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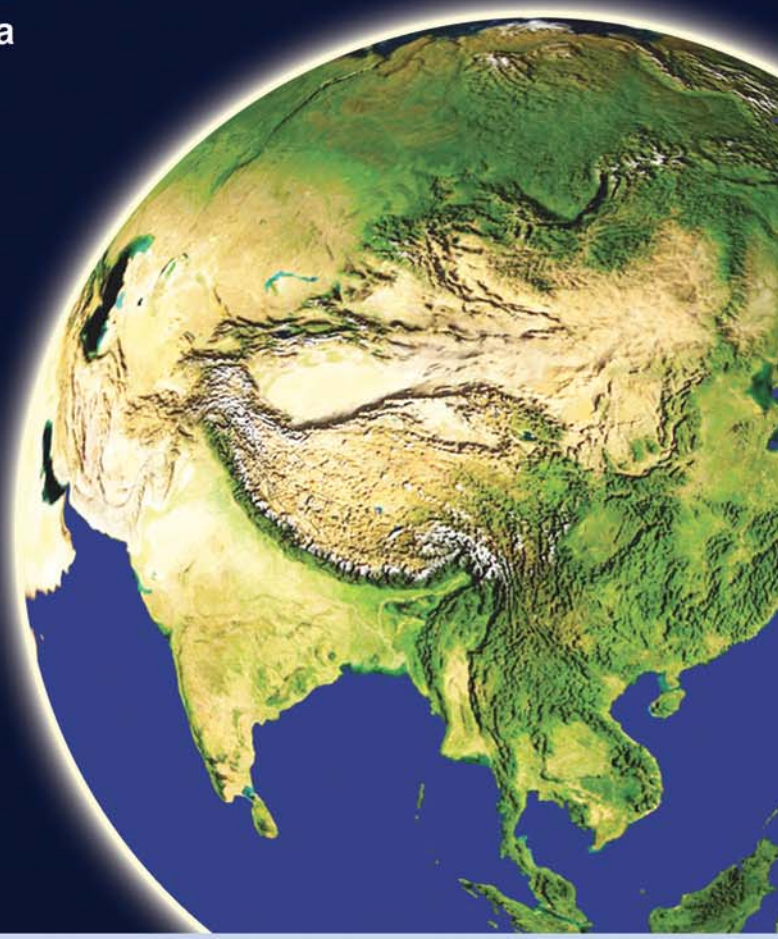
2008 - The International Year of Planet Earth



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

2008 - The International Year of Planet Earth

Earth is the only planet we know of with life on it; on which animals, plants and microorganisms maintain a delicate balance with a variety of life forms we call biodiversity. Each species depends on other species for its existence. Surely, when we talk of life on Earth, we also talk about the human species. If we want to understand and preserve our environment, we shall need to understand the interdependence of the species on each other and the importance of natural resources like air, water and soil for living beings.

Life has continued to evolve on Earth over millions of years, adapting to changing environment. Only those species have survived that have adapted to the changing environment. This change could be due to natural causes like earthquakes, eruption of volcanoes, cyclones, and so on. It could even be due to climate change. This is how there was a three-kilometre thick sheet of ice over northern mid-latitudes some 12,000 years ago, but today there are oceans. Grasslands turned into deserts and glaciers grew; and of late they have been receding!

However, quite often this change in the environment is brought about by the species higher up in the ladder of evolution. They rather try to control environment to suit their needs and for development. This is precisely what human species has done and continues to do to this fragile planet of ours. We need energy for development; which we traditionally obtain by burning natural resources like firewood, coal and petroleum. We have been burning these resources for centuries to meet our energy needs. Today there is consensus that human activities like burning of fossil fuels and consequent pumping of greenhouse gases like carbon dioxide into atmosphere have been responsible for the Earth getting hotter and hotter.

Today, there are threats to our planet arising from climate change, degrading environment, increasing rate of extinction of species, declining availability of fresh water, rivers running dry before they can reach sea, loss of fertile land due to degradation, depleting energy sources, incidence of diseases, and the challenge of feeding an exponentially growing population. The human population is now so large that the amount of resources needed to sustain it exceeds what is available. Humanity's environmental demand is much more than the Earth's biological capacity. This implies that we are living way beyond our means, consuming much more than what the Earth can sustain; and that the well-being of billions of people in the developing world is at risk. We have discussed many of these issues at length earlier in this column.

To draw the attention of the world to these aspects and in an attempt to establish that environment is where we live; and development is what we all do in attempting to improve our lot within that abode, the United Nations (UN) General Assembly during its 60th Session in 2005 declared the year 2008 as the International Year of Planet Earth. It noted that the wealth of scientific information available on planet Earth has remained largely *untapped* and hardly known to the public or even to policymakers and decision makers, and that education in Earth Sciences provides humankind with tools for the sustainable use of natural resources and for building the scientific infrastructure essential for sustainable development.

The UN General Assembly recognized the crucial role the International Year of Planet Earth 2008 could play in raising public awareness of the importance for sustainable development of the Earth's processes and resources; disaster prevention, reduction and mitigation; and capacity-building for the sustainable management of resources. The broad themes identified for International Year of Planet Earth include groundwater, hazards, health, climate, resources, megacities, deep Earth, oceans and outreach. The prominent organisations that would be involved in coordinating and executing the programme across the world include United Nations Educational, Scientific and Cultural Organization (UNESCO), United Nations Environment Programme (UNEP), and the International Union of Geological Sciences (IUGS). It is hoped that with the efforts of individuals, Governments and voluntary organisations, and international co-operation, we shall be able to save the biodiversity and the life on this planet. A host of activities and programmes have been planned in different parts of the world for this purpose.

Contd. on page... 30

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Jnan Chandra Ghosh

Pioneer of Technological Education in India

Subodh Mahanti
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"Where knowledge is free
Where words come out from the depths of truth,
Where the clear stream of reason has not lost its way into
The dreary desert sand of dead habit.
Unto that Heaven of Freedom, my Father, let my country awake."

– Rabindranath Tagore

"The stupendous task need not make us despair. The very creditable performances of her sons in the different spheres of scientific and intellectual activity have amply demonstrated that with proper guidance and plan, India is quite capable of solving her own problems, and of maintaining her position and ideal with dignity and prestige. What is only wanted is prudence and foresight, liberal statesmanship, resolute cooperation and efficient leadership."

– Jnan Chandra Ghosh in his Presidential Address to the Indian Science Congress at Lahore (1939)

Jnan Chandra Ghosh

Jnan Chandra Ghosh (mostly known as J. C. Ghosh) was one of those noblest Indians, who strived hard to make the country a better place to live in. As time passes such individuals are becoming rarer and rarer. He is best known for his research on the theory on strong electrolytes. This theory was proposed in 1918 and it was designed to account for the abnormality of strong electrolytes. This work evoked worldwide appreciation. Great scientists like Walther Hermann Nernst (1864-1941), Max Planck (1858-1947), William Lawrence Bragg (1890-1971) and Gilbert Newton Lewis (1875-1946) appreciated it. Nernst cited this in his famous book, *Theoretical Chemistry*. Ghosh's work also found mention in Lewis and Randall's book, *Thermodynamics*. Lewis and Randall stated: "If then we agree that strong electrolyte is one which is completely polar and that the ions are held to one another by a simple electrostatic force which obeys Coulomb's law it becomes merely a matter of terminology to decide whether we shall say that a certain fraction of such electrolyte is dissociated or with Ghosh that a certain fraction of the ions are free or outside the sphere of mutual attraction." Peter Debye (1884-1966) and Erich Huckel (1896-1980) developed a more suitable theory of strong electrolytes only after incorporating the observations of Ghosh. The concept of ion atmosphere of Debye is essentially an extension of the postulates of Ghosh. The other areas in which he made significant contributions were kinetics, fluorescence, catalysis, auto-oxidation, and other allied branches.

Ghosh played a very important role in shaping science and engineering education in the country. He worked in Calcutta University (1915-1921), Dacca University (1921-1939), Indian Institute of Science, Bangalore (1937-1947), and Indian Institute of Technology Kharagpur (1950-54) of which he was the first director.

Jnan Chandra Ghosh was born on 4 September 1893 in Purulia, West Bengal (then in undivided Bengal). His father Ram Chandra Ghosh owned a mica mine. However, the family had to pass through a difficult patch of time because of heavy financial loss incurred in the family business. Jnan Chandra studied at the Giridih High School, from where he passed the Entrance Examination of Calcutta University in 1909. He then joined the Presidency College, Kolkata (then Calcutta). In 1911, he passed ISc examination of Calcutta University, standing fourth in order of merit. He passed the BSc (1913) and MSc (1915) examinations in chemistry of the Calcutta University from Presidency College. In both the examinations he stood first in first class. At Presidency College he came under the influence of Acharya Prafulla Chandra Ray. Among his fellow students at the Presidency College were Satyendra Nath Bose, Meghnad Saha, J. N. Mukherjee, and Prankrishna Parija.

Shortly after passing the MSc examination, he got an appointment as an assistant to the Palit Professor of Chemistry in the then newly established University College of Science, Kolkata. In 1917, Ghosh was appointed lecturer in chemistry for the newly opened post graduate classes of the University College of Science. He was awarded DSc degree in 1918 for his work on the theory of strong electrolytes. In 1919, he was awarded the Sir Tarak Nath Palit Scholarship. This enabled him to visit England, where he worked under the supervision of F. G. Donnan in the University College of Science, London. He also visited Germany where he met Nernst and Fritz Haber (1868-1934), both of whom showed keen interest in his work.

Peter Debye

In 1921, Ghosh returned to India from England. He joined the newly created Dacca University as Professor and Head of the Department of Chemistry. It was Sir Phillip Hartog, Vice Chancellor-designate of the proposed University of Dacca who persuaded Ghosh to join the Dacca University. Here he built up a brilliant school of physical chemistry devoted to photochemistry and gas reactions. He was able to attract research students from all over India

In 1939, he left Dacca University and went to Bangalore to join the Indian Institute of Science as its Director. He succeeded C. V. Raman. He expanded the scope of the institute rapidly and introduced new branches of studies such as aeronautical engineering, internal combustion engineering, fermentation technology, high pressure technology, etc. In spite of his heavy administrative responsibilities, Ghosh actively pursued his research activities. Here he switched to new fields of research suited to industrial problems. Ghosh and his group pioneered investigations in two important areas, the Fischer-Tropsch synthesis for obtaining liquid fuel from carbon monoxide and hydrogen and step-wise mechanism of ammonia synthesis from its elements, nitrogen and hydrogen. The findings of his researches carried out at the Indian Institute of Science were incorporated in a book titled *Some Catalytic Gas Reactions of Industrial Importance*.

Like his Guru Acharya P. C. Ray, Ghosh was concerned with the development of industries in India. In 1939, he advocated the creation of an All India Council of Scientific and Industrial Research. He said: "…there should be set up an All India Council of Scientific and Industrial Research with functions and powers similar to those entrusted to the Department of Scientific and Industrial Research in Great Britain. it would be apt to quote here the following observations of Lord Rutherford – 'In Great Britain the responsibility for planning the programme of research, even when the cost is directly borne by the Government rests with research councils and committees who are not themselves state servants, but distinguished representatives of pure science and industry. It is to be hoped that if any comparable organisation were set up in India, there will be proper representation of scientific men from the universities and

Walter Nernst

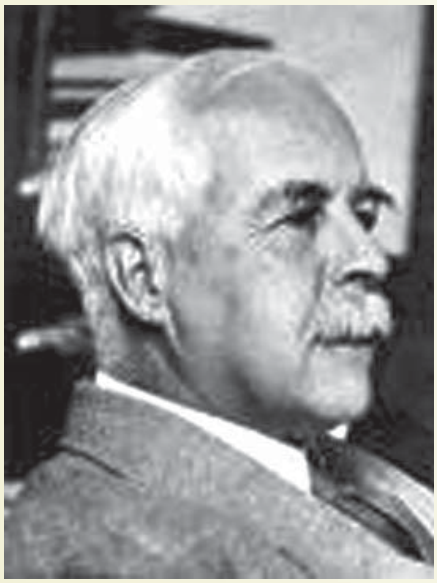
also of the industries concerned.' Indeed for anyone who has followed the recent happenings in this world, with any attention, this industrial planning for India would seem to be long overdue. Now, more than ever, a planning on all fronts would seem an urgent and immediate need."

Fritz Haber

While he was engaged in investigations of India's raw materials for developing industries, specially urea, phosphatic fertilisers, synthetic rubber, etc., Ghosh was appointed Director General, Industries and Supplies, Government of India. While serving in this post (1947-50), aided by foreign and Indian experts, Ghosh developed industrial schemes, which apart from steel and heavy chemical industries, laid the basis of the petroleum, petroleum-refining, machine tool, cable, wireless equipment, and radar industries in India.

Ghosh served as a member of All-India Council of Technical Education and as the President of the Principals of Technical Institutions in India. He helped the organisation of training in these institutions. He realised the inadequacy of trained personnel for taking up large-scale industrial development projects in the country. This realisation led to the creation of technological institutions in India. Ghosh himself became the first Director of the Indian Institute of Technology at Kharagpur, the first institute of this kind. The Institute was inaugurated on 18 August 1951. Ghosh created most of the departments of the institute.

In 1954, Ghosh left Kharagpur to become the Vice Chancellor of Calcutta University. He could not stay long in this



G. N. Lewis

post. He undertook a very painstaking survey of the living conditions of students of colleges and the university. He initiated the establishment of "Day students' homes" for providing accommodation for purposes of study during the day when students had no class work.

In 1955, Ghosh joined the Planning Commission as one of its members at the invitation of Pt. Jawaharlal Nehru, the first Prime Minister of India. In Planning Commission, Ghosh was in charge of Education, Scientific Research and Health. He persuaded the Government of India to grant one crore of rupees to the universities of Bombay, Calcutta and Madras for their development projects during their centenary celebrations. He made possible allocation of large amounts of money for organising medical research and organising medical relief for rural areas.

Ghosh was of the opinion that the universities should play a greater role in the development of the country. He said: "The universities of India have a great responsibility to discharge at this juncture. If the process of industrialisation is to be accelerated in this country it will not do for them to take upon an attitude of laissez-faire. The forces of nature are the enduring wealth of mankind, but for the solution of India's economic problems and prosperity of her 380 million, it is necessary that brilliant young men should be trained in ever-increasing numbers, who are capable of tapping these sources of wealth. The modern young student of science must realise that while fundamental theoretical work must continue to be basis of all scientific advance, his subject would lose much of its importance, if this training did not fit for tackling large-scale problems which arise in industries."

Ghosh believed that without being conscious of social justice, the mere development of science and technology will not lead to advancement of civilization. He said: "Every intelligent man and woman have now got to ponder deeply over the problem that the scientific search for truth has not assured the advance of civilization. Inventions intended to relieve toil, and to control the forces of nature which should have given to all a fuller and more satisfying life, have been perverted into forging instruments of destruction. The paradox of poverty amidst plenty mocks us in the face. In one part of the world wheat and

E. Huckel

cotton are being burnt and milk thrown into streams, while in another part half-naked people are starving. It is not difficult to get at the root of this evil. In respect of scientific knowledge and its applications to the problems of life, each generation stands on the shoulders of the preceding one, but in respect of social, cultural and spiritual qualities, no comparable development is noticeable – perhaps there has been retrogression since the days of Asoka and Christ. Modern science has, indeed, become a menace to civilization, because we have refused to work for social justice, because the interests of individuals and communities have not been subordinated to those of the country, and because considerations of patriotism and prejudices of race, creed, and colour, have been allowed to override the wider considerations of humanity. Therein lies the tragedy of the modern world…"

Ghosh, along with J. N. Mukherjee and S. S. Bhatnagar founded the Indian Chemical Society in 1924 and he served as its President from 1935 to 1937. Ghosh was elected General President of Indian Science Congress Association in 1939. He was elected the President of the National Institute of Sciences of India (later renamed Indian National Science Academy) in 1943. Ghosh also served as the president of the Indian Association for the Cultivation of Science (1951-55). He was associated with the Council of Scientific and Industrial Research since its inception.

Ghosh died on 21 January 1959. His life's ambition was to make the world a better place to live in through his dedicated services in science and technology.

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Chemical Processes on Solid Surfaces

□ Biman Basu
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Heterogeneous catalysis has been a central process in the chemical industry for a century. Agriculturists around the world have been supplied with ammonia-based nitrogen fertilisers since 1913 due to the Haber-Bosch process, where the nitrogen of the air is converted to ammonia using an iron-based catalyst. Today every car has a catalytic converter in its exhaust system that converts carbon monoxide and hydrocarbons to carbon dioxide in the exhaust gases and also reduces the content of nitrous gases. In the microelectronics industry thin semiconductor layers are produced by chemical vapour deposition in large quantities. The formation of the ozone hole over Antarctica is also facilitated by surface reaction when chlorine atoms and ozone molecules come close together and react on the surfaces small ice crystals in upper atmosphere. Thus the action of catalysts as well as certain industrial processes and atmospheric phenomena depend on surface chemistry.

The German chemist Gerhard Ertl has been awarded the Nobel Prize in Chemistry for 2007 for his thorough studies of fundamental molecular processes that take place at the gas-solid interface. A professor emeritus in the Depart of Physical Chemistry at Berlin's Fritz Haber Institute, which is part of the Max Planck Society, Ertl is known for determining the detailed molecular mechanisms of the catalytic synthesis of ammonia over iron (Haber-Bosch process) and the catalytic oxidation of carbon monoxide over palladium (catalytic converter). During his research he discovered the important phenomenon of oscillatory reactions on platinum surfaces and, using photoelectron microscopy, was able to image for the first time, the oscillating changes in surface structure and coverage that occur during reaction. Thus by providing a detailed description of how chemical reactions take place on surfaces Ertl laid the foundation of modern surface chemistry.

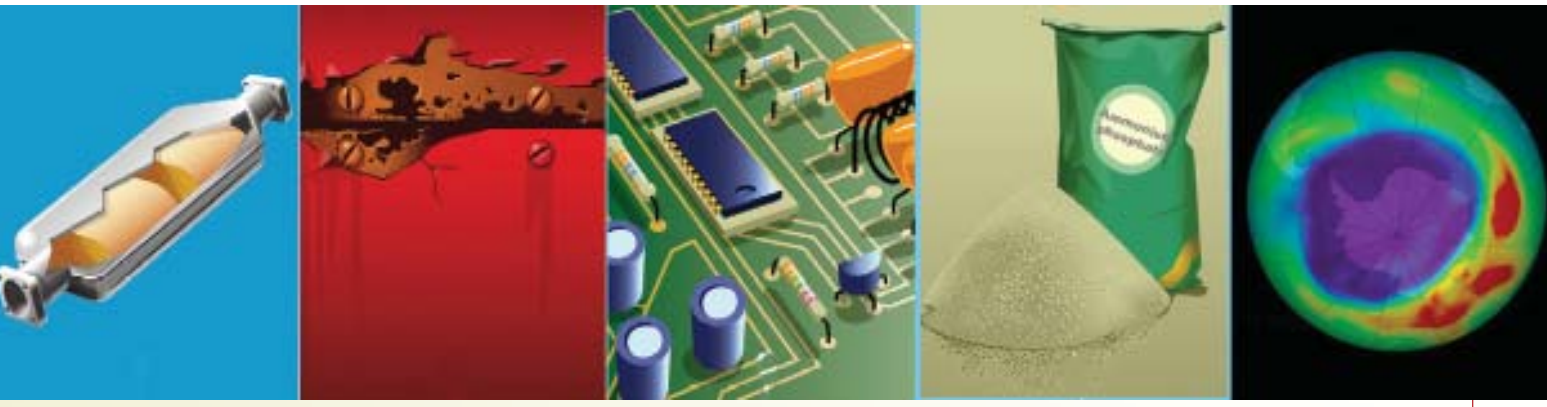
Surface chemistry looks at what happens when a molecule of gas hits a solid. When a small molecule hits a solid surface from a gas phase there are a number of possible outcomes. The molecule may simply either bounce back or be adsorbed. It is the latter case that carries the most interesting possibilities. The interaction with the atoms of the surface can be so strong that the molecule dissociates into constituent groups or atoms. The molecule can also react directly with surface groups and change the chemical properties of the surface. A third possibility is that the adsorbed molecule encounters another previously adsorbed one and there is a binary chemical reaction on the surface.

Gerhard Ertl

The modern science of surface chemistry really got a boost with the processes developed in the semiconductor industry in the 1960s and Ertl was one of the first to foresee the potential of these new techniques. He first studied the behaviour of hydrogen on metal surfaces. This was important because hydrogen gas can not only be produced at one of the electrodes in an electrochemical solar cell, but can also be used to generate electricity in a fuel cell. In both process the behaviour of hydrogen on solid surfaces is crucial. There exist many more possible examples.

Ertl's major work was the study of the catalytic role of iron in the Haber-Bosch process, in which nitrogen is made to combine with hydrogen to produce ammonia. The catalyst used in the Haber-Bosch process is finely divided iron and the reaction takes place using the surface of the grains of iron as support. Nitrogen and hydrogen both attach to the iron surface and can react more easily with one another. One of the crucial questions which Ertl addressed is which step in the reaction is the slowest. In order to improve the efficiency of the process as a whole it is the slowest step that one needs to speed up.

In order to find out what really happens, Ertl used an idealised system – a clean and smooth iron surface in a vacuum chamber into which he could introduce well controlled amounts of the different gases. By measuring the concentration of nitrogen atoms on the iron surface while simultaneously adding hydrogen to the system, Ertl found that the more hydrogen he added, the more the concentration of nitrogen atoms on the surface diminished, which showed the first step in the Haber-Bosch-reaction takes place between hydrogen and atomic nitrogen. To distinguish atomic



Surface reactions are vital in many processes today (from l to r): In catalytic converters used in cars; in rusting of iron; in the manufacture of semiconductor materials for electronic components; synthesis of ammonia used in chemical fertilisers; and in the depletion of ozone layer by chlorofluorocarbons by reacting on the surfaces of small ice crystals.

nitrogen from molecular nitrogen Ertl used different spectroscopic methods. Thus Ertl's contribution has been to provide not only detailed knowledge about how the process works, but also an example of the systematic methodology he has applied to surface chemistry problems.

Ertl was born on 10 October 1936, in a suburb of Stuttgart in Germany and studied at Munich's Technical University. He completed his diploma in physics in 1961 and his PhD in 1965. In 1973 he became professor and director of the Institute for Physical Chemistry at the Ludwig Maximilians University in Munich, a post he held for 13 years. He has been visiting professor at universities in Wisconsin and California. He became professor at the Humboldt University of Berlin in 1996. He was Director of Fritz Haber Institute, Berlin, from 1986-2004.

Editorial (Contd. from page 35)

Outreach is an important component that aims at making people aware about the challenges we face and help them work for the possible solutions to save this planet from heading towards catastrophe. It is with this aim that Vigyan Prasar has chalked out a national campaign with activities built around the main theme 'Planet Earth'. What is envisaged in this campaign is the development and production of a variety of software related to Planet Earth, awareness programmes for school / college students and the general public; and training of resource persons in collaboration with Government and non-Government agencies / organisations.

Vigyan Prasar is in the process of bringing out a series of publications / books on different aspects of Planet Earth, activity kits and packages, slide shows, interactive CDs, and poster sets, to be used as resource material during the training programmes for Master Resource Persons in different parts of the country. A 52-episode radio serial *Dharti Meri Dharti* on the theme Planet Earth jointly produced by Vigyan Prasar and All India Radio (AIR) in 18 Indian languages and English to be broadcast from 117 stations of AIR has already gone on air in early January 2008. We request our esteemed readers to tune in their radio sets and send their reactions / responses on this programme to us. Also on the anvil is a 26-episode television serial which is expected to go on air later this year. Incidentally, audience participation is an important aspect of both the serials. It is planned to bring out both, the radio and the television serial, in CD / DVD format for wider dissemination.

We do hope our efforts result into a cascading effect stimulating individuals, schools / colleges and various agencies / organisations to initiate similar efforts and programmes in their neighbourhood, emphasising various aspects related to the Planet Earth – its origins, lithosphere, oceans, atmosphere, biosphere and biodiversity, how human beings have adversely affected the Earth and what we need to do to once again to bring joy and equilibrium back on the Earth – our only home and the only planet we know of with life in this universe.

Vinay B. Kamble

Surviving Space

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29 June 1971. The first space station *Salute-1* was in the orbit. First occupants of the station, cosmonauts Vladislav Volkov, Georgi Dobrovolski and Viktor Patsayev spent 23 days in the space station. After completing their mission of preparing the space station for prolonged use they got into the decent module of *Soyuz-11* for return to Earth. The crew was returning after creating yet another milestone in space endurance, conducting various experiments.

Tragedy struck on morning of 30 June 30 at 6 a.m. Moscow Time. The decent capsule soft landed 125 km east of city of Dzhezkazgan. As usual the military rescue team reached within minutes; stretchers were ready to carry the worn-out cosmonauts. They pried open the hatch to let the cosmonauts to come out of the capsule. But all the three men were dead in their couches. Only dead bodies could be recovered from the otherwise perfect landing capsule. It was a bolt from the blue for the Soviet space programme.

Sure enough this was not the first space casualty. Earlier, *Soyuz-1*, launched on 23 April 1967 had crashed on 24 April while landing, killing cosmonaut Vladimir M. Komarov. Failure of the parachute to open caused the capsule to hurl at Earth at a speed of 400 km per hour resulting in the death of its occupant.

First moon walk- EVA on an extra terrestrial object

However, there was no noticeable malfunction in the *Soyuz-11*. It was a perfect landing. Medical examination showed that the crew of *Soyuz-11* had died due to asphyxiation, lack of oxygen. Detailed investigations revealed that a small valve had accidentally jolted open as the descent module separated from the service module. There were actually two valves. One was indeed designed to explode open at the time of separation of service module, before the retrorockets fired. The other valve, less than 1 mm in diameter, was to explode open only as the capsule was about to land. The second valve was to open and equalise pressure inside the capsule with that of the atmosphere. However by mistake both the valves exploded together. And as the pressure release valve accidentally opened the pressurised air in the capsule escaped into space. This produced unmistakable hissing noise which was indeed noticed by cosmonauts.

Voice recording of the cockpit revealed the anxious last moments. The three cosmonauts desperately tried to locate the source of the noise. As the valve was located beneath the cosmonaut's couches, it proved impossible to even locate, leave alone block the leak before the air was completely lost. Desperately Patsayev and Dobrovlsky tried to close the valve manually, but they were racing against time. Seconds latter all the three lost consciousness. It is estimated that the cabin lost its entire atmosphere in about 30 seconds while still at a height of 168 km above Earth. As the cosmonauts had not been wearing the spacesuit, even the air in their lungs would have been sucked by the vacuum of space. The entire landing was flawless, but a small error caused death of all the three cosmonauts. All the three men were buried in the Red square, with full state honours.

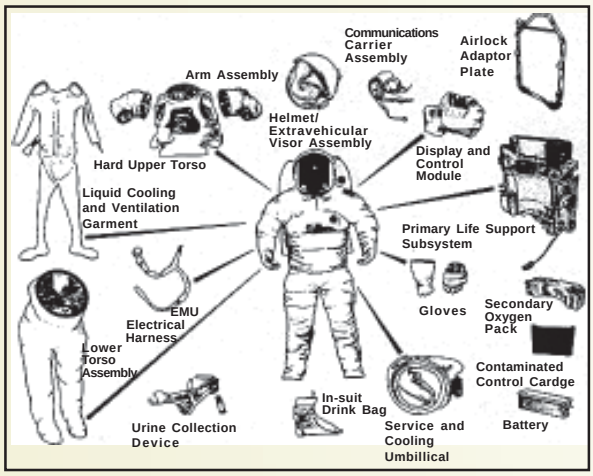
The set back was so severe for the soviet space programme, that for next two years, soviets did not launch any manned flight. *Salyut-1* was de-orbited on 11 October 1972 with no one occupying it even once. If only the crew had spacesuits during the decent they would have not died – this was the verdict Soviet engineers had reached.

Meanwhile, the Soviets undertook major redesign of the *Soyuz* spacecraft, changing both the valve and the explosive bolts. Further it was decided that future Soyuz missions would carry only two cosmonauts. The extra room meant that the crew could wear space suits during launch and landing. In addition the solar panel for generating power in the spacecraft was replaced with internal batteries. After unmanned test flights of the redesigned craft, manned flights were conducted, but with only two cosmonauts. Only around 1980, a new series of *Soyuz –T* craft was designed with free enough space for three cosmonauts in spacesuits to travel in the capsule.

ORLAN spacesuits used in ISS

Protective spacesuits

In fact the development of protective suits for space use started with the Vostok-suit called SK-1, donned by Yuri Gagarin. These suits were based on high altitude Air Force jet pilot's gear. Originally used in the stratospheric fighter planes during the mid 1950s, the suit provided warmth and had a pressurised layer. In the *Vostok* and subsequently the improved *Voskhod* spaceflights the passengers were positioned in their couch. They did not need to move much from their fixed position. Therefore the early design based upon the Air Force model sufficed. However, increasingly, the cosmonauts had to manoeuvre inside the spacecraft and the Soviets proposed to do away with cumbersome spacesuits all together. Instead they used a pressurised



Spacesuit components

cabin. But, as the *Soyuz-11* tragedy showed, the step proved to be a costly one.

The accident of *Soyuz-11* brought the problem to the fore; the Soviets had to come up with new design of spacesuit for ascent and decent. Research was galvanized and a new design spacesuit – light, functional at the same time suitable during the entry and re-entry of spacecraft – was designed. Named 'Sokol', the spacesuit introduced in 1973, was designed to keep alive the wearer in the event of any accidental depressurisation, as happened in the case of *Soyuz-11*. The Sokol-type spacesuit consisted of a hard protective helmet, communication pack, partial pressure suit, parachute harness assembly and parachute pack. The suit not only provided oxygen and pressure in case of emergency, but with the suit the cosmonaut could eject from the capsule and parachute safely. Further the partial-pressure suit and equipment could support a crew member for a 24-hour period in an inflatable raft if they happened to fall on a water body. Most modern spacesuits, of both Soviet and American, have the same features. However, these types of spacesuits are not suitable for spacewalk or extra-vehicular activity.

Spacesuit for space walk

Alexei Leonov was the first person to step out of the spacecraft into the void of space on 18 March 1965. He put on a specially designed spacesuit to meet the challenges of vacuum, opened the hatch of the *Voskhod-2* spacecraft and went out. For the next 10 minutes he was first man ever to 'swim' the vast ocean of space. Since then, dream of every cosmonaut and astronaut is at least to once perform the EVA. Walking in space was not for fun. Even in the initial stages it was realised that cosmonauts and astronauts could not remain in the protective cocoon of the spacecraft for ever. If space stations were to be built, if repair and maintenance of space station or spacecraft were to be undertaken, if humans were to walk on moon, then one would certainly had to step out of the spacecraft.

Soviet space program founder Sergei Korolev saw the ability of people to work outside the spacecraft as crucial for the future of space exploration and jocularly said 'sailors of the ship should be able to swim'. He was also well aware of the *Gemini* spacecraft being developed in the US at the time, which allowed the crew to depressurize the ship and work outside the craft. Korolev rejected the idea of depressurizing the craft. Instead he ordered his engineers to find a way to fit a special airlock into the design

First untethered spacewalk was by American astronaut Bruce McCandless II

of the *Voskhod* spacecraft. Several designs for the airlock emerged – some rigid, some flexible and some that could be rolled into a spiral before launch. In the end a cylindrical airlock design was agreed upon. According to design, the spacewalking cosmonaut would be attached to the spacecraft via an umbilical cord. The cord would supply him with oxygen and provide communication with the commander and ground control. A backpack would contain an emergency oxygen supply.

Spacesuit needed for EVA, extra vehicular activity, had to be different from the requirements of spacesuit for ascent or descent. They had to provide a pressurized atmosphere to retain the body fluids in liquid state; supply oxygen, and at the same

First space walk by Leonov

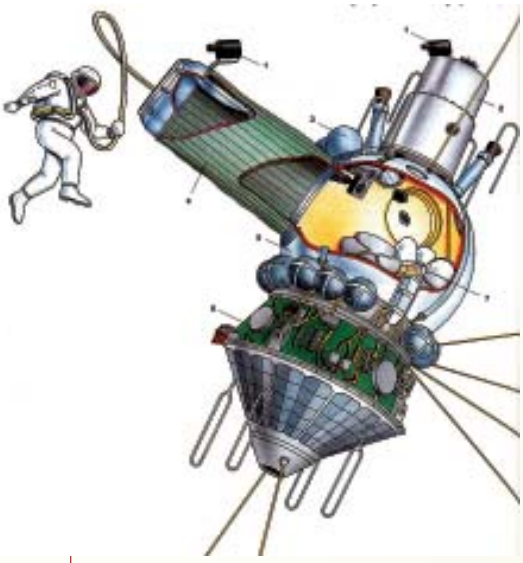
time remove carbon dioxide; maintain a comfortable temperature even when the wearer moved in and out of sunlit areas; protect from micrometeoroids; and shield against radiation. In addition it had to meet certain functional requirements. It had to provide unimpaired vision; allow easy movement of the body; have inbuilt

Space tragedies

The first death to occur in space journey was Vladimir M. Komarov killed as the *Soyuz-1* crash landed on 24 April 1967. Depressurizing of the *Soyuz-11* resulted in death of three cosmonauts in1971. Since then the Soviet/Russian space programme has not seen any loss of life in space journey.

Tragedy struck United States on 27 January 1967 when the *Apollo-1* caught fire in the launch pad killing three astronauts even before they were launched into space. The space shuttle *Challenger* exploded in the launch pad killing all the seven astronauts. Space shuttle *Columbia* exploded and disintegrated in its re-entry killing all the seven crew members.

In total 22 astronauts/cosmonauts have perished during space journey, four Soviets and 18 Americans. This is about 5% of all space travellers, clearly indicating that even while space travel has matured it is not yet completely safe.



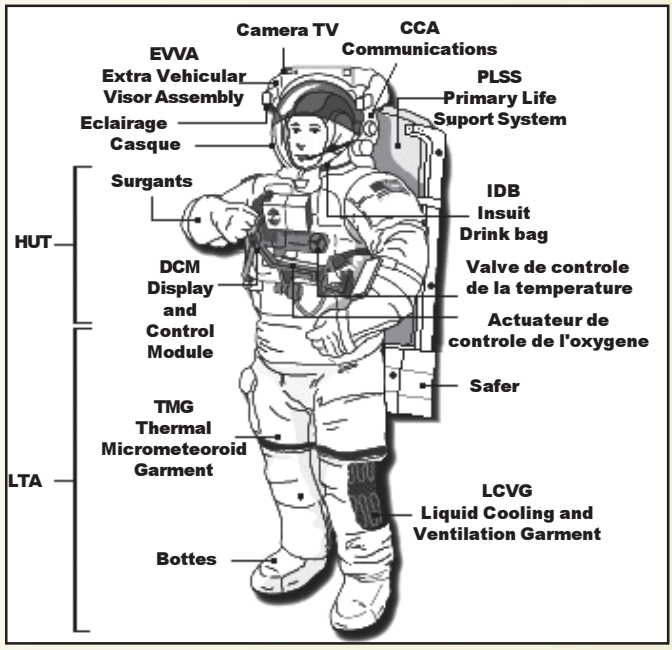
Leonov stepping out of Vostok

communication systems that allowed communication with other cosmonauts and ground controller; and allow movement around the outside of spacecraft. In short, EVA suits had to act like a spacecraft.

Old-model suits were inadequate as they could not give protection to the wearer in the harsh void of space. A special spacesuit by name 'Berkut' was designed for this purpose. It was agreed that cosmonauts staying inside would also wear spacesuits. In case of an emergency during the spacewalk, such as unconsciousness, the commander could depressurize the spaceship; go outside, and save his colleague.

Modern spacesuits

The lure of landing on Moon impelled the Soviets to develop suitable spacesuits for Moon walk. However, as the Soviet lunar programme was terminated in 1972, efforts were concentrated on development of spacesuits suitable for zero-gravity work around the manned space stations *Salyut-6*, *Salyut-7* and *Mir*. These suits have become known as the 'ORLAN-family' of suits. Initial models required the spacesuit to be tethered to the spacecraft for power and oxygen. The Orlan-DM, and all models since are designed to be self-sustaining. Unlike American spacesuits, which are custom-made to fit each person, the Soviet design was adjustable; ORLAN could fit anyone. A cylindrical metal-covered chest and torso-like suit of armour formed the basic underlying feature. At the holes for the hands and legs flexible fabric was attached. To don this spacesuit the cosmonaut had to unhinge the backpack, attach the rigid section, insert his feet and body through the hatch and climb inside. His partner had to then close the hatch and seal it. Improved versions of these ORLAN suits are used in the International Space Station. The gloves have improved flexibility that makes it much easier to do delicate work. The modern suit has an emergency wrist cut off in case the gloves develop leaks. The suits could supply oxygen for about seven hours, generate power from the batteries and had independent communication pack allowing the wearer to be independent of the mother ship. ORLAN space suits have been used by Soviet/Russian, American, and European astronauts.



MMU spacesuit

In the United States, early spacesuits such as the ones used in the *Mercury* projects were modified versions of the Jet pilots' suits. They obtained the oxygen from the craft by an umbilical chord and could be pressurised in the event of emergency. However, when the Gemini program began, US commenced design of spacesuits not only for emergency use, but also for spacewalking. As the Apollo missions commenced, the design was modified. Instead of air cooled system, it was modified to water cooled system and additional systems were added to make the suit environment bearable. Layers of materials were added to give protection from the prolonged exposure to radiation.

It is said that there are more elements and systems in a spacesuits than a car; in fact, one can say that spacesuits, especially the modern ones like NASA's Manned Manoeuvring Unit (MMU) are miniature spacecrafts. Indeed, such suits have their own independent heat regulation system, a medical monitoring block, radio communications facilities, and more importantly, a propulsion system – mini rockets that can be controlled by a hand held device. Nitrogen-filled canisters with attached nozzle provide the impulse for the mini rockets and the astronauts could fly around in MMU independent of the mother ship in space for about 4 to 6 hours.

Spacewalk - milestones

The first EVA by Alexei Leonov was during March 1965. Soon Americans followed; Edward White went outside *Gemini-4* on a tether for 20 minutes 3 June 1965. The first EVA that was a Moonwalk rather than a spacewalk was made by American astronaut Neil Armstrong on 20 July 1969 when the *Apollo-11* Lunar Module *Eagle* landed on the Moon. He was joined by crewmate Buzz Aldrin, and their EVA lasted 2 hours and 32 minutes. While the Soviet Union's Svetlana Savitskaya was the first women to step out into space out of the *Salyut-7* for 3.5 hours 25 July 1984, American astronaut Kathryn Sullivan performed space walk during the *Challenger* mission in October 1984.

All these space walks were around Earth; but the first deep-space EVA was conducted by Alfred Worden in July 1971. He was returning from Moon mission in *Apollo-15*, and stepped out into deep space, for 16 minutes to retrieve two film cassettes from the camera attached to the capsule. Using the Manned Manoeuvring Units, Bruce McCandless and Robert Stewart flew free, without umbilical chord around space shuttle *Challenger* in February 1984. Thus for some time they were like independent spacecraft orbiting Earth all by themselves! As of now, the longest EVA is 8 hours and 56 minutes, performed by Susan J. Helms on 11 March 2001. However in terms of cumulative spacewalk Anatoly Solovyev, with 16 spacewalks, totalling 77 hours, 41 minutes EVA, holds the records for most spacewalks and greatest duration on EVA.

When Tuberculosis Strikes the Backbone

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Tuberculosis – once called the *raja roga*, *raj yakshma*, captain of the men of death, consumption and white plague – is an ancient disease that may have always riddled the human race. The oldest evidence of the disease comes from the Egyptian mummies, which date back to around 2,000 BC. Records of tuberculosis are found in the ancient Hindu, Chinese, Babylonian and Egyptian texts. *Atharva Veda*, one of the four oldest scriptures of Hinduism, presents a most vivid portrayal of its symptoms and terms it a most difficult disease to treat.

The first major breakthrough against tuberculosis was made on 24 March 1882 when Robert Koch, a German physician, announced to the Berlin Physiological Society that he had discovered the cause of the disease. He named the causative organism *Mycobacterium tuberculosis*. Three weeks later, on 10 April, he published an article entitled 'The Aetiology of Tuberculosis'. This was a big discovery. Still, the conquest of tuberculosis was relatively slow. It was not until the 1950s that the first effective line of anti-tubercular drugs, streptomycin, para-amino-salicylate (PAS) and isoniazid (INH) were discovered, and the disease became curable.

In the last 50 years, scientists have discovered several new anti-tubercular medicines, and this has cut short the duration of treatment, but tuberculosis continues to be rife all across the globe. Still, the 'captain of death', it causes more deaths than any other single infectious organism. Currently, eight million new cases of active tuberculosis are diagnosed annually, resulting in one death every 10 seconds. A third of the global population is latently infected with the organism and at risk of developing active disease.

Tuberculosis can strike any part of the body, but lungs are most commonly stricken. Next, in order, are the intestines. But bone and joint tuberculosis is also fairly common, and spine is the favoured site.

Spinal tuberculosis

Tuberculosis can strike any vertebra, but those that lie at the back of the chest, called the thoracic or dorsal vertebrae, are most commonly affected. Often, the disease attacks two or more adjoining vertebrae at the same time, and causes a widespread destruction of the bone(s) and the disc that lies between the vertebral pieces.

Symptoms

Depending on the severity of illness, a number of symptoms can appear. The commonest is a varying degree of pain in the back. The pain classically awakens the sufferer at night, causing what's known as 'night cries'.

If the vertebrae give way, the dorsal spine collapses forward and develops an acute forward bend, causing a hunchback. Since the spinal canal is fairly narrow in this part, this structural collapse and the accumulation of tubercular pus places the spinal cord under pressure. The victim may develop a number of neurological symptoms and signs and suffer weakness of the legs that could worsen over a few days to paralysis and inability to stand. Bladder and bowel control also may be lost.

The collection of pus at various sites may also produce adverse symptoms. Some people develop a boggy swelling on one side of the spine, others a cold abscess in the groin, and a few people a collection along the ribs. The pus can also track into the skin.

A person with tuberculosis is likely to suffer from low-grade fever. The temperature typically rises each evening. He or she may also have sweating at night, cough, blood spitting, and suffer an acute loss of weight. None of the symptoms are peculiar to tuberculosis, but if they occur, they make the diagnosis of tuberculosis more likely. A sense of ill health is a most constant symptom, and the person does not feel like eating.

Diagnosis

If you have the classic symptoms, your doctor might think of tuberculosis and investigate for it. However, often the diagnosis is made by chance when an X-ray of the chest, dorso-lumbar spine or low back is taken. Blood work, including the cell counts and erythrocyte

sedimentation rate (ESR), a polymerised chain reaction (PCR) test on blood, urine, human secretions or a pus aspirate, and a tuberculin skin test can offer useful corroborative evidence.

Cross-sectional imaging, by way of computerised tomography (CT scanning) and Magnetic Resonance Imaging (MRI) can also be extremely useful in delineating the diseased vertebrae and the extent of disease.

Treatment

Treatment of spinal tuberculosis needs a long-term commitment. The line of treatment varies with the severity and extent of disease. If there are no neurological signs, anti-tubercular drugs (including isoniazid, rifampicin, ethambutol, and pyrazinamide), bed rest and a spinal support (spinal jacket, dorso-lumbar brace, Minerva brace, or cervical collar) shape the treatment.

The drug treatment in bone and joint tuberculosis has to be much more rigorous than in lung tuberculosis. Anti-tubercular medicines must be taken, without fail for a period of at least 18 months. While four anti-tubercular drugs are given for the first few months, at least three are necessary for the rest of the period. You just cannot afford to be carelessness with the medicines.

If you neglect the treatment, you run a serious risk. The bacteria could develop resistance to the first line anti-tubercular drugs. In that case, the treatment becomes more difficult and second line anti-tubercular drugs must be started. These drugs are much more expensive and carry a significant risk of adverse effects.

Some patients also require surgery. This becomes particularly necessary if a patient suffers widespread loss of bone and pus formation, and the threat looms large that the spinal cord may suffer compression. The operation is done under either general or local anaesthesia, only after the patient has been on anti-tubercular medication. The key objective of surgery is to clear the pockets of pus and dying tissues completely, and restrict

the damage. Delay in surgery can sometimes lead to irreparable loss of function. ■

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/-

Subodh Mahanti

Recent Developments in Science and Technology

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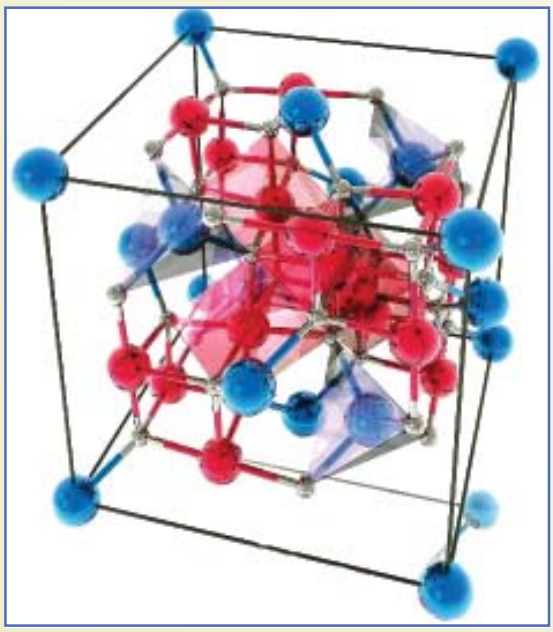
Breakthrough in crystal structure prediction

Any chemical compound has a molecular structure that describes the way the atoms are linked to make up the molecule. But the molecular structure is not always sufficient for predicting all the properties of a molecule; to do that one also needs to know how the molecules are arranged in a crystal of the said compound. For example, crystal structure describes the periodically repeating arrangement of molecules in a material and determines many of a material's properties, such as solubility, dissolution rate, hardness, colour, and external shape. Till recently, despite advances in computer technology, it was not possible to predict the crystal structure of a chemical substance on the basis of its chemical composition alone. Chemists had to use X-ray crystallography to determine how atoms are arranged in a molecule and how molecules pack into a crystal. It is a time-consuming method that has remained practically unchanged for almost a century, and also needs the researchers to first obtain a high-quality crystal of the compound. Now scientists at the Cambridge Crystallographic Data Centre (CCDC) in Britain have developed software that allows prediction of the three-dimensional structure of compounds and could allow the properties of materials, or potential drug candidates, to be examined in advance, before they are made experimentally (*Nature*, 6 December 2007).



New computer software helps predict crystal structure.

Before the recent success many approaches to the problem have been developed and these have been evaluated over the years in international exercises, known as the 'blind tests' of crystal structure prediction. Every three years since 1999, the CCDC has set a challenge for software developers to predict the structure of four molecules, the structure of which was known only to the CCDC. But nobody had been able to predict the correct structures of all four molecules. Although the results of previous blind tests, in 1999, 2001 and 2004, did demonstrate that the crystal structures of small organic molecules can occasionally be predicted under favourable conditions, the rates of success were low and no one method was consistently successful over the range of types of molecules studied. Fifteen research groups took part in the latest test, in which participants were challenged to predict four recently determined crystal structures given only the chemical diagram of the molecules and conditions of crystallisation, with three predictions allowed per crystal.

The results of the 2007 blind test showed a dramatic improvement over what has been achieved previously: three groups had one structure correct within their three allowed predictions; three others had two such hits, and one group predicted all four target crystal structures. The most successful predictions were made by Dr Marcus Neumann of Avant-garde Materials Simulation in Paris, France and Drs Frank Leusen and John Kendrick of the Institute of Pharmaceutical Innovation at the University of Bradford, UK.

Having proven that the crystal structures of small organic compounds can be predicted reliably, the method can now be viewed as applicable to a number of problems of importance in the pharmaceutical industry and more generally to improving our understanding of how molecules are held together in crystalline solids.

Humans evolving faster

According to paleoanthropologists, it took almost three million years for modern humans to evolve from the earliest ape-like human ancestors. Most anthropologists agree that humans first evolved in Africa and then spread to other areas, and the lighter skin colour of Europeans and Asians is generally attributed to selection to allow more absorption of vitamin D in colder climates where the intensity of the Sun is less. But it was widely believed that with the availability of plentiful food that made it easier than ever before to survive and reproduce, humans must have stopped evolving or must be evolving very slowly. But a recent study by a team of researchers

lead by Henry Harpending, an anthropologist at the University of Utah in Salt Lake City, USA, published in the online edition of *Proceedings of the National Academy of Sciences* (PNAS, 2007. DOI: 10.1073/pnas.0707650104) shows that far from slowing down, human evolution has actually speeded up in the past 40,000 years. In the past 5,000 years, genetic change has occurred at a rate roughly 100 times higher than any other period, according to the paper.

The researchers analysed the DNA from 270 people in four populations: Han Chinese, Japanese, Africa's Yoruba tribe, and Utah Mormons who traced their ancestry to northern Europe. The DNAs were part of the International HapMap Project, whose goal is to develop a haplotype (set of alleles or markers on a short chromosome segment) map of the human genome – the 'HapMap' – to describe the common patterns of human genetic variation. The study specifically looked for genetic variations called single nucleotide polymorphisms, or SNPs, which are mutations at a single point on a chromosome. Over time, chromosomes randomly break and recombine to create new sequences of SNPs along the chromosome. In the study the researchers found that seven percent of human genes have been undergoing rapid, recent evolution.

Charles Darwin, the author of *The Origin of Species*, had predicted that evolution happens faster in big populations. Here also the researchers found that the biggest changes have come since the end of the last ice age, about 10,000 years ago, which opened up new environments for the quickly expanding human population to grow from millions to billions.

How plants conquered land

No one knows when exactly one-celled bacteria – the earliest living organisms – started using sunlight to make food, the characteristic of green plants. It was the development of chlorophyll which was responsible for putting free oxygen into the atmosphere. From fossil evidence, it appears that the earliest chlorophyll-using organism were the cyanobacteria, commonly known as blue-green algae, which appeared almost 3,500 million years ago. The earliest evidence of land plants and fungi appears in the fossil record around 435 million years ago. Before that, only the water – the oceans, shallow seas, and lakes, teeming with simple aquatic plants, invertebrates, and primitive jawless fishes – held the secret of life.

Moss *Physcomitrella patens*

From their early beginnings in water, plants moved onto land in the form of algae-like ancestors. But coming on to land from water was not an easy proposition. First, once on land the plants had to hold up against gravity, had to find a way to prevent drying out, and also devise a mechanism for moving water and chemicals around in the body to survive and grow. Mosses, which are primitive plants called bryophytes, took steps to cope but never evolved certain features, such as vascular tissues that could transport water and seeds that could survive dry spells that eventually appeared in flowering plants. By sequencing the genome of the extensively studied moss *Physcomitrella patens* and comparing it to the sequenced genomes of rice, the flowering plant Arabidopsis, and single-cell algae, an international team of 45 researchers has been able to look at what the ancestral land-plant genome looked like (*Science*, 13 December 2007, 10.1126/science.1150646), which may provide clues as to how plants moved onto land.

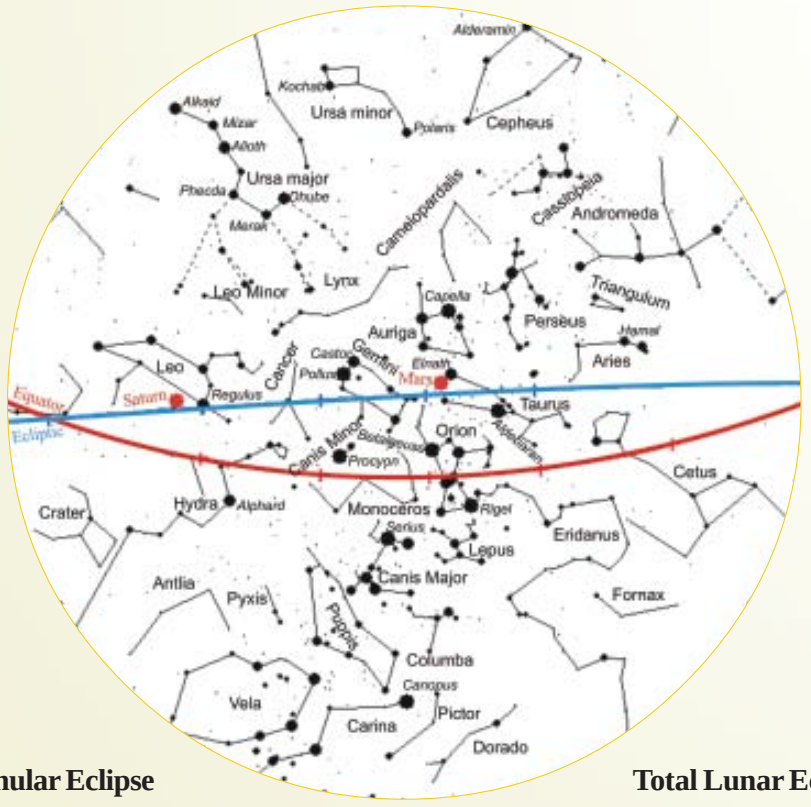
Mosses appear quite simple, lacking the roots, seeds, and flowers typical of most land plants. Yet the first analysis of a moss genome reveals that mosses are surprisingly complex, with 35,000 potential genes – 10,000 more than the first land plant sequenced – and a host of unique adaptations not found in other green land plants. About 20% of the moss's genes are new to researchers and likely specific to moss. Some of these, such as the genes that help mosses come back to life after being dried out, are shared with other land plants and so evolved even earlier in plant evolution. Additional water-stress genes suggest that *P. patens* has evolved independent ways to deal with water shortages as well. According to the researchers, the moss genome may reveal clues about how plants accomplished the transition to land. ■

Sky Map for February 2008

Full Moon

20 February

North

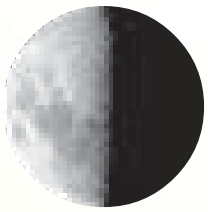


East

West

South

Moon - Last Quarter

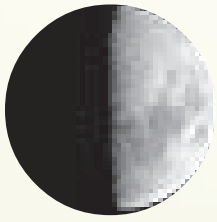


28 February

New Moon

7 February

Moon - First Quarter



13 February

Annular Eclipse

7 February*

Total Lunar Eclipse

21 February*

* These eclipses are not visible from India.

The sky map is prepared for viewers in Nagpur (21.09^0 N, 79.09^0 E). It includes bright constellations and planets. For viewers south of Nagpur, constellations of the southern sky will appear higher up in the sky, and those of the northern sky will appear nearer the northern horizon. Similarly, for viewers north of Nagpur, constellations of northern sky will appear higher up in the sky, and those of the southern sky will appear nearer the southern horizon. The map can be used at 10 PM on 01 February, at 9:00 PM on 15 February and at 8 PM on 29 February.

Tips for watching the night sky :

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

Planet/Dwarf Planet Round Up:

Mars : In the constellation Taurus (*Vrishab Rashi*) up in the zenith sky.

Saturn : In the constellation Leo *(Simha Rashi)* near eastern horizon

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

Eastern Sky : Crater, Hydra (Alphard), Leo (Regulus)/ *Simha Rashi (Magha),* Leo Minor.

Western Sky : Andromeda, Aries (Hamal) / *Mesha Rashi,* Cetus, Triangulum.

Southern Sky : Antlia, Canis Major (Sirius), Carina (Canopus), Columba, Dorado, Eridanus, Fornax, Lepus, Pictor, Puppis, Pyxis, Vela.

Northern Sky : Camelopardalis, Cassiopeia, Cepheus (Alderamin) / *Vrishaparv,* Ursa Major/ *Saptarishi*, Ursa Minor (Polaris) / *Dhurva Matsya* (*Dhurva Tara*).

Zenith : Auriga (Capella), Cancer / *Karka Rashi*, Canis Minor (Procyon), Gemini (Castor, Pollux)/ *Mithun Rashi*, Lynx, Monoceros, Orion (Betelgeuse, Rigel, Saiph), Perseus, Taurus (Aldebaran) / *Vrishabh Rashi.*

□ **Arvind C. Ranade**

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Astronomy

Earthquake Tip-20
How do Beam-Column Joints in RC Buildings Resist Earthquakes?

Why Beam-Column Joints are Special

In RC buildings, portions of columns that are common to beams at their intersections are called 'beam-column joints' (Figure 1). Since their constituent materials have limited strengths, the joints have limited force carrying capacity. When forces larger than these are applied during earthquakes, joints are severely damaged. Repairing damaged joints is difficult, and so damage must be avoided. Thus, beam-column joints must be designed to resist earthquake effects.

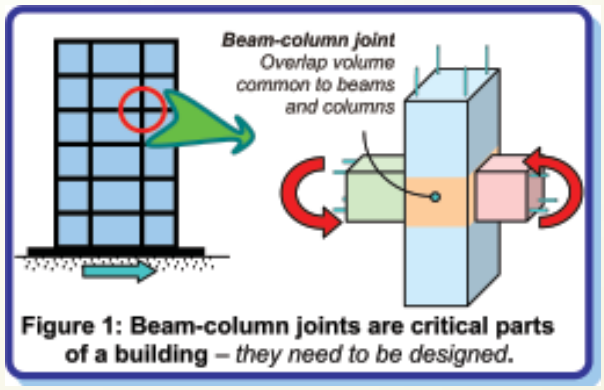

Figure 1: Beam-column joints are critical parts of a building – *they need to be designed.*

Earthquake Behaviour of Joints

Under earthquake shaking, the beams adjoining a joint are subjected to moments in the same (clockwise or counter-clockwise) direction (Figure 1). Under these moments, the top bars in the beam-column joint are pulled in one direction and the bottom ones in the opposite direction (Figure 2a). These forces are balanced by bond stress developed between concrete and steel in the joint region. If the column is not wide enough or if the strength of concrete in the joint is low, there is insufficient grip of concrete on the steel bars. In such circumstances, the bar slips inside the joint region, and beams lose their capacity to carry load.

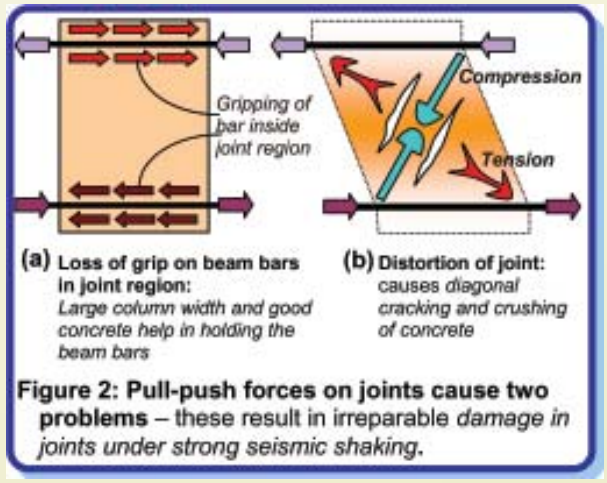

Figure 2: Pull-push forces on joints cause two problems – these result in irreparable *damage in joints under strong seismic shaking.*

Further, under the action of the above pull-push forces at top and bottom ends, joints undergo geometric distortion; one diagonal length of the joint elongates and the other compresses (Figure 2b). If the column cross-sectional size is insufficient, the concrete in the joint develops diagonal cracks.

Reinforcing the Beam-Column Joint

Problems of diagonal cracking and crushing of concrete in the joint region can be controlled by two means, namely providing large column sizes and providing closely spaced closed-loop steel ties around column bars in the joint region (Figure 3). The ties hold together the concrete in the joint and also resist shear force, thereby reducing the cracking and crushing of concrete.

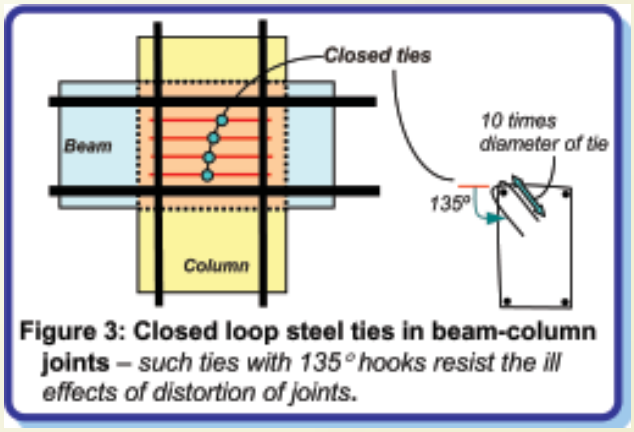

Figure 3: Closed loop steel ties in beam-column joints – *such ties with 135° hooks resist the ill effects of distortion of joints.*

Providing closed-loop ties in the joint requires some extra effort. Indian Standard IS:13920-1993 recommends continuing the transverse loops around the column bars through the joint region. In practice, this is achieved by preparing the cage of the reinforcement (both longitudinal bars and stirrups) of all beams at a floor level to be prepared on top of the beam formwork of that level and lowered into the cage (Figures 4a and 4b). However, this may not always be possible particularly when the beams are long and the entire reinforcement cage becomes heavy.

Anchoring Beam Bars

The gripping of beam bars in the joint region is improved first by using columns of reasonably large cross-sectional size. As explained in *Earthquake Tip 19*, the Indian Standard IS:13920-1993 requires building columns in seismic zones III, IV and V to be at least 300mm wide in each direction of the cross-section when they support beams that are longer than 5m or when these columns are taller than 4m between floors (or beams). The American Concrete Institute recommends a column width of at least 20 times the diameter of largest longitudinal bar used in adjoining.

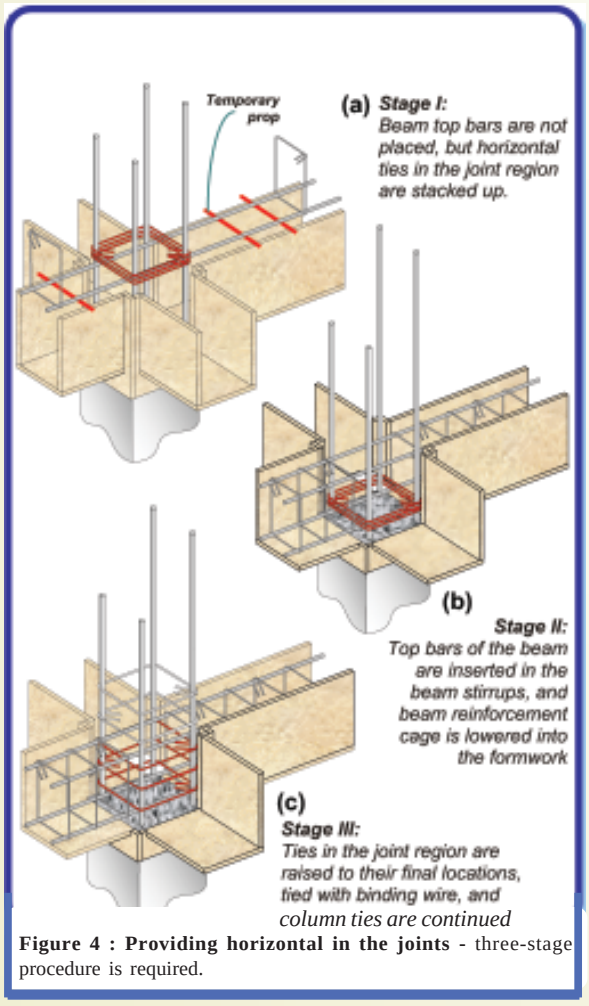

Figure 4 : Providing horizontal in the joints - three-stage procedure is required.

In exterior joints where beams terminate at columns (Figure 5), longitudinal beam bars need to be anchored into the column to ensure proper gripping of bar in joint. The length of anchorage for a bar of grade Fe415 (characteristic tensile strength of 415MPa) is about 50 times its diameter. This length is measured from the face of the column to the end of the bar anchored in the column. In columns of small widths and when beam bars are of large diameter (Figure 5a), a portion of beam top bar is embedded in the column that is cast up to the soffit of the beam, and a part of it overhangs. It is difficult to hold such an overhanging beam top bar in position while casting the column up to the soffit of the beam. On the other hand, if column width is large, the beam bars may not extend below the soffit of the beam (Figure 5b). Thus, it is preferable to have columns with sufficient width. Such an approach has been used in the American practice [ACI318M, 2002].

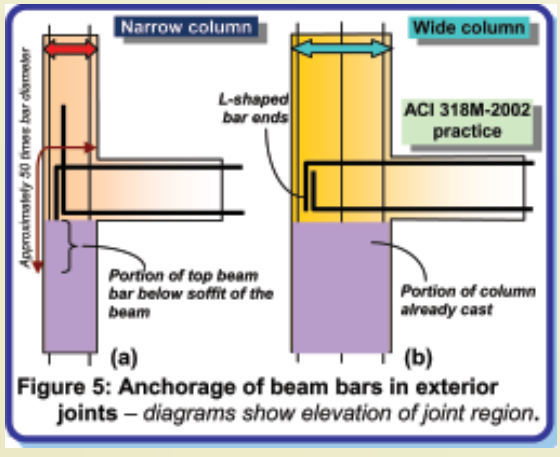

Figure 5: Anchorage of beam bars in exterior joints – *diagrams show elevation of joint region.*

In interior joints, the beam bars (both top and bottom) need to go through the joint without any cut in the joint region. Also, these bars must be placed within the column bars and with no bends (Figure 6).

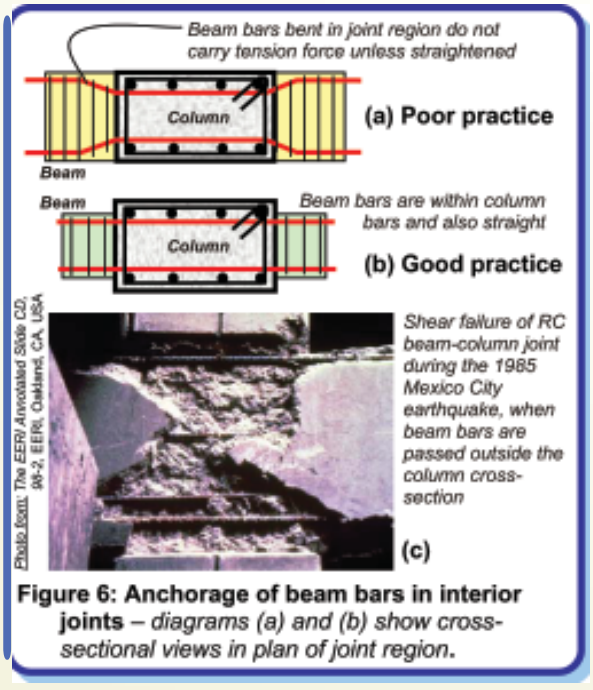

Figure 6: Anchorage of beam bars in interior joints – *diagrams (a) and (b) show cross-sectional views in plan of joint region.*

Related IITK-bMTPC Earthquake Tip

Tip17: How do Earthquakes Affect Reinforced Concrete Buildings?
Tip18: How do Beams in RC Buildings Resist Earthquakes?
Tip19: How do Columns in RC Buildings Resist Earthquakes?

Resource Material

1. ACI 318M, (2002), *Building Code Requirements for Structural Concrete and Commentary*, American Concrete Institute, Farmington Hills, (MI), USA.
2. IS 13920, (1993), *Indian Standard Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces*, Bureau of Indian Standards, New Delhi.
3. SP 123, *Design of Beam-Column Joints for Seismic Resistance*, Special Publication, American Concrete Institute, USA, 1991

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9th National Science-Fiction Conference at Puducherry

(From L to R) Dr. K. S. Purushothaman (speaker), Dr. N. Natarajan, Prof. P. Balaswamy, Prof. N. Kannan, Dr. Subodh Mahanti and Dr. M. H. Srinarhari

Indian Association for Science Fiction Studies (IASFS) with the support of Vigyan Prasar organized the 9th National Science Fiction Conference at Puducherry on 8-9 December 2007. The 8th National Conference was held at Aurangabad (Maharashtra) in 2006.

The conference was inaugurated by Prof. N. Kannan, vice chancellor of Thiruvalluvar University, Vellore. In his address, he emphasized that science fiction story is not meant for scientists only, as it is commonly presumed. It should be read by all. He said no other literary form has given so much importance to science as science fiction. Science fiction is useful in the inculcation of scientific attitude in the society, he added.

Delivering the key-note address, Prof. P. Balaswamy, ex-Head of English Department, Pondicherry University, described science fiction as the 'marriage of science and literature.' He quoted a line from the poetry of John Keats 'Beauty is truth, truth is beauty'. He said that this beautiful line is relevant to the case of sci-fi also. Here, truth stands for science and beauty for humanities.

A view of the audience

A book entitled *Understanding Science Fiction* authored by Dr. M. H. Srinarhari and Dr. K. S. Purushothaman was released on the occasion. The book documents the origin, history, various principles, concepts and revolutions of the genre of science fiction.

In Session I on 'Science in sci-fi' Manish Mohan Gore, Dr. H. Kalpana and Dr. Binu Zakaria presented their papers. The session was chaired by Dr. Sujatha Vijayaraghavan. The Session II on 'Science fiction today' was chaired by Prof. Palanivel R. Dr. P. K. Mukherjee, Miss Zahira Bano and Miss Zuligah presented their papers.

On 9th December in Session III on 'Story reading', three science fiction stories were read. Dr. Yashwant Deshpande, Dr. R. S. Bhoosnurmath, and Dr. Paneerselvam read their sci-fi stories. The session was chaired by Dr. N. Natrajan, Head of English Department, Pondicherry University.

In the Session IV, Prof. J. A. K. Tareen, vice chancellor of Pondicherry University, in his address said, "Science cannot provide inner solace but after blending with literature it can do so. Sci-fi works as a precursor to the future. So, this genre should be encouraged." After his address, he switched on the video conference replay with Prof. James Gunn, an authority of sci-fi from USA. In Session V on 'Science Today', six papers were presented. The speakers were S. N. Banerjee, Manoj C. R., Mrs. Prashant Kumari, Dr. Panerselvam, Dr. Michael Vishwamitra, and S. Umashankar. Dr. Y. Deshpande, renowned Marathi sci-fi writer chaired this session.

Session VI focussed on Tamil sci-fi was chaired by Dr. Babu Abraham, Dean, humanity studies, Pondicherry University. Four participants, namely P. Shanmugavel, Dr. Arivunambi, Miss T. R. Muneera and C. Arun presented their papers.

Session VII covered three papers and the presenters were Raju Parghi, Miss Lily Sharmila and Vishnu Patil respectively. Dr. Subodh Mahanti chaired this session.

The conference ended with expression of thanks to all the guests, supporters and participants by Dr. K. H. Purushothaman, president IASFS and Dr. R. S. Bhoosnurmath, vice president IASFS.

Letters to the Editor

Helpful to students

I am a student. I have been receiving *DREAM 2047* since September 2007. I find plenty of information about the scientists and also about the recent developments in science and technology. These topics certainly help students like us to cultivate the habit of reading books and magazines. I would request you to also publish the scientific puzzles and quiz, because would be helpful for students.

Sanjana S.
Chitradurga (Dist),
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The article 'Global Environmental Challenge to Technological Management'by Shruti Shukla (December 2007) was informative. Dr. Yatish Agrawal's 'Check Station: Understanding the Diagnostic Tests of the Heart' helped me to understand the methods of medical diagnostics.

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