February to May 1992 for conservation of the genetic resources of the mangrove trees and for the expansion of mangrove forests. Out of the participants one Vietnamese trainer was awarded Vavilov medal which has been initiated by MSSRF in the memory of the great Russian Geneticist Prof. N. I. Vavilov. The MSSRF has also started a "Mangrove Ecosystem Information Service" Which ultimately gave rise to the "Global Mangrove Information Service". This whole programme was actually launched in September 1989 at Tokyo, the capital of Japan where an international conference was organized on "Environment and Sustainable Development". Prof. M.S. Swaminathan warned that the global warming may cause the rising of sea level to the extent that the salt-water of the oceans will enter the coastal areas causing disastrous impact. He pleaded that the Bioshield of Mangrove trees must be conserved because they are the only trees which can grow successfully in the brackish water of the seas. He also called for anticipatory research so that scientists could transfer the salt-tolerant characteristics of mangroves to other plants, especially to the crops. This will help in maintaining and increasing the productivity of various crorps inspite of climate change which is happening due to global warming, In 1990 an International Society for Mangrove Ecosystems (ISME) was established in Okinawa, Japan. Prof. Swaminathan was elected its first president.

Immediately after the Chennai workshop of January 1990 the MSSRF established a Mangrove Genetic Resources Centre at Pichavaram to conserve the biodiversity of mangroves with the support of the Department of Biotechnology (DBT) of the Government of India. The forest department of Tamilnadu provided the land for this centre. A seed bank of Mangroves was established in Bhitarkanika Sanctuary of Orissa during three years from September

1994 to August 1997 and rejuvenation of the degraded Mangrove forests was taken up. Very soon the mangrove trees started flourishing in about 50 hectares. In addition to the rural people of the adjoining villages, the school children also participated in this project. They were trained for this work and were also awarded for their good work.

The techniques for identification of genetic diversity of mangrove and for their conservation were developed by May 1996 and a project on "Coastal Wetlands Mangrove Conservation and Management" was undertaken in Tamilnadu, Andhra Pradesh, Orissa and West Bengal with the support from "India - Canada Environment Facility. This project was completed by the year 2003 in Tamilnadu, Andhra Pradesh and West Bengal and by the year 2004 in Odisha.

Prof. M.S. Swaminathan used to call the Mangrove trees as Bioshield because the mangrove forests serve as speedbreakers during the incidence of coastal storms and Tsunamis. This unique quality of the mangrove trees was proved in October 1999 during the Super Cyclone which attacked the coast of Orissa and on 24th December 2004 in the coastal areas of Andaman & Nicobar islands and other coastal areas during the fury of Tsunami. The forceful high waves of the sea were faced by the mangrove trees on their body and were able to reduce the damage to the coastal areas, wherever the Mangrove Trees were standing. MSSRF conducted a survey of the Tsunami-affected areas after the earthquakes in collaboration with the forestry-experts of Sri Lanka, Indonesia, Thailand, Denmark and USA. This survey conclusively shown that mangrove trees faced the fury of the Tsunami waves mitigating successfully their impact. The impact depended on the height and density of the mangrove trees as well as the area covered by their roots. The longer and dense trees and larger root-zone were able to reduce the speed and force of the Tsunami waves. This research concluded that in a 100 meter wide belt, if 430 mangrove trees are growing with the density of 10 trees per square meter then the mangrove trees could reduce the pressure and speed of the 4-5 meter high waves of Tsunami by 90 percent. Prof. M.S Swaminathan headed the National Farmers Commission and when he submitted its report in January 2005, he suggested that an Integrated Action Plan may be implemented. For the implementation of this action plan he included programmes to improve the psychological condition as well as the provision of livelihood, agricultural and ecological security of the people of that area. It also envisages a programme of formation of Bioshield for the protection of coastal areas of the Tsunami and Super Cyclone affected areas using mangrove as well as non-mangrove trees like Casurina species with the active participation of local communities, gram-panchayats and NGOs to support a movement for the protection of the coastal areas. The implementation of this action plan has been initiated in Tamilnadu, Andhra Pradesh and a Bioshield has already been established in 260 hectares. A belt of Casurina trees has been established in rows in the sand along the coastal areas parallel to the mangroves in the wetlands for double protection. M.S. Swaminathan Foundation has developed a system of plantation after identifying species of mangrove trees suitable for the particular area and after planting them in the first rows in the salt waters, the non-mangrove species are planted in parallel rows in the sands towards the land to provide food, fodder and fuel as well as timber to ensure the livelyhood security of the communities living in the villages of the area. This will also ensure that the coastal forests will not be destroyed by human intervention. Otherwise people continued the un-ecological practice of using mangrove species for fuelwood and other purposes as was done earlier. These forests also act as a habitat for unique species of marine organisms and birds and the Sunderban is known for its Tigers. This whole ecosystem is unique and useful and therefore its protection will not only save the environment but also it is essential from economical, social and cultural perspective.

The bioshield of mangroves to protect the coastal areas from cyclones and tsunamies

The coastal fisheries sector generated employment to more than sixty million people, mostly fishermen. To support them Prof. M.S. Swaminathan has developed an "Integrated Mangrove Fisheries System". An integrated programme is being implemented by MSSRF for growing salt-tolerant halophytes and for farming of fish, crabs and prawns in the coastal wetlands. This will ultimately lead to the sustainable development of the coastal aquaculture and will pave the way for the protection of the coastal ecosystem. This system utilizes the tidal salt-waters and the labour and expenditure of removing this brackish water from the land areas, are also saved. The spawn of fishes and prawns also enter the wetlands alongwith the tidal waves which act as seeds for rearing fishes and shrimps. The natural feed for the shrimp and fishes also becomes available. This action plan is being implemented with full gest and commitment of the local communities on participatory basis under the guidance of MSSRF in Tamilnadu and Andhra Pradesh. It will provide a viable model for sustainable development of the coastal areas.

Presently the coastal wetlands have been identified to establish a Global network of mangrove Genetic resource centres in Papua NewGuinae, Philippines, Indonesia, Malaysia. Thailand, Cameroon, Senegal and Pakistan in addition to India. A database of 650 international mangrove experts (MANEXP) have been developed alongwith other databases such as Mangrove Bibliographic database (MANBIB), Mangrove Resource Database (MANRES) of 22 core Mangrove sites; Mangrove Genetic Variability Database (MANVAR) in addition to Global Mangrove Database and Information System. These databases will help all the international organizations and institutions for R & D on Mangroves. The regional centre of Global Mangrove Database and information system for India has been established at MSSRF in Chennai.

What is a mangrove?

Mangrove grows as a bush or tree. It may grow to the height of three to 14 metres. The bark of the tree is brown, uniform but instead of being smooth the bark is divided into

rough plates. The leaves are oval shaped with length of five to eight centimetres and having smooth and shining upper surface, while the lower surface is hairy. All the species of *Avicennia* mangrove have aerial roots. These aerial roots are about 20 centimetres long and have a radius of one centimetre. These aerial roots are used by the mangrove tree for absorbing oxygen from air because there is little oxygen in the salt-water in which it grows. Mangrove flowers have different colours, ranging from white to golden-yellow and light pink, etc. Flowers are borne on the plant in clusters containing three to five flowers per cluster. The seeds are flashy. Usually the seeds start germinating while still attached with to plants. After germination they drop into the salt-water where they start growing roots to remain grounded. Sometimes they float and go to the sea with receding tidal waves which bring them back again to their original habitat.

A fattened crab from a restored wetland of mangroves.

The mangrove tree is able to expel some of the salt through its aerial roots. This enables them to tolerate the high salinity, which can kill other plants. The sap in the leaves of the mangrove plants is lesser saline them the salt water of the sea to the extent of 1/10. They have some special cells in the leaves called Parenchyma which are able to give out the extra salt alongwith the sap. The species of *Avicennia* are more efficient in expelling the extra amount of salt. *Avicennia marina* is called *Tawarian* in Gujarati, *Tavir* in Marathi, *Tellamada* in Telugu, *Kanna* in Tamil, *Ipati* in Kanada and *Orayi* in Malayalam.

Although mangrove trees grow in brackish water they must be washed regularly by freshwater. This requirement is accomplished by the rainwater and the coastal areas usually get the rains throughout the year. The roots of the mangrove trees are very special as they keep the tree fixed even in the muddy and marshy water because of special cells called lenticels which are able to draw air from the surroundings. These lenticels are so specific that only air can enter through them and the water and salt cannot get through. All the aerial roots of the mangrove trees have specialised tissue called aerenchyma, which have special spaces to store air inside. This helps the roots to respire even when they are submerged in the tidal waters. The roots which draw nutrients from the surface of the muddy soil are very slender and come out of the cable-wire like aerial roots at the lowest surface above the mud. The aerial roots give out air-carrier roots called pneumatophores. If an *Avicennia* tree is about three metres high, it may produce about 10,000 pneutmatophores. Genus *Sonoraria* too has pneumatophores but they are conical. *Bruguiera*'s roots come out of the marshy land and grow out of the surface and after that again loop back in. The roots of *Rhizophora* arise out of the trunk and then take the shape of knee to support the tree. They absorb air from the atmosphere.

The wood of mangrove does not contain heartwood and instead consists of narrow tube-like structure which makes it dense and uniform. This kind of structure of the wood keeps the bark and trunk intact even under the stress and pressure of the waves and winds. The tree may bend but it will not break. When the germinated seed falls in the muddy water, they can survive before being rooted to the soil by using the nutrients stored in them. These seedlings can swim. Some species of mangrove trees show different kinds of adaptations to survive in adverse conditions. For example, in *Avicennia*, when the germinated seed separates from the fruit, it also produces a small stem. This characteristic is also found in *Rhizophora* and *Bruguiera* species.

A mangrove drops its germinated seeds at the time of arrival of the tide. Often the germinated seeds float, maintaining their vertical position and leaves and the roots appear in the floating seeds. It is because of such ecological adaptations that the mangrove trees continue to grow and multiply even under adverse conditions. In about a year or two the plants growing out of the germinated seeds become so big that they start producing aerial roots. The leaves are waxy and spiny and have other attributes to help them conserve water by restricting transpiration.

Tree climbing crabs and sea snails climb to the aerial roots of mangroves to avoid marinepredators. The network of roots of mangroves under the marshy land makes a safe habitat for the eggs and fingerlings of fishes. Various kinds of birds and animals also get refuge among the dense growth of mangroves. Even the flashy leaves that fall in the salt-water below the trees rot and provide rich manure for the growing mangrove trees. The mangrove trees absorb more CO_2 per unit area than the phytoplanktons in the tropical coastal regions. Actually carbon sequestration potential of the mangrove forests is 50 times greater than that of tropical forests.

However the mangroves are now facing danger of massive degradation and deforestation. Some wetlands have been acquired for growing shrimps and others have been cleared of the mangroves and other vegetation to construct hotels and water sports and resorts in addition to human settlements. According to survey about 5 percent area of mangrove forests in India has been grabbed by exporters of shrimps.

Women empowerment street plays for social mobilisation

It is essential to stop destruction of mangroves

Mangrove forests once covered 3/4th of the coastlines of the tropical and subtropical countries. Today less than 50% of the mangrove forests have survived, and of this 50% of the remaining mangroves about half is degraded and not in good shape. According to a report of the Ministry of Environment and Forests, India lost 40 percent of the mangrove area in 19th century. This destruction continued in the 20th century and the National Remote Sensing Agency (NRSA) recorded a decline of 7,000 hectares of mangroves in India within the six-year period from 1975 to 1981. Between 1987 and 1997 about 22,400 hectares of mangrove were lost in Andman & Nicobar Islands.

The scientific management of the mangrove forests in India was started from the Sunderban's mangroves located in the Bay of Bengal, partly in India and partly in Bangladesh. In 1892, first mangrove management plan was implemented in the deltas of the Godavari, Krishna, Mahanadi, and Kollidam rivers on the east coast. After independence, a National Mangrove Committee was formed for the first time in 1976 in the Ministry of Environment and Forests and the work of conservation of mangrove forests was started. In the same year an amendment was made in the Indian Constitution, which states that it shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wild life. The mangrove management picked up speed after the Environment Protection Act of 1980 and the National Forest Policy of 1988.

Sundarbans is spread over about 80,000 square kilometres and is the largest delta of the world encompassing the mighty rivers of Ganga, Brahmputra and Meghna. At a time there were mangrove forests in 10,000 square kilometres, out of which 40 percent was in India and 60 percent in Bangladesh. It has a tiger sanctuary also. Half of the Sundarbans is under water and the total area of mangrove forests here is only 4,262 square kilometres. Botanists have found about 334 species of plants growing in the Sundarbans. Out of these, 69 are mangrove species.

Along the coast of Mumbai the Sewari Mangrove Park has been established as a protected area. It consists of about 6 hectares of mangroves in the mudflats between Sewari and Trombay. It is inhabited by about 800 species of birds. Seven species of mangroves have been identified in this area and afforestation programme is continuing. There is a mangrove forest along the coast of Goa covering about 500 hectares. Out of this, 178 hectares have been declared as protected area. New mangrove plantation has resulted in increasing the growth of mangrove trees in 976 hectares by the end of 1996-97. There are mangrove forests in an area of 23,400 hectares in Andaman & Nicobar Islands. The extraction of mangrove wood has been banned here since 1987.

The restoration of mangrove forests in Pichavaram, Tamilnadu : A success story

Pichavaram is situated in the south of Chennai at a distance of about 200 kilometres. In 1930 the British cleared about 70 hectares of the mangrove forests of the Pichavaram. A later survey revealed that the mangrove trees were cut down during decades of 1910 to 1960. The land denuded of mangrove trees dried out due to heat of the Sun. When tidal waves brought the sea-water here the place was turned into small ponds and the marshy soil which was the abode of mangrove trees, disappeared.

Restoration of degraded mangroves restored the smiles and happiness.

When the work of R&D on restoration and conservation of mangrove forests at Pichavaram was started in the year 1993 under the leadership of Prof. M.S. Swaminathan, out of about 1,400 hectares some 565 hectares of mangrove area was totally degraded. The MSSRF scientists restored an area of 20 hectares and developed a method of afforestation of mangrove with great success. The method is very simple. "It was demonstrated in a 10-hectare degraded plot. A canal system consisting of main and feeder canals was designed and dug in the degraded area. The main canals were connected to natural canals nearby. This enabled tidal water to flow freely in and out of the degraded area (instead of stagnating), thus decreasing soil salinity. Planting mangrove saplings in the degraded area completed the task of restoration. This technology was demonstrated at Pichavaram between 1993 and 1996". The ministry of Environment and Forests recognised the technique and a plan was made to adopt it in various degraded mangrove areas of Tamil Nadu, Andhra Pradesh, and Odisha.

In 1993, the "India-Canada Environment Facility" was formed. With its help demonstrations of the 'Joint Mangrove Management (JMM)' model were held in the 37 villages of Tamil Nadu, Andhra Pradesh and Odisha. The state departments of forests, other government agencies, banks, gram panchayats and gram sabhas, schools, and NGOs joined hands with MSSRF to bring about the change, Wherever the mangrove trees were missing the seedlings of the new trees were planted with full participation of the people including school children. The Self Help Groups, mainly having women members, joined this greening movement enthusiastically. To save the mangrove trees from cutting for fuelwood, quick-growing species of trees were planted to fulfill the need of fuelwood. There were healthy mangrove forests in an area of 399.42 hectares in Pichavaram and 565.05 hectares was degraded. There were nine hamlets of fishermen and six hamlets of farmers, and the total population consisted of about 22-23 thousand people.

The programme of plantation of mangroves was initiated in December 1998. New mangrove forest was created by December 2003 in an area of 396 hectares. Some mangrove species are unique to this area and do not occur in any other area. The wetlands started yielding on an average 208 tonnes of prawns, 19 tonnes of fishes, and 9 tonnes of crabs per year. It generated an

income of Rs. 90 lacs per year. The income was shared by 2,600 fishermen and every fisherman started earning Rs. 3,500 per month. A technique of fattening of crabs was developed and the training was imparted. This led to an income of Rs. 4,000 per month for every family of MGR Nagar, a colony of fishermen. When the MSSRF started working in this colony of fisherman in September 1998 every person was loaded with the debt of moneylenders. The mangrove forests were totally degraded. The fishermen somehow survived by selling fish fish caught without net and boat. During monsoon the colony used to be flooded with rainwater. Fuelwood was missing. With their participation, the MSSRF was able to plant 400,000 mangrove trees between January 1999 and February 2001. Out of them 80 percent trees were established. About 200,000 mangrove trees were planted in another place. Self Help Groups were formed. Every female member of the SHG received Rs. 20,000 as loan from banks. Boats and nets were purchased. About 61 grocery shops were opened. One SHG got a loan of Rs. 65,000 and started a unit of coir-rope-making and to repay the loans taken from the moneylenders. An all male SHG got a loan of Rs. 1,25,000 for buying a mechanised boat, for fishing in the sea. The concrete building of the primary school was constructed at the cost of Rs. 1, 28,000. The local community mobilised Rs. 100,000 and deposited the money in a bank to meet the recurring expenses. All of them were relieved of the debt of moneylenders. The MSSRF showed the way to develop a colony of frustrated helpless people into a happy society by using sound ecological and sustainable technologies to ensure livelihood and social security.

Success stories of Andhra Pradesh, Odisha and Sunderbans

This experience was repeated in the five villages of Godavari delta. Later on it was extended to 46 villages in Godavari district and 27 villages of the Krishna district. Ultimately 48 Self Help Groups in 1,835 villages joined the movement. A vigorous mangrove awareness drive was undertaken in the nine villages for the local communities, government officials, NGOs, panchayat members and school children. A number of communication-tools were tapped, such as street plays, newsletters and pamphlets in Telugu including wall-board paintings, mangrove-clubs in schools, video documentaries, meetings and exhibitions. After making a bench-mark survey of socio-economic status of the people, activities of rural development and forest development were started. Trainings were conducted in making coir-ropes, door-mats, tailoring and prawn-prickle, nursery, raising of mangrove saplings, candle making, vermicomposting, etc. Fast growing trees were planted to reduce the dependence on mangroves for fuelwood, fencing, fodder and timber. More than 100 improved *chulhas* and kerosene stoves were also provided.

Raising a nursery of evergreen revolution of mangrovs.

There were healthy mangrove trees in 12,400 hectares and 4,200 hectares of mangrove forests were degraded in the delta of the Godavari river. Krishna delta consisted 7,350 hectares of dense, healthy mangroves and 15,300 hectares of degraded mangrove area. Two mangrove nurseries were established in both the districts in the years 1998 and 1999. After plantation, 30 lakh trees of mangrove started growing. The restoration of the degraded mangrove forests, establishment of nurseries, and plantation activities generated about Rs. 52 lakh for the rural people of the area. A Mangrove Genetic Resource Centre was established in Koringa after bringing various species of mangrove trees from different places.

A total area of 190 hectares of degraded mangroves was restored in Odisha in the Mahanadi delta and in the mouth region of River Devi. After the 1999 Super Cyclone, degraded mangroves in another 240 hectares were restored with the participation of the people of ten villages. A Mangrove Genetic Resource Conservation Centre was set up at Kansardhia Forest Block in the Mahandi detla with 14 species of mangroves which were grown there. As an alternative to mangrove wood as kitchen fuel, 436 improved portable *chulhas* were introduced in the four village and later a study showed that these *chulhas* have reduced fuel consumption by 31 percent.

The Joint Mangrove Management (JMM) project was also implemented in 24 Parganas (South) in 15 villages from four forest ranges of Sundarbans of West Bengal. About 3,00,000 seedlings were planted on 25 hectares of *panchayati* land during July 2000. Of these seedlings, 92 percent survived and grew into trees. "Forest Protection Committees" were formed in 11 villages, while in the other four villages "Beneficiary Committees" implemented the project. Four endangered mangrove species were planted in a nine-hectare plot separately to enhance the natural stock of these species (*Heretiera minor, Nipa fruticans, Carapa obovata, Carapa molucensis).* About 180,000 seedlings were distributed for planting in a 100-hectare plot. Eight hundred grafts of fruit trees and 6,000 bamboo seedlings were also distributed for planting. The local community planted 3,000 seedlings of

A mangrove tree with flowers in the restored area.

bamboo in homestead land.

The M.S. Swaminathan Research Foundation not only restored the degraded mangrove forests in selected areas of Tamil Nadu, Andhra Pradesh, Odisha and West Bengal, but also restored the whole socio-economic system. The empowerment of women help immensely in success of the various projects. Facilities and infrastructures were created for safe drinking water, irrigation, education, etc., in addition to food and nutrition security and livelihood security.

During an international seminar on "Mangrove for Coastal Area Management" held in Chennai from 7 to 10 August 2011, to commemorate International Year of Forests, 2011, the 86th birthday of Prof. M.S. Swaminathan was also celebrated. The 21st report of the MSSRF and a report on 20 years of research, development and management of mangrove ecosystem titled "Mangrove Ecosystem and Management: Two Decades of Learning" were released on the occasion.

According to 'India State of Forest Report' of 2009 the mangrove forests covered an area of 4,639 square kilometres in the nine coastal states and three union territories of India. This was about 58 square kilometers more than the figure in 2005. In comparison to 2005 about 58 squares kilometer Mangrove plantations were added to this area in four years by the end of 2009.

This growth was observed mainly in Gujarat, Odisha, Tamil Nadu, Andhra Pradesh and West Bengal. Out of these states except Gujarat, MS Swaminathan Research Foundation was active in the implementation of conservation and restoration of mangroves in four states. Globally, the India has joined the community of those very few countries where the reduction in the area of mangrove forests has been stopped and the expansion of mangrove areas has gained momentum. The mangrove forests have expanded by 56 square kilometers in Gujarat, 16 square Kilometers in West Bengal, 4 Square Kilometers in Orissa and by three Kilometers in Tamilnadu. This The impressive expansion has been achieved by adopting just one model of Joint Mangrove Management (JMM). If this model can be adopted in all the coastal areas of India and the rest of the world, it will rejuvenate the degraded mangrove forests which will form an evergreen bioshield against the natural calamities of super cyclones and tsunamis of the future. This was but a very small but impressive gift on the 86th birthday of Prof. M.S. Swaminathan whose life-time achievements towards helping the disadvantaged sections of the society were praised by Ms Jayanti Natarajan describing Prof. M.s. Swaminathan as the "National Treasure" who deserved Bharat Ratna. The secretary of the Department of Science and Technology, Dr. T. Ramasamy also graced the occasion.

Overall impact of the 20 years' work of MSSRF done in the selected mangrove-growing areas using innovative and simple ideas with a science-based, people-centered approach is very much visible in the project areas. Mangrove Management Committees were formed in 33 villages with the participation of 5,240 mangrove-dependent families. About 6.8 million saplings of mangrove trees were planted in the restored areas, out of these 75 to 80 percent survived to become trees forming the strong bioshield. The people's committees became the custodians of about 12,000 hectares of the green healthy mangrove forests with a commitment to conserve it. 194 Self Help Groups were established. Two mangrove wetlands were completely restored in Pichavaram in Tamil Nadu and Godavari District of Andhra Pradesh. The most laudable impact was the wide adaptation of the MSSRF model of Joint Mangrove Management by the Forest Departments of different coastal states. The NGOs trained during the last 20 years of the project from the year 1990 to 2011 are taking the movement ahead with great enthusiasm. The Ministry of Environment and Forests is busy in drafting a "National Mangrove Action Plan" as a positive outcome of the hard work of 20 years of linking science and sustainable development. ■

Jayanthi Natarajan, Union Minister of State for Environment and Forests, and M.S. Swaminathan, chairman, MSSRF, at the MSSRF Foundation Day Celebrations in Chennai on Sunday. T. Ramaswamy, Secretary Department of Science and Technology, is in the picture. Photo: R. Ragu (Photo Curtsey: The Hindu)

Salim : wins UN Award for outstanding campaign on conserving Mangrove

Twenty four years old Salim has won an UN award for outstanding Youth campaign. He was chosen from contenstants from over 150 countries. Salim is travelling along the coastal area of Tamilnadu to spread awareness about Mangroves. The UN award has made Salim believe that herd work is always appreciated. Salim is now working with people along the coasts of Chennai to grow more Mangroves. His aim is to create a green belt along the entire wastline of India, to prevent major damages in case of any Natural disaster like Cyclone or Tsunami. "Mangroves - A life saving vegetation' was part of Salim's thesis for his Postgraduation in Biotechnology. He then decided to travel and put his project to practical use.

(Translated by Dr. Anurag Sharma)

Back to the Basics
Bronchial Asthma

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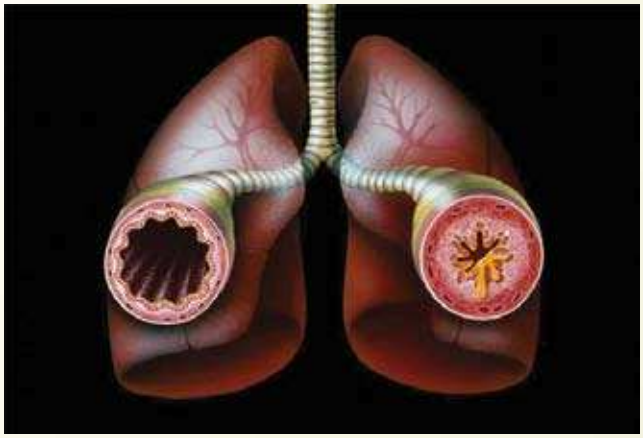
"Difficulty, my brethren, is the nurse of greatness—a harsh nurse, who roughly rocks her foster-children into strength and athletic proportion."

—William Cullen Bryant

Asthma occurs when the main air passages of the lungs, called the bronchial tubes, become inflamed. The muscles of bronchial walls tighten, the airways narrow and swell, they produce extra mucus, and breathing becomes difficult.



Asthma attacks can last for just a few minutes, or they can go on for hours and even days. The most common symptoms are coughing, wheezing, 'tightness' in the chest and shortness of breath. For some people, asthma symptoms are a minor nuisance. For others, they are a major problem that interferes with daily activities. If you have severe asthma, you may be at risk of a life-threatening asthma attack.

In emergencies, the person will have extreme difficulty in breathing, bluish lips and nails, severe breathlessness, increased pulse rate, sweating and severe coughing.

Asthma is a serious medical condition, but with proper care and treatment you usually can control your symptoms and lead a normal life. Treatments include taking steps to avoid asthma triggers, using long-term control medications to prevent flare-ups and using a quick-relief inhaler to control symptoms. As the severity of asthma fluctuates over time, you need to work with your doctor to track your signs and symptoms and adjust your treatment.

Asthma can begin at any age. Approximately about half of the children who have asthma develop the condition before age 10. It is usually an inherited condition, and it is not contagious.

Symptoms

The severity of asthma symptoms can range from minor to severe and vary from person to person. Some people have mild symptoms and suffer from infrequent asthma attacks. Between the flare-ups they may feel normal and have no trouble breathing. Others may have symptoms primarily at night, during exercise or when they are exposed to specific triggers. Some have asthma symptoms all the time.

If you are an asthmatic, you may experience a variety of signs and symptoms, which may include:

- Shortness of breath
- Chest tightness or pain
- Trouble sleeping caused by shortness of breath, coughing or wheezing
- An audible whistling or wheezing sound when exhaling
- Bouts of coughing or wheezing that are worsened by a cold or flu

Some signs indicate that your asthma is probably getting worse. These include:

- More frequent and bothersome asthma signs and symptoms
- Increased difficulty in breathing (this can be measured by a peak flow meter, a simple device used to check how well your lungs are working)
- An increasingly frequent need to use a quick-relief inhaler

What triggers asthma?

It isn't clear why some people get asthma and others don't, but it's probably due to a combination of environmental and genetic (inherited) factors.

Asthma triggers are different from person to person. Exposure to a number of different allergens and irritants can trigger signs and symptoms of asthma, including:

- Airborne allergens, such as pollen, animal dander, mould, cockroaches and dust mites
- Respiratory infections, such as the common cold
- Physical activity (exercise-induced asthma)
- Cold air
- Air pollutants and irritants, such as smoke
- Certain medications, including beta blockers, aspirin and other nonsteroidal anti-inflammatory drugs

- Strong emotions and stress
- Sulphites, preservatives added to some types of foods and beverages
- Gastro oesophageal reflux disease (GERD), a condition in which stomach acid backs up into your throat and air passages
- Menstrual cycle in some women
- Allergic reactions to some foods, such as peanuts or shellfish
- Fragrances and odours, including body odours

Risk factors

A number of factors are thought to increase a person's risk of developing asthma. These factors include:

- Having a blood relative (such as a parent or sibling) with asthma
- Having an allergic condition, such as atopic dermatitis or allergic rhinitis
- Being overweight
- Being a smoker
- Exposure to second-hand smoke
- Having a mother who smoked while pregnant
- Exposure to exhaust fumes or other types of pollution
- Exposure to occupational triggers, such as chemicals used in farming, hairdressing and manufacturing
- Low birth weight

Exposure to allergens, exposure to certain germs, and having some types of bacterial or viral infections may also be risk factors. However, more research is needed to determine what role they may play in developing asthma.

Exacerbating Factors

For some people, asthma symptoms flare up in certain situations:

Allergy-induced asthma

Some people have asthma symptoms that are triggered by particular allergens, such as pet dander, cockroaches or pollen.

Exercise-induced asthma

This occurs during exercise. For many people, exercise-induced asthma is worse when the air is cold and dry.

Occupational asthma

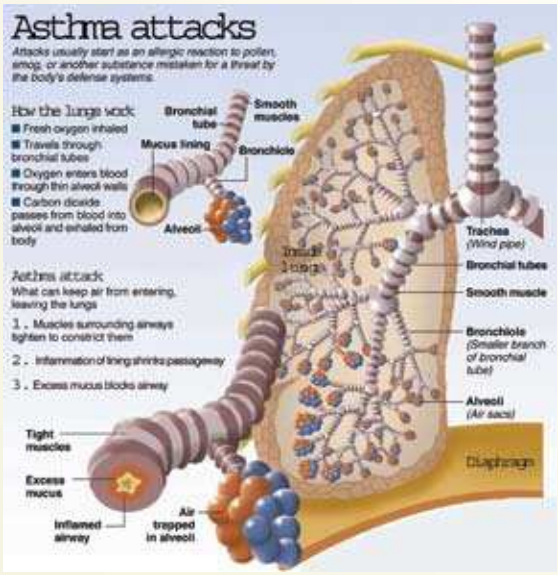
This is a form of asthma that's caused or worsened by breathing in a workplace irritant such as chemical fumes, gases or dust.

Complications

Asthma may cause a number of complications, including:

- Symptoms that interfere with sleep, work or recreational activities
- Sick days from work or school during asthma flare-ups
- Permanent narrowing of the bronchial tubes (airway remodelling) that affects how well you can breathe
- Emergency room visits and hospitalisations for severe asthma attacks
- Side effects from long-term use of some medications used to stabilise severe asthma

Proper treatment makes a big difference in preventing both short-term and long-term complications caused by asthma.



When to see a doctor

These key circumstances may lead you to talk to your doctor about asthma:

If you think you have asthma

If you have frequent coughing that lasts more than a few days or any other signs or symptoms of asthma, see your doctor. Treating asthma early, especially in children, may prevent long-term lung damage and help keep the condition from worsening over time.

To monitor your asthma after diagnosis

If you know you have asthma, work with your doctor to keep it under control. Good long-term asthma control not only helps you feel better on a daily basis, but also can prevent a life-threatening asthma attack.

If your asthma symptoms get worse

Contact your doctor right away if your medication doesn't seem to ease your symptoms or you need to use your quick-relief inhaler more and more often. Don't try to solve the problem by taking more medication without consulting your doctor. Overusing asthma medication can cause side effects and may even make your asthma worse.

To review your treatment

Asthma changes over time. Meet with your doctor on a regular basis to discuss your symptoms and make any needed adjustments to your treatment.

Preparing for the Consultation

You're likely to start by seeing your family doctor. However, when you call to set up an appointment, you may be referred immediately to a pulmonologist (respiratory diseases specialist).

It is a good idea to be well prepared when you go to the doctor. You might consider taking the following steps to make the most of your appointment:

- Write down all the symptoms you're having.
- Note when your symptoms bother you most — for example, if your symptoms tend to get worse at certain times of the day; during certain seasons; or when you're exposed to cold air, pollen or other triggers.
- Write down key personal information, including any major stresses or recent life changes.
- Make a list of all medications, vitamins and supplements that you're taking.
- Write down questions to ask your doctor.

Your time with your doctor is limited, so preparing a list of questions will help you make the most of your time together. List your questions from most important to least important in case time runs out. For asthma, some basic questions to ask your doctor include:

- Is asthma the most likely cause of my breathing problems?
- Other than the most likely cause, what are other possible causes for my symptoms?
- What kinds of tests do I need?
- Is my condition likely temporary or chronic?
- What's the best treatment?
- Do alternative treatments help?
- I have these other health conditions. How can I best manage them together?
- Are there any restrictions that I need to follow?
- Which websites would you recommend visiting?
- Are there any brochures or other printed material that I can take home with me?

In addition to the questions that you've prepared to ask your doctor, don't hesitate to ask questions during your appointment.

Be ready with the answers

Your doctor is likely to ask you a number of questions. Being ready to answer them may reserve time to go over any points you want to spend more time on. Your doctor may ask:

- What exactly are your symptoms?
- When did you first notice your symptoms?
- How severe are your symptoms?
- Do you have breathing problems most of the time, or only at certain times or in certain situations?
- Do you have allergies, such as atopic dermatitis or hay fever?
- What, if anything, appears to worsen your symptoms?
- What, if anything, seems to improve your symptoms?
- Do allergies or asthma run in your family?
- Do you have any chronic health problems?

Recognizing the severity

To classify your asthma severity, your doctor will consider your answers to questions about symptoms (such as how often you have asthma attacks and how bad they are), along with the results of your physical exam and diagnostic tests. Determining the severity level of your asthma will help your doctor choose the best treatment for you. Asthma severity often changes over time, requiring an adjustment to treatment.

Asthma is classified into four general categories:

Asthma classification	Signs and symptoms
Mild intermittent	Mild symptoms up to two days a week and up to two nights a month
Mild persistent	Symptoms more than twice a week, but no more than once in a single day
Moderate persistent	Symptoms once a day and more than one night a week
Severe persistent	Symptoms throughout the day on most days and frequently at night

Tests and diagnosis

Diagnosing asthma can be difficult. Signs and symptoms can range from mild to severe and are often similar to those of other conditions, including emphysema, early congestive heart failure or vocal cord problems. Children often develop temporary breathing conditions that have symptoms similar to asthma. For example, it can be hard to tell asthma from wheezy bronchitis, pneumonia or reactive airway disease.

In order to rule out other possible conditions, your doctor will do a physical exam and ask you questions about your signs and symptoms and about any other health problems. You may also be given lung (pulmonary) function tests to determine how much air moves in and out as you breathe.

The following simple tests help measure the lung function:

Spirometry

This test measures the narrowing of your bronchial tubes by checking how much air you can exhale after a deep breath and how fast you can breathe out.

Peak flow meter

A peak flow meter is a simple device that measures how hard you can breathe out. Lower than usual peak flow readings are a sign your lungs may not be working as well and that your asthma may be getting worse. Your doctor will give you instructions on how to track and deal with low peak flow readings.

Lung function tests often are done before and after taking a bronchodilator such as albuterol to open your airways. If your lung function improves with use of a bronchodilator, it is likely you have asthma.

When to seek emergency treatment

Severe asthma attacks can be life threatening. Work with your doctor ahead of time to determine what to do when your signs and symptoms worsen — and when you need emergency treatment.

Prevent fatal attacks by treating symptoms early. Don't wait for wheezing as a sign of severity; wheezing may disappear when airflow is severely restricted. Get emergency care if:

- Breathing becomes difficult and your neck, chest or ribs pull in with each breath
- Nostrils flare
- Walking or talking becomes difficult
- Fingernails or lips turn blue
- Peak airflow (measured with a handheld meter you can use at home) reading decreases 50 per cent below your normal level or keeps decreasing even after you take your medication. ■

Recent developments in science and technology

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2011 Nobel Prizes in Science

The 2011 Nobel Prize in Physics have been jointly awarded to three astrophysicists for the discovery of the accelerating expansion of the Universe through observations of distant supernovae. Half of the Prize money goes to Saul Perlmutter of Lawrence Berkeley National Laboratory in California, USA for leading a team that discovered that the Universe is expanding at an ever-increasing rate. Brian Schmidt of the Australian National University in Weston Creek, Australia, and Adam Riess of the Space Telescope Science Institute in Baltimore, Maryland, USA share the other half of the prize for independent measurements of the cosmic acceleration, which researchers have struggled to explain ever since.

2011 Nobel Prize in Physics

Saul Perlmutter

Brian Schmidt

Adam Riess

All three scientists reached their conclusions on the basis of measurements of distant Type Ia supernovae, which are found in very specific types of binary star system, in which a white dwarf star tears matter away from its partner until it gains enough mass to explode. They precisely measured the brightness of these supernovae using newly developed digital sensors in the late 1980s and early 1990s, and then compared the brightness to the redshift – the change in colour of the light that results from the motion of the supernovae away from us. Both teams found that the supernovae were dimmer than expected at the measured redshift. The only explanation could be that the Universe was not only expanding – which astronomers first realized in the 1920s – but expanding faster and faster. Today, the acceleration is thought to be driven by dark energy, but what that dark energy is remains an enigma.

The 2011 Nobel Prize in Chemistry has been awarded to an Israeli scientist who discovered a type of crystal so strange and unusual that it upset the prevailing views on the atomic structure of matter. The scientist is Daniel Shechtman of the Israel Institute of Technology, Haifa, Israel, who made the discovery in 1982 while studying a rapidly chilled molten mixture of aluminium and manganese under an electron microscope. Quasicrystals behave differently than other crystals in that they have an orderly pattern that includes pentagons, five-fold shapes, but unlike other crystals, the pattern never repeats itself exactly. The discovery was more than just conceptual. Following Shechtman's discovery, scientists have produced other kinds of quasicrystals in the lab and discovered naturally occurring quasicrystals in mineral samples from a Russian river. Quasicrystals are used today in surgical instruments, LED lights and non-stick frying pans. They have poor heat conductivity, which makes them good insulators.

2011 Nobel Prize in Chemistry

Daniel Shechtman

The 2011 Nobel Prize for Physiology or Medicine has been jointly awarded to three scientists for their research that has revolutionised our understanding of the immune system by discovering key principles for its activation. The discoveries of the three Nobel Laureates have revealed how the innate and adaptive phases of the immune response are activated and thereby provided novel insights into disease mechanisms. Their work has opened up new avenues for the development of prevention and therapy against infections, cancer, and inflammatory diseases.

One half of the Prize money has been awarded to Ralph Steinman of the Rockefeller University in New York, USA, who unfortunately passed away before the prizes were announced on 3 October. Steinman discovered the dendritic cells of the immune system and their unique capacity to activate and regulate adaptive immunity – the later stage of the immune response during which microorganisms are cleared from the body. Ironically, before his death Steinman was being treated for his pancreatic cancer with a therapy derived from his original discovery. Although Nobel Prizes are not awarded posthumously, this time the Nobel Committee decided to give away the award to Steinman because it was not aware of Steinman's death when it reached its decision.

The other half of the prize money is to be shared by Jules Hoffmann at the French National Centre for Scientific

2011 Nobel Prize for Physiology or Medicine

Bruce Beutler

Ralph Steinman

Jules Hoffmann

Research (CNRS) Institute of Cell and Molecular Biology in Strasbourg, France, and Bruce Beutler of the Scripps Research Institute in La Jolla, California, USA, for their discoveries concerning the activation of innate immunity.

Particles moving faster than light?

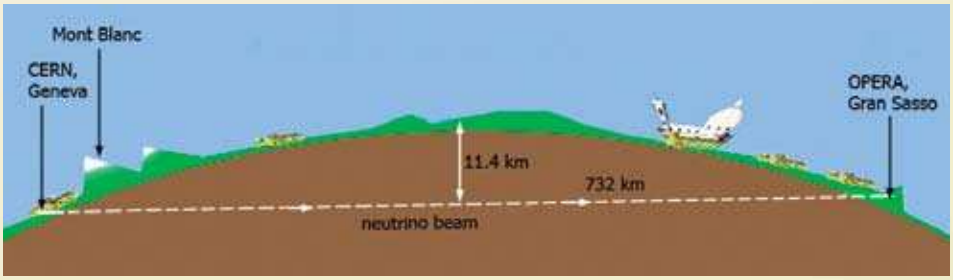
The idea that nothing can travel faster than light in a vacuum is the cornerstone of Albert Einstein's special theory of relativity, which forms the foundation of modern physics. This foundation appears to be in danger of crumbling, with the recent discovery of fundamental particles called muon neutrinos travelling faster than light. The startling observation was made by researchers working with a particle detector called OPERA (Oscillation Project with Emulsion-tRacking Apparatus), situated 1,400 metres underground in the Gran Sasso National Laboratory in Italy. The 1,800-tonne OPERA detector is a complex array of electronics and photographic emulsion plates to detect the tiny flashes of light created by interacting neutrinos. It is specifically designed to study a beam of neutrinos coming from the Super Proton Synchrotron accelerator at CERN, Europe's premier high-energy physics laboratory located 730 kilometres away near Geneva, Switzerland. The results were announced on 23 September by the OPERA team.

The OPERA neutrino detector

Neutrinos are electrically neutral, almost massless, fundamental particles that rarely interact with other matter. But they are all around us – the Sun produces billions of neutrinos as a by-product of nuclear reactions and many billions pass through our body every second. Neutrinos cannot be detected directly because they rarely interact with matter. But when they do, they produce tiny flashes of light that can be detected by sensitive photo-detectors fitted to large tanks filled with extremely pure water or mineral oil. Such detectors have been used in the past to detect neutrinos from the Sun, from cosmic rays, a supernova, and from nuclear reactors and particle accelerators, as was done in the present instance.

For the experiment, the researchers installed atomic clocks at both ends of the neutrino beam to establish exactly when the neutrinos are created and detected, and used GPS-based measurements to precisely measure the length of the baseline – the velocity being derived by dividing the baseline by the time of flight. The researchers claim to have measured the 730-kilometre trip between CERN and its detector to within 20 centimetres and the time of the trip to within 10 nanoseconds, and have found that the neutrinos were arriving 60 nanoseconds faster than the speed of light allows. They claim to have seen the effect in more than 16,000 events measured between 2009 and 2011.

Not everyone is, however, convinced with the results, and for obvious reasons. According to astrophysicist and cosmologist Martin Rees of the University of Cambridge, Neutrinos were observed from the supernova SN1987A more or less coincidentally with the explosion – not four years earlier, as would have been the case if the velocity difference had been the same as is now claimed. Moreover, if neutrinos could indeed travel faster than light, then one of the most fundamental assumptions of science – that the rules of physics are the same for all observers – would be invalidated. Significantly, the results are yet to be published in a peer-reviewed scientific journal, which is a hallmark of the credibility of a scientific paper. There are also reports that several of the 30 group leaders within the 160-strong collaboration are opposed to the submission of the paper for publication without further tests of possible systematic errors being carried out. Only further verification of the results will tell us whether Einstein was really right.



The neutrino experiment

Prehistoric painters used pigments 100,000 years ago

Cave paintings are among the earliest manifestations of human creativity. Cave paintings of Chauvet in France are considered the oldest and are believed to date back to 33,000 BC. Cave painters mostly used natural pigments and red or yellow ochres, which are among the earliest pigments used by mankind. They were derived from naturally tinted clay containing mineral oxides. Chemically, ochre is hydrated iron (III) oxide. A recent discovery in South Africa suggests that prehistoric human painters have been using ochre paint as early as 100,000 years ago. They had everything they needed to mix ochre pigments which they did in abalone shells. Scientists had earlier found signs of ochre use in a few South African sites that could be up to 165,000 years old, but solid evidence that the pigment was used in artistic or other symbolic communication has been lacking.

Abalone shells from the prehistoric ochre toolkit (Credit: Prof. Chris Henshilwood, University of the Witwatersrand, Johannesburg)

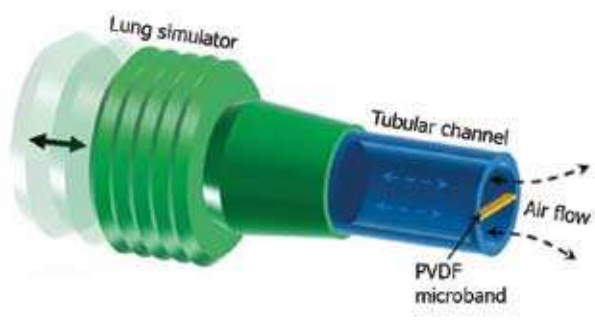
In the present study, Christopher Henshilwood of the University of Bergen in Norway and his colleagues found two ochre-processing 'toolkits' at Blombos, about 300 kilometres east of Cape Town, dated to 100,000 years ago with a technique called optically stimulated luminescence. The technique measures how long grains of sand in archaeological layers have been hidden from sunlight. The toolkits, found only 16 centimetres apart in the same layer, were very similar. Both consisted of abalone shells filled with a mixture of ochre, crushed bone, and charcoal. One of the shells also had part of the forearm bone of a wolf or fox, which the team thinks might have been used to stir the paint or transfer it out of the shell. (*Science*, 14 October 2011).

According to the researchers, the two shells appear to be components of an ochre 'workshop'. They further infer that the prehistoric artists at Blombos followed a specific series of steps to create the ochre paint, including grinding the pigment into a powder, heating the bone before crushing and adding it to the mix, and then putting the paint into the shells where it was gently stirred. They suggest that it might have been used for decorating skin or clothing or for protecting the skin because ochre is known to repel mosquitoes and other insects.

Some archaeologists have described the discovery as "astonishing" and "extraordinary." According to them, the shells are evidence that these early modern humans could "multitask and think in abstract terms about the qualities of the ingredients that they manipulated."

Device turns human breath into electricity

Researchers at the University of Wisconsin-Madison, USA, have developed a system that can generate electricity from human breathing using a novel piezoelectric material. The device, developed by Materials Science and Engineering Professor Xudong Wang, postdoctoral Researcher Chengliang Sun and graduate student Jian Shi, uses low speed airflow like that caused by normal human respiration to cause the vibration of a plastic microbelt engineered from a piezoelectric material called polyvinylidene fluoride (PVDF). The device basically harvests mechanical energy from biological systems. The researchers engineered PVDF to generate sufficient electrical energy from respiration to operate small electronic devices (*Energy and Environmental Science*, September 2011).



A simulated lung with the piezoelectric PVDF microband that vibrates as air flows past it (Image credit: EES Blog)

To thin the PVDF material to micrometer scale while preserving its piezoelectric properties, Wang's team used an ion-etching process. With improvements, the researchers expect that the thickness can be controlled down to the submicron level and lead to the development of a practical micro-scale device that could harvest energy from the airflow in a person's nose. Tests conducted by the team saw the device reach power levels in the millivolt range, but reached up to 6 volts with maximum airflow speeds. . Because PVDF is biocompatible, the development represents a significant advance toward creating a practical micro-scale device for harvesting energy from respiration.

The new piezoelectric device may be useful for powering implantable biomedical devices, such as pacemakers, cochlear implants, neurostimulators and various monitoring devices that are critical to the well-being of diverse patients worldwide. Over the past few decades, the design, efficiency and reliability of these devices has generally improved. Traditionally, implantable batteries are most commonly used for such devices. However, providing adequate power sources for these devices remains a challenge. For such gadgets the new device certainly seems promising. ■

Vigyan Prasar Foundation Day

Vigyan Prasar celebrated its twenty-second anniversary day on 12 October 2011. Professor Ashoka Chandra, Principal Advisor to International Management Institute, India, delivered the first Foundation Day Lecture on 'Science, Technology & Knowledge Economy – the Societal Connectivity'. The celebration was organized at National Science Centre, Delhi.

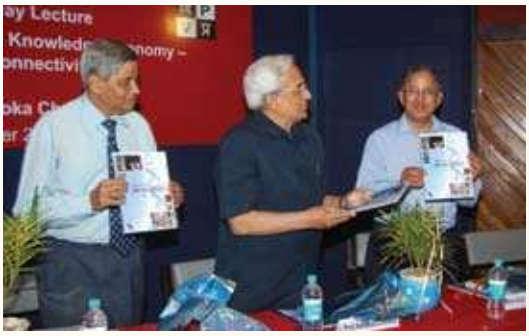
Er Anuj Sinha, Director, in his welcome address briefly described VP initiatives in S&T communication during last two decades. He mentioned major achievements during the journey and the future plans and thrust areas of Vigyan Prasar in coming years.

Shri G.S. Rautela, DG, NCSM and member, Governing Body, Vigyan Prasar, in his Guest of Honour address, highlighted the need to communicate science to general public and importance of National Council of Science Museum and Vigyan Prasar in reaching out to people and communicating science.

Professor Ashoka Chandra released a book titled *Vigyan Prasar ke bees saal – sab tak pahuchna hai* (Vigyan Prasar in 20 years – reaching to all) written by Sri Vijay Kishore Manav, Senior Journalist and Former Editor, Hindustan Times Group. Salient features of Vigyan Prasar's activities and projects are described in the book.

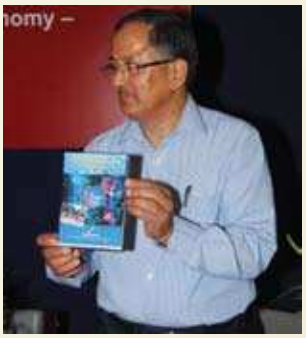
Shri G. S. Rautela released a CD titled "Innovative experiments in chemistry" on the occasion of the International Year of Chemistry. The year 2011 was declared as International Year of Chemistry by the International Union of Pure and Applied Chemistry (IUPAC) and UNESCO, to commemorate the centenary of the award of the Nobel Prize in Chemistry to Madam Curie in 1911. VP has initiated a number of activities and projects during the year on the theme "Chemistry – our life, our Future". The interactive CD was one among them.

Er Anuj Sinha released a 30-sec film spot produced for television audience of VP highlighting Vigyan Prasar's objective – "Informed decision making"(title of the spot is *Vigyan Prasar – taki har nirnay gyan aadharit ho).*



Release of book Vigyan Prasar ke bees saal – sab tak pahuchna hai

Release of 30 film spot on *Vigyan Prasar – taki har nirnay gyan aadharit ho*



Release of CD Innovative experiments in chemistry

Prof. Ashoka Chandra delivered the first Foundation Day Lecture on 'Science, Technology & Knowledge Economy – the Societal Connectivity'.

Professor Ashoka Chandra in his presentation recapitulated development over the past six decades and how Science and Technology have come to be regarded as a direct practical tool for creating wealth and global competitiveness. Concomitant to this, the need for adopting a scientific approach and to advance scientific temper was emphasised in policy pronouncements in order for the country to emerge as a progressive and enlightened society, to enable people's participation in development process, and to apply S&T for human welfare. It was pointed out that development of scientific temper is not optional, but a fundamental duty of every citizen as per the Constitution of India. Activities aimed at science communication and building scientific temper are, therefore, not just a desirable objective, but a national obligation.

Professor Chandra also mentioned that science and technology are spoken in the same breath as if they were a single concept. However, there are significant conceptual differences, as well as deep connectivity between the two, which need to be appreciated. Technology has been the dominant driver of economic growth for millennia across the globe. It cannot be regarded as an exogenous factor but as intrinsic strategy for economic growth and India's competitiveness in emerging knowledge paradigm around the world. In this context it is important to recognise the cultural dimension of Knowledge Economy and the role of Social Science and Humanities in Knowledge Economy. Lastly the presentation touched briefly on interface between societal culture and science communication and some strategies for enhancing effective science communication.

Dr. Subodh Mahanti, Scientist 'F', Vigyan Prasar gave a vote of thanks. ■

Making a difference through science and technology based broadcasting

Vigyan Prasar (VP) in collaboration with SEVAKS, New Delhi and Amity University, Uttar Pradesh organised a five-day regional workshop on science broadcasting at Amity School of Communication, Amity University, Lucknow from 5to 9 September 2011. Media professionals, faculties and students participated in the workshop.

Inaugural session of the workshop

Inaugurating the workshop Er Anuj Sinha, Director, Vigyan Prasar and consultant to Department of Science and Technology, Govt. of India shared the importance of science and technology and said that we can make a difference through science and technology based broadcasting. He said variety, team work and recognition were the characteristics of fulfilling careers. Er Sinha also spoke about *Dream 2047*.

Chief Guest of the inaugural session Dr P.K. Seth, CEO, Biotech Park, Lucknow spoke on communicating science among masses, proper procedure of science communication, methods to be used, and finally, about anticipated impacts. He also emphasised on miscommunication of science which he said is a serious matter.

Prof. A.K. Sharma, Director, Institute of Mass Communication in Science and Technology, and Head, Department of Zoology, Lucknow University, in his keynote address shared his vast experience of science communication professional courses and talked about the importance of science communication in media studies as well as media industry. He added that India has got very rich infrastructure in science and we need to make full use of it.

Maj Gen K.K. Ohri, AVSM (retd), Director General, Amity University, Lucknow also shared his experience of those days when technology was at its weakest. He said youngsters should make use of techno-friendly era to the fullest.

In the beginning of the inaugural session Prof. S.M. Johri, Director, Amity School of Communication, welcomed all the guests and talked about science and media. Being a science journalist he gave some practical insights. He said that scientists are still shy and as media persons we need to work on it.

Mr K.P. Madhu, the master resource person and content developer of the workshop shared his experience of previous workshops and explained about the various sessions of the workshop. Mr Nimish Kapoor, Scientist, Vigyan Prasar and Coordinator of the workshop delivered a vote of thanks.

Technical sessions

Mr K.P. Madhu conducted various interactive sessions in which participants were trained through hands-on activities and other games. The topics covered by Mr Madhu during five days included 'Differences between popular perceptions and practitioner's views of science'; 'Why report science?'; 'Philosophy and methods of science'; Comparison of the philosophy and methods of media'; 'Common ground between scientists and media professionals'; Differences between the prioritisation of questions in science and media'; 'Reporting by scientists – comparison with the structures that media uses'; Discussion on recent papers selected from *Science*, *Nature*, and *Current Science*'; 'Problems in popularising and reporting science'; 'Myths created by media, search'; and 'Research for content: search engines, storytelling – structure of story', etc.; and related practical work.

Workshop in progress

Shri Pradeep Kumar Srivastava, Scientist, CDRI, Lucknow, known as the 'Scientoon man', discussed about various aspects of scientoons – a very unique technique which includes science and cartoons. How tough technical topics can be made into the simplest way was also talked about.

An informative session was conducted with Dr Chandra Mohan Nautiyal, Scientist, BSIP, Lucknow on how to bridge the gap between media and science. He discussed about what we can do to become science communicators and journalists. He gave valuable tips for media professionals as how to deal with scientists.

Mr Nimish Kapoor talked about various challenges in preparation of television science programmes. He talked about basics of science communication and how journalists and producers can plan science stories or programming for a TV channel.

Mr Romesh Chaturvedi, Sr. Lecturer, Amity School of Communication, discussed about visual packaging in TV science stories. He talked about concept, idea, research, and script and how to execute these elements from the Indian perspective. Use of visuals in Indian films related to science and technology was also discussed.

Closing session

At the outset, Mr. S.M. Johri expressed his gratitude to Vigyan Prasar for organising the workshop. He also shared his experience and gave valuable inputs on science reporting, as he himself belong to this field. Chief Guest and Director of Amity School of Engineering and Technology Professor S.T.H. Abdi spoke on how to allocate science knowledge so that our country can be free from superstitions. He said use of science in everything will definitely make people aware and they will not fight for pity things. Mr. K.P. Madhu shared his experience regarding the workshop. He said that at the beginning he had a lot of anxiety as it was a fusion of professionals, faculties and students, but everything was perfect in the workshop. ■