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Climate Change: A Threat to the Sunderban Ecosystem

John Tuzo Wilson
(A Major Contributor to the Plate Tectonics Theory)

(1908-1993)

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

Three transitions in the interface of science, scientists and citizens defined by Vincent BB – 2013

Dr. R. Gopichandran

Thank you for your attention on this editorial. This is part of a persistent effort of the editorial segment of DREAM. The objective is to assist individuals and institutions engaged in science and technology communication take note of some recent and insightful consolidation of thinking on the dynamics of engaging with citizens on the aspects stated. In this context, it will be appropriate to take note of Vincent BB's analysis (2013) of the nature of dilemmas that dominate the interface of science, scientists and citizens.

The author defines a continuum across efforts to bridge knowledge gaps between scientists and citizens typical of the early years of emergence of science and technology. Today's context on the other hand appears to be dominated by voices of citizens to influence policies pertaining to science and technology choices. Typical cases in point are nuclear energy and biotechnology tools and techniques. In either scenario it was absolutely essential to present only facts in a holistic manner, free of biases. The author further indicates that scientists and lay persons differed only in their styles of argumentation in the earlier periods of the past century. The second transition was when "formalisation" and mathematical / quantitative correlates in science increased. Science magazines and museums helped bridge the communication gap between scientists and citizens. The third transition was with much greater advancements in science and technology towards the latter part of the past century, wherein the challenges of translating science into vernacular modes only grew. However, challenges in communication were compounded with the growing perception that science and progress of civilization were not exactly synchronized. The most important message by Vincent (*op.cit*) was that science in its early period of development was a "social activity" "open to amateurs" whereas presently "...lay practices of science, ..popular and indigenous knowledge..", have been ".. disqualified as pseudoscience". It will be useful to comprehend this message for its worth, and rightly so; while designing popularization and other initiatives focusing on scientific temper.

An interesting emphasis over the past year has been on aspects of science of technology directly relevant for livelihoods and related quality of life implications. I continue to emphasise that these aspects will be robust entry points for engagement with citizens. A typical case in point is the opportunity provided by the International Year of Family Farming 2014. This is promoted by the World Rural Forum with an equal emphasis on policies and related enabling circumstances (www.familyfarmingcampaign.net). Food security, hunger, poverty and sustainable development angles could be explored on the basis of empirical evidences. It will be useful to assess preparedness of communities to comprehend adaptation strategies to design need based information support and technical assistance programmes for the benefit of communities. This will also create an invaluable opportunity to stimulate scientific thinking regarding practices. The chances that they will be readily imbibed by communities are quite large because of the real-life connect. Importantly, the scope to integrate verifiable indigenous knowledge could also be significant; only to strengthen perceptions sound on science. Agricultural universities across the country and outreach mechanism at the grassroots level including village level workers and *krishi vigyan kendras* should be involved in this convergence.

[Vincent BB 2013. Reconfiguring the public of science. Pp 105 – 118. In: Science Communication today – International Perspectives, Issues and Strategies. 318 p. Baranger P & Schiele B (Eds) 2013 CNRS Editions. Paris. Universite' de Lorraine & International Conference on Science Communication.]

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John Tuzo Wilson

A Major Contributor to the Plate Tectonics Theory

Dr. Subodh Mahanti
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"Wilson did much to establish the new discipline of plate tectonics during the early 1960s and was the first to use the term 'plate' to refer to the rigid portions (oceanic, continental, or a combination of both) into which the Earth's crust is divided. In 1963 he produced some of the earliest evidence in favour of the sea-floor spreading hypothesis of Harry H. Hess…His most significant work, however, was contained in his important paper of 1965, 'A New Class of Faults and their Bearing on Continental Drift', in which he introduced the idea of a transform fault."

A Dictionary of Scientists, Oxford University Press, 1999

"Tuzo Wilson's approaches to science and to life were straightforward. He himself had the wonderful capacity to assimilate and retain the detail, while arrive intuitively at simple yet elegant models. He was one of the most imaginative earth scientists of his time, and the father of academic geophysics in Canada. Canadian geophysicist J. Tuzo Wilson was also pivotal in advancing the plate-tectonics theory. Intrigued by Wegener's notion of a mobile Earth and influenced by Henry Hess' exciting ideas, Wilson was eager to convert others to the revolution brewing in the earth sciences during the early 1960s"

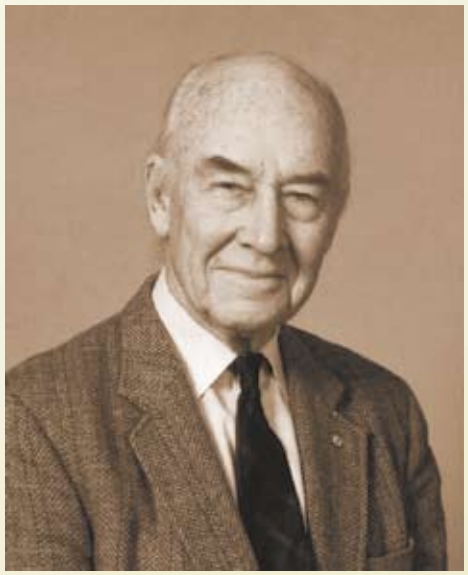
http://academic.emporia.edu/aberjame/histgeol/JT_Wilson.pdf, retrieved 10 November 2013

"Tuzo's (John Tuzo Wilson's) mind had a fascinating way of solving problems. Unlike most physicists, who find their solutions via mathematics, Tuzo solved problems almost entirely with visual images and then presented the solutions in extremely clear prose. He had a remarkable ability to look into the heart of extreme complexity and see simplicity itself. The nearest mind that I can think of to compare with Tuzo's was that of Michael Faraday who, instead of integrating differential equations to calculate the electric field, imagined a charged particle to be an octopus with tentacle-like lines of force reaching out into the space around it."

Derek York, Physics Department, University of Toronto (http://gsahist.org/gsat/gtolsept 24_25.htm, retrieved 11 November 2013

John Tuzo Wilson (usually known as Tuzo Wilson) proposed the concept of transform fault in plate tectonics, which occurs where continental plates slide past one another rather than one sinking below the other in a subduction zone. He explained the occurrence of volcanoes far away from the plate boundaries by formulating his 'hot-spot' theory. This helped establish the theory of plate tectonics. Wilson was one of the first geologists to link seafloor spreading with land geology. In 1963, he supported the sea-floor spreading hypothesis of the US geologist and geophysicist Harry Hammond Hess (1906-1969) by pointing out that the age of islands on either side of the mid-oceanic ridges increases with their distance from the ridge. The Wilson Cycle of seabed expansion and contraction bears his name. Wilson also pioneered the use of air photos in geological mapping. He played a key role in preparing the first glacial map of Canada. He was second Canadian to fly over the North Pole.

Wilson's role as a teacher was very significant. He had an extraordinary ability for spotting and nurturing talent. He co-authored *Physics and Geology* (1959), one of the first geophysical textbooks. Wilson served on the National Research Council of Canada (1958-64). He wrote for popular audiences including two books on China that helped open relation between China and the western countries. He was a great science populariser and served as the director-general of the famed Ontario Science Centre, where he promoted hands-on displays and mobile exhibits. He hosted the television series *The Planet of Man*.



John Tuzo Wilson

Tuzo Wilson was born on 24 October 1908 in Ottawa to Henrietta Tuzo and John Armistead Wilson. His mother Henrietta Tuzo was an adventurous woman, who loved mountaineering. Henrietta Tuzo and her Swiss guide Christian Bohre were the first to scale the Peak Seven in the Valley of the Ten Peaks in Alberta, Canada. In honour of her accomplishment Peak Seven was named as Mount Tuzo. Wilson's father, a Scottish engineer, played an important role in the development of civil aviation in Canada. He helped develop airfields throughout Canada. He also helped plan the Canadian Arctic Expedition of 1913-1918.

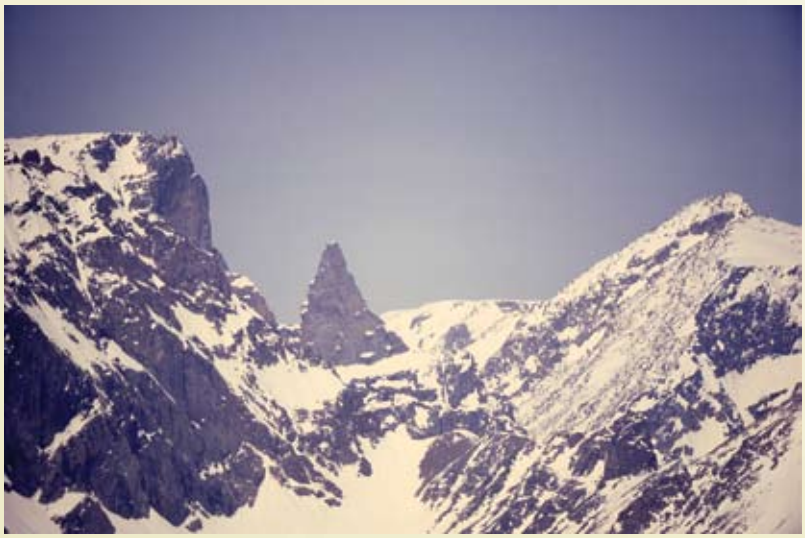
Wilson studied in a private school in Ottawa. After completing his school education he studied physics and geology at Toronto University from where he graduated in 1930. Wilson was the first Canadian to take a university course in geophysics. At the age of 17 he had an opportunity to work as a field assistant to the famous Everest mountaineer Noel Odell. Wilson later recalled that it was Odell who showed

him 'the wonders of field geology.' After obtaining his graduate degree from Toronto University he went to study at Cambridge University in England on a Massey Edward Fellowship. He wanted to pursue a graduate course in geophysics at Cambridge. However, after reaching Cambridge Wilson found out that there was no organised geophysics department. He attended lectures both in physics and geology and found them interesting.

Harry H. Hess

After returning to Canada he worked for a year under W.H. Collins (1878-1937), Director of the Geological Survey of Canada. As there was no permanent position, Collins suggested to Wilson that he should go to an American University for doing his PhD and then come back. Wilson went to Princeton University, though he had offers from Harvard University and Massachusetts Institute of Technology. As part of his PhD work, he carried out geological mapping in the Beartooth Mountains of Montana. His PhD supervisor was Taylor Thorn, who was a structural geologist and an expert on the Beartooth Mountains. During his PhD work Wilson made the first recorded climb of Mount Hague, an elevation of 12,328 feet (3,758 m). At Princeton he met Harry Hammond Hess, Maurice Ewing and George Woodland, who would later made pioneering contributions in geophysics. Wilson obtained his doctorate degree in 1936.

When the Second World War broke out, Wilson left Geological Survey of Canada to join the Canadian Army. After serving four years overseas Wilson returned to Canada as a Colonel and Director, operational research. He organised Exercise Musk-Ox, which he described as 'the first and still the most extensive motorised expedition ever to cross the Canadian Arctic.' He directed 10 army vehicles 5,470 km through the Canadian Arctic and demonstrated that people could travel to this part of the country. He was the second Canadian to fly over the North Pole. He was searching unknown Arctic islands during 1946-1947.



Beartooth mountains

In 1946, Wilson had three career choices before him. He could remain in the Army, return to Geological Survey of Canada and engage himself in geological survey (he had been promised the directorship), or accept the position of Professor of Geophysics in the Department of Physics, Toronto University. Influenced by Chalmers Jack Mackenzi (1888-1984), the then President of the National Research Council of Canada, Wilson opted for the Professorship in Toronto University.

At the beginning of his research career, Wilson published research papers in defense of contractionism and to expand its scope to explain the origin of continents, their growth and the origin of mountains and island arcs. According to the theory of contractionism the Earth was slowly cooling and shrinking and the mountain ranges formed like the wrinkles on a dried apple. Further the oceans were merely submerged parts of earlier continents. Wilson believed that the idea of contractionism with suitable modification will serve better than mantle convection. He had discarded continental drift by arguing that there could not be such a strong physical force to break apart a supercontinent.

Michael Faraday

In 1963, Wilson published his hotspots theory, which removed an apparent contradiction to the plate tectonics theory – the occurrence of active volcanoes located many thousands of kilometres away from the plate boundaries. Wilson argued this could happen only if relatively small, long-lasting and exceptionally hot regions or hotspots existed below the plates capable of providing localised sources of heat to sustain volcanoes. He proposed that Hawaii and other volcanic island chains might have formed due to the movement of a plate over a stationary hotspot in the mantle. At the time of proposing his hotspots theory, it was considered too radical an idea to be accepted. His paper describing his hotspots theory was not accepted for publication. It was finally published in a relatively obscure journal, the *Canadian Journal of Physics*. The paper later became a milestone in plate tectonics.

In 1965, Wilson published his famous paper titled *A new class of faults and their bearing on continental drift.* In this paper Wilson introduced the idea of transform fault. Before the introduction of idea of transform fault by Wilson, two types of plate movements had been identified, namely divergent and convergent plate movements. In divergent plate movement plates are separated by the production of new oceanic crust from the mid-ocean ridges. In convergent pate movement, plates move toward each other with one plate sliding under the other. Wilson realised the need of a third kind of movement to explain the distribution of seismic activity and why the ocean ridges do not run in continuous lines.

Transform faults, also called conservative pate

boundaries, connect oceanic ridges (divergent boundaries) to oceanic trenches (convergent boundaries). This is a type of faults in which two tectonic plates slide past each other. Transform faults allow for plates to slide past each other without any oceanic crust being created or destroyed. The spatial orientation of transform faults is typically parallel to plate motion but it is not always the case. They were regarded as the missing piece in the puzzle of plate tectonic theory. Transform faults end abruptly and are connected on both sides to other fault ridges or subduction zones. Transform faults are the only type of strike-slip faults that can be classified as a plate boundary. While most transform faults are hidden in the deep oceans where they form a series of short zigzags accommodating seafloor-spreading, the best known are those on land at the margins of tectonic plates. The San Andreas Fault between the North American and Pacific plates is the most famous example of a transform fault.

Tuzo mountain

In 1967, Wilson became the first Principal of Erindale College, a suburban campus of the University of Toronto. At the time of his joining the college constituted one building in 120 hectares of land. In fact the college existed only on paper. Before his mandatory retirement in 1974 at the age of 65 he converted it into a model of modern university college.

After his retirement from the University of Toronto, Wilson took up the post of Director General of the Ontario Science Centre and remained there till 1983. During his tenure as Director General, the Centre expanded its "hands-on approach" so that the visitors could do experiments on their own and enjoy science as a creative and fun activity. He also developed mobile exhibits so that science could be taken to people in remote areas of Ontario. He helped establish a northern extension of the Science Centre, Science North, in Sudbury, Ontario.

Wilson received several awards in recognition of his outstanding contributions including: Officer of the Order of the British Empire (1946), R. M. Johnston Medal of the Royal Society of Tasmania (1950), the Willet G. Miller Medal of the Royal Society of Canada (1958), the S. G. Blaylock Medal of the Canadian Institute of Mining and Metallurgy (1959), the Logan Medal of the Geological Association of Canada (1968), the Bancroft Award of the Royal Society of Canada (1968), the Bucher Medal of the American Geophysical Union (1968), the Penrose Medal of the Geological Society of America, the J. J. Carty Medal of the US Academy of Sciences (1974), the Gold Medal of the Royal Canadian Geographical Society (1978), the Wollaston Medal of the Geological Society of London (1978), the Vetlesen Prize (a prize regarded as the equivalent of the Nobel Prize in earth sciences) of the Columbia University (1978), the Ewing Medal of the American Geophysical Union (1980), the Huntsman Award of the Bedford Institute of Oceanography (1981), the Alfred Wegener Medal of the European Union of Geosciences (1989), and the Killian Award of the Canada Council (1989).

In 1957, Wilson was the President of the International Union of Geodesy and Geophysics. He was elected President of the Royal Society of Canada (1972-73), and of the American Geophysical Union (1980-82). He was the Chancellor of the York University (1983-86).

Wilson died on 15 April 1993 in Toronto, Ontario, Canada at the age of 84. Mountains in Antarctica and an extinct volcano on the floor of the Pacific off Canada's west coast have been named in honour of Wilson. The John Tuzo Medal of the Canadian Geophysical Union recognises achievement in geophysics.

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(*The article is a popular presentation of the important points on the life and work of John Tuzo Wilson available in the existing literature. The idea is to inspire the younger generation know more about John Tuzo Wilson. The sources consulted for writing this article have been listed. However, the sources on the Internet have not been individually listed. The author is grateful to all those authors whose writings have contributed to writing this article. The author is also grateful to the sources from which the illustrations/photographs have been reproduced*).

India's Mars Orbiter Mission

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On 5 November 2013, the mood in the hi-tech mission control centre at Sriharikota, India's vast spaceport not far from Chennai, was surprisingly relaxed despite the fact that a mission of both national and international importance was slated for lift off in a few hours. Gradually, the relaxed atmosphere in the control room began to give away to one of tension and nervous apprehension—quite understandable.

A few minutes later there was an announcement that the mission was a 'go' for launch. Mission director P. Kunhi Krishnan announced: "Based on all these parameters the launch operation sequence has been authorised for the PSLV-C25/ Mars Orbiter Mission." The vehicle director then gave the 'go' for the automatic launch sequence system to be activated. The on-board computer flight programme was initiated with only six minutes left for the launch. This was followed by the all too familiar final moments of this historic countdown – 10-9-8-7-6-5-4-3-2-1-0. One could hear a thunderous sound followed by an announcement "Lift off normal." It was 2.38 p.m.

Within seconds, the awesome brown-and-white four-stage rocket, the highly-successful Polar Satellite Launch Vehicle (PSLV), came into sight followed by a yellow and white fiery plume as it rose higher and higher into the clear blue sky over Sriharikota with an ear-deafening sound. As it climbed the rocket triggered a huge applause in the mission control room, among the invitees and those who had gathered in the nearby building balconies and terraces.

This was a flight indeed of tremendous importance and significance, perhaps a landmark one in ISRO's 50-year-old history. The rocket had as its payload which by no means was an ordinary one.

The 1,350 kg spacecraft carried by the PSLV-C25 was heading for Mars. It is an orbiting mission provisionally with a six-month life span and not a landing one. Carrying a price tag of a mere Rs 450 crores – which is approximately equivalent to 72 million US dollars – it has been billed as the cheapest Mars mission in the world. In contrast, NASA's latest mission to the Red Planet – the Mars Atmosphere And Volatile Evolution Mission (MAVEN), which was launched on 18 November 2013, costs 671 million US dollars.

Going by the simple name Mars Orbiter Mission, or more affectionately just MOM, it carries five scientific instruments or payloads for studying the Martian atmosphere, explore the surface features and topography, and most importantly, trace the source of the elusive methane which will help to find out if the Red Planet ever supported life. Its instruments include a Mars Colour Camera, which will take pictures of the planet. En route to Mars, the camera took a shot of India on the afternoon of 19 November and this can be accessed on ISRO's website as well as MOM's ever increasing popular official Facebook.

PSLV-C25 carrying ISRO's Mars Orbiter Mission takes off from Satish Dhawan Space Centre SHAR on 5 November 2013.

The five payloads of MOM are:

(1) Lyman Alpha Photometer, which in layman's parlance will help scientists understand the loss process of water from the planet.

(2) Methane Sensor for Mars, which will measure methane in the Martian atmosphere.

(3) Mars Exospheric Neutral Composition Analyser (MENCA), which will undertake particle environment studies.

(4) Mars Colour Camera, which is tri-colour and will provide images and information about the surface features and composition of the Martian surface. These will be useful for monitoring important Martian events and the weather of Mars. The camera will also probe the two satellites of Mars – Phobos and Deimos.

(5) Thermal Infrared Imaging Spectrometer (TIS), which will map the surface composition and mineralogy of Mars.

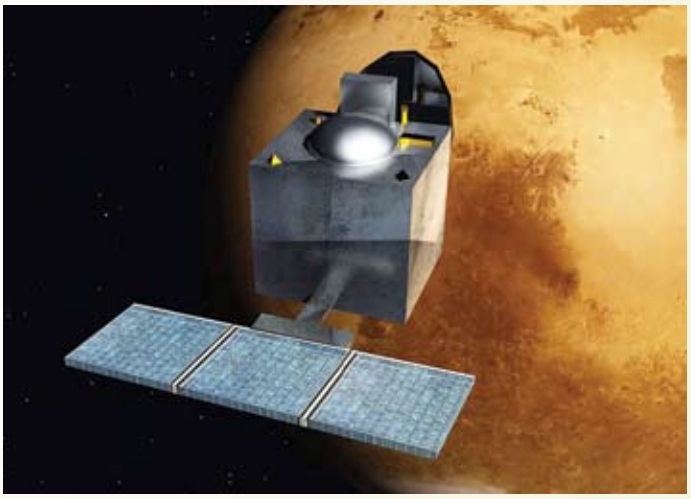
Director of ISRO's Ahmedabad-based Space Applications Centre, A.S. Kiran Kumar has been quoted in the media as saying that the methane sensor in MOM will pick up the methane absorption wavelength and measure for the magnitude of methane up to the surface of the planet. His statement assumes significance because it was his organisation which developed the sensor. About NASA's Curiosity rover not finding methane, he said that its finding was focussed at a particular location and did not cover the entire Red Planet, which MOM will do.

The original plan envisaged MOM carrying nine scientific instruments, but these were finally reduced to five because of weight constraints imposed by the rocket. The weight of the five payloads is 15 kg.

MOM's configuration is a mix of designs from the flight-proven Indian Remote Sensing Satellite, the Indian National Satellite System, and Chandrayaan-1, India's first mission to the Moon. For the Mars mission changes were made in the areas of communication, power and propulsion (for the liquid apogee motor to restart after a year) systems.

The mission is basically a technology

demonstrator and the objectives include the design and realisation of the Mars orbiter with a capability to survive and perform Earth-bound manoeuvres, a cruise phase, and the Mars orbit insertion. A tricky aspect of this mission is the autonomy of the spacecraft. The reason: the spacecraft has to act on its own once it is in deep space. For a signal to be transmitted one way from the ground station to the spacecraft will be around 20 minutes. So it will be 40 minutes both ways. In the event of an emergency this is a long time for a quick response. Considering this the spacecraft has to think independently.



Artist's rendering of the MOM orbiting Mars.

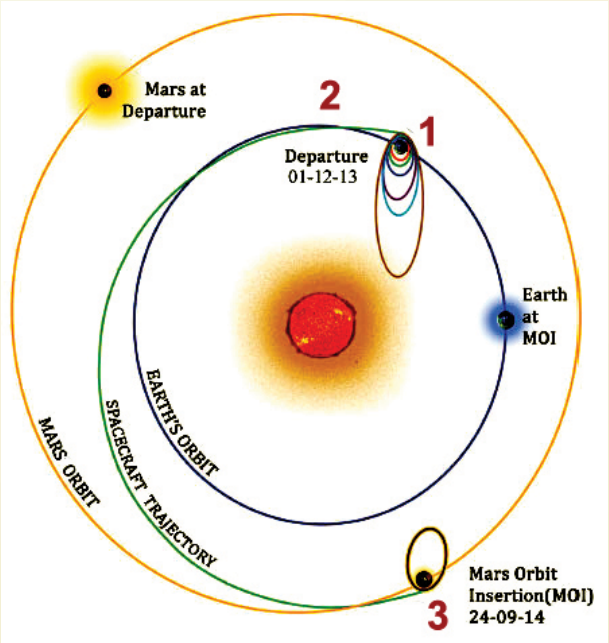
After a flawless take off on 5 November, when the rocket was flying at a whopping velocity of 12,440 km per second, the third stage of the rocket separated, and 28 minutes later its fourth stage ignited. There was tension among the scientists when there was a long coasting period over the South Pacific near Fiji lasting for 28 minutes – a first for an ISRO mission. What made it particularly nerve-wracking was that, out of the 28 minutes there was no communication with the spacecraft for 10 minutes. In a pre-planned manoeuvre the rocket switched off its engine to coast without consuming fuel.

Since the spacecraft was passing through a region where there was no ground station visibility, two civilian ships of the Shipping Corporation of India, "SCI Nalanda" and "SCI Yamuna," were deployed in the South Pacific to track the spacecraft. To the tremendous relief of the ISRO team "SCI Nalanda," picked up the signal from the spacecraft 33 minutes after launch.

Then, just before firing the fourth stage, the rocket restarted the engine on its own. After this the first important sequence occurred 2656.72 seconds after lift-off when MOM separated from the rocket and was placed in an elliptical Earth orbit. There was a sense of relief and the atmosphere turned celebratory because the first major milestone had been crossed without a hitch.

After this there were seven orbit raising manoeuvres over a period of time. These manoeuvres increased the velocity of the spacecraft before another historic event took place in the early hours of 1 December 2013. Called the Trans Martian Injection (TMI) it involved what is known as the mother of slingshots – hurling MOM into the nearly 300-day 680 million-km trajectory to the Red Planet.

It was another critical and nail-biting exercise which took place successfully at 12.49 a.m. on 1 December. The spacecraft's liquid apogee motor (LAM) began firing for 23 minutes which gave the spacecraft an incremental velocity of 648 metres per second that imparted it enough velocity to escape Earth's sphere of influence..



PSLV inserts the orbiter to an Earth Parking Orbit of 248 × 23,000 km. 2. Spacecraft leaves Earth in a trajectory that takes it towards Mars. 3. Spacecraft arrives at Mars in a hyperbolic trajectory and enters Mars orbit.

In short, the mission is divided into three phases. The first is known as the geocentric phase covering the Earth's sphere of influence. The second is the heliocentric phase, which makes MOM come under the Sun's influence. And finally the third phase is the Martian phase.

Once the spacecraft flew into the trans-Mars trajectory its velocity and distance were monitored and compared with the desired trajectory. Yes, they matched and TMI was successful. This exercise was a key mission test which had been accomplished without any hitch, and also ISRO's first-ever experience of hurling a spacecraft beyond the Earth's sphere of influence, kick starting a new era of interplanetary missions for India.

The mission was being tracked by radars at Sriharikota, Port Blair, Brunei, and Biak in Indonesia, apart from "SCI Yamuna" and "SCI Nalanda." Once MOM was placed in its orbit, a network of ground stations which include Byalalu near Bangalore, and NASA's Jet Propulsion Laboratory deep space network at Goldstone in California, Canberra in Australia, and the one in Madrid, Spain began monitoring the mission.

In the orbit-raising manoeuvres, MOM successfully sustained several passes of lethal radiation belts speculated to have been formed by furious solar winds and harmful cosmic rays. According to ISRO, MOM has been designed with sufficient safeguards against such fatal particles.

By 5 p.m. on 2 December MOM had travelled a distance of 5,36,000 km crossing the lunar orbit, becoming the furthest Indian-made object in space. MOM struck another milestone on December 4, bidding a final goodbye to Earth at about 1.14 a.m. zooming beyond the Earth's sphere of influence.

According to ISRO, all the velocity needed by MOM to reach

Continued on page 22

Bose and the Sound of Music

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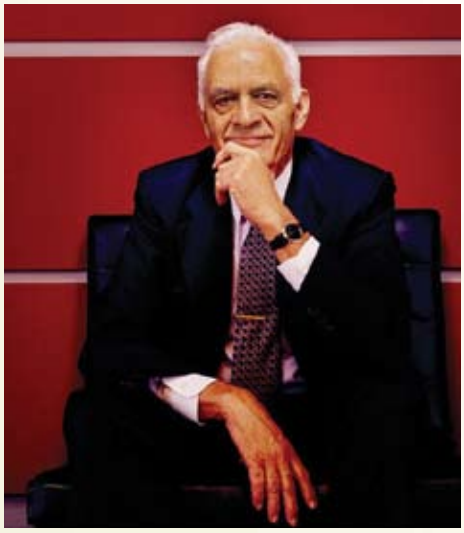
The world of acoustics lost one of its greatest innovators on 12 July 2013. Amar Gopal Bose, who dominated the music industry for nearly five decades and changed the way people listen to and enjoy music, was no more. He was 83.

Who was Bose?

Amar G.Bose, Retired Professor of Electrical Engineering, Massachusetts Institute of Technology (MIT), Boston, USA and Chairman, Bose Corporation was an inventor par excellence. His father, NaniGopal Bose from Kolkata, was a staunch nationalist and a freedom fighter. In 1920, NaniGopal Bose had to flee from India to escape persecution from the British and immigratedto USA with just five dollars in his pocket. He toured from Philadelphia to Washington DC for 15 years, lecturing on the atrocities of the British Rulers in India. During this period, he met an American lady by name Charlotte and the two got married. Amar Bose was born on 2 November 1929 in Philadelphia. Though his mother was an American, Bose recalls in an interview to the *Discover*magazine in 2004, "The food we ate was Indian, and both my parents were very deep into the ancient philosophy of India, so it could have been an Indian household".

From childhood, Amar Bose was curious about things around him. He used to tinker with toys. He loved music and started learning violin from age five. Later he developed interest in radio and even learnt to repair them. "I joined Boy Scouts when I was 12. One of the other scouts had a radio transmitter. I learned that if I correlated the parts of the transmitter with a diagram, I could learn to read schematic drawings. At 13 I realised that I could fix anything electronic. It was amazing. I could just do it. I started a business repairing radios. It grew to be one of the largest in Philadelphia," Bose recalls.So when he entered MIT for graduate studies, he already had a background of electronics and chose Electrical Engineering for higher studies. He went on to earn a Ph.D. degree and then started teaching there.



Amar G. Bose

His romance with acoustics started in the 1950s, when he was still a student. Bose bought a stereo system, which boasted impressive reproduction of the original sound. However, he was utterly disappointed, because it failed to stand up to its promise. That ignited in young Bose the quest for a better sound system for home use.

In the spring of 1956, Bose came to India to teach under a Fulbright Scholarship. During his spare time, he studied books on acoustics and learnt that in a concert hall only a small portion of the sound heard by a listener constituted direct sound from the stage; the rest arriving after many reflections from walls, ceilings, etc. Only about two percent of thesound is absorbed in each reflection. When he went back to USA, he did experiments with the Boston Symphony. "The concert hall became our laboratory and an unconventional line of thought evolved. Most of the sound at a live performance is reflected off the walls, ceiling and floor." Bose recalls. He actually measured the angles of incidence of sound arriving at the ears of the audience and analysed them at the MIT. He confirmed that 80% of the sound heard by a person in a concert hall was reflected sound. Unfortunately, loudspeaker designers of that time had ignored this phenomenon of 'psychoacoustics'– the way humans perceive sound. Therefore, in 1964 he founded Bose Corporation with the motto "better sound through research".

In the beginning, it was not easy. The first problem was finance. Fortunately, he received support from Dr. Y.W.Lee, another professor at MIT. However, he had to work even late at night on sponsored research without financial returns. Through years of hard work his engineers began to understand why the ratio of the reflected sound to direct sound was so important to live music. Their experiments revealed that it was the spatial characteristics of the concert hall that gave the music its live quality. To get the same effect from a loudspeaker they had to emulate those characteristics. Through further experiments they found that the desired ratio is about eight or nine to one. On that basis Bose, in 1968, came out with a new speaker design that incorporated his ideas of psychoacoustics. It had a pentagon shape and consisted of eight identical small, mid-range drivers, which were aimed at the wall behind the speaker cabinet and one driver aimed forward. This ensured the dominance of reflected sound on direct sound as in a live performance. Each driver was equipped with an electronic equaliser. He called the design "Direct/Reflected Model 901" and it became an instant success. In a home setting, the listeners could finally experience the rich and vivid music of a concert hall. From then of Bose Corporation grew rapidly.

Acoustic waveguide technology

In the 1970s, it was generally believed that only large speaker assemblies could produce good quality sound, covering a wide range of frequencies– from the intricate notes of a violin to low-frequency bass of a tabla. Hence, good sound systems were either full-sized floor-standing units or book- shelf type, accompanied by a subwoofer to handle only very low frequencies. They occupied the whole room and were unsuitable for home setting. The challenge was to produce a compact system, which faithfully reproduced

Concept of acoustic waveguide

the frequency range without distortion.

Bose observed that in a flute a small stream of air through the mouthpiece can produce sound loud enough to fill a room. By placing his fingers at different positions along the length of the flute, the artist can produce different frequencies. The flute worked like an "acoustic waveguide". Bose and his team realised that by mounting a speaker inside a tube, the system could act as an acoustic waveguide, effectively transforming a small amount of the input air into a large sound. The movement of the speaker cone in the tube was equivalent to varying the length of the waveguide, generating a range of frequencies. That meant that even a small speaker mounted in a tube could produce a clear, loud sound without distortion. In addition, they also found that the tube could be folded into an intricate pattern to conserve space without compromising on the quality of sound. The result was a compact stereo system with a folded acoustic waveguide, delivering life-like quality sound without the need for huge, room-filling speakers and components. For example, the Bose Acoustic Wave music system good for a large theatre is less than 30-cm high but contains a waveguide that is 200 cm long.

Based on the same technology, Bose Corporation also produced compact a radio with the trade name "Waveradio". The complete system is only 35 cm wide, yet delivers rich sound thanks to a87-cm waveguide wrapped inside. Then they went on to design car stereos with palm-sized speakers to produce the same rich quality sound, previously thought impossible from speakers so small. The acoustic waveguide technology was so revolutionary that it reshaped the conventional thinking about the relationship between the speaker size and quality of sound. Bose and his engineer Dr. William R. Short were together named the "Inventor of the Year" in 1987.

A noiseless headphone

In 1979, while on a flight to Europe, Bose tried out a new headphone offered to him to listen to music. However, he could not really enjoy the music because of the roaring sound of the engine in the background. That set him thinking about a headphone that could filter the noise and leave the music unaffected. After researching for more than a decade on noise reduction technology, Bose came up with an ingenious design which he called "Acoustic noise cancellation", to selectively eliminate the background noise.

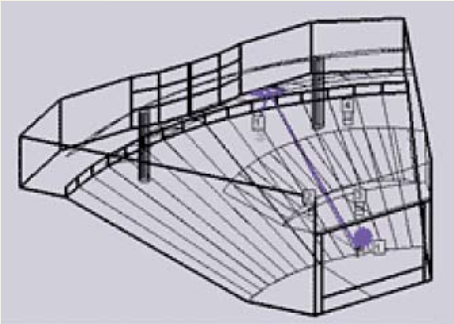
Acoustic noise cancellation head phone and its inside view

The novel design, in addition to using sound absorbing material to passively filter high-frequency sound, also incorporated an electronic method to actively erase the unwanted low-frequency sound. It consisted of a microphone and some additional electronic circuits. According to a description given by the Bose Corporation "the microphone hears the sound waves an instant before they reach the ears. The advanced electronics system recognises what the listener wants to hear– a message from the control tower, music, an in-flight movie or nothing at all and compares it to the sound that the listener does not want". The electronics system then generates sound waves which mimic the noise both in frequency and amplitude, but 180 degree out of phase. These waves interfere with the incoming waves and cancel them out, leaving behind only the desired sound. Incorporating this technology into the "Triport" headphones produced another innovative design to produce deep low notes, which enabled onetoenjoy the rich music without external noise. Besides music lovers, astronauts in NASA'sspace shuttles, US military and pilots around the world, wherever clean sound is desired, also have been using it. It also protects againsthearing damages.

Acoustics and architecture

Sound in an auditorium is not just where you place the speakers. The audience at the end of a program remembers a performance for the quality of the sound. It has been the philosophy of Bose that a sound system does not and cannot perform independently of its surroundings. The sound waves interact with the building's geometry and materials. Hence, it has always been his endeavour to integrate acoustics with architecture. This can be seen best in "Auditoner", a technology he developed to design sound systems for arenas and halls. It is based on a software called "Bose Modeller" that allows acoustic engineers to hear precisely what a proposed audio system would be like from every seat, even before the construction of the building. It utilises the geometries of the auditorium walls and ceiling to push back the sound to the room. Like using mirrors to reflect light in specific ways, they use the architectural features to fine-tune the redirection of the acoustic energy. As a result a person can speak at a normal level and be confident that everyone

Kamala Nehru College Auditorium in Delhi designed by Bose Corporation India



Auditioner system diagram

in the auditorium can hear. A question asked anywhere in the auditorium will be easily heard by all.

Using this technology Bose engineers have designed many auditoria to provide quality sound with uniform dispersion, appropriate level and optimum speech intelligibility. The polygon-shaped Sri Sathya Sai Sanskrit Sadan Auditorium in Bangalore, Kamala Nehru College Auditorium in Delhi and the Gujarat Law Society Auditorium are some of the examples of this technology.

Gliding on the road

Bose's attention was not confined to acoustics alone. Anything challenging attracted him. Automobile suspension is one example. The objectives of an automobile suspension are passenger comfort and vehicle control. Comfort is provided by isolating the passenger compartment from bumps and potholes on the road. Control is achieved by keeping the car body from rolling and pitching excessively while taking sharp turns and maintaining a good contact between the tyres and the road. However, in the present automobile suspension systems based on hydraulics, both the goals are seldom realised together in the given vehicle. Luxury sedans are good in passenger comfort, but poor in vehicle control. Sports cars pay more attention to vehicle rolls and pitches at the cost of comfort. The challenge is to design an automobile suspension, which can provide both comfort and control satisfactorily. After studying the problem for nearly 20 years, Bose, in 2004, came up with a revolutionary suspension system based on electromagnetic principles. In the new system, ultra-fast linear electromagnetic motors are mounted on each wheel. They receive inputs from sensors located throughout the vehicle, react to the bumps and potholes, and isolate the passenger compartment accordingly. The result is an unbelievably smooth journey even on the worst roads. Additionally, the motors have been designed with enough power so that they can put out sufficient force to prevent the vehicle from rolling and pitching even during aggressive driving manoeuvres.

Vehicles fitted with Bose suspension have been tested under a variety of driving conditions and have demonstrated excellent comfort and control. Auto experts have expressed the opinion that it is a "mega-breakthrough in car suspension".

Chasing ideas

Amar Bose retained all the curiosity and tenacity that characterised his childhood. He said in an interview that he started Bose Corporation not just to make money, but also to chase ideas. And he chased ideas successfully not only in acoustics and automobiles but also in many other areas like defence, aviation, nuclear physics, and so on. He was featured in 2006 Forbes 400.

In February 2008, Amar Bose was inducted to the US National Inventors Hall of Fame. The Hall of Fame Foundation which started in 1973 had inducted, till then, 371 inventors– most of them posthumously, in recognition of their technological advances and contribution that make human, social and economic progress possible. With this induction Bose joined the ranks of the mighty ones like Thomas Alva Edison, Alexander Graham Bell, and others.

Bose Corporation now employs more than 8,000 people around the world, owns more than a dozen patents and boasts a turnover in excess of 1.5 billion US dollars. There are many Bose Corporation outlets in the major cities of India where one can buy Bose sound systems.

Bose did not believe in notion of "retirement age". He offered his mentorship and technical expertise to Bose Corporation until his passing away. Bose Corporation emphasises on sustained research to produce quality products, though they come at a higher price. If you are sitting in front of a wide-screen TV and immersed in surround sound, if you are enjoying the pleasures of a live concert in your living room with nothing more than a modern music system, if you are visiting a concert hall and experience rich and vibrant sound, it is more likely that you are being served by Bose sound system. A website on Bose says, "Today you can find Bose wherever quality sound is important. From the Olympic Games to the Sistine Chapel; from NASA space shuttle to the Japan National Theatre. In homes and on the road, from large outdoor arenas to intimate neighbourhood stores, restaurants and clubs, you will hear the realism of the most respected name in sound– Bose".

Popular Science magazine summed up the merit of Bose saying, "The value of Amar Bose and by extension his company– isn't so much in the things he has invented, but in the possibilitieshe inspires… Bose reminds us that we could all afford to be much more sky-ward looking, far-fetched and curious, and that we could all believe more strongly in our own potential to create".

In a website "In MemoriumAmar Bose" created three days after his passing away, 232 persons from all parts of the world have remembered Bose in various ways for his enduring contribution to the world of acoustics and music.One satisfied customer, JetzeGorterfromNetherlands, posted:"Dr. Bose: thank you for the music that I am enjoying. You will be remembered by me every day I am playing music or watching movies over my Bose 901 VI system"..

(All pictures are sourced from Bose Corporation website)

Dr M.S.S.Murthy retired as a senior scientist from the Bhabha Atomic Research Center, Mumbai in 1997. He is a popular science writer and authored a number of books.

Climate Change: A Threat to the Sunderban Ecosystem

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Sunderban, where the sea meets the land, is famous for its littoral swamp forests dominated mainly by mangroves. Covering some 10,000 sq km of mangrove forest and water body, Sunderban is part of the world's largest delta formed from sediments deposited by river Ganges, Brahmaputra and Meghna, which converge on the Bengal Basin. Major portion of this deltaic landmass falls within neighbouring Bangladesh. The Indian Sunderban extends over an area of 4,262 sq km, of which 2,320 sq km is forest and the rest is water. The Sunderban area in the South 24-Parganas district of West Bengal consists of Matla, Gosaba, Chhotahardi, Mayadwip, Chamta, Gona, and Baghmara forest blocks (*see* Box). The whole region is intersected by a maze of tidal rivers, creeks and canals that run in a north-south direction. Sunderban is a tide-dominated mangrove wetland that harbours a large number of floral and faunal species of significant ecological importance. Most of the species of this contiguous mangrove ecosystem are either endangered or threatened and at the same time are endemic.

Covering some 10,000 sq km of mangrove forest and water body, Sunderban is part of the world's largest delta formed from sediments deposited by river Ganges, Brahmaputra and Meghna

Plants of Sunderban

Sunderban is a very unique kind of tidal swamp forest composed mainly of true salt-tolerant plants and associated plant species. In a strict sense, mangroves are 'facultative halophytes', i.e., the presence of salt in the environment is not necessary for the growth of mangroves and they can grow very well in fresh water. One particular advantage of growing in a saline environment is the lack of competition. Mangrove plants live in hostile environmental conditions such as high salinity, oxygen deficient waterlogged soil, tidal pressures, strong winds and sea waves. Mangroves have adopted to cope with such an adverse environment and extreme conditions.

Animals of Sunderban

Sunderban is the only remaining habitat in the lower Bengal Basin for a great variety of animal species comprising of terrestrial, estuarine as well as marine forms. The majority of the animal groups include large number of invertebrates (animals without backbones). Most importantly mangroves provide critical habitat for numerous species of crabs, shrimps, prawns and other crustaceans that are adapted to feed, shelter and reproduce among the tangled mass of air-filled roots of mangrove plant. Sunderban biosphere provides important habitat for a variety of terrapins, turtles, estuarine crocodiles, lizards, and snakes.

Mangrove forest is considered to be the lifeline of Sunderban region (Photo by Souvick Mukherjee)

Tiger (Panthera tigris tigris) – the keystone species of Sunderban Biosphere (Photo by Siddhartha Goswami)

Some important faunal species of Sunderban (Clockwise from top left): Rhesus macaque (Macaca mulatta); Wild boar (Sus scrofa); Estuarine crocodile (Crocodilus porosus); Brown winged kingfisher (Pelargopsis amauroptera) (All Photos by Siddhartha Goswami)

Sunderban is the home of a wealth of water birds, and some birds of prey. Moreover, this area is important for certain rare winter migrants.

Sunderban is also the home of the famous Royal Bengal tiger. Unlike in other habitats, here tigers live and swim among the mangrove islands, where they hunt prey such as deer, boar, and monkey. The tigers do also regularly attack and kill humans who venture into the forest. Other mammals of this biosphere include deer, boar, monkey, cat, and Gangetic dolphin that roam the waterways.

Global warming effects

Rising of sea level, especially in the coast-bound countries of the world, is a serious present day problem. According to the Inter-governmental Panel on Climate Change (IPCC), India is amongst twenty-seven countries that are most vulnerable to sea level rise accentuated by global warming. Within India, Sunderban is already affected by climatic changes, importantly from increasing sea level as well as salinity and extreme weather events like tropical cyclones. Nearly half of the 102 islands of Sunderban spread over 9.5 sq km area have been experiencing an abnormal rise in the sea level (at an average rate of 3.14 mm per year) and massive erosion during the last four decades.

Research based on satellite images has revealed that a rise up to 1 metre is expected to deluge about 1,000 sq km of the Sunderban biosphere. In reality, Sunderban is losing 100 sq km every year. A large part of Sagar Island, one of the first inhabited islands in the world, has been already submerged by the rising seas. About a fifth of the southern part of this delta complex, the heart of the Tiger Reserve, is also submerged. Inundation of other two big islands, Bedford and Lohachara islands has displaced thousands of climate refugees and their inward migration is responsible for indiscriminate deforestation, mainly of coastal mangrove vegetation.

Global warming is accelerating the process of erosion in coastal and estuarine zones either through increased summer flow from the snow-fed rivers or by increased tide penetration due to sea level rise. At the current rate of erosion a loss of 15 per cent of farmland and more than 250 sq km of the Sunderban National Park in the next two decades is expected. Large scale erosion is leading to a continuous natural subsidence in the Sunderban.

The salinity of the surface soil is governed by the quantity of freshwater flow and monsoon rainfall. Heavy siltation and solid waste disposal as well as climatic changes is leading to a reduction in the periodicity and quantity of freshwater reaching the Sunderban delta. The average soil salinity is highest in the middle of summer and lowest in the rainy monthsDue to global warming, the surface water temperature in the Indian part of the Sunderban has been rising at the rate of 0.5°C per decade over the past three decades,. This rate is much higher than the global warming rate of 0.06°C per decade and IPCC documented rate of 0.2°C per decade in the Indian Ocean during 1970-99.

Post climate change impact

A perceivable change has been observed in the local weather of Sunderban region during the past few years. The frequency of the cyclonic storms has decreased but their severity has increased,whereas rainfall has become more erratic within a span of last ten years. Agricultural yield too has been falling because of rising salinity of the water and soil. Moreover, people faced with poverty and unemployment, are trying to deforest the exiting mangrove vegetation for better opportunities like shrimp farming and newer agricultural land.

A study by scientists and researchers of the Department of Marine Sciences, Calcutta University has revealed that the surface water pH over the past three decades has decreased in the region, thus increasing acidification. The variations in salinity and increased temperature could be reasons for observed variations in pH and dissolved oxygen. The concentration of dissolved oxygen in the western part of the Sunderban shows an increasing trend in contrast to the eastern part where it is decreasing significantly. Global warming also accelerates erosion and sedimentation processes along with subsequent churning action, which in turn increases the saturation of suspended solids, thus decreasing the transparency of water. The reduced transparency affects the growth and survival of phytoplankton, the small microscopic plant community involved in large-scale food production and oxygen evolution in aquatic ecosystems. Damage

How has the present day Sunderban come into being?

The Baghmara forest block contains the ruins of a city built by the Chaand Saudagar merchant community around AD 200-300. Much later, during the Moghul Empire, Raja Basant Rai and his nephew took refuge in the Sunderban area from the advancing armies of Emperor Akbar. The building which they erected subsequently fell to Portuguese pirates, salt smugglers and dacoits in the 17th century. The ruins are evident at Netidhopani and elsewhere. However, the reclamation of present day Sunderban commenced in 1770 onwards. In British period, all forest in the then 24-Parganas district was first notified as protected forest on 7 December 1878. Much of this was subsequently leased out by the British Government for purposes of cultivation, but the boundaries of the remaining protected forests were fixed under a notification issued on 9 April 1926. Protected forests remaining in the Basirhat Division of the district were declared reserved forests on 9 August 1928 and those remaining in the Namkhana Division on 29 May, 1943.

The Sunderban Tiger Reserve was established in 1973. The area comprising of the present tiger reserve is 2,585 sq km including land area of 1,600 sq km and water body of over 985 sq km. Within the area, 1,330.12 sq km is designated as core area, which was subsequently declared as Sunderban National Park on 4 May 1984. The entire Sunderban area (containing three sanctuaries within its buffer zone) was declared aBiosphere Reserve on 29 March 1989. Later, Sunderban was designated as a Ramsar site on 21 May 1992. Sunderban was designated as a Natural World Heritage site by UNESCO in 1987.

to this community may adversely affect the food chain in this mangrove-dominated estuarine ecosystem, which is the nursery and breeding ground of numerous aquatic life forms.

All the previous and recent studies on the environmental impact of climate change indicate a clear challenge to the survival of flora and fauna in the Sunderban region. Mangrove species such as Sundari (*Heritiera fomes*) and water coconut (*Nypa fruticans*) and mammals like fishing cat (*Felis viverina*) and small-clawed otter (*Anonyx cinerea*) are fast disappearing due to increasing salinity and habitat loss, respectively. Certain endemic plants and animals are also in danger for the same reason of climate change. World Wildlife Fund estimates that due to sea level rise, nearly 7,500 hectares of mangrove forest in the Sunderban will be flooded. Moreover, at the current rate of erosion, a loss of 15 per cent of personal farm land and more than 10 per cent of the core forest area in the near future is expected. From such information, it is feared that one day the only possible natural habitat of the Bengal tiger (a keystone species) in the Sunderban delta will disappear forever.

Apart from a wide range of ecological alterations, climate change has created serious socio-economic problems in the region, leading to a crisis in the livelihoods of the local inhabitants, most of whom are poor and marginal people. The continuing submergence of habitable landmass is leading to thousands becoming climate refugees. A study conducted by the researchers of Jadavpur University, Kolkata has also pointed out that the Sunderban would lose another 15 per cent of its total habitable land, displace more than 30,000 people by 2020.

Conclusion

Sunderban is considered as one of the world's most fragile forest ecosystems. Extensive unscientific human activities are perturbing the entire milieu so badly that the inhabiting flora and fauna of this region are in real danger. With its ever-changing geomorphic and hydrological characters, Sunderban now reveals the extreme consequences of global warming and climate change. However, scientists say that the situation in Sunderban Biosphere is still at a controllable stage. Recent researches have also found that Sunderban mangroves are South Asia's largest carbon sink that mops up huge amounts of carbon dioxide during photosynthesis and thus help to control global warming. Therefore, mangrove plantation is perhaps the ultimate solution to save Sunderban and its wealth from extinction. To achieve the success in restoration of mangrove cover, some of the efforts like new innovative policy framing, continuous monitoring and management interventions are urgently needed.

A teacher by profession, Dipanjan Ghosh is an equally well-known popular science writer and an editor of the journal *Indian Science Cruiser* published from Kolkata.

Form IV (see rule 8)

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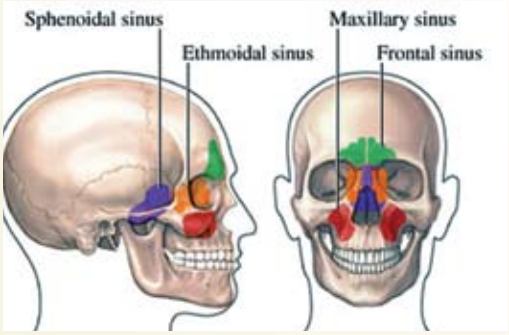
I, Subodh Mahanti, do hereby declare that to the best of my knowledge and belief, facts mentioned above are true.

Sd/-
Dr Subodh Mahanti

Sinusitis—
Simple recipes work a cure

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

The sinuses are air-filled hollow cavities in the bones situated behind the nose and eyes and in the cheeks and forehead. They are lined with a mucus-secreting membrane and are connected to the nasal cavity by a number of narrow channels. Normally, air passes in and out of the sinuses and mucus drains through these channels into the nose. Inflammation of the sinuses, known as sinusitis, may be acute and may develop and clear up rapidly; or be chronic, a condition that continues to simmer and plague you for long.



Signs and symptoms

In its acute stage, sinusitis can produce a plethora of signs and symptoms. These may include:

Nasal discharge

A person with inflamed sinus commonly complains of drainage of a thick, yellow or greenish discharge from the nose or down the back of the throat. The latter is often referred to as the post-nasal drip in medical parlance.

Aches and pains

Quite frequently, sinusitis produces pain, tenderness, swelling and pressure around the eyes, cheeks, nose or forehead. The pain occurs due to inflammation or from the pressure as secretions build up in the sinus. Characteristically, the pain gets worse if you bend over with the head down.

Nasal obstruction

A person with sinusitis often suffers from nasal blockage or congestion, which causes difficulty in breathing through the nose.

Other signs and symptoms

You may experience:

- Reduced sense of smell and taste
- Cough, which may be worse at night
- Ear pain
- Headache
- Aching in your upper jaw and teeth
- Bad breath (halitosis)
- Fatigue
- Fever

Causes

Most frequently, it all begins with a viral infection, such as the common cold. The mucous membranes of the nose, sinuses and throat become inflamed and swollen. If the channels connecting the nose to the sinuses become blocked, mucus collects in the sinuses. These mucus-laden sinuses create a moist environment which makes it easier for infection to take hold. In some cases, the mucus becomes infected with bacteria. As a result, the infected sinuses become pus filled, producing thick, yellow or greenish discharge, pain, nasal obstruction, fatigue, fever and other signs of infection.

However, other than viral infections, sinusitis can also be caused by a bacterial infection. When an upper respiratory tract infection persists longer than seven to 10 days, remember that it is more likely to be bacterial rather than a viral infection. In a few people, the infection may be neither viral nor bacterial, and is actually, fungal. This risk particularly exists for those people who have sinus abnormalities or a weakened immune system.

Some cases of sinusitis also relate to allergies such as hay fever. Inflammation that occurs with allergies may block the sinuses.

Risk factors

Blockage of the sinus channels is more likely in people with an abnormality of the nose or neighbouring structures, those who suffer from upper airway allergies, those with certain congenital conditions, and those with reduced immunity. In a nutshell, you are likely to be at risk of being affected with sinusitis if you have:

Nasal polyps or tumours

These tissue growths may block the nasal passages or sinuses, making you vulnerable to sinusitis.

Deviated nasal septum

A crooked septum — the wall between the nostrils — may restrict or block sinus passages, and this opens you to the risk of developing sinusitis.

Allergic condition

Hay fever and other allergic conditions can also affect your sinuses. In many people, sinusitis is simply fallout of allergy.

Medical conditions

Gastro-oesophageal reflux disease (GERD) is a common problem particularly in people in the 40s and older, and those who are obese and those taking certain kind of medications. If uncontrolled, it can lead to a number of complications, and this includes sinusitis.

Immune system disorders

Some people are affected with immune system disorders such as immunoglobulin or antibody deficiency. This may also result in blocked sinuses or an increased risk of infection.

Effect of pollutants
Regular exposure to pollutants such as cigarette smoke accentuates your risk of developing sinusitis.

Tooth infection
A small number of cases of acute sinusitis are also caused by an infected tooth.

Complications
Acute sinusitis can be associated with a variety of complications. These include:

Asthma flare-ups
Acute sinusitis can trigger an asthma attack.

Chronic sinusitis
Acute sinusitis may be a flare-up of a long-term problem known as chronic sinusitis. Chronic sinusitis is sinusitis that lasts longer than eight weeks.

Meningitis
This occurs when infection spreads to the lining of the brain.

Vision problems
If infection spreads to your eye socket, it can cause reduced vision or even blindness. This is a medical emergency that requires immediate treatment to prevent potentially permanent damage.

Ear infection
Acute sinusitis may occur with an ear infection.

What to do
You can take a number of simple self-help measures, which can offer you relief from the difficulties arising due to sinusitis. These steps include:

Get plenty of rest
This will help your body fight infection and speed recovery.

Drink plenty of liquids
Drink plenty of fluids, such as water or juice. This will help dilute mucous secretions and promote drainage. Avoid beverages that contain caffeine or alcohol, as they can be dehydrating. Drinking alcohol can also worsen the swelling of the lining of the sinuses and nose.

Moisten your sinus cavities
Drape a towel over your head as you breathe in the vapour from a bowl of hot water. Inhale steam. Keep the vapour directed toward your face. Or take a hot shower, breathing in the warm, moist air. This will help ease pain and help mucus drain.

Try applying warm facial packs
Apply warm compresses to your face. Place warm, damp towels around your nose, cheeks and eyes to ease facial pain.

Rinse out your nasal passages
Use a specially designed squeeze bottle to rinse your nasal passages. This home remedy, called nasal lavage, can help clear your sinuses. If you make your own rinse, use water that is contaminant-free — distilled, sterile, previously boiled and cooled, or filtered using a filter with an absolute pore size of 1 micron or smaller — to make up the irrigation solution. Also be sure to rinse the irrigation device after each use with contaminant-free water and leave open to air-dry.

Sleep with your head elevated
This will help your sinuses drain, reducing congestion.

Stay indoors in an even temperature
Too much of cold weather and cold air can worsen your sinusitis.

Take care of the posture
Refrain from bending over with your head down. This movement usually increases the pain.

Take pain relievers
To ease the discomfort and pain, take pain relievers. Use over-the-counter (OTC) saltwater (*saline*) nose drops. Try OTC decongestants and short-term decongestant sprays.

Avoid antihistamines
Avoid antihistamines, unless your doctor prescribes them. Antihistamines can do more harm than good by drying out your nose too much and thickening secretions. Use them only if the condition is allergic and your physician recommends them.

When to seek medical help
If you have mild symptoms of sinusitis, try self-care. However, be careful. Contact your doctor if you have any of the following:

- Symptoms that don't improve within a few days or symptoms that get worse
- If the pain does not resolve in 24 hours or if the pain occurs repeatedly,
- A persistent fever of more than 101° F,
- A history of recurrent or chronic sinusitis

See a doctor immediately if you have any of the following signs or symptoms that may indicate a serious infection:

- Pain or swelling around your eyes
- Swollen forehead
- Severe headache
- Confusion
- Double vision or other vision changes
- Stiff neck
- Shortness of breath

Tests and diagnosis
Your doctor may use several methods to check you out:

Physical exam
To look for the cause of your symptoms, your doctor will feel for tenderness in your nose or throat. Your doctor may use a tool to hold your nose open. This makes it easier to see inside your nasal passages. Your doctor will then shine a light into your nasal passages to look

for inflammation or fluid. This visual inspection will also help rule out physical conditions that trigger sinusitis, such as nasal polyps or other abnormalities.

Nasal endoscopy

A thin, flexible tube (endoscope) with a fibre-optic light inserted through your nose allows your doctor to visually inspect the inside of your sinuses. The procedure is carried out under local anaesthesia. It can be repeated easily to monitor the progress of disease or treatment.

Imaging studies

Images taken using X-rays, computerised tomography (CT) or magnetic resonance imaging (MRI) can show details of your sinuses and nasal area. While not recommended for uncomplicated acute sinusitis, imaging studies may help identify abnormalities or suspected complications.

Nasal and sinus cultures

Laboratory tests are generally unnecessary for diagnosing acute sinusitis. However, in cases in which the condition fails to respond to treatment or is progressing, tissue cultures may help pinpoint the cause, such as identifying a bacterial cause.

Allergy testing

If your doctor suspects that the condition may be brought on by allergies, an allergy skin test may be recommended. However, this process is tedious, and the results not that gratifying.

Medications

Your doctor may recommend some simple treatments to help relieve sinusitis symptoms, including:

Saline nasal spray

Saline nasal spray is an effective remedy. You may use the spray several times a day to rinse your nasal passages.

Nasal corticosteroids

These nasal sprays help prevent and treat inflammation. Examples include fluticasone, mometasone, budesonide, triamcinolone, and beclomethasone.

Decongestants

These medications are available in over-the-counter and prescription liquids, tablets and nasal sprays. OTC oral decongestants include Sudafed, Actifed and Drixoral. Nasal sprays include oxymetazoline and others. These medications are generally taken for only a few days at most. Otherwise they can cause the return of more severe congestion (rebound congestion).

Anti-inflammatory analgesics

Your doctor may recommend pain relievers, such as aspirin, paracetamol or ibuprofen. They ease the pain and reduce inflammation. Aspirin has been linked with Reye's syndrome, so use caution when giving aspirin to children or teenagers. Though aspirin is approved for use in children older than age 2, children and teenagers recovering from chickenpox or flu-like symptoms should never take aspirin. Talk to your doctor if you have concerns.

Antibiotics

Antibiotics are usually not needed to treat acute sinusitis. They do not help when acute sinusitis is caused by a viral or fungal infection. Most cases of bacterial sinusitis improve without antibiotics. Antibiotic treatment is generally needed only if the infection is severe, recurrent or persistent.

Antibiotics used to treat acute sinusitis caused by a bacterial infection include amoxycillin, doxycycline or the combination drug amoxycillin-clavulanic acid. If the infection doesn't go away or if the sinusitis comes back, your doctor may try a different antibiotic.

If your doctor does prescribe antibiotics, it is critical to take the entire course of medication. Generally, this means you'll need to take them for 10 to 14 days — even after your symptoms get better. If you stop taking them early, your symptoms may come back.

Antifungal medications

Rarely, acute sinusitis is caused by a fungal infection, which can be treated with antifungal medication. The dose of medication — as well as how long you'll need to take it — depends on the severity of your infection and how quickly your symptoms improve.

Surgery

If you are found to have nasal polyps or tissue growths which are blocking the nasal passages or sinuses, your surgeon may like to dissect them out. Likewise, a terribly crooked nasal septum may also require surgical correction.

Prevention

Take these steps to help reduce your risk of getting acute sinusitis:

Avoid upper respiratory infections

Minimise contact with people who have colds. Wash your hands frequently with soap and water, especially before your meals.

Carefully manage your allergies

Work with your doctor to keep symptoms under control.

Avoid cigarette smoke and polluted air

Tobacco smoke and other pollutants can irritate and inflame your lungs and nasal passages.

Use a humidifier

If the air in your home is dry, such as it is if you have forced-air heat, adding moisture to the air may help prevent sinusitis. Be sure the humidifier stays clean and free of mould with regular, thorough cleaning.

Recent developments in science and technology

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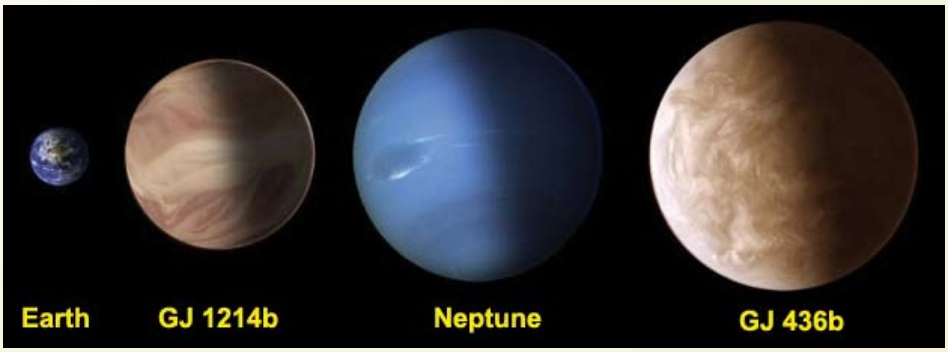
Clouds on exoplanets discovered

Among the planets of our solar system all the rocky planets, except Mercury, have atmosphere, some thick like that of Venus and some thin like that of Mars. Venus is perpetually covered with thick clouds, while clouds are also common on Earth although not as thick as on Venus. But till recently there was no recorded evidence of clouds on any planet around stars other than the Sun, or an exoplanet. Despite numerous efforts, the nature of the atmospheres surrounding these planets had eluded definitive characterisation until now. Recently scientists using NASA's Hubble Space Telescope have characterised the atmospheres of two of the most common type of planets in the Milky Way galaxy and found both may be blanketed with clouds. The planets are GJ 436b, located 36 light-years from Earth in the constellation Leo, and GJ 1214b, 40 light-years away in the constellation Ophiuchus (*Nature*, 2 January 2014 | doi:10.1038/nature12888).

The planets GJ 436b and GJ 1214b are among the closest to our Solar System to have been found so far. The two planets fall in the middle range in mass, between smaller, rockier planets such as Earth and larger gas giants such as Jupiter. GJ 1214b is the smallest and most Earth-like world yet to yield the secrets of its atmosphere, while GJ 436b is a larger, Neptune-sized world. These observations suggest that clouds may envelop many exoplanets. The researchers described their work as an important milestone on the road to characterising potentially habitable, Earth-like worlds beyond the solar system.

Both GJ 436b and GJ 1214b can be observed transiting, or passing in front of, their parent stars. This provides an opportunity for scientists to study these planets in more detail as starlight filters through their atmospheres. The discovery of clouds on GJ 1214b was made by a team led by Laura Kreidberg, of the University of Chicago in Illinois, USA, studied near-infrared light filtering around the exoplanet during 15 of its passages in front of its star. This gave the scientists enough data to conclude that the planet must be covered with clouds.

The other study was done by a research team led by Heather Knutson of the California Institute of Technology in Pasadena, California, USA, who carried out an atmospheric study of GJ 436b based on transit observations with Hubble Space Telescope over the past one year. Here, too, the team found no evidence of an atmosphere and concluded that the planet is covered with clouds.



GJ 1214b and GJ 436b compared with Earth and Neptune

However, according to the researchers, those clouds would be unlike any on Earth, given the temperatures and pressures in the exoplanet's atmosphere. Models of GJ 436b and GJ 1214b predict clouds that could be made out of potassium chloride or zinc sulphide at the scorching temperatures of several hundred degrees Celsius predicted to be found in these atmospheres. Both of these compounds would condense into microscopic droplets, and thus form clouds, under such conditions. The researchers described their work as an important milestone on the road to characterising potentially habitable, Earth-like worlds beyond the solar system.

New evidence of past life on Mars

Speculations about the existence of life have been rife in recent months, especially after some new data and images were received from the Mars rover Curiosity. Curiosity's new analyses of sediment from the bed of a long-vanished lake hint that Mars harbours substantial amounts of organic matter of some sort. The lake lay in the same crater where NASA's Mars rover Curiosity landed last year and has been exploring ever since. Analysis of clays drilled out from two rock samples in the area known as Yellowknife Bay show the freshwater lake existed at a time when other parts of Mars were dried up or dotted with shallow, acidic, salty pools ill-suited for life. The clays appear to have formed at the lake bottom, not swept down from the walls of Gale Crater, strengthening the case that the lake water was not acidic.

Curiosity drilled and analysed two pieces of rock in detail using instruments on the rover. The scientists could not tell directly from those sedimentary rocks whether life existed in the lake. But the makeup of the clay rocks revealed that they had to form in the presence of fresh water, not the acidic conditions detected elsewhere on the planet. In fact the freshwater lake environment was characterised by neutral pH, low salinity, and variable redox states of both iron and sulphur species. Curiosity also measured carbon, hydrogen, oxygen, sulphur, nitrogen and phosphorus, elements that are critical for life on Earth, as well as iron and sulphur minerals that could have served as food for microbes, especially those that live in caves, hydrothermal vents and the deep underground. The environment likely lasted for hundreds to tens of thousands of years. Scientists say this is the strongest evidence yet of an ancient freshwater lake on

NASA's Curiosity rover has uncovered signs of an ancient freshwater lake on Mars that may have supported tiny organisms for tens of millions of years.

Mars that could have been home for life as we know it (*Science*, 9 December 2013, doi: 10.1126/science.1242777).

For decades, scientists have known there was water on Mars in the distant past. The planet's red surface was once carved into canyons and riverbeds by liquid water, and there is ice in its soil and at its poles. The planet's surface is riddled with geologic features carved by water, such as channels, dried up riverbeds, lake deltas and other sedimentary deposits. What was not known as much about was what that water was like.

According to John Grotzinger, the chief scientist of the Mars Curiosity mission, as the rover turns back toward Mount Sharp, its primary mission – that of determining whether Mars hosted an environment that would have been habitable – is already complete. What has not been found yet is solid evidence for the carbon molecules known as organics that could serve as the building blocks of life. Such molecules are not always preserved in stone and are destroyed by radiation. The team is turning now to a much more difficult task: finding carbon-based organic molecules, an essential ingredient for life on Earth.

Process turns algae into biofuels faster

With the growing concern over global warming and climate change due to fossil fuel burning there has been constant search for alternative eco-friendly fuels. Recently, researchers at the US Department of Energy's Pacific Northwest National Laboratory (PNNL) have created a continuous process that produces useful crude oil minutes after harvested alga is introduced. This new process does not require drying out the algae, which grow in water, saving time and energy that would be otherwise wasted. The final product can be refined into aviation fuel, diesel, or gasoline (*Algal Research*, 29 September 2013, doi: 10.1016/j.algal.2013.08.005).

Out of all the clean energy options under development, it is algae-based biofuel that most closely resembles the composition of the crude oil that gets pumped out from beneath the surface of Earth. It only makes sense that scientists should be able to figure out how to turn algae into crude oil. After all, most of the oil that we drill out of the ground was formed by algae and other sea-borne flora that piled up at the bottom of the ocean over millennia, then got compacted and heated over eons and transformed into petroleum. The new process not only replicates, but speeds up this "cooking" process to the point where a mixture of algae and water can be turned into a kind of crude oil in less than an hour.

Algae has long been considered as a source of biofuel, but the steps needed to turn a wet, green plant into clear, burnable fuel have been both expensive and time-consuming. The algae had to be processed in a series of steps, one of which involved drying it out and removing all the water, which might be 80 per cent of the biomass. Then solvents were used to extract energy-rich hydrocarbons from the dried material. The process could be used only in batches.

In contrast the new process is a continuous process that starts with the wet algae which is subjected to a high temperature of 350°C and pressures of about 20 megapascals. According to the researchers, "It's a bit like using a pressure cooker, only the pressures and temperatures we use are much higher. In a sense, we are duplicating the process in the earth that converted algae into oil over the course of millions of years. We're just doing it much, much faster."

The process yields several products including crude oil, which can be further refined into aviation fuel, gasoline, or diesel fuel; clean water, which can be used to grow more algae; fuel gas, which can be burned to make electricity or cleaned to make natural gas; and nutrients like nitrogen, phosphorus, and potassium – needed for growing algae.

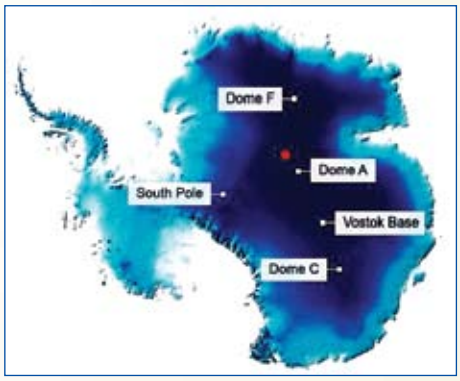
One of the main advantages of the process is that, the potential for much higher yields, algae fuel is still cleaner than petroleum, as the marine plants devour carbon dioxide from the atmosphere. Agriculturally, algae flourish in a wide range of habitats, from ocean territories to wastewater environment. It is not hazardous like nuclear fuel, and it is biodegradable,

Steps in the process for making fuel from algae (from left): the algae slurry, crude oil, and refined diesel fuel.

unlike solar panels and other mechanical interventions. It also does not compete with food supplies and, again, is similar enough to petrol that it can be refined just the same using existing facilities.

The coldest place on Earth

Winter in Antarctica is bitter cold and the lowest temperature recorded on the frozen continent till date was minus 89.2°C, recorded at the Russian base Vostok on 21 July 1982. But now the record has been breached; the coldest place on Earth now is a spot at latitude of 81.8 degrees South and longitude of 59.3 degrees east, at an elevation of about 3,900 m on a 1,000 kilometre swath of the highest section of the East Antarctic ice divide. The temperature here is minus 93.2°C, arrived at by scientists at the National Snow and Ice Data Center (NSIDC), Boulder, Colorado, USA, using data from a NASA polar orbiting satellite. The researchers found that the coldest moments in Antarctica occur in the dark winter months at high elevations, where the extremely dry and clear air allows heat to be radiated very efficiently out into space.



The Earth's coldest spot (red dot) was recorded in Antarctica, just south of a ridge running between Dome Argus (Dome A) and Dome Fuji (Dome F).

According to Ted Scambos of the NSIDC, under clear winter skies in these areas, cold air forms near the snow surface. Because the cold air is denser than the air above it, it begins to move downhill. The air collects in the nearby hollows and chills still further, if conditions are favourable. The record-breaking conditions seem to happen when a wind pattern or an atmospheric pressure gradient tries to move the air back uphill, pushing against the air that was sliding down. "This allows the air in the low hollows to remain there longer and cool even further under the clear, extremely dry sky conditions," he said. "When the cold air lingers in these pockets it reaches ultra-low temperatures."

Dr Scambos announced the findings in San Francisco, USA, at the American Geophysical Union Fall Meeting, the largest annual gathering of Earth scientists attended by 20,000 Earth and space scientists, educators, students, and policy makers.

Continued from page 34 (India's Mars Orbiter Mission)

Mars had already been imparted during the TMI and at present the spacecraft is cruising with a velocity of about 32.8 km per second. MOM will continue to be in its state of motion unless disturbed by a force, as per the first law of motion.

When MOM was 2.9 million km away from Earth, speeding towards the Red Planet, the first trajectory correction manoeuvre (TCM) was executed at 6.30 a.m. on 11 December by firing of its 22-Newton thrusters for 40.5 seconds. Three more such TCMs are planned in April, August and the last one in September before the much-awaited Mars capture in September 2014.

What is of significance is that MOM does not require any fuel to fly from Earth to Mars in its Mars transfer trajectory. "Just like a spacecraft orbits Earth without spending any fuel, MOM is presently circling the Sun in an elliptical orbit till it encounters Mars. A little amount of fuel, however, is needed though for correcting its trajectory and controlling its orientation," says a statement in ISRO's Facebook post.

Charles Elaichi, Director of JPL, has compared MOM's navigation challenge to hitting a golf ball from India to a hole in Los Angeles. According to Elaichi, the golf ball has to come straight into the hole – that's how accurate you have to come in. "And to make it a bit more challenging, the hole is moving," he has stated.

The next nail-biting and nerve-wracking manoeuvre will be at 2.24 a.m. on 24 September 2014, when the much-awaited Mars Orbit Insertion (MOI) takes place. Present indications are that the Canberra Deep Space Network will be the first to acquire data about the outcome of the MOI.

Once it arrives at the Red Planet, MOM will operate in an elliptical orbit with the periapsis – the point closest to the surface of Mars being around 365 km – and the apoapsis – the point farthest away being 80,000 km.

A mission to Mars is a logical extension to a Moon mission. And so it is from Chandrayaan-1 to MOM.

Srinivas Laxman worked with the Times of India, Mumbai and has covered several rocket launches at Sriharikota, including India's first mission to the Moon, Chandrayaan-1. He has interviewed several astronauts including Kalpana Chawla, Sunita Williams, India's first cosmonaut Rakesh Sharma, and former president APJ Abdul Kalam. He has written two books: Dreams to Reality, a biography of APJ Abdul Kalam, and Moonshot India, on the Chandrayaan-1 mission.

Nationwide Sensitisation Programme for Mathematics Teachers gains Momentum

Vigyan Prasar (VP) in association with NCSTC-Network, New Delhi and All India People's Science Network has launched a nationwide sensitisation programme on mathematics for teachers in November 2013. In this programme a total of 30 workshops covering all states were proposed. This programme is now gaining momentum and several mathematics teachers from different parts of country are showing interest and registering themselves online as participants through VP website. From 15 December 2013 to 15 January 2014, six workshops were conducted at following places:

State	Place	Date	Venue	Local Organisation
Madhya Pradesh	Indore	15-16 Dec 2013	Devi Ahilya Viswavidyalay, Indore	Children's Science Centre, Indore
Uttarakhand	Dehradun	19-20 Dec 2013	Doon University, Dehradun	SPECS, Dehradun
Madhya Pradesh	Chitrakoot	21-22 Dec 2013	MGCG, Viswavidyalay, Chitrakoot	Yuva Vigyan Parishad, Gwalior
Gujarat	Rajpipla Distt. Narmada	20-21 Dec 2013	Manthan Narmada Lok Vigyan Kendra, Rajpipla	Manthan Educational Programme Society, Ahmedabad
Kerala	Palakkad	4-5 Jan 2014	Integrated Rural Technology Centre, Palakkad	Integrated Rural Technology Centre, Palakkad
Punjab	Amritsar	9-10 Jan 2014	Bhagat Puran Singh Adarash School, Pingalwara Complex, Amritsar	BJVS, Chandigarh

Hands on activity session of workshop at Amritsar, Punjab

Prof. N.C. Gautam, Vice Chancellor, MGCG, Viswavidyalay, Chitrakoot addressing the participants

VP in consultation with local organisation selected 50-60 teachers for each workshop on the basis of centrally online registration. VP is also taking the expertise of Dr. Dharam Praskash, Ex-Prof and Head, NCERT, New Delhi, Shri V.S.S. Shastri, from Bangalore, Dr. R. Ramanujan, IMS, Chennai, Ms Mohini Kumar, Delhi Math club, Delhi, Ms. Swati Bedkar, Vadodara, Gujarat, Shri Raj Narayan Rajoriya, Bhind, MP, Dr M.S. Ranga Chary, Warangal, AP, Ms Geeta, Mahashabde, Navnirmiti, Pune, Shri M.P. Narayananunni, DIET, Kerala, , Ms. Rekha, Hissar, and Ms Pragati, Hissar as resource persons for all the proposed workshops. Beside this, several resource persons were also invited for the different interactive sessions, locally.

View of participants at Rajpipla, Gujrat

In these workshops different sessions like 'India and Mathematics', 'Mathematics Teaching: an approach', 'Recent developments in Mathematics', 'Hands-on Mathematics', 'IYMPE-13', 'Mathematics in daily life', etc., were organised and in open session several problems related to mathematics teaching were discussed.

As programme coordinators, Dr. T. Gangadharan, Secretary, AIPSN, Er. Anuj Sinha, Chairman, NCSTC Network, Dr. T.V. Venkateswaran, Academic Head, VP, Dr. Arvind Ranade, Scientist-D, VP, Dr. Bharat Bhusan, Scientist-C, VP and Shri Kapil Triapthi, Scientist-D, VP participated and conducted the programme at different places.

VP distributed resource material in the form of books, poster, CDs, films, etc., related to mathematics to participants. Till now 10 workshops has been successfully conducted and dates for the remaining workshops have been announced and details have been posted on VP website. ■