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Vigyan Prasar

# DREAM 2047

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## Edwin Powell Hubble
## Founder of the science of cosmology



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

# Feeding the Hungry

The Green Revolution heralded breakthroughs in food grain production, with bumper yields of wheat and rice in particular. Along with improved varieties of wheat and rice, the Green Revolution emphasized the application of agricultural science and the need for modern techniques for greater yields, especially in the third world countries. It began in Mexico in the late 1950s, and spread to Asia including India during the 1960s and 1970s. It continued in China in the 1980s and 1990s. Over a 40-year period, the proportion of hungry people in the world declined from about 60 per cent in 1960 to 17 per cent in 2000. During this period, our granaries became full and India became a net exporter of rice. Indeed, the Green Revolution was a technical and scientific breakthrough and one of the most important accomplishments of the 20th century. Had this not occurred, there would be an additional one billion hungry people in the world today.

It appeared that most countries in the world would be capable of adequately feeding their people as a result of the Green Revolution. The rich countries were even trying to figure out what to do with their huge surpluses of food. Today, however, things have completely changed. Growing population, droughts, changing life-styles and consumption patterns, high oil prices, rush to grow biofuels, and other factors have caused shortages of most of the major food crops. There is a concern over increasing food prices almost everywhere in the world. The cost of producing and transporting food has gone up considerably with the increase in the price of oil. Further, the price of oil does not show any signs of coming down, at least for the time being. The demand for meat, especially in the developing countries, has been steadily increasing. Meat, incidentally takes a lot of grain to produce. Growth in population has made food scarcer and more expensive because demand is outstripping supply. And finally, the climate change, which is here to stay.

What went wrong the world over, then? The Green Revolution promoted exploitation of natural resources that involves heavy inputs in terms of chemical fertilisers, pesticides and irrigation. What is the trade-off for chemical-dependent yield increases? There has been both qualitative and quantitative degradation of land, water, and bio-resources. Fertile lands have become uncultivable due to water-logging and salinisation. Yields have come down because of wrong cropping pattern and faulty usage of fertilisers. Excessive pumping of water has caused such acute depletion of water table that even drinking water has become scarce in many areas.

Often, it is argued that we have already hit the limit of what a given piece of land can produce, and hence it would not be possible to meet the demands of the growing population. However, there is little evidence in favour of this argument. The agricultural scientists have been warning for years that of late the rich governments, that fund most of the world's agricultural research and development, have not been investing enough; and that we are now suffering from the consequences. The governments would be able to mitigate the crisis if they invest in the science that can increase the yields and the infrastructure to get the resulting technologies to the farmers. It takes 15-20 years for the scientific research to filter down to farms. Hence, we must act fast. With focus on right priorities, it would be possible to feed a lot more people, argues Debora MacKenzie in an article published in a recent issue of *New Scientist* (14 June 2008).

After the Second World War, fear of famine and its political impact led rich countries to fund research and development in Green Revolution for the rest of the world, while continuing to boost their yields. Between 1960 and 1980, the food production had doubled and prices fallen. The famine had disappeared in most parts of the world, and the rich countries had huge surpluses of food grain. It was then that the rich countries became complacent and investment in agricultural R&D was slashed. It is interesting to note that investment in agricultural R&D grew at 2 per cent per year during the 1980s, but declined by 0.6 per cent since 1990 every year! Next, research in agricultural sciences was increasingly privatised, and the companies focussed more on their profits rather than increase in the yields! These changes resulted in the slowing down of the rate of food production – although the quantity of grain produced on each hectare of farmland is still rising. We have now reached a point when the production has been outpaced by the increase in demand!

Indeed, for the past eight years, global demand for grain has been increasing faster than supply! While grain yields are increasing at 1.1 per cent per year, the world's population is growing at 1.2 per cent per year! Consider India. In 1980s the average total food-grain production was 146.5 million tonnes, and a population of 684 million. The year 2007-2008 witnessed an all-time high production of 227.3 million

*Contd. on page... 21*

**Editor** : **V.B. Kamble**
Address for correspondence : Vigyan Prasar, C-24, Qutab Institutional Area, New Delhi-110 016; Tel : 011-26967532; Fax : 0120-2404437
e-mail : info@vigyanprasar.gov.in
website : http://www.vigyanprasar.gov.in



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# Edwin Powell Hubble

## Founder of the Science of Cosmology

Subodh Mahanti
E-mail: subodh@vigyanprasar.gov.in

"The history of astronomy is a history of receding horizons."

Edwin P. Hubble (Quoted in *To Infinity and Beyond* by E. Maor, 1991)

"He (Hubble) found that spiral nebulae are independent stellar systems and that Andromeda nebula in particular is very similar to our own Milky Way galaxy. In 1929 he announced his discovery that galaxies recede from us with speeds which increase with their distance. This was the phenomenon of the expansion of the universe, the observational basis of modern cosmology. The linear relation between speed of recession and distance is known as Hubble's law."

*Chambers Biographical Dictionary* (Centenary Edition), 1997

"It is interesting to note that Hubble was always cautious in interpreting Hubble's Law of 1929, which is based on the spectroscopic red shift and Doppler's principle, as meaning that the universe is expanding. Hubble's rather ambiguous writings on this imply that possibly the observed increase in red shift with distance had other causes; and bearing in mind the novel views advanced in cosmology since 1929, he was probably right to be prudent."

*The Cambridge Dictionary of Scientists*, 2003

Edwin Powell Hubble was one of the leading astronomers of the 20th century. *The Times* obituary rightly noted: "Dr. Hubble's work was outstanding for the power and originality of its method, his observational skill, the objective character of his deductions, and the general brilliance of his results."

Hubble dramatically changed astronomers' understanding of the universe. In Hubble's days most astronomers believed that the universe was synonymous with the Milky Way galaxy, which meant that the entire universe – that is, the planets, the stars and other objects including the fuzzy objects called nebulae seen with the naked eye and the powerful telescopes – was contained within the Milky Way galaxy. However, contrary to the then prevailing belief, Hubble proved that the so-called spiral nebulae were in fact spiral galaxies. Hubble's discovery was as profound as the discovery of the heliocentric solar system, which placed the Sun at the centre of the Solar System. So it is no wonder that Hubble's contribution to science has been compared to the works of epoch-making scientists like Isaac Newton and Galileo Galilei.

Today we know that the idea of an expanding universe is fundamental to our understanding of the cosmos. Hubble's work provided the first direct evidence supporting the idea of an expanding universe. It is true that some cosmologists had earlier theoretically predicted the idea of an expanding universe – Willem de Sitter (1872-1934) in 1917, Aleksandr Alexandrovich Friedmann (1888-1925) in 1922, and Georges Edouard Lemaitre (1894-1966) in 1927. However, it was Hubble's work, which persuaded the astronomers to take the idea of expanding universe seriously.

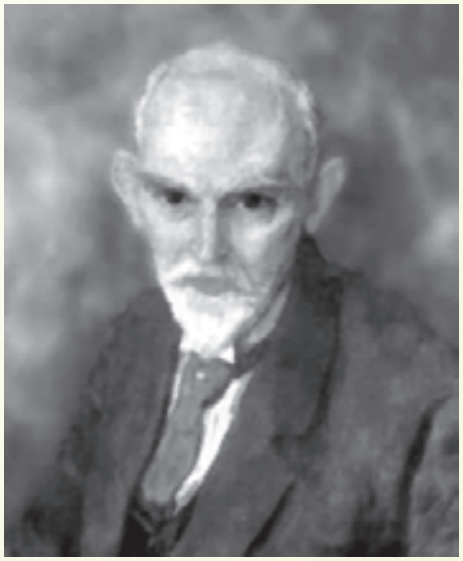
Edwin Powell Hubble

Hubble's observations demonstrated for the first time that two fundamental quantities of the universe could be measured – the knowable size and age of the universe. Knowable size of the universe means the distance at which the recession velocity reaches the speed of light and this has been estimated to be about 18 light years. The age of the universe is somewhere between 12 and 15 billion years. Hubble himself estimated the age of the universe as 2 billion years. It is interesting to note that Hubble's original value for the age of the universe was less than the age of the oldest rocks on the Earth measured by radiometric dating. This was certainly a curious anomaly. Hubble also made a major contribution to the study of galactic evolution by producing the first significant classification of galaxies. Hubble's classification of galaxies is widely used today.

Hubble was born on 20 November 1889 in Marshfield, Missouri, USA. His parents were John P. Hubble and Virginia Lee James Hubble. Hubble's father was an agent in a fire insurance firm. His mother was a descendant of the American colonist Myles Standish (c.1584-1656). Edwin was the third of seven children of his parents. He spent his childhood in Missouri, and entered school in 1895. In 1898, Hubble's father was transferred to the Chicago office of his firm and the family followed him. They first stayed at Evaston and then moved to Wheaton, both Chicago suburbs. In 1906, Hubble passed from Wheaton High School and received a scholarship for studying in Chicago University. At the University, Hubble studied mathematics, physics, chemistry and astronomy. To meet his college expenses he tutored and worked in the summer. While studying at Chicago University he worked as assistant to the physicist Robert Andrews Millikan (1868-1953). Hubble graduated from Chicago University in 1910 with a BS in mathematics and astronomy.

While Hubble did well in his studies in school and college, he did much better in sports. In 1906, he won seven first places and a third place in a single high school track meet. In the same year he also set a state record in high jump. He was also an amateur boxer. Apparently sports promoters tried to persuade Hubble to become a professional boxer. However, Hubble declined such offer. Based on his combined achievements in sports and studies Hubble was awarded the Rhodes scholarship for studying at Oxford University in 1910. Hubble joined the Queen's College at Oxford University. He first studied law and then shifted to Spanish. At Oxford he continued to pursue his athletic interests. He excelled in high jump, broad jump, shot put, and running.

Hubble returned to USA in 1913 and started his career as a high school Spanish teacher and a basket ball coach in New Albany High School in Indiana. He also became a member of the



*Willem de Sitter*

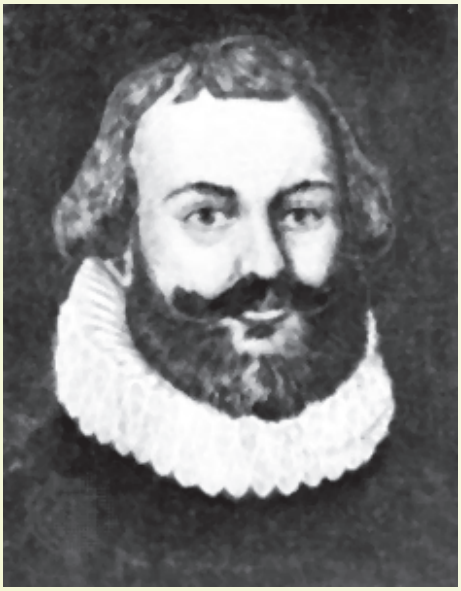
Kentucky bar, but never actually practised law. He did not stay long as a school teacher. He went back to Chicago University to work at the Yerkes Observatory for doing a PhD in astronomy. He worked under the supervision of Edwin B. Frost, then the

*Aleksandr Alexandrovich Friedmann*

Director of the Observatory. He was awarded his PhD degree in 1917. The title of his PhD thesis was "Photographic investigations of faint nebulae". After getting his PhD he was offered a position at the Mount Wilson Observatory by its Director George Ellery Hale. It was Hale who had established the Yerkes Observatory. Hubble could not take the offer to join the Observatory immediately as he had to serve in the First World War. He served in France and rose to the rank of a Major. During the Second World War Hubble worked as chief of exterior ballistics and director of the supersonic wind tunnel at the Ballistic Research Laboratory at Aberdeen Proving Ground in Maryland.

After being discharged from his war duties in 1919, Hubble joined the staff of the Mount Wilson Observatory, near Pasadena, California and worked there till his death, except during the period of the Second World War. At Mount Wilson Observatory, Hubble got the opportunity to use the newly built Hooker Telescope, a 100-inch (254-cm) telescope. It was then the world's largest telescope.

For his PhD work Hubble had studied the faint nebulae, the objects that appeared as fuzzy extended images. Hubble believed that while some of these objects were indeed members of the Milky Way galaxy and were clouds of luminous gas and dust, some others – particularly the objects known as spiral nebulae – could be objects that lay beyond the Milky Way galaxy. With the help of the powerful telescope at Mount Wilson Observatory, Hubble produced some of the significant findings of 20th century astronomy. In 1923 he was able to resolve the outer region of the Andromeda nebula (now called Andromeda galaxy) into "dense swarms of images which in no way differ from those of ordinary stars." Hubble also identified a special type of stars called Cepheids in one of the photographs of the Andromeda nebula. This finding was very important because Henrietta Leavit and Harlow Shapely had earlier shown that Cepheids could be used to measure distance. Making use of their work Hubble calculated that the distance to the Andromeda nebula was 900,000 light years. The distance found was unexpectedly large. Hubble's results were in direct conflict with the results earlier



Myles Standish

obtained by the Dutch astronomer Adrian van Maanen. However, Hubble continued with his observations. Based on his observations he published three major papers during the period 1925-1929. These papers clearly demonstrated that the spiral nebulae were at enormous distances, well beyond the Milky Way galaxy, and that they were independent systems of stars. Van Maanen, on re-examining his data, found them unsatisfactory and he discarded them in favour of Hubble's results.

Based on his own determination of the distances of 18 galaxies and measurements of radial velocities from the galactic red shifts carried out by Vesto Sliper and Milton Humason, Hubble found that the recessional velocity of the galaxies increased proportionately with their distance. This relation between recessional velocity of a galaxy and its distance came to be known as 'Hubble's law'. Mathematically this observation is put as $v = H_0D$, where $v$ is the velocity, $D$ is the distance, and $H_0$ is a constant called the 'Hubble constant', the figure that relates the speed of an object's recession to its distance. Hubble constant is measured in units of kilometres per second per megaparsec (1 megaparsec = 1 million parsecs, or $3.08\times10^{22}$ metres). This work of Hubble finally convinced astronomers that the idea of an expanding universe proposed earlier was indeed correct. It should be noted here that Albert Einstein could have proposed the idea of an expanding universe as a natural consequence of his theory of general relativity. Instead he introduced an arbitrary constant in his mathematical equations so that his theory did not predict an expanding universe. Today the constant introduced by Einstein is known as cosmological constant. When Hubble's measurements confirmed that the universe was indeed expanding, Einstein declared that the introduction of the cosmological constant in his equation was the greatest blunder of his life.

It was soon realised that the Hubble constant, which could be measured from the mean value of the ratio of the velocity and distance: that is $v/D$, contained the key to the size, age and future of the universe. In 1931 Hubble proposed value of Hubble's constant to be 558. Soon it became

Georges Edouard Lemaitre

apparent that there was something wrong in Hubble's measurements. In 1952 Walter Baade announced that the Hubble constant was about 250 and this meant that the Andromeda galaxy was twice as far away as Hubble had originally estimated. In 1956 Allan Sandage, in a paper jointly written with Milton L. Humason and Nick Mayall, calculated the value of Hubble constant as 180. Sandage further revised this value and by the early 1960s his best estimate of Hubble constant was 75. Sandage was proved right when in the 1990s data sent by the Hubble Space Telescope confirmed that the value of Hubble constant is between 65 and 77. According to the Big Bang Theory, the Hubble constant varies with time and in that sense it is not truly a constant. It is more appropriately called the Hubble parameter.

Hubble developed a classification system for galaxies based on their visual appearance. Today the Hubble classification is widely used. The classification starts with round elliptical galaxies having no disks. Increasing flattening of a galaxy denoted by a number derived from $10(a-b)/a$, where $a$ and $b$ are the major and minor axes as measured in the sky. The galaxy with a number 7 (E7 galaxy) is the flattest galaxy. After E7 an apparent clear disk is seen in the lenticular or $S_0$ galaxies. The classification then branches into two parallel sequences of disk galaxies showing spiral galaxies – ordinary spirals and barred spirals. The diagram developed to show different types of galaxy in Hubble's classification is called 'tuning-fork' diagram. It is so named because it resembled a tuning fork. The 'handle' of the fork consists of elliptical galaxies arranged in order of increasing flattening. One of the parallel prongs consists of ordinary spiral galaxies from type *a* (near the handle) to type *d* (tip of the prong). The other prong consists of the barred spiral galaxies in the same order.

Hubble took interest in collecting antique books on history of science. He was a Trustee of the Hutington Library in San Marino, California (1938-1953). His personal interest also included fishing. He fished in Scotland and the Colorado Rockies. He frequently interacted with famous movie stars and literary figures of his time including English film actor and director Charlie

Chaplin (1889-1977), Swedish-born US film actress Greta Garbo (1905-90), English novelist and essayist Aldous Leonard Huxley (1894-1963), US novelist Christopher William Bradshaw Isherwood (1904-86) and US writer Anita Loos (1893-1981).

The awards received by Hubble include the Catherine Wolfe Bruce Medal (1938), the highest honour of the Astronomical Society of the Pacific, and the Gold Medal of the Royal Astronomical Society (1940). He was a Fellow of the US National Academy of Sciences; the Royal Astronomical Society of London; the American Astronomical Society, and the American Philosophical Society. Hubble delivered many lectures, the most notable being the course of lectures delivered in Oxford under the Rhodes Trust. The lectures delivered at Oxford were later brought out in book form under the title *The Observational Approach to Cosmology*.

The 2.4-m aperture Space Telescope, launched in April 1990 by the space shuttle *Discovery*, was named Hubble Space Telescope in Hubble's honour. It orbits at an altitude of about 600 km. The Hubble Space Telescope has shown that the universe is not only expanding, as Hubble had discovered, but the expansion is accelerating. It is believed that a mysterious force called dark energy is behind this acceleration. A crater on the Moon and an asteroid have been named after Hubble. An award called the Edwin P. Hubble Medal of Initiative has been instituted by the city of Marshfield, Hubble's birth place.


Robert Andrews Millikan

Hubble died on 28 September 1953 at San Marino, California.

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*(The article is a popular presentation of the important points on the life and work of Edwin Powell Hubble available in the existing literature. The idea is to inspire the younger generation to know more about Edwin Powell Hubble. 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.)*

VP News

# Popular science writing in Marathi in the past

Vigyan Prasar has been trying to document the efforts of popularising science in different Indian languages in the past. The project in Marathi has been entrusted to Marathi Vidnyan Parishad, a well-known organisation engaged in science popularisation activities in Maharashtra. The first meeting for the project was held on 9 May 2008 under the chairmanship of Professor B. M. Udgaonkar. Subsequently, the Parishad identified sources for collecting material. The complete catalogue of Marathi periodicals was scanned for identifying relevant periodicals by a team of Parishad members. All the issues of the selected magazines were then examined by visiting various libraries in Maharashtra and copies of the articles considered useful were collected. A total number of about 900 articles have been collected.

A meeting was held on 11 June 2008 at Marathi Vidnyan Parishad, Mumbai to finalise the scope of the project. About 20 experts associated with the project took part in the meeting. Shri A. P. Deshpande, Hony. Secretary, MVP briefly described the progress of the project. Dr. Subodh Mahanti, Scientist 'F', Vigyan Prasar shared his experience of the other two projects (Hindi and Bengali) earlier implemented by Vigyan Prasar. Vigyan Prasar has published two volumes as an outcome of such a project in Hindi. A volume on popular science writing in Bengali has been published by the Asiatic Society, Kolkata. Dr. Mahanti observed that the outcome would be an important historical document in the field of science popularisation. The project in Marathi is expected to be completed by July 2009.


A view of the participants

# Cholesterol gallstones

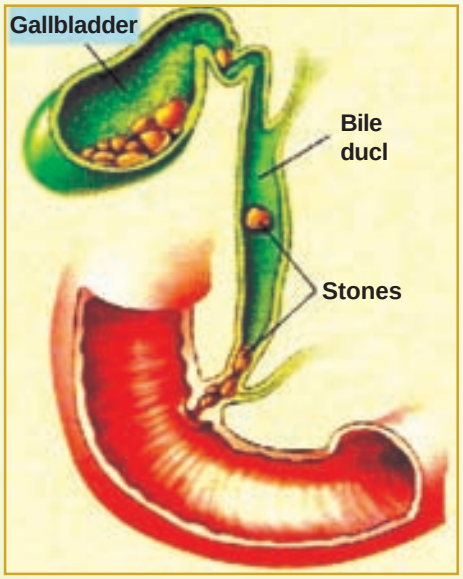
R.L.R. Reddy and K.Srinivasan

E-mail: ksri.cftri@gmail.com

Gallstones disease is the most common disorder affecting the body's biliary system – the organs and ducts that make, transport, store, and release bile. The gallbladder is a small hollow organ that is located under the liver and serves as the key storage facility for bile, which is essential to the body's digestive system. Bile is a yellow viscous fluid, made in the liver and stored in the gallbladder that acts in the small intestine to help in digestion and absorption of dietary fat. Bile contains water, cholesterol, bile salts (the chemicals necessary to digest fat), proteins, bilirubin (a breakdown product from blood cells), and small amounts of copper or other materials. The bile secreted by the liver flows through hepatic ducts to the gallbladder. There, it is stored until bile is needed to digest fat from food. After a meal, the gallbladder contracts and pushes bile through the common bile duct into the duodenum, the first segment of the small intestine.

Cholesterol is the principal component of plasma membrane (a selectively permeable lipid bilayer found in all cells) in every animal cell and a smaller amount of it is found in membranes of intracellular organelles. It is a molecule that modulates membrane fluidity and permeability. Cholesterol serves as a precursor for all steroidal hormones which serve as biological signals that regulate body's intermediary metabolism and also reproductive physiology. Presence of cholesterol in excess, however, make way for certain disorders among which, the cholesterol gallstone disease is prominent because of its high prevalence. Cholesterol gallstones (CGS) are abnormal masses of a solid mixture of cholesterol crystals, mucin, calcium bilirubinate and proteins. This disease was first described by a Florentine pathologist, Antonio Benivenius in 1507. The first ever surgical removal of gallbladder affected with CGS was made in 1882. This technique remained the standard therapy for symptomatic gallstones for a long time, while in 20th century, various medical treatments for CGS have come into use.

There are three types of gallstones depending on the major constituents

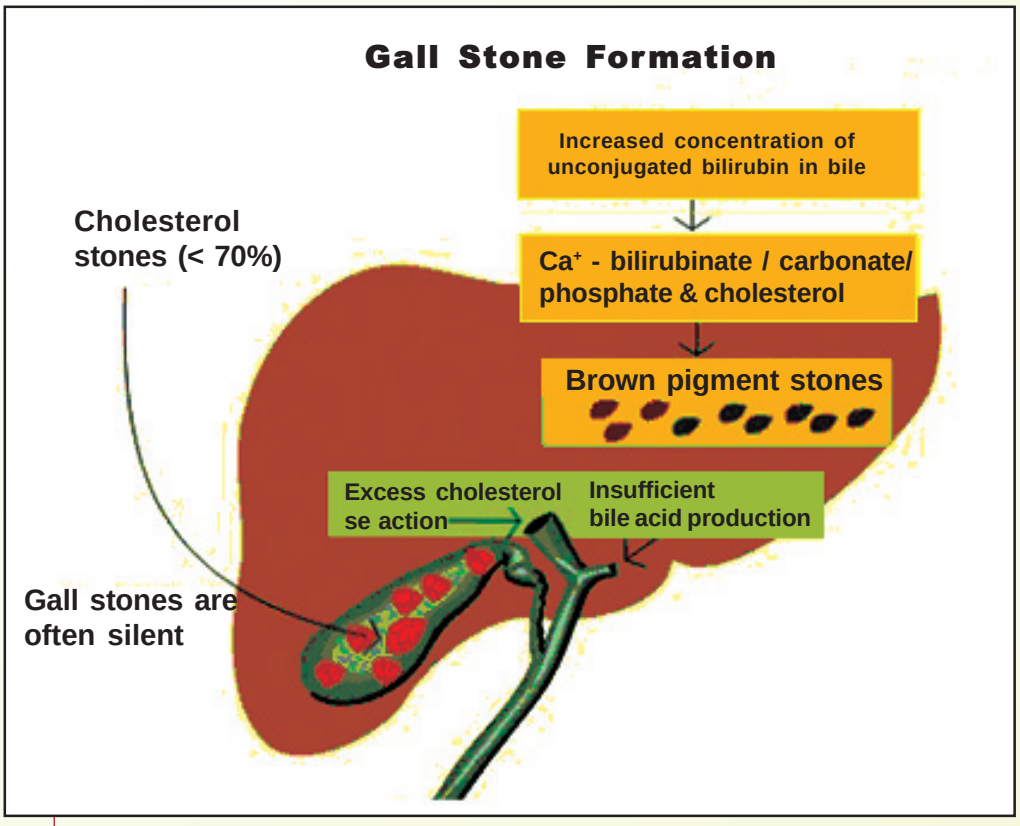



they contain: cholesterol gallstones, pigment gallstones, and mixed gallstones. About 85 % of all gallstones are cholesterol stones – yellow to gray coloured stones made up of hardened cholesterol. Cholesterol stones are associated with bile that contains an overabundance of cholesterol. Pigment stones, which are black or brown in colour, are composed of bilirubin and other elements. Black pigment stones consist primarily of calcium bilirubinate, whereas brown pigment stones are associated with infections of the biliary tract. Mixed gallstones consist of small amounts of calcium and bilirubin salts. Both pigment and mixed gallstones are more frequent in Asians, but rarely found in U.S. patients. These are mainly caused by the infection or contamination of the biliary tract, thus highlighting the prevailing unhygienic conditions in Asian countries. In Western countries, the incidence of pigment and mixed gallstone is very low compared to CGS. Cholesterol gallstones, which are yellow to gray in colour contain 50 to 90% cholesterol as major component, and are mainly formed by supersaturation of bile with cholesterol.

The size of gallstones varies from as small as a sand grain to as large as a golf ball. Although about 10% of the population has gallstones, majority experiences no symptoms necessitating treatment; only in 1- 2 % of these people, gallstones can cause problems by lodging in the bile ducts, hindering the flow of bile or digestive enzymes, and leading to severe abdominal pain, vomiting, inflammation, and even life-threatening infection. Gallstones can block the flow of bile if they lodge in any part of this system of ducts. If bile becomes trapped in these ducts, it can lead to inflammation of the gallbladder. The end of the common bile duct also allows the flow of digestive enzymes out of the pancreas. If a gallstone blocks the opening to the common bile duct, these enzymes can become trapped in the pancreas and lead to a condition called gallstone pancreatitis, which is extremely painful and serious. If any portion of this biliary system remains blocked by gallstones for an extended period, possibly fatal infections of the gallbladder, liver, or pancreas can result.

## How gallstones develop

Cholesterol gallstones develop when bile contains too much cholesterol and not enough bile salts. Besides a high concentration of cholesterol, other factors seem to be important in causing gallstones. Cholesterol stones form when three conditions exist: (a) bile must be supersaturated with cholesterol; (b) the cholesterol in bile must rapidly




transform into crystals; (c) there must be a decrease in gallbladder contractions. Without proper movement of the gallbladder cholesterol, crystals in the bile remain in the gallbladder long enough to form stones.

## Risk factors

Obesity, aging, oestrogen treatment, pregnancy and diabetes are the major risk factors that lead to formation of CGS. A number of dietary factors are also involved. Low-fibre, high-cholesterol diets, and diets high in starchy foods have been suggested as contributing to gallstone formation. Other nutritional factors that may increase risk of gallstones include rapid weight loss, constipation, eating fewer meals per day, eating less fish, and low intakes of the nutrients folate, magnesium, calcium, and vitamin C. Consumption of simple sugars and saturated fat has been mostly associated to a higher risk, while fibre intake and moderate consumption of alcohol, consistently reduce the risk. The association between cholesterol intake and gallstone disease has been variable in different studies.

Investigations in the last few years have suggested the involvement of regulatory genes of lipid metabolism in biliary lipid secretion and hence in cholesterol gallstone formation. This has opened up new possibilities of understanding the relationship between lipid homeostasis, diet and CGS.

## Factors that appear to promote CGS

*Age:* The incidence of CGS increases with age, since there is a disordered hepatic sterol and bile acid metabolism as one ages resulting in the secretion of bile supersaturated with cholesterol. The likelihood of developing gallstones increases after age 60.

*Gender:* CGS is more common in women than men. Excess oestrogen from pregnancy, hormone replacement therapy and birth control pills appears to increase cholesterol levels in bile and reduce gallbladder movement. Both these factors lead to CGS formation.

*Ethnicity:* Ethnicity is a critical risk factor in the development of gallstones, though no gene responsible for gallstone formation has yet been discovered. American Indians (Pima Indian) are at particular risk, as they are known to secrete high levels of cholesterol in bile. A majority of American Indian men have gallstones by age 60, and among Pima Indian women, 70 % will have gallstones by age 30. Hispanics and Mexican-Americans, particularly women, and people from Norway have a higher risk for CGS than Asians and Africans. This is because of their prevailing food habits. African-Americans seem to have lower rates of gallstone disease than American Indians, whites, or Hispanics.

*Obesity:* Obesity is a significant risk factor for CGS, particularly for women. Women with a body mass index of over 30 have twice the risk of gallstone disease compared to those who are not overweight. One explanation for the link between obesity and gallstones is that the overweight condition tends to upset the balance between cholesterol and other components of bile, either by reducing the other components relative to cholesterol or by causing excessive secretion of cholesterol into the bile. Obesity also slows down the emptying of the gallbladder. Central obesity (belly fat) in particular dramatically increases the chance of developing gallstones.

*Rapid weight loss:* CGS formation is a most frequent and significant complication of rapid weight loss. Cholesterol from fatty tissue are activated and secreted into the bile, leading to both cholesterol supersaturation and diminished gallbladder contractions. Studies of people on very low calorie weight-loss plans or people who experience rapid weight loss resulting from gastric bypass surgery indicate that gallstone formation is a common unwanted side effect.

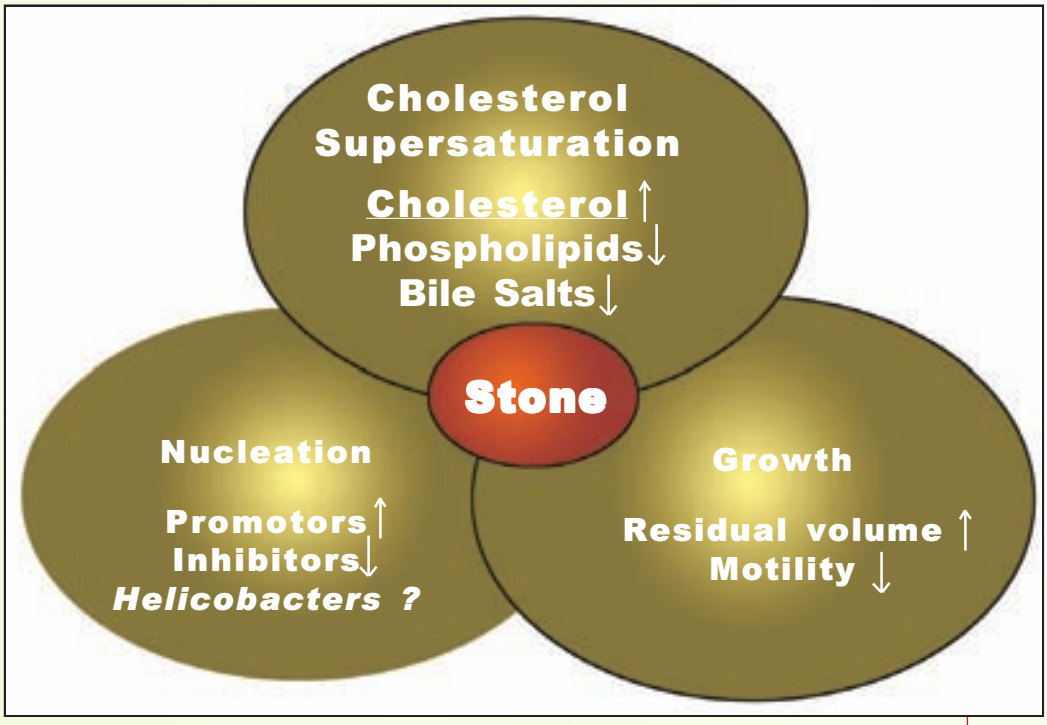
*Prolonged fasting:* Fasting also decreases gallbladder movement and causes bile to over-concentrate cholesterol, leading to gallstones. Sluggish gallbladder is the common feature of fasting, which favours accumulation of cholesterol causing the bile to become supersaturated with cholesterol, which can lead to gallstone formation. During fasting, metabolism of the body fat secretes extra cholesterol into bile, which also favours CGS formation.

*Sedentary life style:* This is one of the main causes for obesity. Besides

being beneficial in weight control, physical activity has been found to promote a rapid transit time in the gastrointestinal tract, which may help prevent formation of gallstones.

*Diabetes:* People with diabetes often have high levels of triglycerides in their blood, and these fatty acids tend to increase the risk of CGS.

*Cholesterol lowering drugs:* Persons with low HDL cholesterol levels or high triglycerides are at a risk for gallstones. Cholesterol lowering drugs like Gemfibrozil and Clofibrate reduce cholesterol levels in blood actually by increasing cholesterol secretion to the bile, thus favouring the CGS formation.




## Diet as a Risk Factor

The following dietary factors have been correlated to gallstone disease: energy intake, fatty acids, cholesterol, highly refined carbohydrates, alcohol, micronutrients and dietary fibre.

*Energy intake:* Energy intake is directly correlated with risk of gallstone formation, mainly by contributing to development of obesity. Obesity is a well known risk factor, acting primarily by increasing the cholesterol synthesis, biliary cholesterol secretion and cholesterol supersaturation. A higher risk has been shown to be associated to a high-calorie diet (>2500 kcal/day), especially in the case of men.

*Fatty acids:* There is a risk of CGS associated with consumption of high amount of lipids, mainly saturated fatty acids. Animal studies have shown that monounsaturated fatty acids may decrease the risk of gallstone formation. It has been reported that consumption of fish oil has a protective effect on the occurrence of gallstones.

*Carbohydrates:* Consumption of high amounts of refined sugars generally increases the risk of CGS. This is attributed to a high synthesis of cholesterol in the liver secondary to an increase in insulin secretion. Carbohydrates induce changes in lipoprotein metabolism that in turn leads to modifications in the bile composition. It is estimated that consumption of more than 40 g of sugar per day doubles the risk of CGS.

*Fibre:* A large number of epidemiological studies have shown that insoluble fibre intake is inversely associated to gallbladder disease. Fibre protects gallstone formation by speeding up intestinal transit time, reducing the generation of secondary bile acids such as deoxycholate and also inhibits CGS formation by reducing biliary cholesterol saturation.

*Vitamins and minerals:* It is reported that vitamin-C deficiency hinders the activity of cholesterol-7a-hydroxylase in liver, a regulatory enzyme in the conversion of cholesterol to bile acids, thus leading to cholesterol supersaturation in bile. Supplementation of vitamin-C (2 g/day for 2 weeks) induces changes in bile composition and also prolongs the cholesterol nucleation time. Ascorbic acid supplementation among women has been found to be associated with a lower prevalence of clinical gallbladder disease. Some studies have found an inverse association between dietary calcium and gallbladder disease.

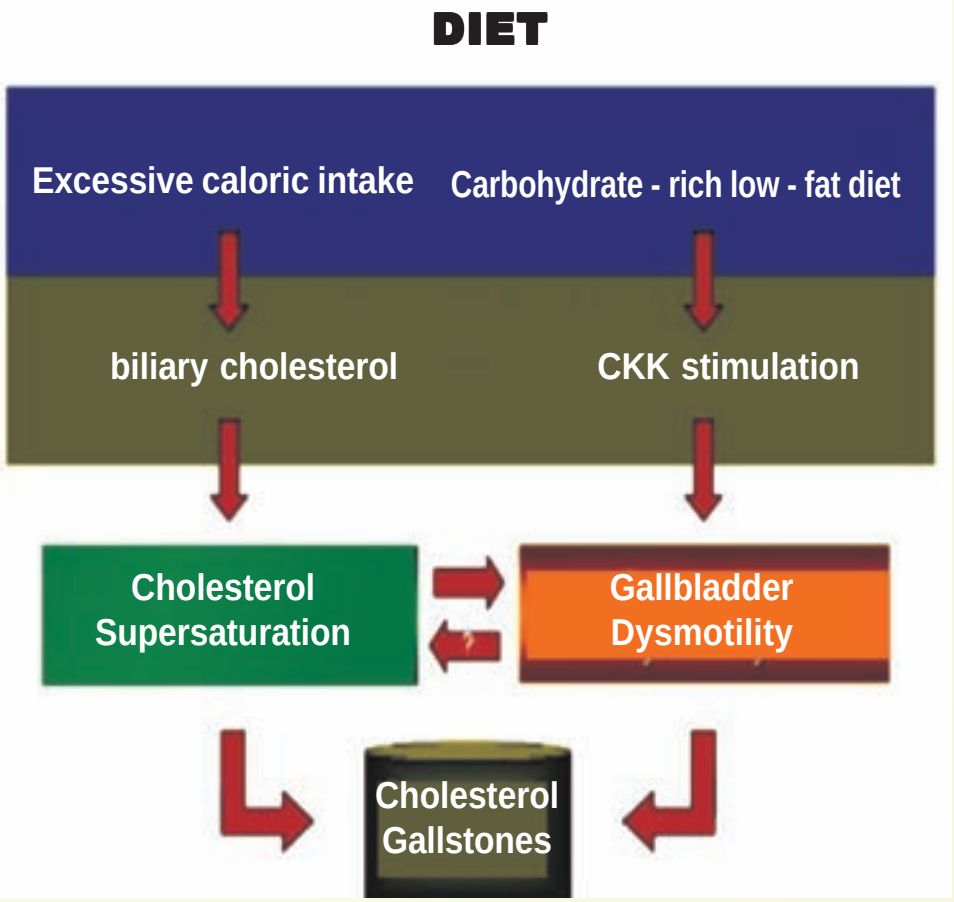
*Alcohol:* Moderate consumption of alcohol is found to reduce the risk of CGS formation. Studies have indicated that alcohol lowers cholesterol saturation in bile and increased conversion of cholesterol to bile acids in liver. Moderate alcohol consumption also increases plasma HDL cholesterol levels, which lowers the risk of CGS formation. Excess alcohol however causes cirrhosis of liver, which on its own is associated with pigment gallstones.

## Symptoms

Gallstones are usually asymptomatic in the beginning and symptoms become apparent once the stones reach a certain size (greater than 8mm). Presence of gallstones does not generate symptoms in the majority of cases (60-80 %). The average risk of developing symptoms for asymptomatic gallstone patients is low, 2-5 % per year; thus the disease is very difficult to diagnose. The main symptom of gallstones is an intense pain in the upper abdominal region. The association of pain with nausea, vomiting, fever, and jaundice suggests complicated biliary pain. Often, these attacks occur after a particularly fatty meal and almost always happen at night. Other symptoms include abdominal bloating, intolerance of fatty foods, belching, gas, and indigestion.

## Diagnosis

The correct identification of symptomatic gallstone patients is essential and plays a vital role in the treatment of the disease. The diagnosis of the disease involves: (a) laboratory




tests; and (b) imaging techniques. The laboratory tests include estimation of the activity of enzymes like, alkaline phosphatase and bilirubin which are usually elevated. Imaging techniques include various types of ultrasonography. Abdominal ultrasonography is the accepted standard for diagnosing gallstones. It also allows functional studies of gallbladder motility, which is frequently impaired in gallstone patients.

## Treatment of CGS

There are two approaches to treat CGS: (1) non-surgical removal of the stones, and (2) surgical removal of the gallbladder. Treatment for patients with evidence of infection involves administration of intravenous fluids and painkillers and antibiotics. In the case of gallstones associated pain but not infection, laparoscopy and lithotripsy are performed. Drug therapy is preferred for patients who are unwilling to undergo surgery. Cholesterol gallstones can sometimes be dissolved by oral ursodeoxycholic acid. Gallstones may recur however, once the drug is stopped. In the case of acute infection, early gallbladder removal is often warranted. Gallstones associated with pancreatitis require surgery.

Gallbladder removal is often not recommended unless there is a threat to life, since gallbladder is necessary for the normal functioning of the body. The primary advantages of surgical removal of the gallbladder over non-surgical treatment are elimination of gallstones and also prevention of gallbladder cancer. Gallbladder removal guarantees that the patient will not suffer a recurrence of gallstones.

## Prevention of CGS

Diets containing fibre and hypocholesterolemic spices have proved to reduce the risk of CGS formation. It was speculated that the lower prevalence of CGS among Indians is mainly attributable to the consumption of spice-rich diet regularly. Studies on laboratory animals in recent years have indicated that consumption of specific spices, viz., fenugreek, garlic, onion, red pepper and turmeric cause not only reduction in the incidence of CGS but also regression of pre-established gallstones as well. Consumption of spices increases the production of bile acids and phospholipids and the quantity of bile, while decreasing the biliary cholesterol concentration. Spices mediate mainly through stimulation of the activity of cholesterol-7a-hydroxylase in liver. Prevention of CGS is feasible by the bile acid medication Ursodiol (ursodeoxycholic acid) that dissolves some of the cholesterol gallstones and also prevents them from forming.

## Conclusion

Cholesterol gallstone disease has emerged as one of the complex diseases involving liver, gallbladder and the intestine. CGS is a complex interaction of genetic and environmental factors. New findings highlight gene transcription, protein function, and regulation of lipid metabolism to have an important role to play in CGS. Factors such as age, pregnancy, oestrogen replacement therapy, obesity, diabetes, rapid weight loss, prolonged fasting, sedentary life style, consumption of refined sugar and saturated fat have been mostly associated with higher risk for this disease. It is apparent that high energy intake and energy storage, which are related to obesity, represent an important risk factor for the formation of gallstones. Of the specific dietary constituents, consumption of simple sugars and saturated fat has been found to be associated with a higher risk of gallstone. An optimal diet recommended for the prevention of atherosclerosis, such as fibre-rich food and moderate consumption of alcohol, also appear to reduce the risk of cholesterol gallstone formation. New knowledge related to the molecular genetic regulatory mechanisms of hepatic cholesterol metabolism and secretion into bile and the modulatory interactions between dietary lipids and orphan nuclear receptors may lead to better understanding of the role of diet in CGS formation.

R.L.R. Reddy (Senior Research Fellow) and Dr. K.Srinivasan (Senior Scientist) - Department of Biochemistry and Nutrition, Central Food Technological Research Institute, Mysore – 570 020

# The Office Fitness Drill

## Ways to Break Free of that Stiff-as-a-Board Feeling

Dr. Yatish Agarwal
e-mail: dryatish@yahoo.com

Staying glued to your desk for many hours at a stretch can exhaust you both physically and mentally and leave you, at times, so stiff and lethargic and yawny that you would rather go to sleep. The best way to beat this stiff-like-a-board feeling is to give yourself a break. Take a brisk five-minute walk. A perfect recipe, it revs up your engine and recharges you. You return to your work fully charged and refreshed.

But some situations just do not permit a break like this. You cannot leave your office because you could miss an important client, a phone call or the boss is extra testy and wants you around all the time. What can you do then to wake yourself and come alive? Just stretch yourself out! Try these simple exercises, specially tailored to suit such occasions. They will loosen your muscles, fill you with oxygen and fire up your system.

### Stretch your calf tendon

Stand 60-90 cm from a wall. Lean forward, body straight. Place your palms against the wall at eye level. Step backward. Continue to support your weight with your hands. Remain dumb-footed till you feel your calf muscles stretch.

### Do simple neck stretches

Stand or sit with your back straight, facing directly ahead. Slowly tilt your head up as if to look at something on the ceiling. After holding that position for ten seconds, turn and look over your left shoulder without twisting your upper body. Hold for ten seconds, and then turn to the right. Again, hold, then look down, trying to touch your chin to your chest.

### Stretch out your shoulders

Grasping your elbows, lift your arms over your head. Drop your left hand down to your shoulder blade. Still grasping your left elbow, slowly pull it behind your head. Hold. Repeat the same sequence of movements on the other side.

### Bend and stretch

While standing, clasp hands behind your waist. As you slowly bend forward at the waist, lift your arms, keeping your elbows straight. When you begin to feel slight pressure in your arms and back, stop and hold. Return to starting position and repeat.

### Carry out a side-to-side stretch

Stand with your feet shoulder-width apart, left hand at your side, right hand extended over your head. Slowly bend at the waist towards your left. Reach down your leg with your left hand. Try to get your upper body parallel to the floor. Hold for eight to ten seconds, and then come back to neutral position. Relax. And repeat in the other direction.

Besides doing these simple exercises, it would also be worthwhile to follow a simple "safety-first" approach:

### First and foremost, find a comfortable position

Use a chair that supports your lower back's curve or place a rolled towel or pillow behind your lower back. The seat of your chair should not press on the back of your thighs or knees. If you can afford to procure a new chair, find one with sound ergonomic attributes.

### Relax

Check your shoulders from time to time. Are they tense? Take three deep breaths. Make a conscious effort to relax them.

### Change positions often

Get up and move. For example, stand while you're on the phone. Print out computer files, move to a new location and proofread on paper instead of the monitor.

### Avoid high-risk moves

Don't bend continuously over your work. Hold reading materials at eye level.

If you are on the phone a lot, get a headset. Too much twisting, bending and reaching fatigue your back and leave it vulnerable to injury.

## Rest your feet

If you stand for long periods, rest one foot on a footrest or stool from time to time. Change leg positions often.

## Lift objects properly

Carry objects close to the body at about waist level.

## Working on a computer

Computers are increasingly becoming a part of life in each and every vocation. If you work long hours at a computer, here's what you must be careful about:

Keep your computer monitor and your keyboard at a proper height. The computer screen should be positioned straight in front of you. It should be 15 degrees lower than the height of your eyes and about an arm's length away from you. In the seated position, your work surface should ideally be at elbow height. So should your keyboard. Lighting should be adequate and the screen should be in focus.

Sit comfortably upright. Use a proper work chair. Avoid slouching.

If you do a lot of word processing, you should consider getting a stand to hold documents. Placed adjacent and at the same height to the screen, the stand will limit straining. You will not need to look up and down repeatedly.

Use a good wrist pad and armrests.

If you have problems with your eyes, consider getting a bigger screen so that you can see more clearly without having to poke your chin forward.

Make sure your eyeglasses allow you to see the screen without tilting your head. If you use bifocal lenses, avoid wearing them while working at a computer. If you do, you will tilt your head back to look through the bottom of your glasses, and this shall strain your neck.

Often we tend to sit in front of the computer for long periods of time, forgetting about posture and not checking whether we are actually comfortable. This can damage your back. Take 30-second micro-breaks every 30 minutes. During these breaks move your neck from side to side and turn your back from left to right; this will help prevent strain on the neck and the back.

Don't type while cradling the phone on your shoulder. Use a speakerphone. If you spend much time on the phone, consider using a headset.

If you follow these simple etiquettes, there's no reason why you should not stay fit as a fiddle despite those long hours in that swivel chair!

# Recent Developments in Science and Technology

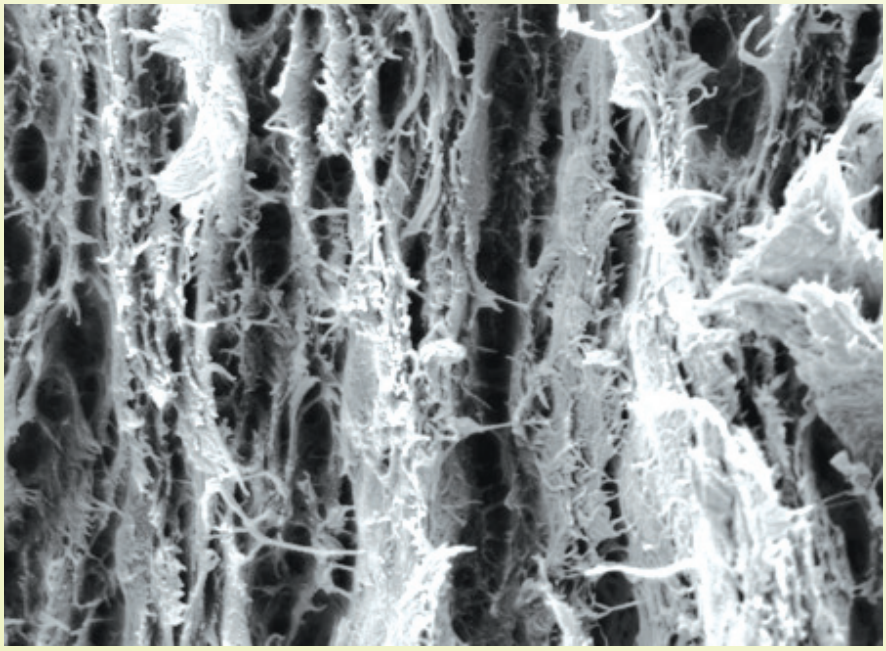
□ Biman Basu
Email: bimanbasu@gmail.com

## Nanopaper is tough

Can you think of carrying water in a paper bag? Of course, you cannot do it if you use ordinary paper, which will become soft and tear, spilling the water. But you can do it if you use nanopaper, which is tougher than cast iron. A team of researchers led by Lars Berglund, a lightweight structures engineering expert at the Royal Institute of Technology in Stockholm, Sweden has developed a method to toughen paper up by reducing the fibre size (*Biomacromolecules*, June 2008). The material – made from nanosized whiskers of cellulose (nanofibrils) – is also lighter than conventional paper and could provide sturdy scaffolds for growing replacement tissues and organs. According to the researchers, cellulose nanofibrils offer interesting potential as a "native fibrous constituent of mechanical performance exceeding the plant fibres in current use for commercial products."

To make nanofibres of cellulose, Berglund and his colleagues first used a combination of enzymes to break down wood pulp in water followed by mechanical beating. The product they obtained contained defect-free nanofibres about 1,000 times smaller than typical cellulose fibres. As a final step, the researchers treated their nanofibres with carboxymethanol, which coated the fibres in carboxyl groups. These groups readily form hydrogen bonds that help the fibres make tight contacts with one another, further strengthening the material.

The tensile strength of paper made from the modified fibres was 214 megapascals (MPa), far above the 130 MPa of cast iron and the previous record of 103 MPa for a high-strength paper. According to the researchers, in addition to improving paper products directly, the new cellulose nanofibres could help create reinforced plastic composites cheaper than those reinforced by carbon fibres.



*A cross-section of paper made from cellulose nanofibres. (Credit: Courtesy of American Chemical Society)*

## Stem cell therapy for brain

Myelin is a protein that insulates the long 'arms' of nerve cells, called axons, and helps the conduction of neural signals throughout the nervous system. In humans, myelin loss causes serious diseases. Multiple sclerosis is an autoimmune condition in which the immune system attacks the central nervous system, leading to loss of myelin in some areas of the brain. The disease causes numerous physical and mental symptoms, and often progresses to serious physical and cognitive disability. The disease does not have a cure. Some rare childhood diseases such as adrenoleukodystrophy are also caused by an inability to produce myelin. Now the work of a team of researchers led by Steven Goldman at the University of Rochester in New York, USA offers hope for the cure of such disorders. The team has used human stem cells to correct abnormal brain development in mice with fatal brain disorders caused by myelin loss, opening up possibilities for treating a range of neurological disorders including some deadly childhood genetic diseases. For the treatment the researchers used human glial progenitor cells – cells that can differentiate into the glial cells that, among other things, make up myelin (*Cell Stem Cell*, 5 June 2008).

For the study a special strain of mutant mice called 'shiverer mice' were used. The mice, which shiver and shake as their name suggests, have severe neurological defects caused by a genetic mutation that stops them producing myelin. Usually, as they grow, shiverer mice become unable to walk forwards,

have increasing numbers of seizures, and typically die at just 18–21 weeks of age. What Goldman and his team did was to take progenitor cells from white matter in the foetal human brain and inject them into the spinal cords of mutant shiverer mice shortly after their birth, with the hope that the injected cells would stimulate growth of myelin. The researchers used five injection sites to allow the human stem cells to penetrate the entire nervous system of the baby mice.

The team treated 26 shiverer mice with human glial progenitor cells, 29 with a set of control injections, and left 59 untreated. All the mice deteriorated in health in the first 130 days, as is usual for shiverer mice, and by 150 days all of the control and untreated mice had died. But six of the stem-cell-treated mice survived for longer than 130 days, and four of those went on to live for 14 months. The mice that survived longer showed impressive myelin growth at sites where the new cells had been implanted. More importantly, the mice did better than just survive – as the myelin grew, the mice began to lose signs of being shiverers. They gained normal brain activity, no longer had seizures, and lost much of the shakiness. The researchers are hopeful that once the technique meets with the approval of the US Food and Drug Administration, clinical trials in humans may start in a few years.

## Bacteria can foresee the future

It has always been believed that only organisms with complex nervous systems have the ability to anticipate future events and prepare for them. Now a new study shows that even the puny bacteria has this ability. The study, by researchers at Princeton University, USA shows for the first time that bacteria do not just react to changes in their surroundings – they anticipate and prepare for them (*Science*, 6 June 2008). The research team, which included biologists and engineers, used lab experiments to demonstrate this phenomenon in the common bacteria *Escherichia coli* – the ubiquitous bacterium that travels back and forth between the environment and the gut of warm-blooded vertebrates.

The peculiarity of *E. coli* is that it can switch from aerobic (oxygen) to anaerobic (oxygen-less) respiration depending on its environment. While in the gut it adopts anaerobic respiration, but outside the gut it behaves like aerobic bacteria. The researchers wanted to know what triggers this changeover in *E. coli*. Does it react to the change in the oxygen level after sensing it? According to the researchers, that would be a rather slow process. So they looked for other clues.

During life cycle of *E. coli*, oxygen level is not the only thing that changes – it also experiences a sharp rise in temperature when it enters an animal's mouth. This sudden warmth could be a cue to the bacterium to prepare itself for the subsequent lack of oxygen in the gut. To test this idea, the researchers exposed a population of *E. coli* to different temperatures and oxygen changes, and measured the gene responses in each case. The results showed that the bacterium could actually anticipate lack of oxygen as soon as they experienced a rise in temperature. They had actually "learned" this response by associating specific temperatures with specific oxygen levels over the course of its evolution.

Lacking a brain or even a primitive nervous system how can a single-celled bacterium perform such feat? According to the researchers, unlike higher animals that can learn new behaviour within a single lifetime, bacterial learning takes place over many generations and on an evolutionary time scale. In order to gain a deeper understanding of this phenomenon, the researchers also carried out computer simulations using a virtual microbial ecosystem, called Evolution in Variable Environment.

The findings are significant because in addition to shedding light on deep questions in biology, they could have many practical implications. They could help scientists understand how bacteria mutate to develop resistance to antibiotics. They may also help in developing specialised bacteria to perform useful tasks such as cleaning up environmental contamination.

Scanning electron micrograph of *E. Coli*

## Pluto becomes a plutoid

Nearly two years after the International Astronomical Union (IAU) stripped Pluto of its former status as a planet, an IAU committee has recommended that small, nearly spherical objects orbiting beyond Neptune should be called "plutoids" rather than dwarf planets.

In 2006, redefining Pluto's status was considered necessary because new telescope technologies had begun to reveal objects beyond Neptune that rivalled Pluto in size. Without a new classification, these discoveries raised the prospect that textbooks could soon be talking about 50 or more "planets" in the Solar System, which was considered too much by the IAU. So IAU members decided to redefine the Solar System as having just eight planets – Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. Pluto was relegated to a grouping that includes Ceres (the largest asteroid), and Eris, an object slightly larger than Pluto that orbits even further out from the Sun in an icy region known as the Kuiper Belt.

In a statement the IAU's Committee on Small Body Nomenclature has defined plutoids as celestial bodies that "have sufficient mass for their self-gravity to overcome rigid body forces so that they assume a hydrostatic equilibrium (near-spherical) shape, and that have not cleared [their orbits of debris]." The plutoids will also need to have a minimum brightness. Ceres will not be considered a plutoid because of its position in the asteroid belt between Mars and Jupiter.

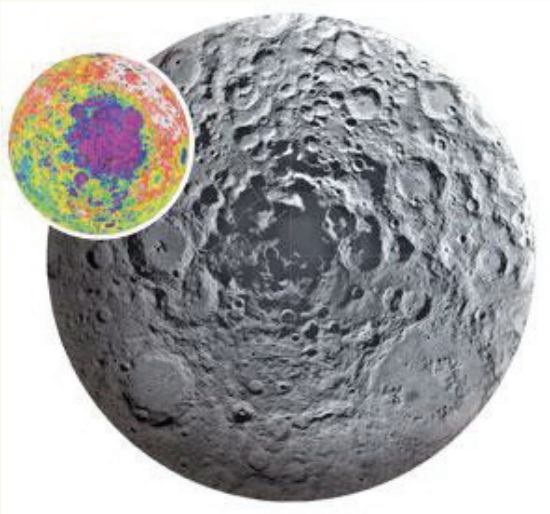
## Global warming making plant species move higher

Global warming is now an accepted fact and evidence of its impact on the weather, glaciers and sea level are well known. But there has been little research on the impact of climate change on flora and fauna. Now a study of plants across temperate and Mediterranean mountain forests in western Europe by a team of French and Chilean scientists has brought to light distinct upward shift of species due to rise in temperature (*Science*, 27 June 2008). The reason is simple; by moving higher the plants are able to grow in a cooler environment and escape the rising temperature.

The researchers compared the altitudinal distribution of 171 forest plant species between 1905 and 1985, and 1986 and 2005. They covered the entire elevation range – from 0 to 2,600 metres above sea level in the region and found that global warming had led to a significant upward shift in species. The average rate of upward shift was 29 metres per decade. However, not all plants were found to shift altitude at the same rate. In general, species that shared the same ecological properties were found to show similar consistent pattern of changes. The shift was found to be larger for species restricted to mountain habitats and for grassy species, which are characterised by faster population turnover. According to the researchers, changes in range limits, however, are just one expression of the likely consequences of climate change. More subtle changes within the ranges of species are also likely and, although poorly explored as yet, might have important ecological and evolutionary consequences.

## New light on Moon's South Pole

A giant crater on the lunar far side holds the key to a catastrophic bombardment that reshaped the Moon, Earth and other planets. The first evidence of a catastrophic bombardment comes from a piece of dark-coloured Moon rock named Dhofar 961, which fell as a meteorite into the Oman desert in the Arabian Peninsula, tens of thousands of years ago. The rock is very dark coloured — almost purple — and contains big metallic grains. It is believed that the rock was chipped off from the Moon by some anonymous impact and that it escaped the Moon's feeble gravity and was drawn by Earth's gravity to fall as a meteorite. Scientists believe Dhofar 961 may have been ejected when the large impact basin at the bottom of the lunar backside, known



South Pole-Aitken

as the South Pole-Aitken (SPA), was formed by the biggest-known impact the Moon has seen (*Nature*, 26 June 2008). With a size of more than 2,600 kilometres across and 12 kilometres deep, South Pole-Aitken is the second largest impact basin in the Solar System and also the biggest and oldest basin on the Moon.

It has been known to planetologists that just after the Solar System formed some 4.6 billion years ago, leftover planetesimals regularly blasted the newborn planets. The barrage even knocked off enough of Earth to create the Moon in the first place. By 3.8 billion years ago, impact rates had come down to what we see today. But what happened in the intervening period is not known. It is speculated that the big lunar impact that created the South Pole-Aitken basin happened around 3.9 billion years ago. Although its absolute age is not known, Dhofar 961 could pin down the timing of a lunar cataclysm. Many lunar scientists, however, feel that the best way to date South Pole-Aitken is to go there, get a rock, and date it, and a group of lunar scientists is contemplating a robotic South Pole-Aitken sample return mission, which would be the first lunar sample return since the last Soviet *Luna* spacecraft returned 170 grams of soil in 1976.

## Editorial (Contd. from page 35)

tonnes. However, by then the population had jumped to 1,130 million! Although the production had increased by a factor of 1.55, the population had increased by a factor of 1.65, implying a deficit of about 15 million tonnes! Also, changing lifestyles and increasing urbanisation are increasing the demand for animal-based food. This puts further pressure on grain production. We may note that it takes 2 kg of grain to be fed to a cow to make 1 kg of milk. It takes 6 kg of grain to make 1 kg of beef, 2 kg to make 1 kg of chicken, and 1.5 kg to make 1 kg of pork!

Next, diverting food grain to biofuel production also has been playing a part in pushing up the price of food grain. Government subsidies to farmers to grow biofuels in some rich countries have been responsible for 30 per cent of current increases in the price of grain. In addition, Australia, a major wheat exporter, has faced six years of drought. The skyrocketing oil prices have made it expensive to run tractors, transport food and make nitrogen-based fertilizers. Looming shortages have compelled countries like India and China to restrict export of grain in order that their own people are fed. But, this has hit countries like Bangladesh and many African countries which are net importers of food.

True, the situation is alarming, but not hopeless. What could we immediately do under the prevailing circumstances? It is imperative that yields have to be increased by making available existing high yielding varieties to farmers and giving them access to the fertilisers, water and pesticides they need. There do exist technologies off the shelf which can triple the yields in parts of Africa, says a noted agronomist. Then, there is huge potential for what is called 'conservation agriculture'. This implies getting more from the land while preserving soil quality and keeping costs and pollution to a minimum. Research in Mexico has shown that ploughing fields only every few years improves the nutrient content and structure of the soil to such an extent that yields can increase by up to 30 per cent. There is also huge potential for developing strains of rice that are resistant to common pests, or wheat varieties that can thrive in semi-drought conditions. Then, nitrogen fixing trees can be grown amid rows of maize to improve degraded soil and provide nutrients, thereby reducing the need for chemical fertilisers. Even techniques like soil depressions that accumulate moisture could make a difference in drought-prone areas. Experiments that decrease losses due to evaporation from leaves and soil have led to bumper harvests in some parts of Africa.

Genetically modified crops may not always be the solution except in certain circumstances. They are no magic bullet, nor panacea! True, some existing varieties could be cultivated with dramatic effect in many parts. But, what is required is to give an opportunity to the farmers to use these varieties and the access to information to improve the way they farm. Also needed is the basic infrastructure like providing simple methods to store the surplus produce and roads to help farmers take their produce to the market.

Agricultural research does not imply developing new high-yielding grain varieties, or plants resistant to diseases and pests alone. It also implies making best use of knowledge and technologies we already have. Since it takes 15-20 years for research to translate into success on the farms, it is imperative that governments and other bodies start investing in research right away as a long-term measure. We have already achieved Green Revolution once. It helped grain production keep pace with population. We certainly can do it again. But, it would prove quite tougher this time. Energy and fertiliser are more expensive. Water and soil resources have been degraded. And above all, we now have to deal with climate change that has been changing the familiar weather patterns with droughts and deluges that are unpredictable! These are the conditions in which we shall need to work and increase yields to feed the hungry of the world. With a proper research programme we can still do it! We shall be able to do it more effectively if we evolve and scrupulously follow an appropriate population control policy at the same time.

☐ **Vinay B. Kamble**

## Letters to the Editor

Haryana Police Academy, Madhuban is regularly receiving one copy of *DREAM 2047* for our Library, However, in view of large number of our trainees (10,000 per year), one copy of the magazine does not serve their purpose. It is, therefore, requested to kindly arrange to send three sets of *Dream 2047* for the benefit of trainees at this Academy. We have three more three more training centres at Bhondsi in Gurgaon, at 3rd Bn. HAR in Hissar, and at Commando Complex, Newal in Karnal.

**Director**
Haryana Police Academy, Madhuban

Every month I and some colleagues eagerly wait for the issue of *DREAM 2047*, each issue of which enables us to know details about an eminent scientist and the latest developments in science and technology.

**Assistant Teacher (Mathematics)**
Digha D.J. Sikshasadan H.S. School
Purba Medinipur, W.B. 721428

I am delighted to receive the copy of *DREAM 2047* (May 2008). The excellent article on Arthur C. Clarke by Dr. Subodh Mahanti provides interesting facts about the creative life of this master exponent of science fiction and visionary of the Space Age. Other articles in this magazine are equally informative as is the editorial 'Smashing Particles to Understand the Universe'.

**Dr. Rajiv R. Upadhyay**
Parisar, Kothi Kake Babu,
Deokali Marg, Faizabad 224001 (U.P.)

I am thankful to you for sending this excellent magazine to our institution regularly. I have asked our teachers and students to read the magazine, which carries useful articles for them.

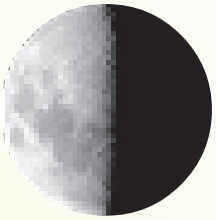
**Principal**
T.C. Govt. Girls' H.S. & M.P. School
Guwahati-781003

# Sky Map for August 2008

Full Moon

16 August

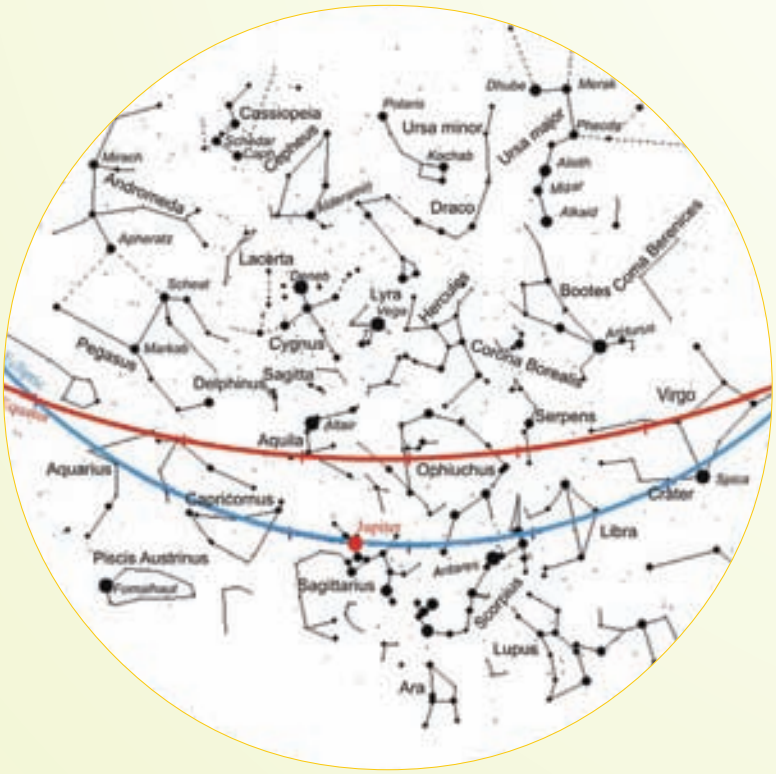
Moon - Last Quarter



23 August

North

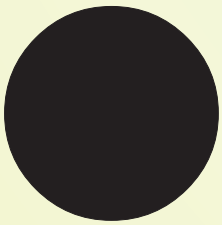
East




West

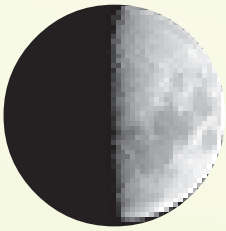
South

New Moon



1 August

Moon - First Quarter



8 August

The sky map is prepared for viewers in Nagpur (21.09$^0$ N, 79.09$^0$ E). It includes bright constellations and planets. For viewers south of Nagpur, constellations of the southern sky will appear higher up in the sky, and those of the northern sky will appear nearer the northern horizon. Similarly, for viewers north of Nagpur, constellations of northern sky will appear higher up in the sky, and those of the southern sky will appear nearer the southern horizon. The map can be used at 10 PM on 01 August, at 9:00 PM on 15 August and at 8 PM on 31 August.

**Tips for watching the night sky :**

*(1) Choose a place away from city lights/street lights (2) Hold the sky-map overhead with 'North' in the direction of Polaris (3) Use a pencil torch for reading the sky map (4) Try to identify constellations as shown in the map one by one.*

**Planet/Dwarf Planet Round Up:**

*Uranus* : In the constellation Aquarius (*Kumbha Rashi*) near Eastern horizon.

*Neptune* : In the constellation Capricornus *(Makar Rashi)* up in the Eastern horizon.

*Jupiter* : In the constellation Sagittarius (*Dhanu Rashi*) up in the zenith sky.

**Prominent Constellations:** Given below are prominent constellations with brightest star therein (in the parenthesis). Also given are their Indian names.

**Eastern Sky:** Andromeda, Aquarius, Capricornus / *Makar Rashi*, Lacerta, Pegasus, Piscis Austrinus.

**Western Sky :** Bootes (Arcturus) / *Bhutaap (Swati)*, Canes Venatici, Libra / *Tula Rashi,* Serpens, Virgo (Spica) / *Kanya Rashi (Chitra)*.

**Southern Sky :** Ara, Corona Australis, Lupus, Sagittarius / *Dhanu Rashi*, Scorpius / *Vraschik Rashi*.

**Northern Sky:** Cassiopeia, Cepheus (Alderamin) / *Vrashaparva*, Draco, Ursa Major (Dhube) / *Saptarishi (Krutu),* Ursa Minor (Polaris) / *Dhruvamatsya (Drhuvataraka)*.

**Zenith** : Aquila (Altair), Corona Borealis, Cygnus (Deneb), Delphinus, Hercules, Lyra (Vega) / (*Abhijeet*), Ophiuchus, Serpens, Sagitta.


□ **Arvind C. Ranade**
E-mail : rac@vigyanprasar.gov.in

# National workshop on Innovative Experiments in Physics

Vigyan Prasar and Department of Physics, Indian Institute of Technology (IIT), Kanpur, have jointly undertaken a project entitled "Development of Innovsative Physics Experiments and Training of Teachers for Experiment Based Teaching". The objective of the project is to train teachers in using innovative activities in the classroom while teaching a particular concept. New activities/ experiments are also to be developed on a continuous basis.

*Professor H. C. Verma (right) interacting with the participants*

A number of innovative experiments have already been developed by Department of Physics, IIT Kanpur in collaboration with Vigyan Prasar, which has developed two multimedia CDs based on these experiments. A kit on Innovative Physics Activities is also under development.

A national workshop on was organised at IIT, Kanpur during 15-20 June 2008 to train teachers in innovative physics activities/experiments. Forty-one teachers from eleven states/ union territories attended the workshop. Professor Kripa Shankar, Deputy Director, IIT Kanpur, was the Chief Guest at the inaugural function. Prof. Shankar enumerated the efforts by IIT, Kanpur to reach the community and appreciated the joint effort of Vigyan Prasar and Department of Physics, IIT Kanpur in disseminating innovative experiment-based science learning.

Prof V N Kulkarni, Acting Head, IIT Kanpur, in his inaugural speech, highlighted the importance of school physics teachers, as it is only this group which interacts continuously with the young students and can contribute much in conducting experiments through their wholehearted involvement. Other dignitaries present were Dr R N Kapoor from *Anveshika* and Professor H. C. Verma of the Department of Physics, IIT Kanpur and Principal Investigator of the project. Scientists, Shri Rintu Nath and Shri B. K. Tyagi represented Vigyan Prasar. Mr. Brajesh Pandey, Research Scholar, IIT Kanpur conducted the programme.

*Shri Rintu Nath, Scientist, Vigyan Prasar demonstrating PC based experiments*

*Demonstration of innovative activities by Shri Samar Bagchi (left)*

*Hands-on experiments by the participants*

Professor H. C. Verma conducted the workshop and demonstrated a number of experiments. He also delivered talks on Children's Science Training Programme. Shri Rintu Nath gave a presentation on the activities of Vigyan Prasar and demonstrated a few experiments based on the PC interface developed by Vigyan Prasar. Shri B. K. Tyagi gave a presentation on the Planet Earth project of VP and VIPNET science clubs. Shri Samar Bagchi, well known science communicator, demonstrated about 30 innovative activities.

During the workshop, 112 experiments/activities were performed and discussed. Twelve resource persons helped participants throughout the workshop in doing hands-on activities. About 30 experiments were demonstrated by the participants. All the participants were given one Physics kit and CD entitled "Innovative Experiments in Physics". The participants were taken around different laboratories of Department of Physics, IIT Kanpur where experts explained the working of many sophisticated instruments.