R. N. 70269/98

ISSN : 0972-169X
Postal Registration No.: DL-SW-1/4082/2007

Vigyan Prasar

DREAM 2047

December 2007 | Vol. 10 | No.3 | Rs. 5.00

Nil Ratan Dhar
Pioneer in Agricultural Research in India

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

Living Beyond Our Means - But How Long?

Through this column, we have discussed from time to time the threats to our planet arising from climate change, degrading environment, the growing 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, the challenge of feeding an exponentially growing population, and so on. These are among the many issues and threats that have remained unresolved over the decades putting 'humanity's very survival' at risk. This final warning comes in the latest report *Global Environment Outlook: Environment for Development* (GEO-4) released by United Nations Environment Programme (UNEP) in October 2007.

It was in 1987 that the World Commission on Environment and Development produced its seminal report, *Our Common Future*, which first popularised the idea of sustainable development. GEO-4 is the fourth report in the series that assesses the current state of the global atmosphere, land, water and biodiversity, describes the changes since 1987, and identifies priorities for action.

What makes GEO-4 so very important for us? Traditional reports generally focus on physical aspects, and see economic and social issues as important but *separate* concerns. GEO-4, on the other hand, represents an *evolution* in environmental assessment from a purely bio-physical focus to one that includes social and economic aspects, inter-linkages among different components of the environment and development and outlook for the future. It also capitalises on findings from organisations like the Intergovernmental Panel on Climate Change (IPCC) and many others. The objective of the report is not to present a dark and gloomy scenario, but an urgent call for action. To begin with, it salutes the world's progress in tackling some relatively straightforward problems. It acknowledges the fact that environment is now much closer to mainstream politics everywhere.

GEO-4 acknowledges that there is now "visible and unequivocal" evidence of the impacts of climate change, and consensus that human activities have been decisive in this change. Global average temperatures have risen by about 0.7 °C since 1906. By the turn of the century, the temperature is expected to rise further between 1.8°C and 4°C. It is believed that a 2°C increase in the global mean temperature (above the levels as compared to the times before the Industrial Revolution) is a threshold beyond which the threat of major and irreversible damage becomes more plausible. The average temperatures in the Arctic are rising twice as rapidly as in the rest of the world. Acid rain is now much less of a problem in Europe and North America, but a challenging problem in countries like Mexico, India and China. Sea-level rise will continue for the foreseeable future adversely affecting over 60 per cent of the population worldwide that lives within 100 kilometres of the coast.

Climate change is a global priority, GEO-4 asserts. What lacks is the political will and leadership to address this issue. And yet, there is a remarkable lack of urgency, and a woefully inadequate global response! The threat is now so urgent that large cuts in greenhouse gases by mid-century are needed. Not only developed countries, but rapidly industrialising countries also need to reduce anthropogenic (man-made) greenhouse gases. In particular, we must do more to use and develop renewable energy.

A crucial point GEO-4 makes is that we are living *far beyond* our means. 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 21.9 hectares per person while the Earth's biological capacity is only 15.7 hectares per person, on an average! This implies that we are living way beyond our means, consuming 40 per cent more than what the Earth can sustain; and that the well-being of billions of people in the developing world is at risk. How long can we afford to do so?

Irrigation already takes about 70 per cent of available water. By 2025, water use is predicted to rise by 50 per cent in developing countries and by 18 per cent in the developed world. Water quality is declining too, polluted by microbial pathogens and excessive nutrients. Globally, contaminated water remains the greatest single cause of human disease and death.

Biodiversity changes are the fastest in human history today. It is alarming to note that species are becoming extinct a hundred times faster than the rate shown in the fossil records. Consumption of fish has tripled since 1961 and today catches are estimated at 250 per cent more than

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Published and Printed by Dr. Subodh Mahanti on behalf of Vigyan Prasar, C-24, Qutab Institutional Area, New Delhi - 110 016 and Printed at Sagun Offset Pvt. Ltd., B-3, Sector-65, Noida (U.P) 201 307.

Nil Ratan Dhar

Pioneer in Agricultural Research in India

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Professor Nil Ratan Dhar was among the originators of modern science in India. Dhar was regarded as the founder of physical chemistry in India. He was a pioneer in agricultural research in India. Dhar was the student of Acharya Jagadis Chandra Bose and Acharya Prafulla Chandra Ray and in that sense he was among the second generation of Indian scientists to take up scientific research in India.

Nil Ratan Dhar was born on 2 January 1892 in Jessore in undivided India. Today Jessore is in Bangladesh. Nil Ratan completed his school education from the Government Zilla School, Jessore, which he had joined in 1897 at the age of five. In school he studied English, Sanskrit, Bengali, mathematics, history and geography. In those days science was not part of school curricula in India. In 1907, he passed the Entrance Examination held by the Calcutta University. He not only passed the examination with distinction but also managed to get a Merit Divisional Scholarship of Rs.15 per month. The scholarship was tenable for two years. He joined the Rippon College and studied there the newly introduced ISc course with physics, chemistry, mathematics and English. The Principal of the College was Ramendrasunder Trivedi, who also taught physics. It may be noted here Ramendrasundar's popular science writing acted as a source of inspiration for his younger contemporaries. He also played an instrumental role in creating for Bengali a linguistic space, which could accommodate scientific, philosophical and epistemological themes without introducing any unnecessary artificiality or stiffness in the language.

Nil Ratan organised a small laboratory in the college for practical work. While studying at the Rippon College, Dhar also attended excellent lectures in physics and chemistry at the Indian Association for the Cultivation of Science, an organisation established by Mahendra Lal Sircar in 1876. These lectures accompanied by experimental demonstrations were delivered by Chuni Lal Bose, a chemical engineer of the Bengal Government, and A. N. Palit, Professor of Physics at the Metropolitan College.

After passing the ISc examination in 1909 with a Government scholarship of Rs.20 per month, Dhar joined the Presidency College for studying BSc Honours in chemistry. It is interesting to note that he resided in the same room (Room No. 4) of the Hindu Hostel, where India's first President, Dr. Rajendra Prasad lived when he studied at the Presidency College. Among his teachers at the Presidency College were Acharya Jagadis Chandra Bose (who was heading the Physics Department) and Acharya Prafulla Chandra Ray (who was heading the Chemistry Department). While he was a student at the Presidency College, he influenced many of his juniors to take deep interest in science. Among them were: J. C. Ghosh, M. N. Saha, J. N. Mukerji, and Pulin Bihari Sarkar.

Nil Ratan Dhar
(Courtesy : Vigyan Parishad Prayag)

In 1911, Dhar passed the BSc Honours Examination and joined MSc course in chemistry in the same college. At the BSc examination he stood first in the Calcutta University. He was awarded Gold Medal and a scholarship of Rs.32 per month. While doing MSc, Dhar also undertook research work on nitrite chemistry under the guidance of Prafulla Chandra Ray. The findings of his research work were published in the *Journal* of the Chemical Society of London. In 1913, Dhar passed his MSc examination. He not only stood first in chemistry but he secured highest marks amongst all the MA and MSc candidates of the university. He received 20 gold medals from the Calcutta University and also from the Asiatic Society of Bengal. He was given Griffith Memorial Prize of Rs.900 and the Merit Scholarship of Rs.100 per month of the Calcutta University. It was certainly an extraordinary feat.

After MSc, Dhar started doing research work independently in the area of physical chemistry. Jointly with one of his juniors, D. N. Bhattacharya he determined the mobility of ions at zero degree temperature. They also determined the transport number of nitrite ion by electrolysis of a solution of silver nitrite. Dhar, with A. K. Dutta, determined the second dissociation constant of dibasic acids. These researches were published in reputed journals in Germany.

In 1915, Dhar left for London on Government of India Scholarship. The scholarship was given to exceptional students for higher studies in Europe and America. The scholarship was tenable in the first instance for three years. At the time of his getting the scholarship, the First World War (1914-1918) was in full swing but Dhar went ahead with his plan for higher studies in England. Dhar's initial plan was to work with F. G. Donnan, FRS, Professor of Physical Chemistry at the University College of London. However, Donnan's Laboratory was undergoing constructional changes and some more time was needed for its proper functioning. He then decided to work with J. C. Phillip

Prof. Dhar inaugurating Dairy Science Association at Kulbhaskar Degree Collage Allahabad in 1966. Also seen from L Dr. R.L. Yadav, Dr Prabhakar Dwivedi and Dr. K.C. Srivastava. (Courtesy : Prabhakar Dwivedi)

of the Physical Chemistry Department of the Imperial College of Science and Technology, South Kensington, London. While in London, Dhar came in contact with such eminent scientists like J. J. Thomson, Ernest Rutherford, and Lord Rayleigh. After receiving the DSc degree of the London University in 1917, Dhar went to France. He wrote up his thesis for the Degree of Docteur es' Sciences of the Sorbonne University – the highest degree possible in France.

Dhar was appointed in the Indian Education Service while he was still in London. He came back to India in 1919 and joined the Allahabad University. He became Head of the Chemistry Department in the Muir Central College Allahabad University.

Dhar is the author of over 450 original papers on electrochemistry, catalysis, velocity of reactions, colloid chemistry, photochemical processes and soil reactions published in national and international journals. His researches have been largely quoted in textbooks on colloid chemistry, photochemistry and soil science. He was the discoverer of the influence of light on nitrogen fixation and nitrogen loss in soils and also of the relationship between the nitrogen and phosphate status of soils. The Royal College of Agriculture, Uppsala, Sweden, verified his theory of nitrogen fixation by adding organic matter to soil, especially in presence of calcium phosphate, and obtained 25 per cent increase in yield in field trials by this method. They also observed marked increase of nitrogen in presence of light.

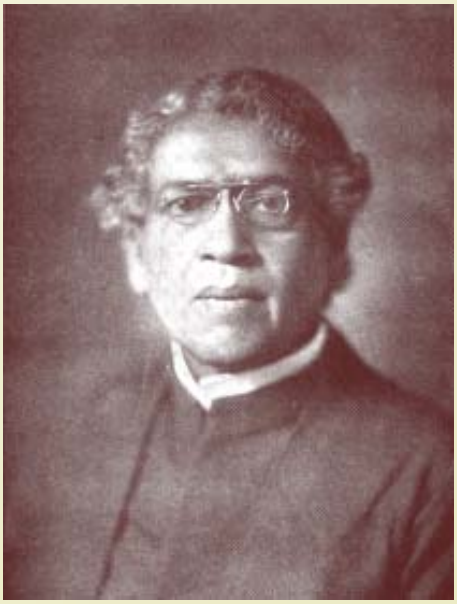
Dhar's life was a life of complete dedication to science. He, like his ideal teachers Ray and Bose, practised science for the benefit of all. There was no place of secrets, patents or royalties in his life.

Dhar believed that science alone can make a country prosperous. He said: "…I sincerely believe that sound progress of our nation depends essentially on science and its applications and I have preached this gospel for over 40 years, I am extremely keen on seeing Indian scientists taking up this matter of national regeneration through science with hard labour, great fortitude, devotion and sacrifice." Throughout his life he encouraged others to take up science as a career. Even when he himself was a student, he encouraged students to take to scientific study, especially chemistry.

Dhar believed that without a strong base in experiments science could not be practised. He was fond of showing demonstration experiments during his lectures. Commenting on the role of experiments, Dhar said: "During the 15th and the 16th centuries the experimental method of science was gradually established in Europe by Paracelsus, Bacon, Boyle, Palissy, and many others. They were followed by Black, Scheele, Priestley, Newton, Cavendish, Davy, Berzelius, Pasteur, Ross, Koch and others who made tremendous sacrifice in pursuing scientific endeavour and experiments. They applied science to all problems of life and developed their natural resources, improved their agriculture and made Europe prosperous. There was marked progress of science and technology for nearly 500 years. The Europeans were taught to depend on experiments and they truthfully and rigidly carried on experiments and drew correct conclusions and was successful in mastering nature."

Dhar lamented the fact that India lagged behind in carrying out experiments. He said: "After the 8th century A.D. we in this country never carried out experiments and never accepted the experimental method of science. This seems to be the main reason why we are backward and not so honest in our efforts and actions as the Europeans who have developed more method and honesty in everyday life. We have been very unlucky because invaders came repeatedly to our land and enslaved us. Instead of following the path of truth, progress and science we succumbed to moral servitude, and mental slavery seems to be persisting. Instead of working hard on scientific and correct lines we try to get on by saluting, propaganda and saying "yes" to the man in authority who may not be sound."

As a teacher Dhar was a great



J.C. Bose

inspirer. It is said: a teacher teaches, a good teacher explains, a very good teacher illustrates, and an excellent teacher inspires.. While teaching he did not like the idea of stuffing information into students' heads. Rather he helped students learn the basic principles of science. He never actually followed the syllabus. His aim was to impart education in the real sense. He could easily establish a rapport between him and his pupils. He was fond of demonstrating experiments. For him the role of experiments was crucial in teaching science. In his class he used to arrange a large number of carefully designed experiments and perform them with the dexterity of a magician.

Dhar considered it tragic that the majority of human beings in the world were still poor, ill-fed, ill-clad and uneducated. This is largely true even today. Dhar was of the opinion that scientists can play an important role in the betterment of the society. To highlight this point he quoted Antoine Lavoisier, the father of modern chemistry, who said: "we shall close this memoir with a consoling reflection. It is not required, in order to merit well of humanity and to pay tribute to one's country, that one should participate in brilliant functions that relate to the organisation and regeneration of empires. The scientist in the seclusion of his laboratory and study may also perform patriotic functions. He can hope by his labours to diminish the mass of ills that affect the human race and to increase its enjoyment and happiness; should he by the new paths which he has opened, have helped to prolong the average life of man by several years or even by only days, he can aspire to the glorious title of benefactor of humanity."

M.N. Saha

Prof. Nil Ratan Dhar (sitting 4th from L) with Nobel laureat Linus Pauling (6th from L) Mrs. Pauling (5th from L) at Mrs. Shila Dhar (7th from L) at campus of Shila Dhar Institute in Feb 1955 (courtesy : Prof. Shiv Gopal Mishra)

Dhar was of the opinion that scientists should sacrifice their own well-being for the uplift of the poor. He was confident that there would be no dearth of such men of science. He said: "I am convinced that this ancient land of Gautam Buddha, Asoka, Vivekananda, Rabindranath and Gandhiji cannot fail to produce sacrificing and devoted men of science for the uplift of the starving millions."

J. C. Bose also highlighted the need of sacrifice. Bose once said: "Nevertheless everyone had said that he had wrecked his life, which was meant for greater things. Few realise that out of the skeletons of myriad lives have been built vast continents. And it is on the wreck of a life like his, and of many such lives, that the greater India yet to be will be built. We do not know why it should be so; but we do know that the Earth-Mother is always calling for sacrifice."

Following the footsteps of his guru Acharya Prafulla Chandra Ray, Dhar donated most of his hard-earned money for the advancement of scientific research in India and for philanthropic purposes. According to one estimate Dhar donated Rs.27 lakh. He gifted land for constructing building for the National Academy of Sciences (India) at Allahabad, the founding of which was spearheaded by Meghnad Saha. He donated large sums of money for the creation of Acharya P. C. Ray Professorship of Agricultural Chemistry in Calcutta University. He also donated large amounts of money to Viswabharati, an institution established by Gurudev Rabindranath Tagore, for the improvement of agricultural research by the creation of an endowment fund out of which research scholars are to be awarded fellowships. He donated Rs. 1 lakh to Chittaranjan Seva Sadan for building nurse quarters. He donated his Barlowganj (Mussourie) House to Ram Krishna Ahsram.

Some of the important books of Dhar are:

1. Chemical Action of Light
2. New Conceptions in Biochemistry
3. Influence of Light on Some Biochemical Processes
4. *Amader Khadya* (Our Food)
5. *Jamir Urbarata Briddhir Upay* (Ways to Increase the Fertility of Soil)

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Mahendralal Sircar

(This article is largely based on "The Professor Nil Ratan Dhar Memorial Lecture" delivered by Dr. Mahanti on September 29, 2007 at Vigyan Parishad Prayag, Allahabad.)

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

what the oceans can sustain. Today, over 30 per cent of amphibians, 23 per cent of mammals and 12 per cent of birds are threatened. The GEO-4 report points out that a sixth major extinction of species is under way. But, this time it is being caused by human behaviour. Our growing demand for food will mean either intensified agriculture (that uses more chemicals, energy and water, and more efficient breeds and crops), or cultivating more land. Sure enough, either way, biodiversity suffers.

Environmental exposure causes almost a quarter of all diseases. About two million people die prematurely every year from indoor and outdoor air pollution. GEO-4 further states that some of the progress achieved in reducing pollution in developed countries has been at the expense of the developing world, where industrial production and its impacts are now being exported.

Indeed, unsustainable land use is causing degradation, a threat as serious as climate change and biodiversity loss. It affects up to a third of the world's people, through pollution, soil erosion, nutrient depletion, water scarcity, salinity, and disruption of biological cycles. The food security of two-thirds of the world's people depends on fertilisers, especially nitrogen. Population growth, over-consumption and the continued shift from cereal to meat consumption mean food demand will increase to 2.5 - 3.5 times the present figure, the report says. By 2030 developing countries will probably need 120 million more hectares to feed themselves.

In last twenty years, the world has changed significantly – economically, socially and politically. Population has increased to 6.7 billion. Trade is almost three times greater. Consumption has been growing faster than population, but unequally. The total annual income of nearly 1 billion people – the population of the richest countries – is almost 15 times that of the 2.3 billion people in the poorest countries. There are fewer resources to share. The amount of land per capita is about a quarter of what it was a century ago, and is expected to fall to about one-fifth of the 1900 level by 2050! By 2025, coastal populations alone are expected to reach six billion. Incidentally, it may be of interest to note that the year 2007 is the first in human history when more than half of all people live in cities.

It is important to realise that the environmental crisis, development crisis, and energy crisis are not separate crises. They all point to the same crisis that includes not just climate change, extinction rates and hunger, but other problems resulting through growing human numbers, the rising consumption of the rich and the desperation of the poor.

What message does GEO-4 carry, then? There is no gainsaying the fact that the world has changed considerably over the past 20 years, but we are yet to make headway towards sustainable development. Surely, we live in a better world than at any time in history, but at the same time, unprecedented environmental change has made us more vulnerable than we have ever been. Change is happening faster than we can keep up with. But, there is a silver lining. Today, we have much better tools and technologies to tackle some of the global challenges. We have better science, a more informed public, and a more proactive private sector. But, we are yet to cross the threshold of sustained action; and need power to reverse the negative trends of environmental decline.

Today, we have a better understanding of the challenges we face. Hence, we can undo and reverse some of the damage now unfolding, and adapt if we cannot do so. But we do not have the luxury of time. Delay would only aggravate the problems, increasing their complexity and cost to address the problems of environmental decline. As stated in *Our Common Future*, "After all, environment is where we live; and development is what we all do in attempting to improve our lot within that abode. The two are inseparable." We must spring into action – now! We cannot make our children pay for our misdeeds.

☐ Vinay B. Kamble

Global Environmental Challenge To Technological Management

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Our home – Earth – is in danger. What is at risk of being destroyed is not the planet itself, but the conditions that have made it hospitable for human being. Without realizing the consequences of our actions, we have begun to put so much carbon dioxide into the thin shell of air surrounding our world that we have literally changed the heat balance of the Earth. If we do not stop doing this pretty quickly, the average temperature will increase to levels humans have never known and put to an end the favourable climate balance on which our civilization depends.

In the last 150 years, in an accelerating frenzy, we have been removing increasing quantities of carbon from the ground – mainly in the form of coal and oil - and burning it in ways that dump 70 million tonnes of CO_2 every 24 hours into the Earth's atmosphere. The concentration of CO_2 has increased from 280 parts per million (ppm) to 383 ppm at present since coal boom. The level of CO_2 had never crossed 300 ppm earlier. Moreover, the north polar ice cap – which helps the planet to cool itself – is melting nearly three times faster than the most pessimistic computer models had predicted. Unless we take care, summer ice could be completely gone in as little as 35 years. Scientists have found new evidence of snow melting in West Antarctica across an area as large as half the size of India.

Consider this tale of two planets. Earth and Venus are almost of the same size, and have almost the same amount of carbon. The difference is that most of the carbon on Earth is inside the ground – which has been deposited there by various forms of life over the last 600 million years –whereas most of the carbon on Venus is present in its surrounding atmosphere. As a result, while the average temperature on Earth is 15°C, the average temperature on Venus is 464°C. True, Venus is closer to the Sun than we are, but such drastically unfavourable temperature conditions are not only governed by the distance from the Sun but some other factor. This factor is the reason that Venus is three times hotter than Mercury, which is closest to the Sun. The factor is CO_2.

According to a preliminary report prepared by the Netherlands Environmental Assessment Agency, China has overtaken the United States as the world's largest emitter of carbon dioxide from burning of fossil fuel. India ranks fourth after taking entire Europe as one entity. If you take per capita figures, they are very low for both China and India because of their large populations. However, we cannot absolve ourselves of our responsibility as one in the four most polluting nations. This is not a political issue. This is a moral issue, one that effects humanity's survival. Once accepted it becomes a technological management challenge at the global level to counter.

The world's primary international agreement on combating global warming is the Kyoto Protocol, an amendment to the United Nations Framework Convention on Climate Change (UNFCCC), negotiated in 1997. The Protocol now covers more than 160 countries globally and over 55 % of global greenhouse gas emission. The United States (historically the largest greenhouse gas emitter), Australia, and Kazakhstan have not ratified the treaty. China and India have ratified the treaty; but as developing countries, they are exempt from its provision.

Managing Global Warming

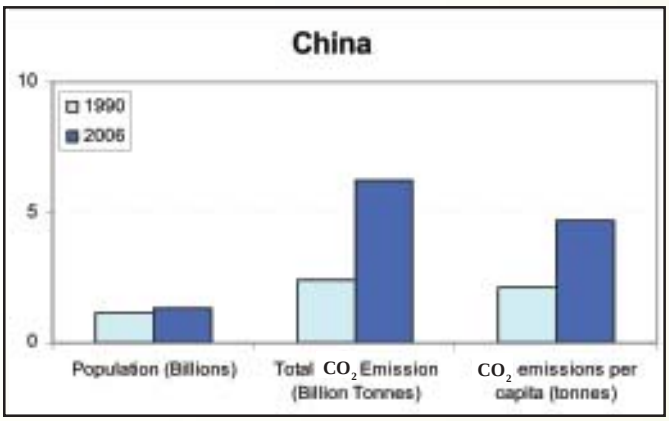
Adaptation and *mitigation* are the two approaches generally talked about in the common analysis in managing global warming. Adaptation of changes is fait accompli acceptance of current and projected, disruption of climate by high level of greenhouse gas emission. Whereas mitigation is the conscious effort made to minimize the global warming by using new technologies to meet the energy demand. There could be various possible simultaneous actions to be undertaken to mitigate global warming:

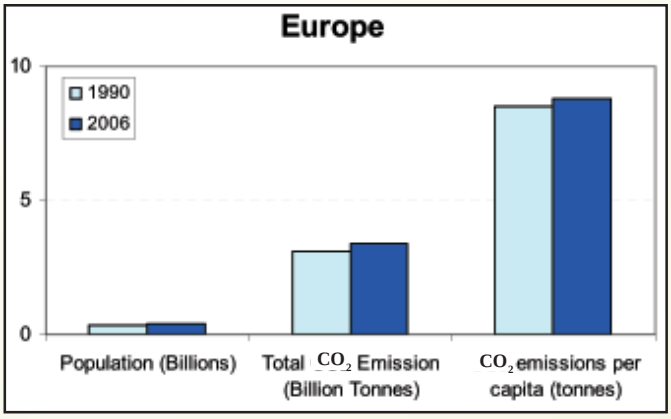
- To cut down energy consumption per person
- Developing alternate energy source to burning of carbon based fuels
- Carbon capture and storage
- Carbon sequestration
- Reducing population there by demand for energy

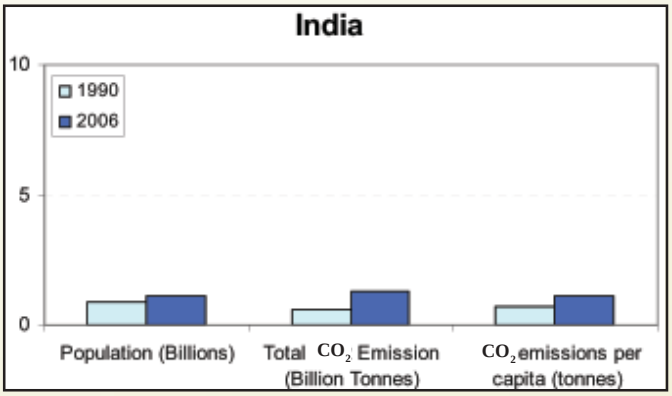
The term 'Carbon capture and storage' used above implies chemically splitting methane or gasified coal into hydrogen, which is burnt and store CO_2 by sending it underground. This is called 'pre-combustion capture'. It is also possible to convert natural gas to hydrogen and carbon dioxide and use the waste CO_2 to flush the reserves of natural gas out of the ageing gas fields, thus storing the CO_2 in process and use the hydrogen to generate clean energy. Such technologies are used in oil refineries but are more expensive than other technologies.

The 'post-combustion capture' is based on dissolving CO_2 in amine before it goes up the chimney. It has been tried on a small scale and could be retrofitted to existing coal fired plants, the main producing source of carbon emission. Small scale demonstration carbon capture and storage plants are under way. Each option has its own merits and optimal utilization pattern. 'Carbon sequestration' is a process in which oxygen is separated from air, nitrogen is released, and coal or gas is burnt in the pure oxygen.

Three out of five of the abovementioned actions need development of commercially viable new technologies. In the area of renewable energy they include biofuels (butanol and biodiesel), solar power, tidal and ocean energy, geothermal power, and wind power; technologies for more fuel-effi-







cient vehicles, electric, hybrid and plug-in-hybrid vehicles, fuel cells, etc.; technologies for large-scale carbon capture and storage ; and new design and development of zero-energy buildings.

In addition to adoption of new technologies financial incentives like financial credits/allowances, carbon taxes, etc. could be implemented by national governments to encourage reduction of carbon emissions. One important innovation has been development of greenhouse gas emissions trading (carbon trading) through which companies, in conjunction with government, agree to cap their emissions or to purchase credits from those who emit below their allowances. Managing emissions is one of the fastest-growing segments in financial services, and companies are scrambling for talent. Their goal – a slice of market now worth $30 billion, but which could grow to $1 trillion within a decade. CO_2 would be the biggest commodity market, and could become the world's market overall.

Tough new standards for carbon trading of allowances would be required to put in place by the efforts of major banks in a bid to prevent false allowances entering the market, which really would not contribute in emission control. For example new factories should not be built because their sole purpose would be to sell high premium credits back to carbon market. Or there could be multiple selling of allowances to different buyers, which risks giving the much broader market a reputation for shoddy practice.

What is possible?

A programme has been proposed to reduce CO_2 emissions by 1 billion metric tons per year or 25 billion tons over the 50-year period. In the Indian scenario any seven of following fifteen actions could be adopted to bring down the current greenhouse gas emission of India to practically zero level:

- Increasing the fuel economy by 100% for 20 million vehicles.
- Reducing use of vehicles. To improve urban design to reduce kilometres driven from 16,000 to 8,000 kilometres per year for 20 million vehicles.
- Efficient building design to reduce energy consumption by 25%.
- Improving efficiency of coal plants from today's 40% to 60%.
- Replacing 30 gigawatts of coal power plants with natural gas.
- Capturing and storing carbon emitted from 35 gigawatts of new coal plants.
- Capturing and reusing hydrogen created by above.
- Capturing and storing carbon from coal to synthetic fuel conversion (gasification of coal) at one million barrels per day.
- Displacing 30 gigawatts of coal power with nuclear power.
- Adding 2,000 one-megawatt windmills (50 times current capacity)
- Displacing 5 gigawatts of coal by solar power generation.
- Stopping deforestation and re-establishing one million hectares of new tree plantation.
- Conservation tillage to apply to all crop land (10 times current usage).
- Controlling population growth by 0.05 percent.
- Providing 20 percent of Indian villages with cooking gas.

Research is underway in most of these areas, but bringing it under one programme with the aim of emission control with targeted dates is the need of hour.

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Check Station : Understanding the Diagnostic Tests of the heart

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Traditionally, for centuries, *vaids*, hakims and physicians had depended on patient's medical history, observation, and examination to diagnose diseases. Stories abound on how the *vaids* perfected the art of diagnosis by reading the pulse. Legend has it that a thread tied to the wrist of the patient could convey to them the signs of the illness.

Among the first diagnostic aids to diagnose the condition of the heart, was the stethoscope, invented in 1816 by the French physician René Laënnec. The sphygmomanometer, which measures the blood pressure, came next, invented in 1896 by the Italian physician Riva Rocci. Just seven years later, in 1903, the Dutch physiologist Willem Einthoven developed the first electrocardiograph. Soon, with the advent of many technological advances, newer diagnostic tests came to the fore, to assist in making specific diagnoses. Today, the diagnostic arena in cardiology is replete with a wide array of investigative techniques. Let's take a look at them.

Electrocardiogram

The electrocardiogram (ECG, EKG) is a graphic tracing of the electrical current generated by the heart muscle during a heartbeat. The tracing is recorded with a relatively simple string galvanometer, and it provides information on the condition and performance of the heart.

How it is done

Small discs (electrodes), held with a salt paste, are attached to your chest, wrists, and ankles while you rest on a bed. They lead off the tiny heart current to the recording instrument producing the trace. The test usually takes a few minutes to complete and is safe and painless.

What is its use

The normal electrocardiogram shows typical upward and downward deflections that reflect the alternate contraction of the atria (the two upper chambers) and of the ventricles (the two lower chambers) of the heart. The first upward deflection, P, is due to atrial contraction; while the Q, R, S, and T deflections, are all due to the action of the ventricles.

Any deviation from the norm is indicative of a possible heart disorder. Information that can be obtained from an electrocardiogram includes whether a patient has suffered an acute or prior myocardial infarction; whether the heart is enlarged and if so, in which part; whether the heart beat is irregular and where the irregularity originates; whether a slow heart rate is physiological or caused by heart block; and whether the pericardial covering of the heart is abnormal. An electrocardiogram may also reveal signs of the presence of high blood pressure, thyroid disease, and certain types of nutritional deficiencies.

The Treadmill test (TMT)

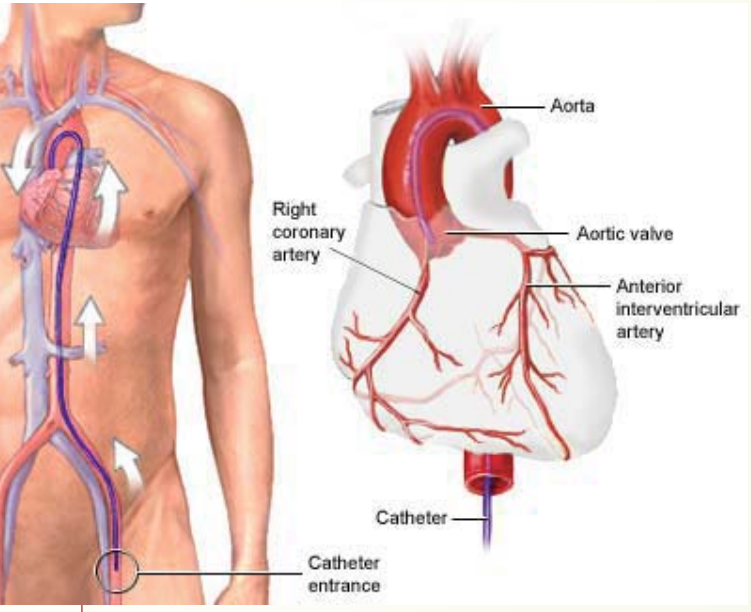
The treadmill or exercise test is usually done when coronary heart disease is suspected. The test is specifically designed to evaluate the ability of coronary arteries to cope with the increased oxygen demand of the heart during conditions of increased workload. The test involves raising your heart rate by exercising and monitoring the heart's function. The exercise is tailored to ensure that your heart is tested adequately without putting you at risk.

How it is done

Small discs (electrodes) are attached to your chest. As you exercise on the treadmill (a motor-driven moving belt upon which you have to walk keeping pace with its speed) or an exercise bicycle, the electric impulses produced by your heart are shown and recorded on an ECG machine. A doctor or a technician stays with you throughout the test. He keeps a careful watch on your ECG tracing, heart rate, and blood pressure. If you feel discomforted at any stage, or your ECG shows any major changes, the test is cut short. The test usually takes about half an hour to complete and is fairly safe and painless.

What is its use

A positive stress test is 90 per cent reliable in diagnosing coronary heart



disease. If you have had anginal attacks, its positive significance rises further. Still it may be false positive in a few cases. But equally, it may sometimes be falsely negative.

Holter monitoring

A Holter test is a record of your ECG over 24 hours, while you perform your daily routine activities. It is a good measure of what happens to your heart while you walk, climb stairs, eat, watch a movie, play, work, sleep, or make love.

How it is done

You are fitted with a wearable device, the size of a pocket transistor, called the Holter monitor. It records the electrical activity of the heart using a number of electrodes attached to the chest. The device is worn for 24 hours. It also has a button, with which you can mark the time if you face any symptoms.

What is its use

The test is of specific value in detecting angina at rest, intermittent arrhythmias (abnormal heart rates and rhythms), spells of dizziness, and in testing the usefulness of a medication and in adjusting its dosage and timing.

Echocardiography

Echocardiography is a technique that uses ultra high-frequency sound waves to image the interior of the heart. An ultrasound probe, the size of a closed fist, is placed on the chest wall. It emits a short burst of ultrasound waves and then measures the reflection, or echo of the sound as it bounces back from such cardiac structures as valves and the muscle wall.

How it is done

You rest on an examination bed. The examining physician applies a gel on the skin of the chest, and an ultrasound probe is moved over the area. An image of the moving heart is displayed on a monitor screen. It can be recorded on videotape and hard copies can also be obtained of the images. The test usually takes about 15-20 minutes and is absolutely safe and painless.

What is its use

Echocardiography is used to evaluate different cardiac parameters: chamber size, wall thickness, wall motion, valve structure, valve motion, and ejection fraction of the left ventricle. It is the method of choice for detecting diseases of the heart valves, infection of the valves (endocarditis), assessment of left ventricular size, wall thickness and function, identifying aneurysms (a complication of heart attack) of the left ventricle, evaluating fluid collection in the bag of membrane enveloping the heart (pericardial effusion), and a variety of birth heart defects.

Stress echocardiography

Stress echocardiography is another method for evaluating the heart condition when coronary heart disease is suspected. It involves the intravenous injection of the drug dobutamine, while monitoring the effects using echocardiography. Dobutamine induces the same changes in the heart that would occur during a standard exercise test. The test is useful in evaluating the heart condition of frail patients and those who have heart disease that precludes exercise.

Radio-nuclear tests

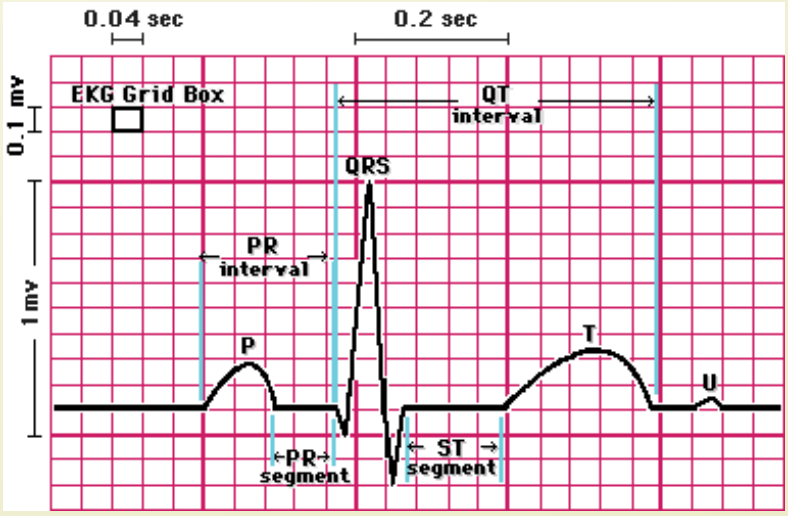
Thallium test

The thallium test makes use of radioactive thallium to image the blood flow or perfusion of the heart muscle (myocardium). Injected intravenously, radioactive thallium is rapidly absorbed by the myocardium and is normally distributed evenly in heart muscle. Deficient blood flow to a portion of the myocardium is readily detectable by decreased uptake in that area.

How it is done

The test is performed in the cardiac radionuclide lab. You are given a shot of thallium-201, a radio pharmaceutical with special affinity for myocardium. Then the pictures of your heart are taken in different projections using a gamma camera.

Evidence of recent and not-so-recent myocardial infarcts will be visible, but most persons with coronary artery disease who have not had



a previous infarction will have normal perfusion patterns when they are at rest. In such a patient a 'thallium stress test' is performed in which the substance is injected while the individual is exercising so that areas of transient ischemia can be identified. Alternatively, an injection of dipyridamole, a vasodilator, is given to put the heart under stress. If required, repeat scans are taken several hours later.

What is its use

This test is used to diagnose coronary heart disease. It is particularly useful in patients who have atypical chest pain and their exercise electrocardiogram is non-diagnostic or cannot be interpreted due to one or the other reason. It can also diagnose recent or old heart attack (myocardial infarction) by picking acute infarcts or old scars in the tissues of the heart muscle.

MUGA test

The MUGA test, also called radionuclide ventriculography (RVG), uses a radioactive blood tracer – usually technetium 99m – to delineate the heart chambers and great vessels. The test allows for a reliable estimation of the chamber volumes, left and right ventricular function (ejection fractions), and rates of chamber ejection and filling.

How it is done

The test is performed in the cardiac radionuclide lab. You receive an intravenous injection of a radionuclide into the vein, and a scintillation camera tracks its transit through your right heart, lungs, and left heart. Counts are recorded from several hundred heart cycles following uniform distribution of radiotracer throughout the blood pool. Based on the data, a computer is used to provide images, and various parameters of the heart are calculated. Repeat scans can be obtained up to 20 hours after injection, permitting effects of exercise and medication on ventricular function.

What is its use

MUGA test is most helpful in diagnosing coronary heart disease. It can reliably assess the left and right ventricular function, and the damage that may have occurred from a heart attack, thereby, prognosticating the patient's heart condition.

Coronary Angiography

Coronary angiography is used to image the arteries that supply the heart muscle with blood. The test employs pushing radio-opaque iodinated fluid into the coronary tree, and taking its serial images or a video film on a specialised X-ray unit.

How to prepare for the test

You have to be admitted to the hospital a day in advance. The doctor would do a thorough physical examination and ask for routine blood work, urine test, ECG, and chest X-ray. A small area in the upper thigh would be shaved before you go to bed. You would stay fasting after midnight, though you may take your medications as before except for the medications for diabetes, which would have to be rescheduled. On the morning of the test, you may be given a sedative so that you feel relaxed.

How it is done

Strict asepsis is maintained inside the coronary angiography room, and the environment looks much like that in an operation theatre. Throughout the test, you would stay awake and rest on the X-ray table. A local anaesthetic is injected, and a fine flexible, catheter is passed into the femoral artery by making a small puncture in the groin. The catheter is passed through the aorta, and is eventually positioned so that its tip rests in a coronary artery. The radio-opaque dye is then injected through the catheter. With the use of X-ray, the dye can be seen to flow easily through the healthy sections but narrows to a trickle or becomes completely pinched off where lesions,

Treadmill

such as fatty deposits, line and obstruct the lumen of coronary vessels. Movie pictures are taken. Images of each coronary artery are obtained by repositioning the catheter and injecting the dye. Once the job is completed, the catheter is withdrawn and the puncture site is dressed. You are wheeled out and taken to an observation unit, where a close watch is kept over you for the next few hours.

Risks

The risk of the procedure is small, but real. There is an overall mortality rate of 1 in 1,000. Complications also rarely occur. One in 1,000 people may suffer a heart attack or stroke, and fewer than 1 in 100 patients experience other problems, such as transient heart rhythm abnormalities or bruising or bleeding at the catheter insertion site. Some people also suffer reactions to the iodine-containing radio-opaque dye.

What is its use

Coronary angiography is the gold standard for imaging the coronary arteries. Its great value lies in the diagnosis and exact estimation of the coronary heart disease. It is a prerequisite for coronary bypass surgery.

Earthquake Tip-18
How do Beams in RC Buildings Resist Earthquakes?

Reinforcement and Seismic Damage

In reinforced concrete (RC) buildings, the vertical and horizontal members (*i.e.*, the *beams* and *columns)* are built integrally with each other. Thus, under the action of loads, they act together as a 'frame' transferring forces from one to another. This Tip is meant for beams that are part of a building frame and carry earthquake-induced forces.

Beams in RC buildings have two sets of steel reinforcement, namely: (a) long straight bars (called 'longitudinal bars') placed along its length, and (b) closed loops of small diameter steel bars (called 'stirrups') placed vertically at regular intervals along its full length (Figure 1).

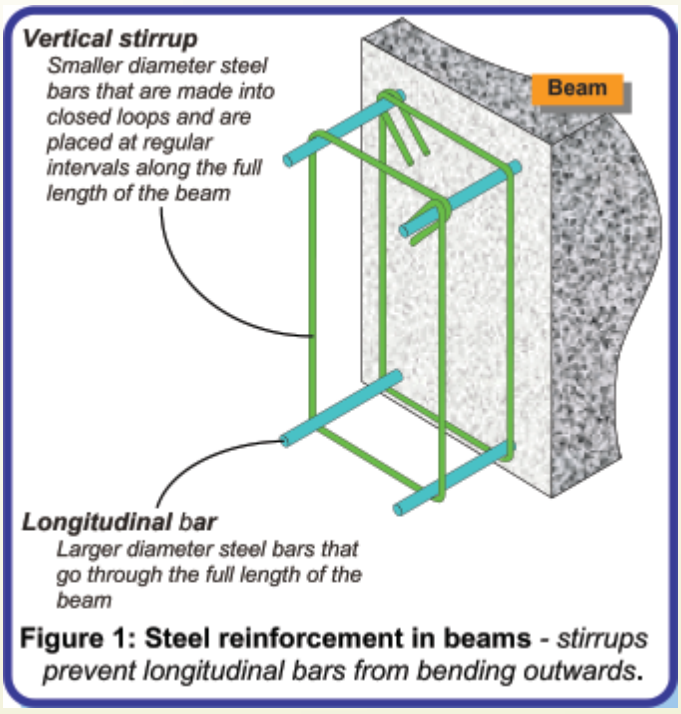


Figure 1: Steel reinforcement in beams - *stirrups prevent longitudinal bars from bending outwards.*

Beams sustain two basic types of failures, namely:

(a) Flexural (or Bending) failure: As the beam sags under increased loading, it can fail in two possible ways. If relatively more steel is present on the tension face, concrete crushes in compression; this is a 'brittle' failure and is therefore undesirable. If relatively less steel is present on the tension face, the steel yields first (it keeps elongating but does not snap, as steel has ability to stretch large amounts before it snaps; see *IITK-BMTPC Earthquake Tip 9*) and redistribution occurs in the beam until eventually the concrete crushes in compression; this is a 'ductile' failure and hence is desirable. Thus, more steel on tension face is not necessarily desirable! The ductile failure is characterised with many vertical cracks starting from the stretched beam face, and going towards its mid-depth (Figure 2a).

(b) Shear Failure: A beam may also fail due to shearing action. A shear crack is inclined at 45° to the horizontal; it develops at mid-depth near the support and grows towards the top and bottom faces (Figure 2b). Closed loop stirrups are provided to avoid such shearing action. Shear damage occurs when the area of these stirrups is insufficient.

Shear failure is brittle, and therefore, shear failure must be avoided in the design of RC beams.

Design Strategy

Designing a beam involves the selection of its 'material properties' (*i.e*, grades of steel bars and concrete) and 'shape' and

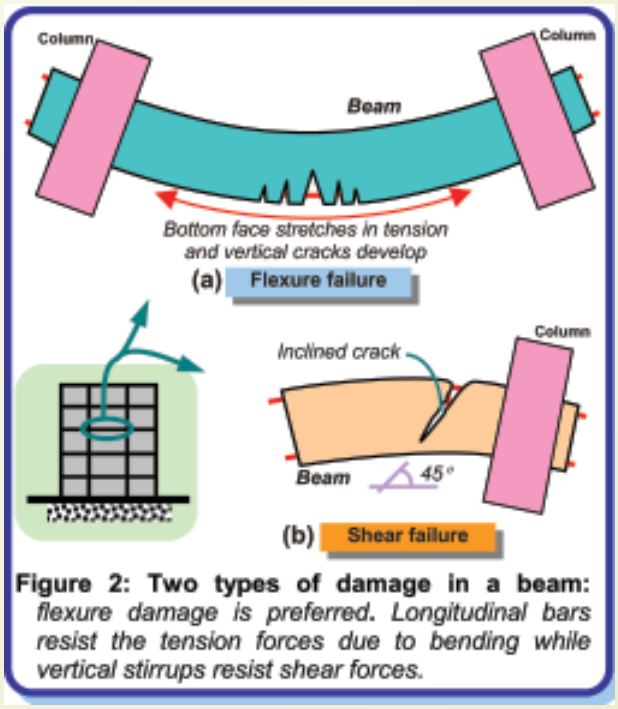


Figure 2: Two types of damage in a beam: *flexure damage is preferred. Longitudinal bars resist the tension forces due to bending while vertical stirrups resist shear forces.*

'size'; these are usually selected as a part of an overall design strategy of the whole building. And, the amount and distribution of steel to be provided in the beam must be determined by performing design calculations as per is: 456-2000 and IS13920-1993.

Longitudinal bars are provided to resist flexural cracking on the side of the beam that stretches. Since both top and bottom faces stretch during strong earthquake shaking (*IITK-BMTPC Earthquake Tip 17*), longitudinal steel bars are required on both faces at the ends and on the bottom face at mid-length (Figure 3). The Indian Ductile Detailing Code IS:13920-1993 prescribes that:

(a) At least two bars go through the full length of the beam at the top as well as the bottom of the beam.

(b) At the ends of beams, the amount of steel provided at the bottom is at least half that at top.

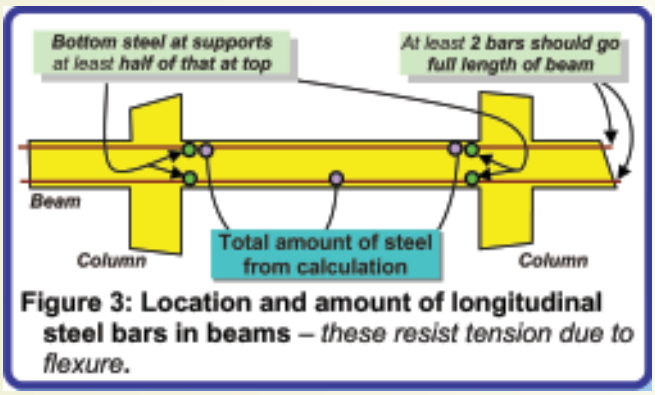


Figure 3: Location and amount of longitudinal steel bars in beams – *these resist tension due to flexure.*

Stirrups in RC beams help in three ways, namely (i) they carry the vertical shear force and thereby resist diagonal shear cracks (Figure 2b), (ii) they protect the concrete from bulging outwards due to flexure, and (iii) they prevent the buckling of the compressed longitudinal bars due to flexure. In moderate to severe seismic zones, the Indian Standard IS:13920-1993 prescribes the following requirements related to stirrups in reinforced concrete beams:

(a) The diameter of stirrup must be at least 6mm; in beams more than 5m long, it must be at least 8mm.

(b) Both ends of the vertical stirrups should be bent into a *135°* hook (Figure 4) and extended sufficiently beyond this hook to ensure that the stirrup does not open out in an earthquake.

(b) The spacing of vertical stirrups in any portion of the beam should be determined from calculations

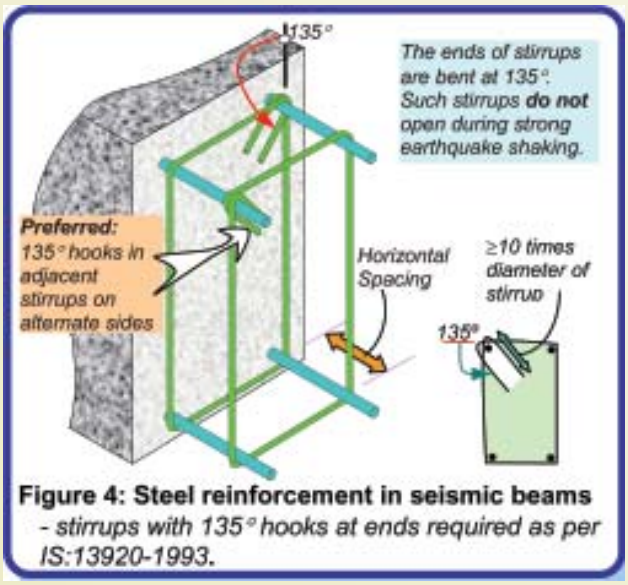


Figure 4: Steel reinforcement in seismic beams - *stirrups with 135° hooks at ends required as per IS:13920-1993.*

(c) The maximum spacing of stirrups is less than half the depth of the beam (Figure 5).

(d) For a length of twice the depth of the beam from the face of the column, an even more stringent spacing of stirrups is specified, namely half the spacing mentioned in (c) above (Figure 5).

Steel reinforcement bars are available usually in lengths of 12-14m. Thus, it becomes necessary to overlap bars when beams of longer lengths are to be made. At the location of the lap, the bars transfer large

forces from one to another. Thus, the Indian Standard IS:13920-1993 prescribes that such laps of longitudinal bars are (a) made away from the face the column, and (b) not made at locations where they are likely to stretch by large amounts and yield (*e.g.*, bottom bars at mid-length of the beam). Moreover, at the locations of laps, vertical stirrups should be provided at a closer spacing (Figure 6).

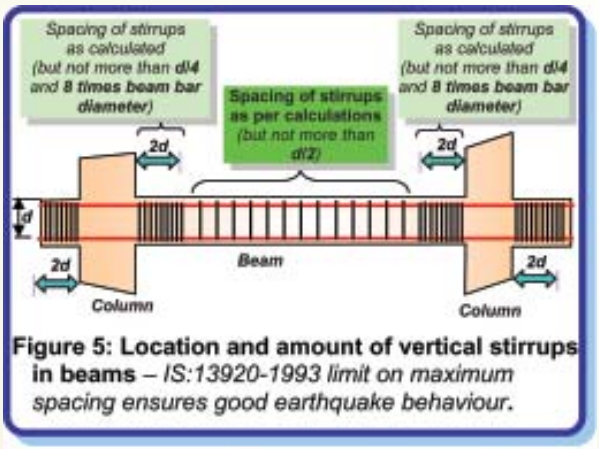


Figure 5: Location and amount of vertical stirrups in beams – *IS:13920-1993 limit on maximum spacing ensures good earthquake behaviour.*

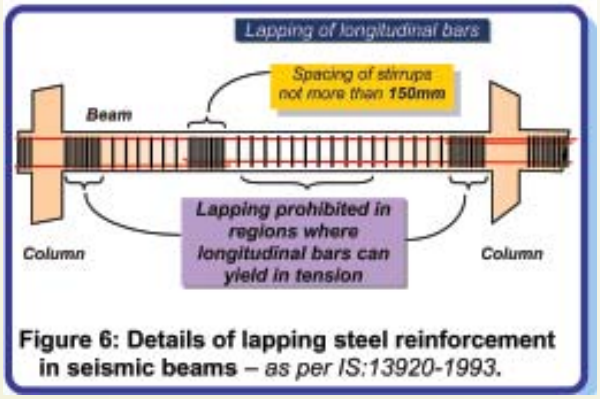


Figure 6: Details of lapping steel reinforcement in seismic beams – *as per IS:13920-1993.*

Related IITK-BMTPC Earthquake Tip

Tip 9 : How to Make Buildings Ductile for Good Seismic Performance?

Tip 17 : How do Earthquakes Affect Reinforced Concrete Buildings?

Resource Material

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.

Paulay,T., and Priestley,M.J.N., *Seismic Design of Masonry and Reinforced Concrete Buildings*, John Wiley & Sons, USA, 1992.

McGregor,J.M., *Reinforced Concrete Mechanics and Design*, Third Edition, Prentice Hall, USA, 1997.

Acknowledgement :

Authored by : C.V.R.Murty, Indian Institute of Technology Kanpur, Kanpur, India.

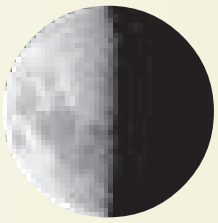
Sponsored by : Building Materials and Technology, Promotion Council, New Delhi, India

Sky Map for December 2007

Full Moon

24 December

Moon - Last Quarter



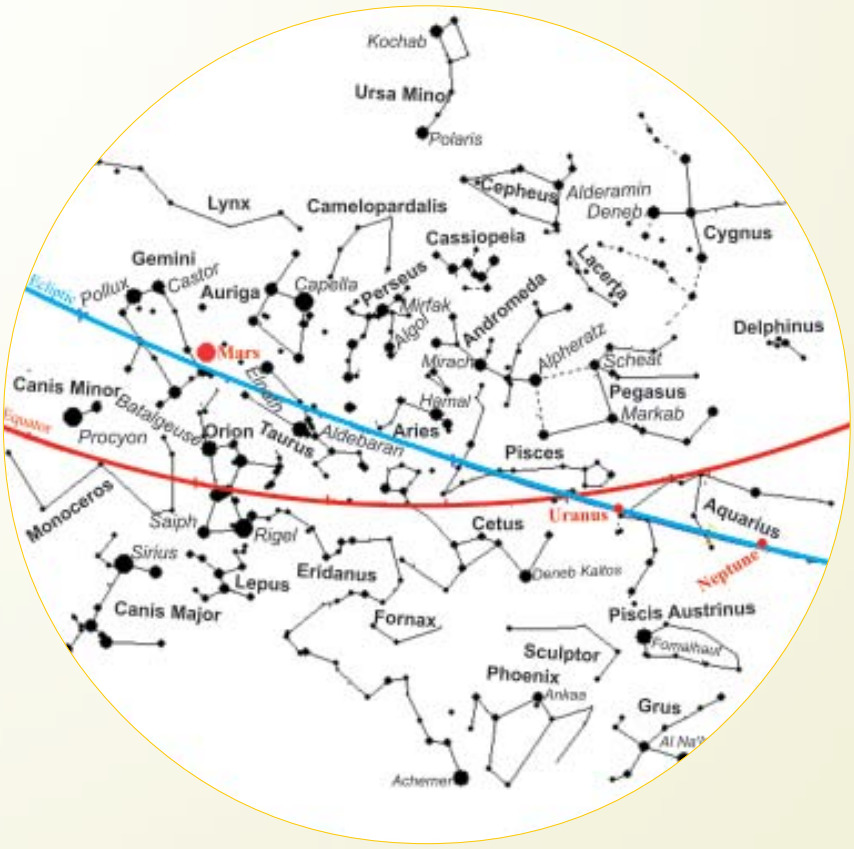
1 December

North

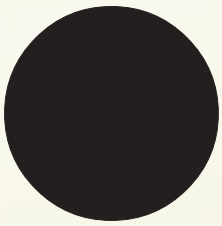
East

West

South

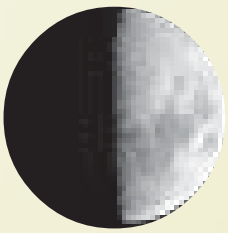


New Moon



9 & 13 December

Moon - First Quarter



17 December

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 December, at 9:00 PM on 15 December and at 8 PM on 31 December.

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 Gemini (*Meethun Rashi*) up in the eastern horizon.

Uranus : In the constellation Aquarius (*Kumbha Rashi*) up in the western sky*.

Neptune : In the constellation Capricorns (*Makar Rashi*) near western horizon*.

(* Are not naked sky objects.)

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

Eastern Sky : Canis Major (Sirius), Canis Minor (Procyon), Gemini (Castor, Pollux)/Meethun Rashi, Lepus, Monoceros, Orion (Betelgeuse, Rigel, Saiph).

Western Sky : Aquarius / *Kumbha Rashi*, Cygnus (Deneb), Delphinus, Lacerta, Pegasus.

Southern Sky : Eridanus, Fornax, Grus, Phoenix, Piscis Austrinus (Fomalhaut), Sculptor.

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

Zenith : Andromeda / *Devayani*, Aries / *Mesha Rashi*, Auriga (Capella), Cetus (Deneb Kaitos), Perseus, Pisces / *Meen Rashi*, Taurus (Aldebaran) / *Vrishabh Rashi*.

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Astronomy

Nobel Prizes 2007

Biman Basu
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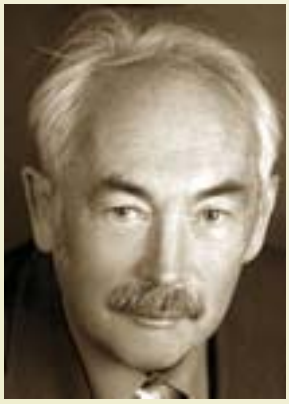
The science Nobel Prizes this year have been shared by six scientists – two Americans, two Germans, one British, and one French. The Nobel Peace Prize this year has been shared by an environmental activist and an International group engaged in environmental assessment and planning.

Physics

This year's Nobel Prize in Physics has been awarded to the Frenchman Albert Fert and the German Peter Grünberg for their discovery of 'giant magnetoresistance', or GMR. The phenomenon called magnetoresistance is the change of resistance of a conductor when it is placed in an external magnetic field. In 1988 two research groups led by Fert and Grünberg independently discovered materials showing a very large magnetoresistance, which was



Peter Grünberg

termed 'giant magnetoresistance'. These materials are so-called magnetic multilayers, where layers of ferromagnetic and non-magnetic metals are stacked on each other like a multi-decker club sandwich.

GMR has already found widespread applications in computer hardware design. A computer hard disk stores information in the form of microscopically small areas magnetised in different directions. The information is retrieved by a read-out head that scans the disk and registers the magnetic changes. But as a result of miniaturisation, hard discs have become smaller and more compact and the individual magnetic areas smaller and weaker. So more sensitive read-out heads are necessary to retrieve information packed densely on a hard disk. This is where GMR

Albert Fert

has come to the rescue. A read-out head based on the GMR effect can convert very small magnetic changes into large differences in electrical resistance and therefore into changes in the current emitted by the read-out head.

The discovery also plays a major role in various magnetic sensors as well as for the development of a new generation of electronics. The use of GMR can be regarded as one of the first major applications of nanotechnology.

Chemistry

The German chemist Gerhard Ertl has been awarded the Nobel Prize in Chemistry for 2007 for his thorough studies of fundamental molecular processes at the gas-solid interface, which play a crucial role in the functioning of catalysts. Surface chemistry looks at what happens when a molecule of gas hits a solid. This is important because many processes in the modern world depend on these chemical reactions. For example, in catalytic converters attached to car exhausts poisonous carbon monoxide is converted into carbon dioxide on platinum/palladium catalyst; iron rusts when exposed to oxygen and moisture; surface reactions are used in the electronics industry to manufacture semiconductor materials for components. 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.

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, he 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. The significance of Ertl's work stems from the

Gerhard Ertl (Photo - Fritz Haber Institute)

meticulous precision in his work combined with an outstanding capacity to refine problems that has enabled him to develop the best experimental techniques to investigate each separate question.

Physiology or Medicine

Two Americans, Oliver Smithies and Italian-born Mario R. Capecchi, and Sir Martin J. Evans of the United Kingdom share this year's Nobel Prize in Physiology or Medicine for their discoveries of principles for introducing specific gene modifications in mice by the use of embryonic stem cells. Their


Oliver Smithies


Mario R Capecchi


Sir Martin J Evans

discoveries have led to the creation of "designer mice" to demonstrate the roles of different genes in human development and disease. The experimental genetic methods developed by Capecchi, Evans and Smithies, commonly called the 'knockout technology', has permitted scientists to determine the role of specific genes in development, physiology, and pathology. It has revolutionised life science research and has been playing a key role in the development of medical therapy.

Stem cells are a special kind of cells that can grow into virtually all other cell types found in the body. So these cells have the potential to repair a wide variety of damaged tissues. Embryos are a rich source of stem cells. Evans first established the embryonic stem cell in cell culture, then modified it genetically, and reintroduced it into foster mothers in order to generate a genetically modified offspring. On their part, Capecchi and Smithies, independently of each other, discovered how homologous recombination – a type of genetic recombination, a process of physical rearrangement occurring between two strands of DNA molecule – can be used to target genes in the mammalian genome and developed methods to generate genetically modified mice.

With gene targeting it is now possible to produce almost any type of DNA modification in the mouse genome, allowing scientists to establish the roles of individual genes in health and disease. Gene targeting has already produced more than five hundred different mouse models of human disorders, including cardiovascular and neuro-degenerative diseases, diabetes, and cancer.

Peace

The Nobel Peace Prize for 2007 has been jointly awarded to the Intergovernmental Panel on Climate Change and the American environment activist Albert Arnold (Al) Gore for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change. The award, it is hoped, would help bring the processes and decisions that appear to be necessary to protect the world's future


RK Pachauri

climate to a sharper focus, and thereby help reduce the threat to the security of mankind. Action is necessary now, before climate change moves beyond man's control.

The Intergovernmental Panel on Climate Change (IPCC), now headed by the renowned Indian Environmentalist Rajendra Kumar Pachauri, was established in 1988 by the United Nations Environment Programme (UNEP) and World Meteorological Organisation (WMO) to provide independent scientific advice on the complex and important issue of climate change. The Panel was asked to prepare, based on available scientific information, a report on all aspects relevant to climate change and its impacts and to formulate realistic response strategies.

Through the scientific reports it has issued over the past two decades, the IPCC has created an ever-broader informed consensus about the connection between human activities and global warming. Thousands of scientists and officials from over one hundred countries have collaborated to achieve greater certainty as to the scale of the warming. Whereas in the 1980s global warming seemed to be merely an interesting hypothesis, the 1990s produced firmer evidence in its support. In the last few years, the connections have become even clearer and the consequences still more apparent.

In February 2007, the IPCC released the summary of its fourth assessment report of the working group on Physical Science Basis of Climate Change. The report "unequivocally" stated that the rise in the average global temperature since 1750s very likely resulted from an observed increase in the concentration of the greenhouse gases such as carbon dioxide and methane released by human activity. This was the strongest vindication of the stand that the signatories of the Kyoto Protocol had all along taken in their campaign to cut down global greenhouse gas emission. In a way, the IPCC played a key role in not only putting the record straight but also in creating wider public awareness about the problem.

Al Gore, former American Vice President, has for a long time been one of the world's leading environmentalist politicians. He became aware at an early stage of the climatic challenges the world is facing. His strong commitment, reflected in political activity, lectures, films and books, has strengthened the struggle against climate change. He is probably the single individual who has done most to create greater worldwide understanding of the measures that need to be adopted. He took up cudgels against the US stand on Kyoto Protocol and started a crusade to help save the planet from irrevocable change. His forceful documentary *An Inconvenient Truth* is a strong rebuttal of the misinformation about global warming that was being spread in his country.

Understanding Earthquakes- An Activity Kit

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Besides being an activity package, the kit is also useful for training programmes on Earthquake awareness. A comprehensive book entitled "Earthquake" also accompanies the kit. The Kit is available both in English and Hindi. The cost of this kit is Rs. 100/- plus Rs. 50/- postal charges. For more details write to the: **Director, Vigyan Prasar, A-50, Institutional Area, Sector-62, Noida-201 307 (U.P.)**

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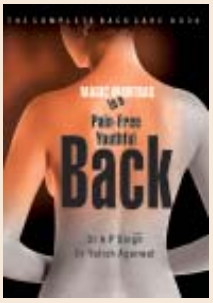

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Obituary

K D Abhyankar
(21 June 1928 - 8 November 2007)

Prof. K D Abhyankar, Indian astrophysicist, teacher and well-known populariser of astronomy, passed away in Hyderabad, Andhra Pradesh, on 8 November 2007 at the age of 79. His popular articles on astronomy have regularly appeared in *Dream 2047*. Prof. Abhyankar was passionately devoted to astronomy. He worked throughout his life with the zeal of a missionary to teach and spread astronomy. He was amongst the few people who are good at both observational and theoretical astronomy. He was not only a successful teacher but also a great research enthusiast. He played a critical role in establishing the Japal Rangapur Observatory (JRO) in Andhra Pradesh. He served as its director and as head of the Department of Astronomy, till he retired in 1988. He also served the faculty of science of Osmania University, Hyderabad, in the capacity of Dean during 1977-80.

Born on 21 June 1928 Abhyankar showed signs of brilliance from early childhood and later won gold medals at high school and college. After completion of his MSc from Agra University, he worked for a short period at Holkar College, Indore. He obtained a Government of India senior research fellowship and worked at Kodaikanal Observatory during 1952-1954. He was awarded a scholarship for doctoral studies at the University of California at Berkeley, USA. His work on binary stars for his PhD thesis was a masterpiece and has been frequently quoted.

On his return from the US, Abhyankar worked for a short while at Kodaikanal Observatory in Uttar Pradesh before joining Osmania University. He was solely responsible for introducing astronomy at the graduate and post graduate levels. He established the Astronomical Society of India (ASI), which has played a very important role in bringing together professional astronomer of the country to share ideas and coordinate programs in astronomy and astrophysics. He has served ASI in several capacities including as its President. In 1963 he worked for a year at David Dunlap Observatory, Canada on NRC post-doctoral fellowship, and in 1967 as a senior post-doctoral resident research associate of NRC-NASA of USA at Jet Propulsion Laboratory, Pasadena, California.

Prof Abhyankar was the recipient of several honours and awards including the Best Teacher award from the Andhra Pradesh Government, NSSA award for Patent Rights on a new technique of measuring optical polarization, INSA Vainu Bappu Award, and the M.P. Birla Award. He was Fellow of Royal Astronomical Society, Indian Academy of Science, Indian National Science Academy; and Member of Sigma Xi of USA, Astronomical Society of the Pacific, American Astronomical Society, and International Astronomical Union. Prof Abhyankar was the founder member of the Andhra Pradesh Academy of Sciences and Maharashtra Academy of Sciences, and has been the Chairman of the Advisory committee of the Positional Astronomy Centre, Kolkata. Prof. Abhyankar was the author of two books and published more than 150 research papers in reputed scientific journals. He also had deep interest in Indian astronomy.

Letters to the Editor

"An excellent magazine to develop rational attitude"

I am a student. I have been enjoying the fan tastic topics of "DREAM 2047" since January 2006. It is an excellent magazine to develop a rational attitude among students. The editorials are excellent and conveys the thrill and excitement of science. In addition, the magazine gives its readers a plethora of information, which is of paramount importance in this highly competitive world. So, please go on publishing the articles which will enthuse many of us to become young scientists.

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