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## Challenges of Water Management in the 21st Century



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# Challenges of Water Management in the 21st Century

Water is an essential prerequisite for people's lives and livelihoods. The relationship between human population and water resources has changed with the progress of human civilisation. Early human civilisations in different parts of the world developed on the banks of major rivers, which ensured a reliable supply of water. With the advent of new technologies, pattern of human settlements no longer depended only on the availability of natural water. Technological interventions made it possible to make water available in areas where it could not have been dreamt of in the past.

In the primitive societies water was essential only for survival. But today water is also important for our economic wellbeing. There are three kinds of major demands for water—agricultural, industrial and domestic. Demand for water increases continually with the growth of world population. The world population crossed 6 billion in 1999 and it would be 10 billion by 2050. The demand of water also increased with the increasing diversity in human activities.

One of the most serious problems humanity facing today is the global water crisis. Development of sustainable and safe drinking water supplies is a global challenge. Unfortunately people in many parts of the world are forced to live without safe water and sanitation services. The number of such people as per the United Nations' third World

Water Development Report (WWRD) is more than 660 million. If these people are to prosper, more secure and low-cost water supplies are needed. The WWRD, which gives an authoritative comprehensive assessment of the world's fresh water resources, is released every three years. The first report was released in 2003.

Earth's total water is estimated to be 1.4 billion cubic kilometres. Out of the total water present on Earth only about 2.8 per cent, which is called fresh water, is suitable for human consumption. The remaining 97.2 per cent is salt water present in oceans. The Earth's fresh water resources consist mostly of icecaps, glaciers and groundwater. The water presents in rivers, lakes and other water bodies on the Earth's surface forms only a small part of the total global freshwater volume. The river runoff represents the renewable water resources and it also provides major volume of water for consumption in the world. Earth's mean annual renewable volume of water is 43,000 cubic kilometres, which is about half of all the Earth's natural lakes and about ten times the volume of all man-made reservoirs. The per capita water availability depends on storage capacity. Developed countries are much ahead in storage capacity than the developing countries. For example India's per capita storage capacity is 213 cubic metres as against 4,733 cubic

metres in Australia and 1,964 cubic metres in the USA

Groundwater is second to rivers as a distributor of fresh water. It is estimated that Earth's fresh groundwater resources is about 10 million cubic kilometres, which is more than 200 times the global annual renewable water resources made available by rain. The extraction of groundwater has made it possible for expansion of agriculture, which in turn has led to rural development and poverty reduction. However, this expansion cannot go on forever. For example, in India out of the total 5,723 blocks, 1,600 blocks are now classified as critical or over-exploited. A situation has been reached where groundwater extraction needs to be balanced with economically viable yields. But it is also true that overexploitation of groundwater is leading to environmental degradation.

Today the agriculture sector is the largest user of freshwater globally. This sector accounts for about 70 per cent of total freshwater consumption globally. The use of water in agriculture is more in the developing countries than in developed countries. In developing countries the agriculture sector accounts for almost 85 per cent of total freshwater consumption. There will be greater demand of water by the agriculture sector, as the food demand is expected

*(Contd. on page...22)*

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# Asutosh Mookerjee

## Mathematician, Jurist, and Educationist

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“Men are always rare in all countries through whom the aspiration of their people can hope to find its fulfillment, who have the thundering voices to say that what is needed shall be done; Asutosh had the magic voice of assurance. He had the courage to dream because he had the power to fight and the confidence to win—his will itself was the path to the goal.”

– Rabindranath Tagore

“Asutosh could become a mathematician of world rank if he had chosen to confine himself to the pursuit of mathematics alone. However, despite all his preoccupation, Asutosh founded the Calcutta Mathematical Society in 1908 and as President, guided its activities until his death. He was a luminary in legal profession but he decided to serve his country in a manner he thought was the best, to take the best out of western education and Indian heritage and set up a University of great distinction to stimulate the minds of young Indians.”

– D. P. Sen Gupta in *Current Science* (Vol. 78, No. 12, 25 June 2000)

Asutosh Mookerjee was one of the Architects of Modern India. He was a distinguished mathematician of his time. He published about 20 original research papers in mathematics in national and international journals. He wrote a book in mathematics titled *Geometry of Conics*. He established the Calcutta Mathematical Society in 1908 and directed its activities as its President up till his death. He pursued his mathematical studies and research even when he was busy as a lawyer at the Court. He was one of the most eminent legal luminaries of pre-independent India. He was a highly successful advocate. As Judge of the Calcutta High Court he passed judgement in nearly 2,000 cases and many of which are still quoted as masterpieces of judgment.

However, Mookerjee is mostly known for his pioneering role in broadening the scope of higher education in the country. As Vice Chancellor of Calcutta University he started postgraduate studies and research in the University. He changed the very direction of Calcutta University. He integrated teaching and research at the University level for the first time in India. Before Mookerjee became the Vice Chancellor of Calcutta University, it was only an examining body. Mookerjee started

a number of post-graduate departments in science. He also played an instrumental role in strengthening the teaching of arts subjects at the post-graduate level. He presided over the first Indian Science Congress in 1914. He was elected President of the Asiatic



Asutosh Mookerjee

Society four times, a record in the annals of the Society up to his time.

Mookerjee was a genius of rare distinction. He was fiercely independent. He never compromised with his principles.

He strived hard to establish a synthesis of the best of Western and Indian culture and education. He once said: “...we cannot sit on the lovely snow-capped peaks of the Himalayas absorbed in contemplation of our glorious past. We cannot waste precious time and strength in defence of theories and systems which, have been swept away by the irresistible avalanche of worldwide changes...we can live neither in nor by our defeated past and if we would live in the conquering future, we must dedicate our whole strength to shape its course...let us raise emphatic protest against all suicidal policy of isolation and stagnation.”

Asutosh was born in Kolkata (then Calcutta) on 28 June 1864 to Gangaprasad Mukhopadhyay and Jagattarini Devi. It may be noted that often the birth date of Asutosh is written as 29 June but in his father's own handwritten record it is mentioned as 28<sup>th</sup> June, Tuesday 1864 at 4 am. Describing the family background of Asutosh Mookerjee, D. P. Sen Gupta wrote: “His father Gangaprasad Mukhopadhyay was a well-known physician and his mother Jagattarini Devi was known to be a woman of courage and considerable strength of character. It is believed that the great Krittibas who wrote the first Bengali version of the *Ramayana* was the ancestor of

Asutosh. So was Ramachandra Tarkalankar who was appointed by Warren Hastings to the Chair of Nyaya in the newly founded Sanskrit College." Asutosh was fondly devoted to his mother. He never went against the wishes his mother. Asutosh was personally nominated by the then Viceroy Lord Curzon as the representative of Calcutta citizens to attend the coronation of King Edward VII. However, his mother did not want his son to go abroad and so Asutosh declined the offer.

Asutosh studied at the South Suburban School and from where he passed the Matriculation Examination of Calcutta University in 1879. He then joined the Presidency College. He passed the F.A. examination in 1881 and joined the B.A. course. While an undergraduate student he published a research paper in mathematics in the journal *Messenger of Mathematics*. The paper was titled "Some extension of a theorem of Salmons." In 1884, he passed the B.A. examination standing first in the University. H. G. Reynolds, the then Vice Chancellor of the University, in his convocation address referred to Mookerjee's achievement: "The senior wrangler of the year, if I may borrow the phrase from Cambridge, is Asutosh Mookerjee of the Presidency College who stands first in the list of B.A. graduates and is in receipt of the Ishan and Vizianagram Scholarships and of the Hurrish Chander Prize." The year in which he passed his B.A. examination, Mookerjee was elected as member of the London Mathematical Society. The news of his election to the London Mathematical Society was reported in *The Statesman* on 12 February 1884: "We understand that Babu Asutosh Mookerjee, who stood first at the last B.A. examination, has been elected a member of the London Mathematical Society. He is the first Indian on whom the Society has conferred this honour."

In 1885, Mookerjee passed his M.A. Examination in mathematics securing first position in order of merit. C. P. Ilbert, the

then Vice Chancellor of the University mentioned Mookerjee's outstanding performance in his convocation address: "In



Asutosh Mookerjee's Father and Mother

the M.A. Examination Mr. Asutosh Mookerjee to whose achievements my predecessor referred to in 1884 retains his pre-eminence as a mathematician, and for the sake of the profession to which I belong, I am glad to see that he has devoted himself to the study of law and has carried off the gold medal recently offered for competition among law students by my friend Maharaja Sir Jyotindra Mohun Tagore."

In 1886, Mookerjee got his M.A. degree in Natural Sciences. The same year he qualified in the special competitive examination for the award of the prestigious Premchand Roychand studentship. He also studied law from the City College and stood

first in all the three examinations of law. He started practising law at the Calcutta High Court in 1888 after obtaining a Bachelor of Law (B.L.) degree the same year. In 1894, he obtained his Doctorate of Law (D.L.) degree. He was invited by Lord Curzon to become a Judge of the Calcutta High Court. Mookerjee joined the High Court in 1904 after obtaining consent from his mother. For a brief period he also served as the Chief Justice of the Calcutta High Court.

It is not widely known that Mookerjee served as lecturer in mathematics and mathematical physics at the Indian Association for the Cultivation of Science from 1887 to 1889. He delivered lectures on physical optics, mathematical physics and pure mathematics. His lectures were of exceptional high standard.

Mookerjee's long association with Calcutta University started in 1889 as a Fellow and the same year he became a member of the Syndicate of the University at the age of 25. He served as President of the Board of Studies in Mathematics. In 1906 he was invited by Lord Minto, the Viceroy, to be the Vice Chancellor of Calcutta University. He remained as Vice Chancellor for the four consecutive terms till 1914. He was again appointed as Vice



The original picture of IACS



*The Science College, Calcutta*

Chancellor for another term in 1921. As Vice Chancellor his first priority was to establish post-graduate teaching departments, both in science and arts. His move was strongly opposed by the government. He could not expect any additional financial support for his move. However, Mookerjee achieved his goal against all odds. He could achieve his goal because of the spontaneous support from Taraknath Palit and Rash Behari Ghosh. Taraknath Palit made an initial donation of Rs.13.66 lakhs to the university for two professorships, one each in physics and chemistry. Palit also donated to the University a plot of land and a residential building. The first Palit Professorship of Chemistry was offered to Acharya Prafulla Chandra Ray, who took up the assignment in 1916 after his retirement from the Presidency College. Mookerjee invited Chandra Sekhar Venkata Raman to become the first Palit Professor of Physics. Raman accepted the Palit Professorship in 1917. In 1914, Rash Behari Ghosh made an initial donation of Rs. 10.46 lakhs, out of which four professorships were created, one each in applied mathematics, physics, chemistry and botany. The first incumbents to these four Ghosh professorships were Ganesh Prasad, D. M. Bose, P. C. Mitter, and S. P. Agharkar. During 1919-21, Rash Behari

Ghosh made another donation of Rs. 14 lakhs, out of which the Technology Faculty with a department each in physics and chemistry was established. Commenting on Mookerjee's ability to collect money B. V. Subbarayappa wrote: "It was Asutosh Mukherjee, the distinguished mathematician and Vice-Chancellor of



*C V Raman*

Calcutta University, who succeeded in rousing public philanthropy and succeeded in raising funds for creating Chairs in physics and chemistry. The University

College of Science at Calcutta played a pivotal role in providing scientific leaders of eminence and generating as well as fortifying research in several parts of the country even in colonial ambience."

Mookerjee appointed Meghnad Saha, S. N. Bose and S. K. Mitra as lecturers in the Physics Department. Saha and Bose were first appointed in the Department of Applied Mathematics but they were later transferred to the Physics Department at the instance of Mookerjee.

Ramananda Chatterjee (1865-1943), one of the builders of modern India, commenting on the services rendered by Asutosh Mookerjee to Calcutta University wrote: "The services rendered to Calcutta University by Sir Asutosh Mookerjee deserves unstinted praise. No man ever devoted his intellectual powers, his energies and his time to the service of this University to the extent that Sir Asutosh has done. No one possesses such grasp of the details of all its affairs as he does." In a similar vein, Lord Lytton, who was governor of Bengal, said: "Asutosh, in the eyes of his countrymen and in the eyes of the world, represented the University so completely that for many years Asutosh was in fact the University and the University Asutosh."

The first Indian Science Congress was inaugurated by Asutosh Mookerjee. The Indian Science Congress was established with the initiatives undertaken by P. S. MacMohan and J. L. Simonsen, who worked jointly as Honorary General Secretaries of the Congress till 1921, when MacMohan was succeeded by C. V. Raman. The first Science Congress was held in January 1914 at Calcutta in the premises of the Asiatic Society of Bengal. In his inaugural address Mookerjee said: "It is now more than two years ago that Professor MacMohan of the Canning College at Lucknow, and Professor Simonsen of the Presidency College at Madras, brought forward a proposal for the foundation of an Indian Association for the Advancement of Science. The object and scope of the proposed Institution were stated to be similar to those of the British Association for the Advancement of Science, namely to give a stronger impulse and a more systematic direction to scientific enquiry, to



Mahendralal Sircar



Meghnad Saha

promote the intercourse of societies and individuals interested in Science in different parts of the country, to obtain a more general attention to the objects of Pure and Applied Science and the removal of any disadvantages of a public kind which may impede its progress. This proposal was widely circulated amongst persons of culture



S N Bose

interested in the spread and development of Science in this country, and the fundamental idea, as might easily have been anticipated, met with favourable reception...But it was felt by many men of experience that the pressure of heavy official duties under which many investigators here carry on their scientific work, the climatic

conditions which prevail in this country, and the long distances which have to be traversed, constitute practical difficulties of no mean order in the way of the immediate formation of a peripatetic association, designed to meet periodically, in turn, in all the different centres of scientific activity...As the result of a full discussion of the situation, the view ultimately prevailed that the desired object could be attained if a Science Congress was held in the first instance in Calcutta, under the leadership of the Asiatic Society..."

Asutosh Mookerjee died on 25 May 1924 in Patna. He had gone Patna in connection with his legal practice.

Remembering Asutosh Mookerjee, Michael Sadler, who was Chairman of Calcutta University Commission during 1917-1919, wrote: "In Asutosh Mookerjee India has lost one of her greatest men; the world one of its commanding personalities. He was mighty in battle. He could have ruled an empire. But he gave the best of his powers to education because he believed that in education rightly lies the secret of human welfare and the key to every empire's moral strength."

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

# Telomeres as protectors of chromosomes

In the nucleus of each cell, the DNA molecule is packaged into thread-like structures called chromosomes. Each chromosome is made up of DNA tightly coiled many times around proteins called histones that support its structure. When the cell is not dividing, chromosomes are not visible in the cell's nucleus – not even under a microscope. However, the DNA that makes up chromosomes becomes more tightly packed during cell division and is then visible under a microscope. Most of what researchers know about chromosomes was learned by observing chromosomes during cell division. It was found that each chromosome has a constriction point called the centromere, which divides the chromosome into two sections, or 'arms.' There are also long stretches at the ends of the chromosome called the 'telomeres'. Telomeres are crucial to the life of the cell. They keep the ends of the various chromosomes in the cell from accidentally becoming attached to each other.

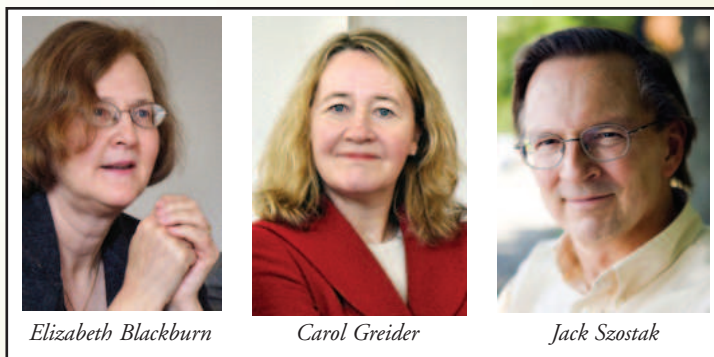
During 1980s, research led to identification of an extraordinary enzyme named telomerase that acts on telomeres and is thought to be required for the maintenance of many human cancers. This last finding has sparked much speculation that drugs able to inhibit the enzyme might combat a wide array of malignancies. The research also opened up the possibility that changes in telomere length over time may sometimes play a role in the aging of human cells.

Certain inherited diseases are characterised by a defective telomerase, resulting in damaged cells. The award of the 2009 Nobel Prize in Physiology or Medicine recognises the work of three scientists in showing how telomeres, and an enzyme that forms them called telomerase, protect chromosomes. The Prize has been shared by three scientists - Elizabeth Blackburn from the University of California, San

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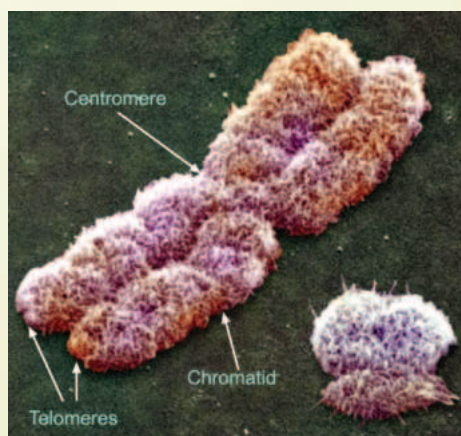
Francisco; Jack Szostak from Harvard Medical School; and Carol Greider from Johns Hopkins University School of Medicine, Baltimore, USA.



## How do cells divide?

There are two types of cell division: mitosis and meiosis. Most of the time when people refer to 'cell division,' they mean mitosis, the process of making new body cells. Meiosis is the type of cell division that creates egg and sperm cells.

Mitosis is a fundamental process for life. During mitosis, a cell duplicates all of



*Electron micrograph of human X (left) and Y chromosome (right)*

its contents, including its chromosomes, and splits to form two identical daughter cells. Because this process is so critical, the steps of mitosis are carefully controlled by a

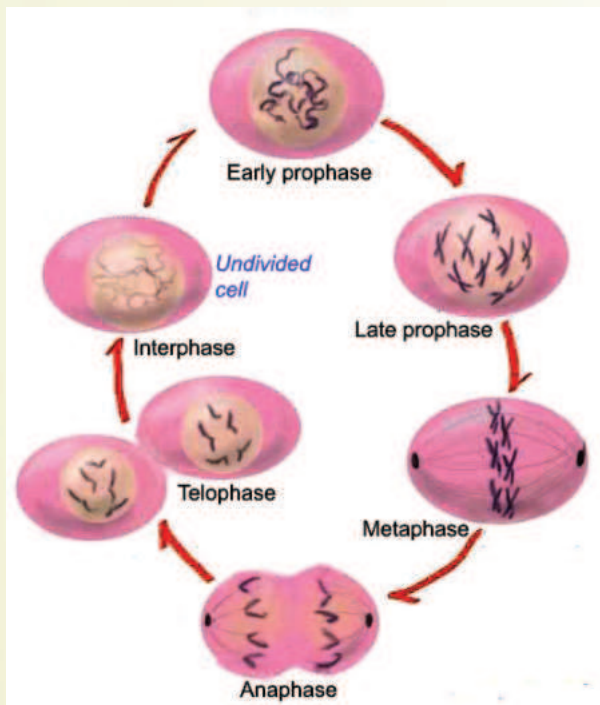
number of genes. When mitosis is not regulated correctly, health problems such as cancer can result.

The other type of cell division, meiosis, occurs during formation of reproductive cells. It ensures that humans have the same number of chromosomes in each generation. It is a two-step process that reduces the chromosome number by half – from 46 to 23 – to form sperm and egg cells. When the sperm and egg cells unite at conception, each contributes 23 chromosomes so the resulting embryo will have the usual 46. Meiosis also allows genetic variation through a process of DNA shuffling while the cells are dividing.

## What is telomere?

A telomere is a repeating DNA sequence (CCCAA) at the end of the body's chromosomes. The telomere can reach a length of 15,000 base pairs (C and A stand for cytosine and adenine, two of the four bases that make up the DNA chain. The other two are thymine, T, and guanine, G.) Telomeres function by preventing chromosomes from losing base pair sequences at their ends. They also stop chromosomes from fusing to each other. However, each time a cell divides, some of the telomere is lost (usually 25-200 base pairs per division). When the telomere becomes too short, the chromosome reaches a 'critical length' and can no longer replicate. This means that a cell becomes 'old' and dies by a process called apoptosis. Telomere activity is controlled by two mechanisms: erosion and addition. Erosion, as mentioned, occurs each time a cell divides. Addition is determined by the activity of an enzyme called telomerase.

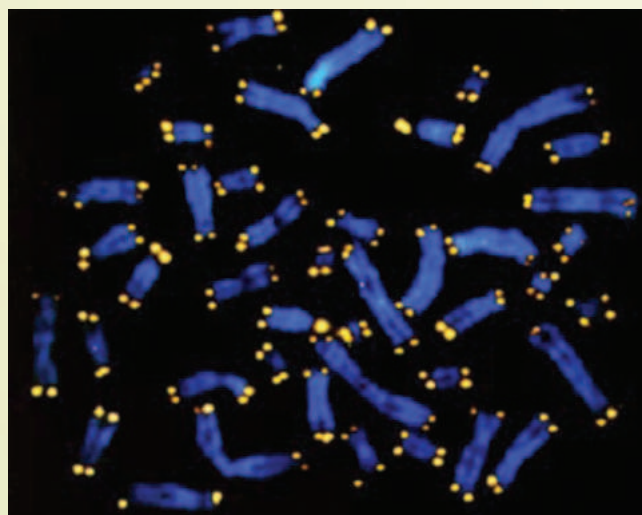
Telomerase, also called telomere terminal transferase, is an enzyme made of protein and RNA subunits that elongates chromosomes by adding



During mitosis, a cell duplicates all of its contents, including its chromosomes, and splits to form two identical daughter cells. The DNA that makes up chromosomes becomes more tightly packed during cell division and is then visible under a microscope.

CCCCAA sequences to the end of existing chromosomes. Telomerase is found in foetal tissues, adult germ cells, and also tumour cells. Telomerase activity is regulated during development and has a very low, almost undetectable activity in somatic (body) cells. Because these somatic cells do not regularly use telomerase, they age. The result of aging cells is an aging body. If telomerase is

replication, could not fully synthesise the 3' end of linear DNA. As a young researcher at the University of California, Berkeley, while studying the chromosomes of a single-cell organism called *Tetrahymena* that commonly lives in water, Blackburn noticed a DNA sequence, CCCCAA, that was repeated several times at the ends of the chromosomes.



Telomeres (yellow) are repeated sequences located at linear ends of chromosomes (blue).

activated in a cell, the cell will continue to grow and divide. This 'immortal cell' theory is important in two areas of research: aging and cancer.

Scientists began to understand how genes are copied, base by base, in the 1950s, but no one could figure out why the very end of a DNA strand could not be duplicated. Early studies by Hermann Muller and Barbara McClintock showed that the ends of chromosomes are capped by a structure called the telomere to prevent chromosome fusions. In the 1970s, as the mechanisms were becoming better understood, it became clear that DNA polymerase, the enzyme responsible for DNA

While presenting her findings at a conference in 1980, Blackburn met Szostak, who had just observed that minichromosomes (a minichromosome is a small chromosome-like structure formed when a virus DNA binds to a histone) rapidly degrade when introduced to yeast cells. The two decided to join forces – introducing the CCCCAA sequence into the minichromosomes and then injecting them into

yeast cells. The sequence protected the minichromosomes from degradation by keeping their ends intact, indicating the existence of a previously unknown mechanism in DNA replication. The results were published in the journal *Cell* in 1982.

Carol Greider, then a graduate student, and her supervisor Blackburn started to investigate if the formation of telomere DNA could be due to an unknown enzyme. On Christmas Day, 1984, Greider discovered signs of enzymatic activity in a cell extract. Greider and Blackburn named the enzyme 'telomerase', purified it, and showed that it consists of RNA as well as protein. The RNA component turned out to contain the CCCCAA sequence. It serves as the template when the telomere is built, while the protein component is required for the construction work, i.e., the enzymatic activity. Telomerase extends telomere DNA, providing a platform that enables DNA polymerases to copy the entire length of the chromosome without missing the very end portion. The two scientists published their findings in the journal *Cell* in 1985 and in *Nature* in 1989.

Blackburn and Szostak went on to discover that mutations in the RNA of the telomerase enzyme led to the gradual shortening of telomeres and eventual inhibiting of cell division in *Tetrahymena* and yeast, respectively. These discoveries had a major impact within the scientific community. Many scientists speculated that telomere shortening could be the reason for ageing, not only in the individual cells but also in the organism as a whole.

The discoveries by Blackburn, Greider and Szostak have added a new dimension to our understanding of the cell, shed light on disease mechanisms, and stimulated the development of potential new therapies. Although the ageing process has turned out to be complex and it is now thought to depend on several different factors, the telomere being one of them, research on the role of telomeres in the process remains intense. ■

# Healing the Mind

## Managing Schizophrenia



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If you talk to God, you are praying; if God talks to you, you have schizophrenia.  
—Thomas Szasz  
in *The Second Sin Schizophrenia*

Though still considered a major illness, the outlook for remission in schizophrenia is no longer bleak. New, effective anti-psychotic medications can help initiate a positive change in a large number of people. With symptoms well under control, productive life can resume. The Hollywood film, *A Beautiful Mind* is a true cinematization

### Forms of Schizophrenia

With the predominant symptoms at the core, schizophrenia has been categorized into five subtypes: paranoid, disorganized (hebephrenic), catatonic, undifferentiated, and residual.

The first is the paranoid type. Its essential feature is the presence of prominent delusions or auditory

the ability to perform daily activities, and oddities of behaviour, such as grimacing and other strange mannerisms. The illness has a continuous course without significant letups.

Catatonic illness is marked by waxy flexibility, extreme negativism, rigid or bizarre posturing, parrot-like apparently senseless repetition of a word or phrase just spoken by another person and repetitive imitation of another person's movements (echopraxia). People with this illness are faced with the risk of becoming malnourished and they may inflict injury on themselves.

The undifferentiated illness features delusions, hallucinations, incoherent speech, disorganized behaviour, or negative symptoms of muted emotion, absence of logic and lack of will to work.

The residual type is characterized by eccentric behaviour, odd beliefs, and mildly disorganized speech. Delusions and hallucinations do not occur, or if present, are mild.

This classification helps in decision-making at the time of treatment and prognosis, but it is not a rigid one. If there is major change in the clinical picture, which happens frequently, the subtype also changes.

### Causes

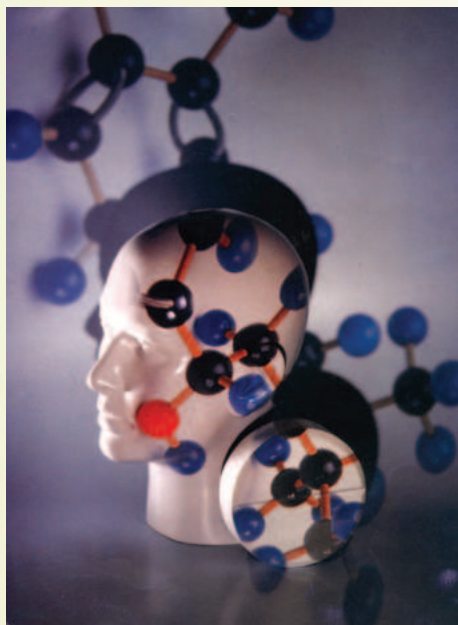
Schizophrenia appears to be related to a cluster of causes rather than to a single cause. The current thought is that schizophrenia is a biological disease linked to genetic factors and the imbalance of neurotransmitters



of the life of the Nobel laureate mathematician John K Nash. That success story can be anybody's story. The unstinting support of a family, their love, understanding, commitment, and care can turn the wheel back on the illness restoring life to normalcy. Some people may not be that fortunate, and their illness may fester, but with suitable attention and therapy, their lives can also improve.

hallucinations. Delusions are typically persecutory or grandiose, and hallucinations may also revolve around similar themes. Associated features include anxiety, anger, aloofness and argumentativeness. The person can benefit from treatment and lead an independent life.

The disorganized type is the most severe. It is characterized by silly speech and misplaced laughter, disruption in



(chemicals) in the brain. In some people, the illness could also be caused by abnormalities in the prenatal environment or some distinct structural abnormalities in the brain. The role of stressful life-events has also been a subject of intense study as it is suspected that they could also be playing a secondary part in the precipitation of schizophrenia in vulnerable people.

### Genetic Factors

It is clear from the studies of twins, family, and adopted children that genes and schizophrenia are intertwined. The risk of the onset of schizophrenia strongly depends on one's genetic inheritance. Studies of families with the illness have found that a child who has one parent with schizophrenia, has a 10–13 per cent risk of developing the illness, whereas a child whose mother and father both have schizophrenia is at a 46 per cent risk of being similarly affected. The risk does not mitigate even if such children are adopted and raised by healthy parents. In comparison, children in the general population are only at about one per cent risk. It is likely that not one or two, but many different genes interacting with each other and with environmental risk factors result in schizophrenia.

### The Dopamine Factor

There is mounting evidence to suggest that schizophrenia could be a result of an imbalance of chemicals in the brain. These chemicals enable brain cells to communicate with each other and are called neurotransmitters. The main culprit seems to be dopamine. Its overactivity in certain parts of the brain is the likely root cause of schizophrenia. The support for this hypothesis comes from several quarters. First, the effectiveness of anti-psychotic drugs, which help in schizophrenia, hinges on blocking receptors for dopamine in the brain. Second, dopamine also plays a role in the mechanisms that govern attention and filtering of stimuli, the breakdown of which can lead to the illness. Third, amphetamines, which increase dopamine activity, intensify psychotic symptoms in people with schizophrenia. Despite these findings, scientists are yet to find out what causes the increase, or increased sensitivity of brain cells to dopamine in the first place.

### Structural Abnormalities in the Brain

With the help of newer brain imaging techniques, researchers have discovered specific structural abnormalities in people suffering from schizophrenia. They tend to have larger cerebrospinal fluid cavities in the brain, a smaller overall volume of brain tissue and an abnormally low activity in the frontal lobe of the brain, which governs abstract thought, planning, and judgment. These defects may partially explain the abnormal thoughts, perceptions, and behaviour that characterize schizophrenia. However, these changes are not universal, and may also be a result rather than the cause of the illness.

### Prenatal Environment

Evidence suggests that pregnant mothers, who have poor nutrition or who get exposed to the influenza virus, are more likely to give birth to a child vulnerable to schizophrenia.

### Psychosocial Stress

There has been a search for stressors and possible schizophrenic personality traits that may affect the onset and the course of illness. These efforts have largely drawn a blank, except for finding that stressful life circumstances can trigger episodes of schizophrenia in a person biologically predisposed to the disease. Individuals who have effective skills for managing stress may be less susceptible to its negative effects.

### Treatment

Even though there is no definite cure for schizophrenia, the use of anti-psychotic medicines can dramatically improve the quality of life. They can check or eliminate the disturbing symptoms, and allow the person to lead a relatively trouble-free life. With their help, a large majority of people with schizophrenia can return to active social life. They usually, however, need to take medicine for a long time if not for the rest of their lives. This is necessary to prevent a relapse.

There are many anti-psychotic medicines which can control the symptoms and are effective against schizophrenia. These include clozapine, risperidone, olanzapine, haloperidol,





thioridazine, chlorpromazine, fluphenazine, and trifluoperazine.

Many people with schizophrenia stop taking medicines because they do not understand that they are ill. Some may also have a delusion that the family and the physician are conspiring against them. In that circumstance, the family has to take some difficult decisions. Either the person has to be placed in institutional care, or the family has to take the responsibility of administering the medication. Some anti-psychotic medicines are also packaged in liquid form. After due consultation with the physician, they may be given mixed with foods and beverages. This is a difficult ethical issue, although the benefit it holds out for a loved one should make the decision easier.

Some families become careless about the treatment as soon as the person shows improvement. This can undo the good effect of medication and the symptoms can worsen.

However, medication can sometimes lead to unpleasant side effects. Minor side effects include dry mouth, constipation, dizziness, blurred vision, and drowsiness. These can often

be tidied over with some little changes in lifestyle, or by substituting one medicine for another. Difficulty arises when the side effects are more serious and debilitating. These may include muscle spasms or cramps, tremors, and tardive dyskinesia, a condition marked by uncontrollable movements of the lips, mouth, and tongue. Newer medications, such as risperidone, clozapine, and olanzapine, produce fewer of these side effects, but the search for a better trouble-free medication is still not over.

Some people continue to experience difficulties despite taking medication and may suffer from overriding suicidal thoughts. These people require other types of treatments, including electro-convulsive therapy, to get better. They may have to be committed to institutional care, so that the risk of suicide can be nullified.

Suitable attention should be paid to individual and group psychotherapy, family counselling, and vocational rehabilitation in order to maximize the benefits of the treatment and to restore the person to useful public life. Training in social and behavioural skills can help them conduct and manage themselves better.

### **The Role of the Family**

The family of the patient has a major role in the management and the eventual outcome of the illness. Each family member must take part in active counselling. This enables them to develop a proper understanding of the illness and treatment, and they can learn to monitor the progress and create a low-stress environment for the patient.

The family must realize that it is pointless to discuss and debate the logicity of thoughts and actions with the patient. Any attempt at this is likely

to complicate matters, simply because the patient lacks insight and cannot be expected to be logical. The situation may become further complicated because of the delusions and hallucinations that occupy the mind of the patient.

The first and foremost duty of the family is to ensure that the patient gets the best possible treatment. If the situation carries risk of self-harm, suitable preventive measures must be initiated. Those people with schizophrenia who express suicidal thoughts require immediate medical attention.

Many families may fail in their duty if they blame themselves and feel guilty for the illness, or simply put the blame on others for it. For this kind of illness, nobody really is at fault. The family should therefore never waste time, effort and resources discussing such trivialities. Rather, they should work cohesively and ensure that the treatment of the patient is not hampered.

The effort must also be geared towards maintaining the patient's passion for life. The patient must be encouraged to take up the chores of daily living, and when appropriate, suitable responsibilities may be given such that he may find confidence and faith in self, and feel that he still has a useful role to play. A home filled with hostility, criticisms, and emotional over-involvement can result in a relapse and affect the outcome adversely.

The family must never disparage the benefits of medication. Many people think that it can be substituted by yoga, meditation, diet, and (or) naturopathy. This belief is misguided. The long-term prospects for people with schizophrenia depend on a family that understands the illness and takes cogent decisions about its management. The illness can be conquered provided the family acts rationally and offers love and care and trust and encouragement to the patient and is ready to raise its own threshold of tolerance.

# Recent Development in Science and Technology

□ Biman Basu

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## Amazing supernova discovered

Supernovas mark the end of massive stars. All supernova explosions are violent affairs, but recently astronomers have spotted a new type of extremely bright cosmic explosion they think originates from an exceptionally massive star.

Two distinct physical mechanisms leading to supernovas are known and

have been identified in nature. The first involves the gravitational core-collapse of a star of mass greater than eight solar masses, following the exhaustion of the nuclear fuel in its core, occurring when silicon is fused to iron. The collapse leads to an implosion which turns into an explosion by recoil. Such explosions leave behind remnants, which may be neutron stars or black holes. This type is known as supernova of type II.

The second process involves the thermonuclear explosion of a degenerate white dwarf star, accreting material from a close companion. Once the mass of the dwarf rises above the Chandrasekhar Limit of 1.4 solar masses, runaway carbon burning begins and the star explodes completely, leaving no remnant. This mechanism is generally assumed to be responsible for the class of supernovas called type I.

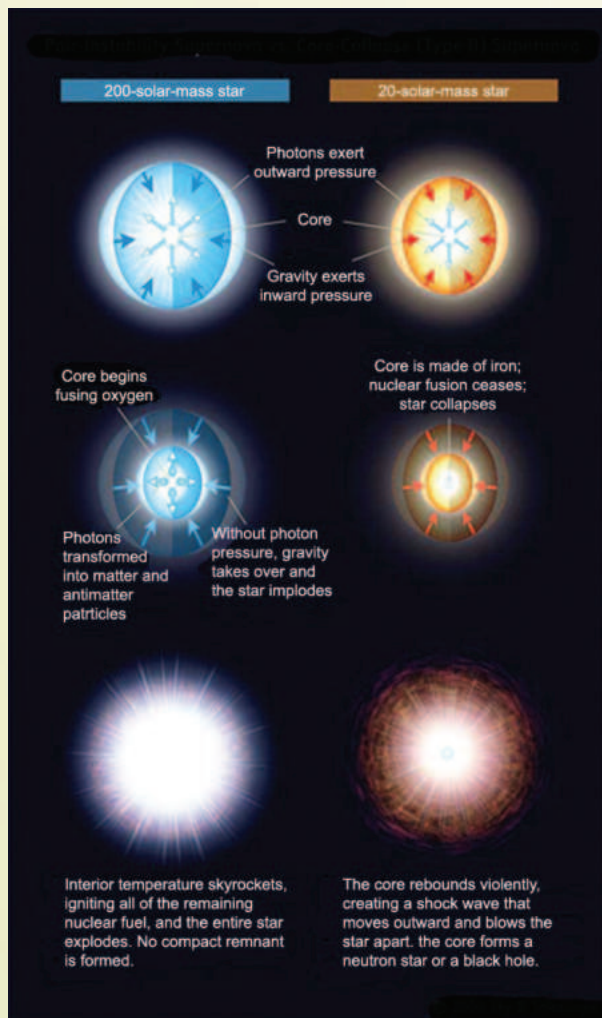
A third type of supernova has been theoretically predicted many years ago, but not convincingly observed till recently. The most massive stars, with initial masses above 100 solar masses or so, develop very heavy cores composed of helium and heavier elements. With so much mass, the star's core is squeezed to such high temperatures and pressures that its nuclear fusion reactions start producing extremely energetic gamma-

ray photons that literally transform themselves (via Einstein's famous equation  $E=mc^2$ ) into particle pairs of electrons and positrons (the antimatter counterpart of electrons). Unlike photons, the particle pairs do not exert an outward pressure strong enough to prevent the star from collapsing gravitationally. As the star implodes, temperatures and pressures shoot through the roof, igniting the entire star's nuclear fuel. Runaway nuclear reactions power a devastating explosion that blows the entire star to smithereens. No compact remnant is left behind; no neutron star, no black hole. Such supernovas are known as pair-instability supernovas (PISN). For very high mass stars, with mass at least 130 and up to perhaps roughly 250 solar masses, a true pair-instability supernova can occur. The discovery of supernova named SN2007bi appears to provide a clean example of a pair-instability supernova.

The supernova was first observed in 2007 in a nearby dwarf galaxy and named SN2007bi and it is still visible. Scientists knew at once it was something different because it was about 50 to 100 times brighter than a typical supernova. It took two years to confirm their hunch. Now it turns out that the dying star may have started out with 200 times the mass of the Sun. After analysing its signature, astronomers have published their findings in *Nature* (3 December 2009), confirming that it matches theoretical predictions of a so-called pair-instability supernova. According to astronomers, the discovery of this rare type of supernova suggests that a few stars actually can grow into such large behemoths.

## Exoplanet with water discovered

A team of American astronomers has discovered an Earth-like planet orbiting a red dwarf star just 40 light years away that may have oceans of water. Dubbed GJ 1214b, the planet is only about 2.7 times larger than Earth and about 6.5 times more massive. Based on its density, scientists think GJ 1214b is made up of about three-quarters liquid water with a solid core of iron and nickel and an



Comparison between pair-instability supernova (left) and type II supernova (right).

atmosphere of hydrogen and helium. According to its discoverers, GJ 1214b is hotter than Earth and its atmosphere is ten times thicker than our own (*Nature*, 17 December 2009).

To discover the exoplanet GJ 1214b the team of astronomers used relatively small (40-centimetre) telescopes equipped with astronomical CCD cameras. The astronomers used an array of eight small telescopes on Mount Hopkins Observatory near Tucson, Arizona called the M<sub>E</sub>arth array, designed to detect minute changes in the brightness of dim, red stars known as M dwarfs. The M<sub>E</sub>arth array accurately and repeatedly measures the brightness of M stars to search for transiting exoplanets. If planets were larger, they would eclipse the stars, however because transiting planets are so much smaller than the stars they only dim the star light a small amount. Periodic dips in starlight can therefore indicate the existence of planet around the star. Because M dwarfs are dimmer than stars like our Sun, it's easier to spot light reductions caused by smaller Earth-size planets. Further, because GJ 1214b passes in front of its star, or transits, from Earth's point of view, it is possible to tell what the planet is made of.

Density is the mass divided by the volume. After astronomers know the radius and mass of a planet, they can calculate the density. GJ 1214b is about 1.9 times the density of water. This density is consistent with a planet consisting of a very deep ocean surrounding a rocky core. Hence astronomers know that GJ 1214b is a very watery world. But the water on GJ 1214b is very hot.

GJ 1214b orbits its star once every 38 hours at a distance of 2 million kilometres — about one-fortieth the distance between Mercury and the Sun. However, despite its close orbit, the planet reaches temperatures of only about 280° Celsius because its star is relatively cool. Astronomers have calculated that the surface temperature of GJ 1214b is 190°C. So GJ 1214b must be a hot steamy world.

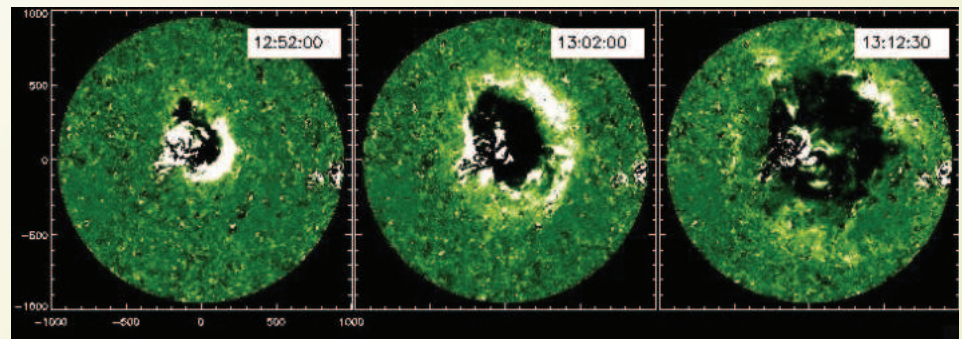
GJ 1214b is considered a super-Earth planet; that is, an exoplanet between 1 and 10 times as massive as Earth. Only 28 of about 400 exoplanets discovered to date qualify as super-Earth type planets.

### Tsunamis on the Sun

When a massive undersea earthquake struck off the west coast of Sumatra, Indonesia, on 26 December 2004, it sent huge waves across the seas that killed more than 230,000 people in 11 countries, including India. The earthquake triggered a series of devastating tsunamis along the coasts of most landmasses bordering the Indian Ocean, with waves up to 30 metres high. It was one of the deadliest natural disasters in recorded history. Now astronomers have confirmed the existence of tsunami waves on the Sun too. Solar tsunamis are launched by huge explosions near the Sun's atmosphere,

kind-a trick of the satellite's eye-but surely not a real wave. It was thought *SOHO*'s observation from a single point of view was not enough to answer the questions about the real nature of the event — neither for that first wave nor for many similar events recorded by *SOHO* in years that followed, until the twin-spacecraft *STEREO* (short for Solar *T*errestrial *R*elations *O*bservatory) was launched by NASA in 2006. The mission uses two spacecraft — one orbiting the Sun ahead of the Earth, the other behind it — to get a stereo view of the Sun.

In February 2009, when sunspot '11012' unexpectedly erupted, the twin *STEREO* spacecraft got the first confirmation of the waves. The blast hurled a billion-ton cloud of gas (CME) into space and sent a tsunami racing along the Sun's surface. The one *STEREO* saw reared up about 100,000 kilometres high, raced outward at 250 km/second, and packed as much energy



*STEREO* images taken in on 19 May 2007 show a tsunami blasting through the Sun's atmosphere at millions of kilometres per hour. (Credit: NASA)

called coronal mass ejections (CMEs). These waves can travel at over a million kilometres per hour.

Solar tsunamis were discovered back in 1997 by the *Solar and Heliospheric Observatory (SOHO)*. In May of that year, solar physicists first witnessed a towering wave of hot plasma racing across the Sun's surface following a CME, they doubted their senses. The scale of the wave was staggering: It rose up higher than Earth itself and rippled out from a central point in a circular pattern millions of kilometres in circumference. Sceptical observers suggested it might be a shadow of some

as 2,400 megatons of TNT ( $10^{29}$  ergs). The report appeared in the 1 August 2009 issue of *The Astrophysical Journal Letters*. According to Spiros Patsourakos of George Mason University, Fairfax, USA, lead author of the paper, it was "not a wave of water, but a giant wave of hot plasma and magnetism."

The physical reality of the waves has been further confirmed by movies of the waves crashing into things. The waves were reflected by sunspots and there is a movie of a solar prominence oscillating after it gets hit by a wave.

According to the researchers, solar tsunamis pose no direct threat to Earth,

but they are important to study. They can be used to diagnose conditions on the Sun. By watching how the waves propagate and bounce off things, it may be possible to gather information about the Sun's lower atmosphere available in no other way.

Tsunami waves can also improve the forecasting of space weather. Like a bull-eye, they 'mark the spot' where an eruption takes place. Pinpointing the blast site can help astrophysicists anticipate when a CME or radiation storm will reach Earth.

### Maize genome decoded

Maize (*Zea mays*) is widely cultivated throughout the world, and the quantity of maize produced each year is much larger than any other grain. While the United States produces almost half of the world's harvest (~42.5%), other top producing countries include China, Brazil, Mexico, Argentina, India and France. Maize and cornmeal (ground dried maize) constitutes a staple food in many regions of the world. Popcorn is

cobs with semi-hardened kernels, coated with lemon juice and spices is a popular snack food in India. Maize is increasingly used as a feedstock for the production of ethanol fuel. Ethanol is mixed with gasoline in order to decrease the amount of pollutants emitted when used to fuel motor vehicles.

Recently a team of more than 250 researchers decoded the complex maize genome containing more than two billion base pairs (compared with the human genome's 2.9 billion base pairs). It is the most complicated plant genome to be deciphered to date and according to the researchers, promises to increase the efficiency of the crop itself.

The four-year project, which was supported by various government agencies promises to contribute a veritable cornucopia of new insights useful to many industries, including agriculture, energy and even manufacturing. The results were published online 19 November in a series of papers in *Science* and *PLoS Genetics*.

than humans do, which are packed onto 10 chromosomes (as opposed to 23 in humans). All of this data, and the repetitiveness of maize's genetic code, made the task a daunting one. The team used a combination of physical and optical mapping to arrive at the findings.

Now that the cereal's 32,000 genes have been mapped, researchers anticipate a new bounty of genetically tuned varieties. A better understanding of the plant's biochemical pathways may even be able to inspire totally new uses. The findings may also help researchers solve the mystery of hybrid vigour, the as-yet unsolved puzzle as to why a hybrid offspring proves to be a better grower than what would be expected from the sum of its parents' genetic assets.

This information is also expected to speed up the development time of new maize varieties. Both academic and corporate researchers will now be able to do genetic tests on seeds to see if they are exhibiting desired traits rather than wait through a full growing season.

According to the researchers, the new picture that has emerged of the plant would also help researchers better understand its evolution and history. The crop was domesticated from a Central American grass called 'teosinte' some 10,000 years ago. Much of the genetic diversity of maize, however, goes back nearly five million years. The new map suggests at least 100 to 200 genes have been involved in the domestication and selective breeding of the plant.

It may seem strange that the number of DNA bases in humans are only negligibly higher than their number in maize, but senior author Richard K. Wilson, Director of Washington University's Genome Center, who led the multi-institutional sequencing effort, points out, "it's important to not get hung up on the numbers." If we based our understanding of sophistication purely on these rankings, he says, "we pale in comparison to the pine tree." It's how the genomes are organised that is important. "Human genes are so much more complicated."



*Maize is widely cultivated throughout the world, and the quantity of maize produced each year is much larger than any other grain.*

kernels of certain varieties that explode when heated, forming fluffy pieces that are eaten as a snack. Roasted dried maize

The task of decoding the maize genome was not simple. The maize genome actually has 12,000 more genes

## Editorial (Contd. from page...35)

to be almost double in the next 50 years. The demand of food will increase not only because of population growth but also because of higher per capita food intake and richer diets particularly in low- and middle-income countries as their economies grow. This additional demand of water for increased food requirements cannot be met without higher water productivity. This can be achieved by improved agronomic practices, technological enhancement and of course more appropriate water management technique. In this area India has to do a lot. Some countries are already producing two to four times more of cereal and high-value crops per unit of land and water. It should be emphasised that while developing strategies for enhancing water productivity it should be ensured that it extends to the poor.

The industrial sector accounts for about 22 per cent of fresh water consumption globally. In developing countries like India, there will be substantial increase in water demand by the industrial sector.

In developing countries like India there is growing urbanisation. As the urban population keeps increasing rapidly, the pressure of urban water supply is also increasing. This is leading or will lead to rural-urban tensions. There is also serious problem of urban wastewater.

The growing concern for water has been echoed in different national and international forums. At international level the first major concern for water was expressed at the UN Conference on the Human Environment held in Stockholm in 1972. The United Nations declared the year 2003 as International Year of Fresh Water. The UN General Assembly at its 58th session (December 2003) proclaimed the years 2005 to 2015 as the International Decade for Action—Water for Life, which began on 22 March 2005 designated as the World Water Day. This was the second International Water Decade. Earlier the

1977 United Nations “Water Conference” at Mar del Plata set up an International Drinking Water Decade, 1981-90.

Despite the fact that India is one of the wettest countries, it is in the midst of a serious water problem. The major reasons for India’s water crisis are: high population density, time and variability of rainfall and increasing depletion and contamination of its surface water and groundwater. The climate change is also affecting the hydrological cycle. Now it is becoming obvious that the impact of climate change on fresh water production and its distribution is going to be really significant.

The most important issue is to redefine water management or water governance. It would require institutional reforms. Education and increased public awareness and participation are paramount prerequisites for better water management.

□ Subodh Mahanti

## Letters to the Editor

### Interesting biographies

I am a regular reader of *Dream 2047*. Its editorials are based on latest problem and thought provoking. I read each and every pages of it with earnest interest. The life histories of scientists are interesting to me. Please introduce in this series the life history and achievements of different mathematicians, like Ramanujan, Euclid, Pythagoras, and, may be, Smt. Shakuntala Devi. I wish a better and brighter future of *Dream 2047*.

**Dharma K. Satapathy**  
Sonepur – 787 018 (Orissa.)

### An archetypal agent for enhancing scientific outlook

I am a student of class IX at Kendrya Vidyalaya, Cuttack. I came across your science magazine *Dream 2047* in our school library. The content of the magazine influenced me much and I think it can serve as an archetypal agent for enhancing scientific outlook of school going students.

**Sandip Jena**  
C/o Sanjay Kumar Jena  
Sector-6, CDA, Cuttack (Orissa)

## Form IV (see rule 8)

Details of the ownership and other facts relating to monthly newsletter ‘DREAM 2047’.

Place of Publication	:	New Delhi
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I, Subodh Mahanti do hereby declare that to the best of my knowledge and belief, facts mentioned above are true.

Sd/-  
Subodh Mahanti

# Sky Map for February 2010

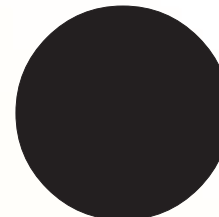
Moon - Last Quarter



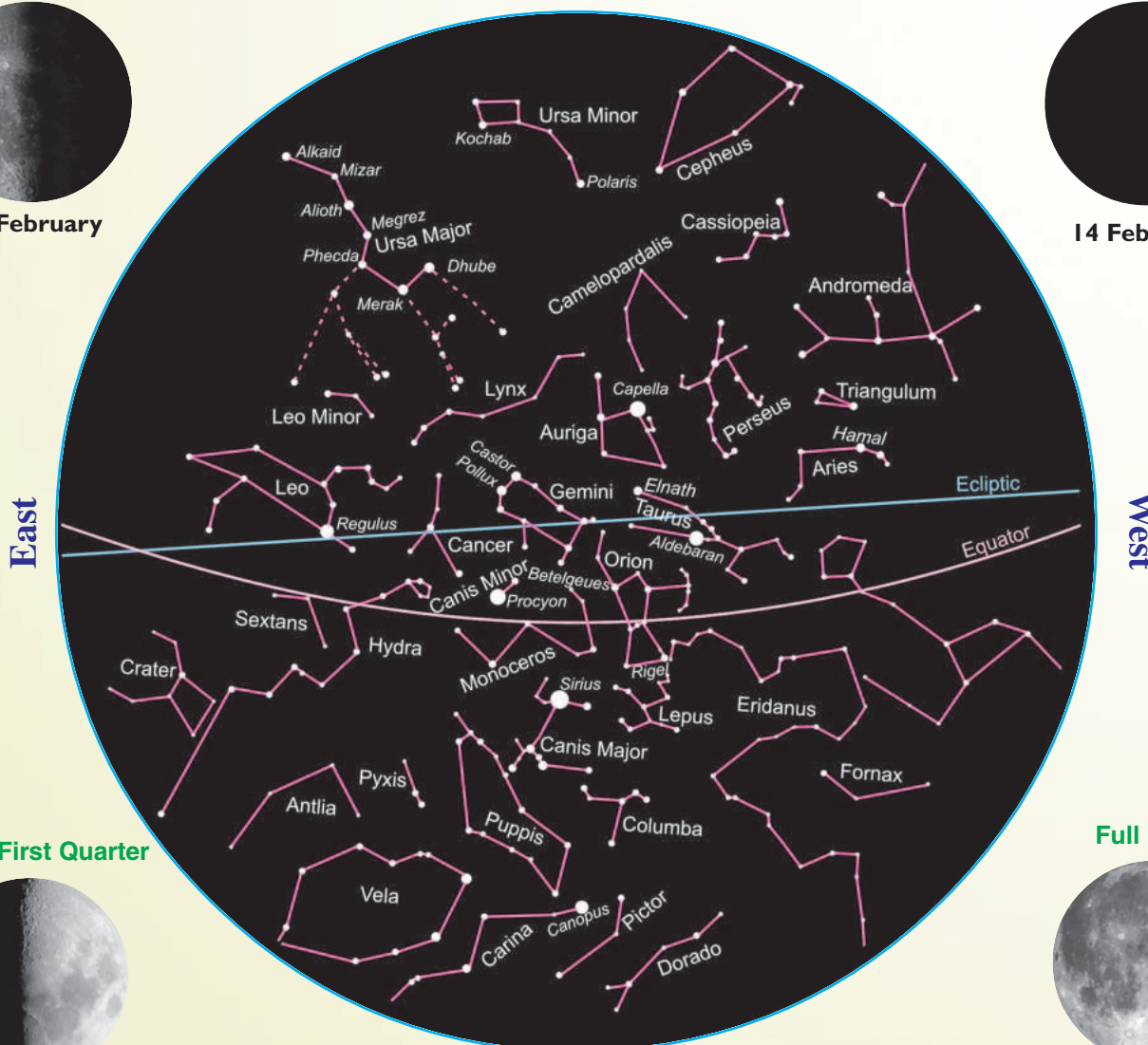
5 February

North

New Moon



14 February



East

West

Moon - First Quarter



22 February

South

Full Moon



28 February

The sky map is prepared for viewers in Nagpur (21.090 N, 79.090 E). It includes constellations and bright stars. 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 viewer 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 1 February, at 9 PM on 15 February and at 8 PM on 28 February.

## Tips to use sky map:

- (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 constellation as shown in the map one by one.

## Visibility of Planets (IST)

	Rising	Setting	In the Zodiac
Mercury	05:39	16:54	Sagittarius-Aquarius
Venus	07:15	18:54	Capricorns-Aquarius
Mars	16:29	05:39	Cancer
Jupiter	07:17	18:56	Aquarius
Saturn	20:48	08:57	Virgo
Uranus*	08:15	20:11	Pisces
Neptune*	06:41	18:10	Capricorns

\*Time shown is subject to vary ( $\pm 1$  hr) from place to place.  
\*Not naked eye object

## Sky Event

Date IST	Event
12	12:25 Moon-Mercury
13	08:36 Moon Apogee
15	05:12 Neptune Conjunction
16	22:11 Venus-Jupiter
28	04:10 Moon Perigee
28	11:11 Jupiter in conjunction

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

## YOUR OPINION

*Dream 2047* has been inviting your opinion on a specific topic every month. The reader sending the best comments will receive a popular science book published by VP. Selected comments received will also be published in *Dream 2047*. The comments should be limited to 400 words.

*This month's topic:*

**“Will the Jawaharlal Nehru National Solar Mission be able to bring electricity to every village in the country?”**

Response should contain full name; postal address with pincode and email ID, if any; and should be accompanied by a recent passport size photograph. Response may be sent by email ([opinion@vigyanprasar.gov.in](mailto:opinion@vigyanprasar.gov.in)) or by post to the address given below. If sent by post, "Response: *Dream 2047* February 2010" should be clearly written on the envelope.



**Vigyan Prasar**

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## Winners of “Your Opinion” contest for November 2009.

**Topic: “Does the discovery of water on Moon by *Chandrayaan-1* open up the possibility of colonising Moon in the near future?”**



**Ms. Bhawana Huidrom**

C/o. H.N. SINGH  
IITM Colony,  
Dr. Homi Bhabha Road,  
NCL Post, Pashan  
Pune – 411008

“The discovery of water on Moon by *Chandrayaan-1* is a major discovery that will change lunar science forever. But the amount of water is tiny – only about one litre per tonne of lunar soil. Unless there is a technological breakthrough, it would be extremely difficult for future Moon colonists to harvest such tiny amounts of water. If harvested, the water can be used to make oxygen for the colonists to breathe and rocket fuel to launch spacecraft to other parts of the solar system. Closed ecosystems will have to be developed where crops can be grown and air, water and other resources can be recycled. But the way some scientists are claiming about the possibility of colonising the Moon in the near future is too far-fetched.”

**Faiyaz Nazar**  
C/o Rajjab Umar  
Qabrastan Gate,  
Mominpura,  
Nagpur – 440 018  
(Maharashtra)

“Although *Chandrayaan's* discovery of water on Moon does not open up any practical possibilities as of now, it has fuelled our imagination to boost the idea about colonising the Moon in future. The traces of water found on Moon should make it possible to extract water from the lunar soil and split the water into its constituents – oxygen, which is the necessary for human survival, and hydrogen, which can be used as a rocket fuel. These elements can also be used for other application in setting up permanent bases on the Moon. This discovery has created the possibility for sending longer manned missions to the Moon and missions to Mars for further colonisation of space.”

## OTHER GOOD RESPONSES

**Sagar Satapathy**  
Near Backgate of Central School  
Siddhamohavir Patana  
PURI – 752 002 (ORISSA)

**N. Lavan Kumar**  
IX A3, Mega City Residential High School,  
Hayath Nagar, Hyderabad - 501 505  
(Andhra Pradesh)

**Sarat Chandra Pandey**  
Pandey Nivas,  
B.T. Road,  
Distt. Sundargarh – 770001  
Orissa

**Mr. M. Banerjee (Consultant)**  
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Flat 12G, Tower 2,  
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Tollygunj, Calcutta – 700 033 (W.B.)

**P. Santosh Kumar**  
S/o P. Nageshwar Rao,  
X Class, Section A2, Mega City High School,  
Hayath Nagar, Hyderabad - 501 505  
(Andhra Pradesh)

**Mehraj Ahmed Dar**  
C/o Sh. Mohi-ud-Din Dar,  
R/o Ashmuji Mirpora  
P/O Ashmuji, Distt. Kulgam,  
Jammu & Kashmir – 192 231

**The winners will receive a copy of VP Publication**

## 17th National Children's Science Congress

The 17th National Children's Science Congress (NCSC) was held at Gujarat Science City and Ahmedabad (Gujarat) from 27-31 December 2009. It was organised jointly by the National Council for Science and Technology Communication (NCSTC), New Delhi; Department of Science and Technology (Govt. of Gujarat); Gujarat Council of Science City (GCSC), Ahmedabad; SGVP International School; and NCSTC network. Vice-President Hamid Ansari inaugurated the five-day Congress. The opening function was presided over by Gujarat Governor Kamla Beniwal with Chief Minister Narendra Modi as the chief guest. The focal theme of the 17th NCSC was "Planet Earth - Our Home- Explore, Care and Share". It also focussed on some important areas such as atmosphere, hydrosphere, lithosphere, biosphere and energy. Around 800 child scientists, including 100 from SAARC countries, selected through a rigorous selection process, took part in the programme.

A stall was put up by VP to display its publications and other software. A survey was also conducted by VP about the perception of the participating child scientists about the Children's Science Congress.



The Child Scientists assembled to form the map of India.

## Workshops on Annular Solar Eclipse

As part of activities during the International Year of Astronomy and to prepare for the Annular Solar Eclipse on 15 January 2010, Vigyan Prasar undertook a country-wide campaign to create awareness about the event among students, teachers and the general public. Two programmes to train master resource persons were organised in Kolkata (14 to 16 December 2009) and Chennai (22 to 24 December 2009). In each programme about 70 resource persons were trained. A variety of software, developed by VP were distributed among the participants.



Participants at chennai workshop

## Bhartiya Vigyan Sammelan and Expo-2009

Bhartiya Vigyan Sammelan (BVS) and Expo-2009 was organised at Indore by the Department of Science and Technology, Govt. of Madhya Pradesh and Vijnana Bharati, in conjunction with Devi Ahilya Vishwavidyalaya and Rajiv Gandhi Technology University from 27 November-3 December 2009 as part of an effort to popularise science and technology for the general public. The theme of BVS was "Green Technologies for Sustainable Development". The event was dedicated to the great Indian scientist Acharya Jagadis Chandra Bose, to mark his 150th birth anniversary. The event was officially inaugurated on 1 December 2009 by Dr. R. Chidambaram. A stall of VP's software was put up at the venue on the occasion.



Stall put up by VP during Bhartiya Vigyan Sammelan and Expo-2009