Indo-US Workshop on Utilisation of Space Based Resources

Vigyan Prasar participated in a five-day Indo-US workshop on Utilisation of Space-based Resources to Enhance Science Education in India during October 15 – 19, 2005 at Aurangabad. The workshop was sponsored by Indo-US Science & Technology Forum. The objective of the workshop was to develop a plan for the joint utilization of the space-based resources for science and technology education developed both in India and USA.

India has vast educational resource materials developed by National Council of Educational Research and Training (NCERT), Homi Bhaba Centre for Science Education (HBCSE), Vigyan Prasar (VP), Indira Gandhi National Open University (IGNOU), National Council for Teachers’ Education, (NCTE) and other Government/ non-Government organisations. India also has launched Edusat – a satellite dedicated for Education Science and Technology. On the other hand, National Aeronautics and Space Administration (NASA) has developed resource materials as part of their public outreach program. It has been proposed to utilize, adapt and share the resources developed by both India and US.

VP-NSC Popular Lecture Series

Vigyan Prasar jointly with National Science Centre organised the fourth popular science lecture on 18 October, 2005 at NSC auditorium. The lecture was delivered by Dr. Krishan Lal, Emeritus Scientist and Former Director, National Physical Laboratory (NPL), New Delhi on “Fascinating World of Crystals”. The lecture was attended by students, teachers and scientists. Professor A.R. Verma, former Director, NPL, was also present on the occasion.

Dr. Krishan Lal initially talked about different types of crystal structures present in the nature. He explained with the help of slides how the arrangement of atoms changes in different crystals. He explained that properties of crystals depend mainly on the arrangement of atoms and on the faults like impurities and dislocations rather than on the materials themselves.
The social and economic progress of a nation depends on the state of its science and technology. It is quantitatively measured and monitored rigorously by several advanced nations on a regular basis. Even a few developing countries also bring out such reports periodically. Such an exercise can assess the impact of science and technology in the country’s economy and growth, and help plan for the future. What in India we have, however, till date are the limited databases of governmental agencies and reports on studies for specific purposes.

In India, we have witnessed over the years, diverse and significant developments related to Science and Technology (S&T). However, a quantitative study of scientific and technological progress has not been done so far. The India Science Report (ISR), released recently, is an exercise in this direction. This is the result of an initiative of the Indian National Science Academy (INSA). The task of preparing the report was, however, entrusted by INSA to the National Centre for Applied Economic Research (NCAER). The report focuses on science education, human resources, and public attitude towards S&T. It is worth noting that this initiative is an important step that would help arrive at appropriate methodologies and indicators for a quantitative measurement of the different aspects of the S&T system in India. Data from an all India field study undertaken by the NCAER - the National Science Survey 2004 - formed the main basis for the results presented in the ISR. These data were supplemented with data available from other secondary sources such as the Censuses of 1981, 1991 and 2001, the household National Sample Survey of 1993-94 and 2000-01, the Department of Science and Technology, the University Grants Commission (UGC) and the Institute of Applied Manpower Research. However, significant variation in the collection of data by various agencies and even non-availability of some relevant data posed a serious problem in preparation of the ISR.

What are the significant findings of the ISR? According to the ISR, there are 48.7 million people who have done graduation and other higher degrees (excluding diploma-holders), and a fourth of them have a background of science education. Of this, 39.2 million are graduates (22.3% per cent of them are from the science stream), 9.3 million postgraduates (19.4% per cent from science) and 0.3 million doctorates (one-third from the science stream). Of the graduates who are unemployed, 22.3% have studied science. The share of post graduates with science background in the total unemployed postgraduates is significantly higher (62.8%). As regards the annual enrollment at the graduate-plus level, it has risen from 6.6 million in 1995-96 to 9.84 million in 2004.

Interestingly, the proportion of those studying science at the graduate-plus level has risen from 28.8% to 34.6% in 2004. This is rather intriguing given the dwindling interest of the youth in science today. This inference, however, could be due to the fact that data includes all institutions and all disciplines categorized as “science” under the survey, which apparently includes Computer Science and Information Technology as well. How about engineering? The proportion of those doing engineering has almost doubled from 6.0% of the population studying at the graduate plus level in 1995-96 to 11.2% in 2003-04! Indeed, engineering education shows the highest growth, from 8.2% per annum in 1995-2000 to 21.9% in 2003-04!

ISR states that there is no decline in interest in the proportion of students who wish to study science. But, a third of the students said they did not study science as they did not feel motivated enough and another 40% said the number of students in a class were too many for them to understand what was being taught! On the other hand, half the teachers interviewed believed that more computers/equipment were required for teaching science subjects since inadequate science training was a serious issue. Since every generation of top quality scientific manpower starts at the school level; a lot also depends on the way science is taught at school levels. Surely, this is an area where we need to focus our attention.

As regards the human resource in science and technology (HRST), ISR states that India has 52.6 million graduates, post graduates and diploma holders. If we remove 12.2 million unemployed and housewives from this category, we get a total of 40.2 million that form an S&T resource base. Those who have a diploma / graduation degree and are employed in a science and technology occupation comprising the HRST ‘core’ group are around 14.2 million.

ISR draws interesting inferences as regards public attitude towards S&T. Over three fourths of the public feel that S&T is important for education; and believe that S&T makes lives healthier and more comfortable. On an average, the level of knowledge the population has about the scientific concepts is very high - 57% of the people knew that the centre of the earth is hot and 86% knew that that

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Ernest Rutherford

"The Newton of Atomic Physics"

Ernest Rutherford was one of the first and most creative researchers in atomic physics. He is regarded as one of the greatest experimentalists of all times. He was also great scientific theorista, whose ideas were based on rigorous experimentation. Einstein called him "a second Newton." Rutherford's pioneering discoveries shaped modern science, created nuclear physics and changed our understanding about the structure of the atom. He discovered the transmutation of elements that is elements are not immutable, they can change their structure naturally by changing from heavy elements to slightly lighter elements. He was first to split the atom, he converted nitrogen into oxygen. He discovered alpha and beta rays. He set forth the laws of radioactive decay. He identified alpha particles as helium nuclei. Rutherford proposed the nuclear model of the atom. Rutherford's model, a small nucleus surrounded by orbiting electrons, became the basis for how we see the atom today.

His many other lesser known discoveries such as dating the age of Earth were enough to make a scientist famous. The first method invented to detect individual nuclear particles by electrical means, the Rutherford-Geiger detector, evolved into the Geiger-Muller tube. The modern smoke detector can be traced back to 1899 when, at McGill University in Canada, Rutherford blew tobacco smoke into his ionisation chamber and observed the change in ionisation.

Among his associates were the following 12 Nobel Laureates: Edward Appleton, Patrick Blackett, Niels Bohr, James Chadwick, John Cockroft, Peter Kapitza, Cecil Powell, George Paget Thomson, Ernest Walton, Otto Hahn, G de Hevesy and Frederick Soddy. Among his other famous students were H. G. J. Moseley and Chaim Weizmann. Moseley, who died in action in the First World War in 1915 at the age of 27, demonstrated the fundamental importance of the atomic number. Moseley described Moseley's law for frequency of x-ray spectral lines.

Rutherford had an extraordinary capacity of work. His students nicknamed him "the crocodile", because they thought, "the crocodile cannot turn its head…it must always go forward with all devouring jaws."

Rutherford in his appearance was far from a scientist. Weizmann described Rutherford as being "youthful, energetic, boisterous. He suggested anything but a scientist. He talked readily and vigorously on any subject under the Sun, often without knowing anything about it... He was quite devoid of any political knowledge or feelings, being entirely taken up with his epoch-making scientific work. He was a kindly person but did not suffer fools gladly."

James Chadwick wrote: “In appearance Rutherford was more like a successful businessman or Dominion farmer than a scholar...when I knew him he was of massive build, had thinning hair, a moustache and a ruddy complexion. He wore lose, rather baggy clothes, except on formal occasions. A little under six feet in height, he was noticeable but by no means impressive...it seemed impossible for Rutherford to speak softly. His whisper could be heard all over the room, and in any company he dominated through the sheer volume and nature of his voice, which remained tinged with an antipodean flavour despite his many years in Canada and England. His laughter was equally formidable."

Rutherford was born on August 30, 1871 at Bridgewater, a small town close to Nelson, New Zealand.
His father James Rutherford, a Scottish wheelwright (a person who makes and repairs wheels and wheeled vehicles), had migrated with his family to New Zealand in 1840s. Rutherford's mother Martha Rutherford (nee Thomson), who with her widowed mother, also emigrated to New Zealand in 1855. In 1877 Rutherford family moved to Foxhill, Nelson Province. Rutherford attended Foxhill School, Nelson Province (1877-1883). In 1883, the family moved to Havelock, Marlborough Sounds, also near Nelson, where Rutherford attended Havelock School (1883-1886). In his early years Rutherford did not show any special inclination towards science. Ioan James wrote: "In his spare time the boy enjoyed tinkering with clocks and making models of the waterwheels his father used in his mills. By the age of ten he had read a scientific textbook, but otherwise there was not yet any sign of special interest in science; he was expecting to become a farmer when he grew up."

In 1887, Ernest won a scholarship to attend Nelson College, which was rather an English grammar school. This scholarship, which Rutherford won on his second attempt, was the only scholarship available to assist a Marlborough boy to attend secondary school. He studied three years at the Nelson College. He won, again on second attempt, one of the ten scholarships available nationally to assist attendance at a college of the University of New Zealand. This scholarship enabled him to attend the Canterbury College (1890-1894) in Christchurch. He studied Pure and Applied Mathematics, Physics, Latin, English and French. He was a regular player of rugby. He participated in the activities of a student debating society called the Dialectic Society. He also participated in the activities of the recently formed Science Society. In 1892 he passed BA.

His mathematical ability won him the one Senior Scholarship in Mathematics available in New Zealand. This made possible for him to study for his Master’s degree. He studied both mathematics and physics. Rutherford was much influenced by one of his teachers Alexander Bickerton, who was a liberal freethinker. As a part of the physics course requirement Rutherford had to carry out an original investigation. Inspired by Nikola Tesla's use of his high frequency Tesla coil to transmit power without wires, Rutherford decided to find out whether iron was magnetic at very high frequencies of magnetising current. As a part of this investigation Rutherford developed two devices; a timing device which could switch circuits in less than one hundred thousandth of a second and a magnetic detector of very fast current pulses. In 1893, Rutherford obtained a Master of Arts degree with double First Class Honours, in Mathematics and Mathematical Physics and in Physical Science (Electricity and Magnetism).

Rutherford wanted to be a school teacher. However, even after trying three times he failed to obtain a permanent school-teacher’s job. For a brief period he toyed with the idea of pursuing a career in medicine. He was also thinking to carry out more research in electrical science and to meet his financial requirements he thought of taking up private tutoring. Rutherford taught briefly at the local high school. In a tiny basement workshop Rutherford began investigating the radio waves earlier discovered by Hertz. He devised a magnetometer capable of detecting radio signals over short distances. The device could be used in lighthouse-to-shore communication. Rutherford did not knew that the device had already been developed by Joseph Henry. Rutherford decided to try for the scholarship given by the Royal Commissioners for the Exhibition of 1851. These scholarships allowed graduates of universities in the British Empire to go anywhere in the world and work subjects seemingly useful for industries in their home. For the graduate students of the Universities of New Zealand one scholarship was available every second year. A candidate had to be enrolled at the University for becoming eligible for applying for the scholarship. Thus in 1894 Rutherford returned to Canterbury College where he took geology and chemistry for a B.Sc degree. For the research work required of a candidate, Rutherford decided to extend his researches carried out for his MA degree. There were two candidates for the only scholarship available for the students of the New Zealand University—Rutherford and James Maclaurin of Auckland University College. The scholarship was first offered to Maclaurin. However, the terms of the scholarship were not acceptable to Maclaurin and so he declined the offer. Rutherford being the only other candidate was awarded the scholarship.

Rutherford left New Zealand in 1895. Before leaving New Zealand, Rutherford had established himself as an outstanding researcher and innovator working at the forefront of electrical technology. He decided to work with J J Thomson of Cambridge University’s Cavendish Laboratory. His decision to work with Thomson was influenced by the fact that Thomson was the leading authority of electromagnetic phenomena, in which Rutherford had developed an interest. Rutherford happened to be the Cambridge University’s first non-Cambridge-graduate research student.

Thomson, who was quick to realise Rutherford’s exceptional ability as a researcher invited him to become a member of the team to study of the electrical conduction
of gases. Rutherford developed several ingenious techniques to study the mechanism whereby normally insulating gases become electrical conductors when a high voltage is applied across them. Rutherford used X-rays, immediately they were discovered, to cause electrical conduction in gases. He repeated his experiments with radioactive rays after their discovery in 1896. He became interested in understanding the phenomenon of radioactivity itself. In 1898 Rutherford discovered two distinct radioactive rays — alpha and beta rays.

In 1898, Rutherford accepted a professorship at McGill University in Montreal, Canada. The laboratories at McGill were very well equipped. The laboratory was financed by a tobacco millionaire who considered smoking a disgusting habit. Rutherford described the laboratory there as ‘the best of its kind in the world’, and used it to work on radioactive emissions.

At McGill University, Rutherford’s first important discovery was radon, a radioactive gas and a member of the family of noble gases. In this he was assisted by his first research student, Harriet Brookes and R. B. Owens, McGill’s professor of electrical engineering. Rutherford jointly with Frederick Soddy discovered the disintegration theory of radioactivity, a phenomenon in which some heavy atoms spontaneously decay into slightly lighter atom. He, assisted by Otto Hahn, monitored the sequence of decay products. In 1904, Rutherford published his book on “Radioactivity”, in which he set forth the principles of radioactivity. This was the first textbook on the subject and which defined the fields for decades. The book was considered as a classic as soon as it appeared. Lord Raleigh while reviewing the book wrote: “Rutherford’s book has no rival as an authoritative exposition of what is known of the properties of radio-active bodies. A very large share of that knowledge is due to the author himself. His amazing activity in that field has excited universal admiration. Scarcely a month had passed for several years without some important contribution from his pupils he has inspired, on this branch of science; and what is more wonderful still, there has been in all this vast mass of work scarcely a single conclusion which has since been shown to be ill-founded."

In 1907, Arthur Schuster offered to relinquish the Langworthy chair of physics at the University of Manchester on condition that Rutherford was invited to succeed him. The University authorities accepted the condition of Schuster and Rutherford accepted the offer. Rutherford spent fourteen productive years at the Manchester University. The discoveries made at the Manchester University included the demonstration of the identity of alpha particles as ionized (doubly positively charged) helium atoms (with his student Thomas Royds), a theory of scattering of alpha particles, and the nuclear model of the atom.

Radioactivity was originally discovered by Pierre and Marie Curie. Rutherford’s studies demonstrated that the radioactive emission consisted of at least two kinds of rays — alpha rays and beta rays. Later a third kind of radioactive rays, gamma rays was discovered. Rutherford jointly with Soddy proposed that radioactive decay occurs by successive transformation, with different and random amounts of time spent between ejection of the successive rays. The time spent may vary from years to a fraction of a second. The radioactive decay is a random process but it is governed by an average time in which half of the atoms of a given sample would decay.

At the Manchester University, Rutherford continued his researches on alpha particles at the McGill University. He and two of his colleagues Geiger and E. Marsden (1889-1970), were carrying out an experiment in which they shot alpha particles at a very thin piece of gold foil, in vacuum. To their surprise they found that most of the alpha particle passed through the gold foil in a straight line, some passed through the gold foil but changed their direction slightly and a small number (1 in 8000 particles) actually bounced back. Based on this experiment Rutherford concluded that the atom must be mainly empty space and that the positive charge was not spread out but it was located in the centre. Rutherford describing his astonishment at the results wrote: “It was quite the most incredible event that ever happened to me in my life. It was as incredible as if you fired a 15-inch shell at a piece of tissue paper and it came back and hit you. On consideration, I realized that this scattering backwards must be the results of a single collision, and when I made calculations I saw that it was impossible to get anything of that order of magnitude unless you took a system in which the mass of the atom was concentrated in a minute nucleus.” In 1911 Rutherford proposed that atoms possess a very small but massive structure at their centre, holding all the positive charge that is required to balance the combined negative charge of all the electrons circling around the positively charged centre (nucleus). This was the first correct structure of the atom.

Rutherford’s research group at Manchester included Niels Bohr, who extended Rutherford’s model into the theory of atomic structure that became the guiding principle in nuclear physics for a decade; Gyorgy Hevesy, who
developed the technique of radioactive tracers and defined the concept of isotopes; and Henry Moseley, whose work on characteristic X-rays established the concept and the significance of atomic number. While recalling his days at Rutherford’s laboratory at Manchester, Bohr wrote: “The effect (the large-angle scattering of alpha particles) though to all intents insignificant was disturbing to Rutherford, and he felt it difficult to reconcile with the general idea of atomic structure then favoured by the physicists. Indeed it was not the first, nor has it been the last, time that Rutherford’s critical judgment and intuitive power have called forth a revolution in science by inducing him to throw himself with his unique energy into the study of a phenomenon, the importance of which would probably escape other investigators on account of the smallness and apparently spurious nature of the effect. This confidence in his judgment and our admiration for his powerful personality was the basis for the inspiration felt by all in his laboratory, and made us all try our best to deserve the kind and unflinching interest he took in the work of everyone. However modest the result might be, an approving word from him was the greatest encouragement for which any of us could wish.”

During the First World War (1914-1918) helped to mobilize British scientists for participating in the war effort. He led a delegation of British and French scientists to Washington. Rutherford worked on sonic methods for detecting submarines. In 1919, Rutherford returned to Cambridge to succeed Thomson as Cavendish Professor of Physics and Director of the Cavendish Laboratory at the Cambridge University. Within months after his return from the war research, Rutherford discovered that nuclei could be disintegrated by artificial means. He disintegrated nitrogen nuclei by striking with alpha particles into carbon nuclei. Later jointly with Chadwick, Rutherford showed that most light atoms could be broken by alpha particles. Like in Manchester, Rutherford built a strong research group at the Cavendish Laboratory. In addition to Chadwick, who on his own proved the existence of neutron in 1932, the group included John Douglas Cockroft (1897-1967) and Ernest Thomas Sinton Walton (1903-1995), who made the first the accelerator that disintegrated an atom with an accelerated particle beam; Charles Thomson Rees Wilson (1869-1959), the inventor of the cloud chamber; Patrick Maynard Stuart Blackett (1897-1974), the discoverer of positron; Pjotr Leonidovich Kapitza (1894-1984), who made the world’s most powerful magnet; and Francis Aston (1877-1945) who demonstrated experimentally the agreement between apparent atomic and true isotopic weights.

Ray Spangenberg and Diane K. Moser wrote: “Rutherford’s idea of an atomic nucleus was a zinger, one for which he has earned the title, “the Newton of atomic physics”. It seemed to solve all the problems with the raisins-in-poundcake model of atoms. Yet even this model had a few problems. To build a more accurate vision of nature of the atom would require the application of an amazing concept called “the quantum” set forth by a somewhat dour German scientist named Max Planck. Like Roentgen’s X-rays, this idea would virtually turn physics upside-down, with implications not just for the concept of atoms, but virtually everything about our understanding of how world works.”

Rutherford was elected a Fellow of the Royal Society of London in 1903 at the early age of thirty-two. In 1904, he was awarded the Rumford Medal by the Royal Society. He was awarded the 1908 Nobel Prize “for his investigations into the disintegration of the elements, and the chemistry of radioactive substances”. He was given Nobel Prize in Chemistry and not in Physics. Arne Westgren, a chemist of the Swedish Academy of Science wrote: “Rutherford had also been suggested by several nominations for the Physics Prize, but at a joint meeting the two Nobel Committees decided that it would be most suitable, considering the fundamental importance of his work for chemical research, to award him the Prize for Chemistry.” Rutherford himself was very much surprised by the decision of the Nobel Foundation to award him Prize in Chemistry. In his Nobel banquet speech, on 11 December 1908, Rutherford said: “... [he had] dealt with many different transformations with various periods of time, but that the quickest he had met was his own transformation in one moment from a physicist to a chemist.” He was knighted in 1914. He was awarded the Order of Merit in 1921. In 1922, he received the Copley Medal of the Royal Society. He served as the President of the Royal Society from 1925 to 1930 and subsequently he became the chairman of the important advisory council which had been set up to allocate public money for the support of scientific and industrial research in the United Kingdom. In1931, he was made Baron Rutherford of Nelson, a place in New Zealand from where he came. The element with atomic number 104 was named after Rutherford.

Rutherford died on October 19, 1937. He was buried in Westminster Abbey close to Isaac Newton. We would like to end this write-up by quoting James Chadwick on Rutherford. Chadwick wrote: “He (Rutherford)...a volcanic
energy and an interest enthusiasm—his most obvious characteristic—and an immense capacity for work. A `clever' man with these advantages can produce notable work, but he would not be Rutherford. Rutherford had no cleverness—just greatness. He had the most astonishing insight into physical processes, and in a few remarks he would illuminate a whole subject. There is a stock phrase—to throw light on a subject.” This is exactly what Rutherford did. To work with him was a continual joy and wonder. He seemed to know the answer before the experiment was made, and was ready to push on with irresistible urge to the next. He was indeed a pioneer—a word he often used—at his best in exploring an unknown country, pointing out the really important features and leaving the rest for others to survey at leisure. He was, in my opinion, the greatest experimental physicist since Faraday.”

References

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the oxygen we breathe comes from the plants. Not surprisingly, given how women are blamed for not having a male child, just 38% knew that the sex of the child depends upon the father. Surely, the answers to science related questions tend to be increasingly correct as the education levels of the respondents rise.

What are the sources of information of the public? Television remains the primary source for 57% of the people of the country, and is almost five times more popular than the newspapers. Close to three-fourths of urban households rely on TV for information, as do half the rural households. Indeed, even educated people rely more on TV than on any other medium. In the case of postgraduates, 65% rely on TV as the primary source of information compared to just 27% on newspapers. Close to two-thirds of the population gets its science related information from TV as compared to 8% from newspapers. Over three-fourths of the people (85%) have a great deal of confidence in the authenticity of the TV, and ironically it is the illiterate that have the least confidence (64%). Nearly 65% of S&T news is got from TV in India, as compared to 7% in the US. The report finds that television is the most popular source of information for most people. But this also calls for a conscious action on the part of all concerned to generate quality S&T programmes for television. Quality S&T TV programmes are few and far between. There is no gainsaying the fact that this source of dissemination of scientific information needs to be exploited fully. This finding makes a strong case to utilize television and the Edusat infrastructure for S&T communication.

How about Internet as a source of information? Internet, however, does not appear to be popular source of information in India. Over 44% of S&T information in the US is got from the Internet as compared to 0.2 % in India at present! There is a need to ensure greater penetrability of Internet and other ICT tools at the school level as also in rural and remote areas so that access to reliable and updated information is considerably improved.

The findings ISR indicate that the initial urge to study science cuts across all sections of the society. However, for the sections in the lower socio-economic stratum, this does not often translate into fact at later stages due to several factors such as lack of affordability, lack of infrastructure; and paucity of information about scope and future opportunities. The report found that those in rural areas tend to go in more for arts than those living in urban areas - may be due to a paucity of trained science teachers in rural areas. This issue needs to be urgently addressed and appropriate measures taken to improve the situation.

Meaningful policies cannot be formulated in the absence of authentic data. Therefore, the necessity of collecting, collating, and analyzing reliable data to arrive at meaningful conclusions cannot be overemphasized. ISR has been the first such attempt in this direction. However, much still needs to be done. There are several critical areas of national importance that have not been objectively addressed in the ISR due to incomplete and / or outdated data, or even due to non-existence of reliable data / information in a few cases. But, as the authors of the report say, “The ISR is an ambitious project that is not an event but a process, of which the first report is only a beginning.”

☐ V. B. Kamble
Tribute to Jack Kilby
A Gentle Giant of Miniaturisation

Jack St. Clair Kilby, Nobel Prize-winning scientist and an inventor of the first monolithic IC, died on June 20, 2005, at Dallas, following a brief battle with cancer. He was 81. He is survived by daughters Janet Kilby, and Ann Kilby; five granddaughters, Caitlan, Marcy, Gwen, Erica and Katrina; and son-in-law, Thomas Cameron. His wife, Barbara Annegers Kilby, and sister, Jane Kilby, preceded him in death. During one of his interview to a magazine Kilby had said “People often ask me what I’m proud of, and, of course, the integrated circuit is at the top of the list. I’m also proud of my wonderful family. I have two daughters and five granddaughters, so you could say that the Kilbys specialized in girls.”

Kilby has made significant contribution to the modern information age. His insights and professional accomplishments have changed the world. His invention of the monolithic integrated circuit (IC) - the microchip in 1958 at Texas Instruments (TI) laid the conceptual and technical foundation for the entire field of modern microelectronics. It was this path breaking breakthrough that made possible the sophisticated high-speed computers and large-capacity semiconductor memories of today’s information age. The revolutionary impact the invention of IC could impart on technology was realised within a decade of its invention. Gordon Moore, one of the founders of Intel, observed in an article in the April 19, 1965 issue of Electronics magazine that innovations in miniaturization technology would allow a doubling of the number of transistors in an IC in a given space every year (in an update article in 1975, Moore adjusted the rate to every two years to account for the growing complexity of chips), and that the speed of those transistors would increase. What is less well known is that Moore also stated that manufacturing costs of chips would dramatically drop as the technology advanced. Moore’s prediction, now popularly known as Moore’s Law, had some startling implications, predicting that computing technology would increase in value at the same time it would actually decrease in cost. Moore’s prophetic observation was based on his vision about the revolutionary benefits and applications of the IC, which was invented by Kilby.

Integrated Circuits (ICs) popularly called the chips have a ubiquitous presence in modern world. ICs are used in running every conceivable modern day electronic and communication devices from digital phones and PCs to stock markets and spacecraft. ICs enable today’s information-rich, converged, digital world. They have truly transformed our modern world. Once elephantine, power hungry, exorbitantly expensive, computers have shrunk in size and improved vastly in performance with the advent of the ICs. Invention of the IC has also helped in creating a semiconductor industry that is now worth one trillion US $ annually. If steel was the raw material for the 20th century, silicon is for the 21st century. The silicon semiconductor industry has delivered a dramatic spiral of rapid cost reduction and exponential value creation that is unparalleled in history. Silicon the raw material of the ICs powers today’s economy. Modern Semiconductor industry and IC manufacturers have continued to make great strides in delivering state of the art integration in ICs. To give an idea of what this means in numbers of transistors per IC, consider this example: World first IC had five components in 1959, in 1965, ICs contained about 60 distinct devices; The original 4004 IC, the first ever microprocessor invented in the year 1971 by Ted Hoff, while working for Intel, contained just over two thousand transistors; the Intel Pentium 4 microprocessor, which now forms the brain of all modern home and business computers released in 2000, contains over forty million transistors. Intel’s latest Itanium chip has 1.7 billion transistors.

A man of few words, Kilby is remembered fondly by friends and associates for being in every sense of the word a gentleman and a gentle man. People in the semiconductor industry, friends, colleagues and admirers from around the world have paid rich tributes to Kilby. He is remembered as a great and gifted personality blessed with simplicity, humility and generosity. When he died, he was still living in the modest house he had brought when he first joined Texas Instruments, in 1958. The value of Kilby’s contribution for the world is articulated in the tribute paid by the chairman of Texas Instruments (TI). “In my opinion, there are only a handful of people whose works have truly transformed the
world and the way we live in it – Henry Ford, Thomas Edison, the Wright Brothers and Jack Kilby,” said TI Chairman, Tom Engibous. He went on to add, “If there was ever a seminal invention that transformed not only our industry but our world, it was Jack’s invention of the first integrated circuit.” “Jack was one of the true pioneers of the semiconductor industry,” said TI President and Chief Executive Officer, Rich Templeton. “Every engineer, myself included, owes no small part of their livelihood to the work Jack Kilby did here at Texas Instruments. We will miss him.” He added. “Jack Kilby was always an engineer’s engineer,” said Gordon Moore, co-founder and chairman emeritus of Intel. “He remained true to his technical roots, loyal to the principles of science and was always a gentleman to those who had the pleasure to meet him. He will be missed.” Moore added. A television program in 1997 said about the integrated circuit and Jack Kilby, “One invention we can say is one of the most significant in history — the microchip, which has made possible endless numbers of other inventions.” It is rather ironical that neither he nor his creation the IC ever received any major public attention despite their astronomical contribution to the creation of modern information revolution.

The integrated circuit is nothing but a very advanced electric circuit. It is built up of transistors and other components like resistors, capacitors and diodes in a single piece of semiconductor material, where they are connected together to form an electric circuit with thin metallic lines. The most important of all the components that are embedded in the IC is a transistor. The transistor acts like a switch. It can turn electricity on or off, or it can amplify current. It is used for example in computers to store information, or in stereo amplifiers to make the sound signal stronger. In 1958, Kilby, working at the Texas Instruments showed that it was possible to fabricate a simple integrated circuit in germanium, a commonly used semiconductor at that time.

Jack Kilby was born in Jefferson City, Missouri, on Nov. 8, 1923. He spent much of his early life in Great Bend, Kansas. He graduated from Great Bend High School. Even today road signs at the entrances to the town commemorate his time there. Kilby developed interest in electronics at a very young age. His father ran a small electric power company that had customers scattered across rural western of Kansas. When Kilby was in high school, a natural calamity occurred in his area. The resulting snow and ice storm broke down the entire communication and power system destroying all the telephone and power lines. In the absence of power and telephone lines Kilby’s father worked with amateur radio operators to communicate with his customers. Young Kilby assisted his father and other amateur radio operators in restoring the power and communication. Radio communication aroused an interest in him and sparked off Kilby’s lifelong fascination with electronics. Kilby had never before seen the power of electronics to shrink distances and to give people hope. It was, he said later, the moment he decided to make electronics his career.

Kilby received his Bachelor of Science degree from the University of Illinois at Urbana-Champaign in 1947 with a degree in Electrical Engineering. Most of his classes at the engineering were in electrical power, but because of his childhood interest in electronics, he also took some vacuum tube engineering physics classes. When Jack Kilby finished his degree in electrical engineering at the University of Illinois in 1947, a computer was something that filled a room and took an army of technicians to maintain. Though the invention of the transistor, by Bell Laboratories in New Jersey, was less than a year away, bulky vacuum tubes still ruled the day. Kilby had taken extra classes on the physics of vacuum tube engineering, little knowing that he himself would help to make them obsolete. Kilby took up his first job in 1947 with a company called Centralab, an electronics company in Milwaukee, where he worked with vacuum tubes and gained some insights into the working of the transistors. He also learned to integrate the vacuum tubes into larger circuits, standardising the way they were connected to other components, and helping in the process to make better hearing aids and televisions. Kilby spent a decade at Centralab and patented 12 inventions. Kilby took up evening classes while working with Centralab Company and finished his masters in electrical engineering at the University of Wisconsin in 1950. Commenting on his completing the masters as a part timer Kilby said, “Working
and going to school at the same time presents some challenges, but it can be done and its well worth the effort.” While working for Centralab, Kilby encountered problems of interconnecting hundreds of components by soldering with hand, which he felt was arduous and problem prone. The problems he encountered were shared by all the best engineers of the day. They, like him, could envision countless electrical products that would transform society, but could not make them. Realising their designs would involve assembling and connecting hundreds or thousands of components by hand, using unreliable solder, and then connecting these circuitry to tens of thousands of bulky, power hungry vacuum tubes. This “tyranny of numbers” held up technological progress all through the 1950s.

In 1958 Kilby was offered a job in Texas Instruments in its semiconductor research group by Willis Adcock. He was offered the job after several rounds of interviews. His duties were not precisely defined, but it was understood that he would work in the general area of micro miniaturization. Soon after starting at TI in May 1958, Kilby realized that the company made transistors, resistors, and capacitors, a repackaging effort might provide an effective alternative to the Micro-Module. Kilby therefore designed an IF amplifier using components in a tubular format and built a prototype. He along with his team performed a detailed cost analysis, which was completed just a few days before the plant shut down for a mass vacation. GWA Dummes, a British authority in Radar in the year 1952, had first proposed the theoretical concept of an IC in which components like the transistor, resistors etc could be incorporated. However he could not succeed in his attempts to build a practical IC. The first real research and investigations in IC and microelectronics technologies began in late 1950s. The objective was to miniaturise electronic equipments to include increasingly complex electronic functions in limited space with minimum weight. Several approaches evolved, including micro assembly techniques for individual components, thin-film structures and semiconductor integrated circuits. Each approach evolved rapidly and converged so that each borrowed techniques from another. It was in a way to find solution to the “Tyranny of Numbers” problem, which the industry faced. By then semiconductor transistors were seriously replacing vacuum tubes.

New to the job, Kilby could not enjoy the privilege of a holiday. While his colleagues took their holidays, his thoughts began to crystallise into a revolutionary idea, which would ultimately lead to the solution of tyranny of numbers. An electronic circuit is basically an interconnection of different components of the circuit wired to realise the intended goal. Depending on how an engineer arranges and connects the capacitors, resistors and transistors, an infinite number of electrical circuits could be created. By then engineers had learnt that a resistor, which restricts the flow of electrical current, is best made of certain materials and a capacitor, which stores electrical charge, of others. By then the transistors were beginning to replace vacuum tubes in electronic circuitry.

On July 24 1958, it is believed that Kilby had a brainwave to solve the problem of interconnecting the components in a circuitry. He worked on his ingenious and unorthodox thoughts and immediately resolved that each electronic component in the given circuitry could be made of the same type of material and integrated into a whole. By carefully controlling its properties, he argued that he could turn a single chip of semiconductor into resistors, capacitors and transistors connected in any way he liked. By then he had also realized that, since all of the components could be made of a single
material, they could also be made in situ, interconnected to form a complete circuit. He then quickly sketched a proposed design for a flip-flop using these components. Resistors were provided by bulk effect in the silicon, and capacitors by p-n junctions. These sketches were quickly completed, and Kilby showed them to Adcock upon his return from vacation. Adcock was enthused but skeptical and asked for some proof that circuits made entirely of semiconductors would work. Kilby therefore built up a circuit using discrete silicon elements. Packaged grown-junction transistors were used in which resistors were formed by cutting small bars of silicon and etching to value. Capacitors were cut from diffused silicon power transistor wafers, metallized on both sides. Kilby assembled this unit and demonstrated to Adcock on August 28, 1958. Although the demonstration showed that circuits could be built with all semiconductor elements, it was not integrated. Kilby then attempted to build an integrated structure as initially planned. The first circuit attempted was a phase-shift oscillator, a favorite demonstration vehicle for linear circuits at that time. His circuit was made up of a thin wafer of Germanium. Kilby’s IC had five components isolated electrically from one another mainly by shaping them in to L’s U’s and other configurations. The tiny wires linking the components to one another and to the power supply were simply soldered on and the whole thing was held together by wax. On September 12, 1958, the first three oscillators of this type were completed. When power was applied, the first unit oscillated at about 1.3 megacycles. This proved to be the world’s first IC. The concept of an IC was publicly announced at a press conference in New York on March 6, 1959. Mark Shepherd said, “I consider this to be the most significant development by Texas Instruments since we divulged the commercial availability of the silicon transistor.”

The first integrated circuits, with their mere tens of components, met some skepticism. They did not find commercial favor until 1966, when Kilby used them to make the first hand-held calculator. After that, engineers squeezed more and more components on to ever-smaller chips.

At about the same time, Robert Noyce described how an integrated circuit could be made in silicon using silicon dioxide as the insulator and aluminum for the metallic lines. This combination was to be the technology of choice for years to come. Kilby and Noyce are considered to be co-inventors of the integrated circuit. Kilby was awarded the Nobel Prize in Physics for the year 2000, in recognition of his role in the invention of the IC. Robert Noyce, who died in 1990, was not considered for the award because Nobel Prizes are normally not awarded posthumously. Kilby was sorry that Noyce could not share the Nobel Prize with him. Kilby had this to say about his Nobel Prize. “It’s gratifying to see the committee recognize applied physics, since the award is typically given for basic research. I do think there’s a symbiosis as the application of basic research often provides tools that then enhance the process of basic research. Certainly, the integrated circuit is a good example of that. Whether the research is applied or basic, we all “stand upon the shoulders of giants,” as Isaac Newton said. I’m grateful to the innovative thinkers who came before me, and I admire the innovators who have followed.” Kilby thoroughly enjoyed his electronics subject. Even at the fag end of his career when young people frequently asked for his advice he would say, “Electronics is a fascinating field that I continue to find fulfilling. The field is still growing rapidly, and the opportunities that are ahead are at least as great as they were when I graduated from college. My advice is to get involved and get started.”

Kilby holds over 60 U.S. patents. He was a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) and a member of the National Academy of Engineering (NAE). Besides the highly acclaimed Nobel Prize in Physics, he has been awarded the Franklin Institute’s Stuart Ballantine Medal, the NAE’s Vladimir Zworykin Award, the American Society of Mechanical Engineers’ Holley Medal, the IEEE’s Medal of Honor, the Charles Stark Draper Prize administered by the NAE, the Cledo Brunetti Award, and the David Sarnoff Award. On the 30th anniversary of the invention of the integrated circuit, the Governor of Texas dedicated an official Texas historical marker near the site of the TI laboratory where Mr. Kilby did his work.
Some people are plain skinny. Do what they might—they simply do not gain weight. Everybody around seems to fuss about this, and most of all, worried elders, who try recipes of all kinds so that you may gain a few pounds. If you fall under this lean category and are eager to fill up, here are a few practical tips:

Enjoy between-meal snacking: If you’re a growing teenager or young adult, you may need more food than what you can eat during the regular meals. There is good evidence to suggest that having several smaller meals daily rather than only a regular breakfast, lunch and dinner can help you put on weight. You could call it, between-meal snacking!

Soft drinks and candy are passé: If you like fizzy drinks and titbits, remember they can be a problem since you may not quite feel hungry if you fill up your belly with useless stuff. Young people require a sizeable amount of food energy and nutrients, which such foods cannot provide.

Take balanced meals and sufficient calories: The development of good food habits is an important prerequisite for good health. Take healthy nutritious food, and work out your daily calorie needs using the calorie chart. To that add 100 to 200 extra calories a day, if you wish to put on weight. The arithmetic is simple: 900 surplus calories add to one kilogram of weight.

Let your chef be imaginative: If the food is attractive, appetising and nutritious, there is no reason why you will not enjoy it. It is best to keep a variety in meals, in methods of preparation, and of serving. You can also try your hand at cooking!

Let meals be times full of fun and warmth: environment in the dining room augurs well for everybody. Your appetite is governed to a large extent by the mood you keep. Do not enter into any heated discussions on the dining table and always maintain a pleasant, warm atmosphere to enjoy a nice meal. (Parents must make a note of this, and refrain from discussing any such subject, that the child finds uncomfortable in talking to you about.)

Don’t be a couch potato: If you spend all your day watching the television, working on a PC or reclining on a sofa or bed, it would be natural if your appetite were to nosedive. Don’t let that happen. Take time out for play and exercise. It is crucial to good health.

Build your muscles: If you are a boy, a weight-lifting programme may do you much good. Your body will require more food, and you will eat more. Thanks to the exercise, you would increase your muscle without adding flab. Regular exercise works well for both sexes and at all ages.

Never take stress to heart: If you feel emotionally upset or deprived at any time or stressed about something, pour your heart out to a friend, parent, brother or sister who you can trust. Don’t take it heart. Blocking stress within you is never healthy.

Check if your intestines are at fault: Rarely, some people just fail to thrive because of defective absorption. A number of conditions can lead to this. Such people often suffer from repeated attacks of pain in abdomen, distension, diarrhoea or constipation and other bowel symptoms. If you have such a doubt, check with a doctor. He can do some simple tests on you.

Guard against chronic infection: If somebody suffers repeated chest infections, urinary tract infection or a chronic infection like tuberculosis he or she may not grow well. The root cause must be eliminated to bring about an improvement.

Each person is different: Yes! While some individuals are small and puny, others are big. Likewise, while some are thin, others are fat. This may be constitutional. If you come from a family of scrawny individuals, just grin and bear it.

The litmus test—to draw a line between normal and abnormal—is how you feel. If you are energetic all day long, sleep well and wake up feeling great, then your low body weight is not a problem. In that case, you’re just naturally thin, and neither your well-wishers nor you should fret about it.
A nyone who suffers from peptic ulcer knows how painful it is. Peptic ulcer is an inflammation of the upper digestive tract, usually in the stomach or duodenum, where the mucous membrane is exposed to gastric acid. For long time peptic ulcer was believed to be caused by stress and lifestyle, bad eating habits, tobacco smoking, spicy food, excessive drinking and a host of other things. The commonly prescribed remedy was regular intake of antacids, or in worse cases, surgery. But the discovery by two Australian doctors Barry Marshall and Robin Warren that ulcers weren't caused by stress, but rather by a bacterium called *Helicobacter pylori*, turned medical dogma on its head. It was now clear why, even though peptic ulcers could be healed by inhibiting gastric acid production by use of antacids, they frequently relapsed. The reason was simple; relapse was inevitable in most cases, as the bacteria and the resultant chronic inflammation of the stomach remained and the bacteria were not eradicated. The two Australian researchers’ work thus transformed peptic ulcer disease from a chronic, frequently disabling condition to one that can be cured by a short regimen of antibiotics and other medicines. For their path-breaking discovery Marshall and Warren have been awarded this year’s Nobel Prize for Physiology or Medicine.

The human body is a highly complex system. Some of the activities that go on inside it appear to defy logic. Take the example of the stomach. The stomach produces copious amounts of hydrochloric acid, one of the strongest inorganic acids that help enzymes in breaking down proteins and digestion of food. A healthy stomach has an acidity level (pH) between 1-2, that is strong enough to burn and dissolve the skin. Then how does the stomach lining remain intact? The secret is mucus secreted by the gastric glands, which helps protect the stomach lining from the action of gastric acids. An ulcer develops when this mucus layer is breached, exposing the underlying layers to the corrosive action of acids.

Robin Warren (born 1937), who retired as a pathologist from Royal Perth Hospital, Australia in 1999, discovered *H. pylori* while studying biopsies taken from patients of gastric ulcer. He found small curved bacteria colonizing the lower part of the stomach in about 50% of the biopsies taken. He made the crucial observation that signs of inflammation were always present in the gastric mucosa close to where the bacteria were seen.

Barry Marshall (born 1951), at present NHMRC Senior Principal Research Fellow at University of Western Australia, became interested in Warren’s findings and together they initiated a study of biopsies from 100 patients. After several attempts, Marshall succeeded in cultivating a hitherto unknown bacterial species (later named *Helicobacter pylori*) from several of these biopsies. Together they found that the organism was present in almost all patients with gastric inflammation, duodenal ulcer or gastric ulcer. Based on these results, they proposed that *H. pylori* is involved in the aetiology of these diseases. Marshall later wrote that he consumed the bacteria-laden drink himself in July 1984 because it was impossible to infect rats, mice and pigs with the bug. He was fine for about five days, and then he had a severe case of gastritis. Although Marshall didn’t actually develop an ulcer, he did prove that a healthy person could be infected by these bacteria.

*Helicobacter pylori* is a spiral-shaped Gram-negative bacterium that colonizes the stomach in about 50% of all humans. The infection is more common in crowded living conditions with poor sanitation. In countries with poor sanitation, 90% of the adult population can be infected. Infected individuals usually carry the infection indefinitely unless they are treated with medications to eradicate the bacterium. Infection is typically contracted in early childhood, frequently by transmission from mother to child, and the bacteria may remain in the stomach for the rest of the person’s life. One out of every six patients with *H. pylori* infection would develop ulcers of the duodenum or stomach.

Marshall and Warren reported their findings in 1982, but it was almost ten years before the medical community widely accepted their explanation. Doctors at that time thought that stress and an unhealthy way of life were the major causes of ulcers. The long-standard teaching in medicine was that “the stomach was sterile and nothing grew there because of corrosive gastric acids.” So everybody believed there were no bacteria in the stomach. However, following Marshall’s and Warren’s work, it is now firmly established that *H. pylori* causes more than 90% of duodenal ulcers and up to 80% of peptic ulcers. The link between *H. pylori* infection and ulcers...
and subsequent gastritis and duodenal ulcers has been established through studies of human volunteers, antibiotic treatment studies and epidemiological studies.

The current view is that the chronic inflammation in the stomach caused by *H. pylori* infection results in an increased acid production from the non-infected region of the stomach, which subsequently predisposes the more vulnerable duodenum to ulcer development. In some individuals *H. pylori* may cause a more widespread inflammation that predisposes not only to ulcer, but also to stomach cancer.

The most surprising discovery is that *H. pylori* is present only in humans and has adapted to the stomach environment and that only a minority of infected individuals develop stomach disease. After Marshall’s and Warren’s discovery, research has been intense. Details underlying the exact pathogenetic mechanisms are continuously being unravelled.

Apart from stomach ulcers, many diseases in humans such as Crohn's disease (a chronic inflammatory disease of the intestines that primarily causes ulcerations of the small and large intestines, but can affect the digestive system anywhere from the mouth to the anus), ulcerative colitis, rheumatoid arthritis, and atherosclerosis are due to chronic inflammation. The discovery that one of the most common diseases of mankind, peptic ulcer, has a microbial cause has stimulated the search for microbes as possible causes of other chronic inflammatory conditions. The discovery of *H. pylori* has also led to an increased understanding of the connection between chronic infection, inflammation and cancer.

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**New Publications of Vigyan Prasar**

- **The Unknown Einstein**
  - Bal Phondke
  - ISBN: 81-7480-120-0
  - Rs. 75/-

- **Fermi Problems or The Art of Estimation**
  - Vinay B. Kamble
  - ISBN: 81-7480-122-7
  - Rs. 20/-

- **The Quest for New Materials**
  - S. T. Lakshmikumar
  - ISBN: 81-7480-121-9
  - Rs. 120/-

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**Welcome**

Shri B.K. Tyagi

has recently joined Vigyan Prasar family as Scientist 'D' (Dissemination & Training)

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**Farewell**

Shri G Biju Mohan,

Technical Assistant (Audio Video) VP has joined Jahanabad Media Institute, Lucknow as a lecturer.
Rashtriya Gyan-Vigyan Award for Dr. Yatish Agarwal

Noted physician, writer, and columnist Dr. Yatish Agarwal was conferred the prestigious Rashtriya Gyan-Vigyan Award for his book “Swasthya Hridya: Dekhkher aur Upchaar” by the Union Home Minister Shri Shivraj V. Patil. The award investiture ceremony, held at New Delhi’s Vigyan Bhavan, was presided over by the State Home Minister Shri Manikrao Gavit.

Published by Rajkamal, the book focuses on heart care offering practical recipes on how to beat heart disease and keep your heart in good health. The book has several interesting sections for everybody. Using the forecast mapping you could calculate your risk for a heart attack, discover ways to reduce cholesterol, grasp the nitty-gritty of various cardiac tests, recognize the symptoms and remedies of angina, take a reality test on heart attack, understand the benefits and limitations of balloon angioplasty, coronary bypass surgery, pacemakers and heart valve surgery—all in a simple, easy-to-understand, friendly idiom and style.

A pioneer in popular health writing in India, Dr. Yatish Agarwal is a senior faculty member at the VM Medical College and Safdarjung Hospital, New Delhi. A prolific writer, broadcaster and health columnist, he has authored 38 books thus far and has received several national awards, including the Atmaram Samman (1999), NCSTC National Science Award (1999), Meghanad Saha Award (1991-1993 & 2002), Shiksha Samman (2001-02), and the Litterateur Award of Hindi Academy (2002-03). Today, several of his works are available in many Indian and foreign languages. Dr. Agarwal has written a book for Vigyan Prasar and he is a regular contributor to “Dream 2047”.

TECHFILM festival - VP’s Films selected

Two of the video programmes produced by Vigyan Prasar, Khoj Radiodharmitha Ki (Discovery of Radioactivity) and X Ray Ki Khoj (Discovery of X Ray) have been selected for entry in the 43rd International TechFILM 2005 to be held at Hradec Kralove, the Czech Republic, from 7 to 10 November. Directed by Sh Rakesh Andaniya of Credence Media Solutions and Sh Subash Kapoor of Vikalp Communications, respectively, the programmes aim to convey in simple terms the context and the significance of the discoveries of X Rays and Radioactivity. The films will be screened before the international Jury on 9th November 2005.

The TECHFILM festival is a prestigious festival on Science, Technology and arts held every year at the university of Hradec Kralove, the Czech Republic and attracts films makers from all over the globe. This festival had become an important European festival with specific emphasis on science, education and technology.

Annular Solar Eclipse of 03 October 2005

Annular Solar Eclipse covering 90% of Sun’s disk occurred on 03 October 2005. The annularity started in the North Atlantic Ocean at 2:11 PM IST and passed through Spain, Algeria, Portugal, Libya, Egypt etc and ended in the Indian Ocean at 5:52 PM IST. In India, only partial eclipse was visible from western part while some of eastern region could witness only the first and/or the second contact.

On this occasion, Vigyan Prasar organized ‘Lecture-cum-demonstration’ programme with the students and teachers from four near by schools of NOIDA and Gaziabad. Total number of participants was over 70.

Dr. V. B. Kamble, Director, Vigyan Prasar in his opening addresses briefly described the various activities of Vigyan Prasar and talked about the general aspects of solar eclipse.

Dr. T.V. Venkateswaran delivered a lecture on ‘Hide and Seek of the Moon and Sun’, where he emphasized on angular size of Sun and Moon with their physical significance of shadow play for different types of Solar Eclipse. Mr. Arvind C. Ranade delivered a talk on ‘Importance of Solar Eclipse and Annular Solar Eclipse: 03 October 2005’. He focused on importance of eclipses for different astronomical studies and types of activities/experiments that can be conducted during the eclipses. Mr. Kapil Tripathi demonstrated the Astronomy Activity Kit developed Vigyan Prasar. In last session, ways and means to observe the Solar Eclipse in a safe manner were highlighted through demonstration. Solar filters were provided to all participants for the safe observation of the Sun. The programme was highly appreciated by students and teachers.

VP-NSC Popular.... (Contd. from page 32)

Considering the nano level dimensions of atoms and molecules, such arrangements and faults cannot be studied by using ordinary light and optical instruments, but by using high frequency waves like X – Rays and using technique like X – Ray diffraction. He talked about several such techniques being used in labs around the country especially in the National Physical Laboratory. He emphasised upon the crystal structure of Diamond and showed how small change in crystal structure changes the property of material drastically as in case of carbon, which is the core element of Coal, Graphite and Diamond. During the lecture students were delighted to see some crystals from his collection. He gave away quartz crystals to three students who asked “good” questions.
**Recent Developments in Science & Technology**

**Sounds of Typing Give Messages Away**

The clackety-clack of your keyboard might be enough to spill your secrets. A team of researchers in California has successfully decoded what was typed into a computer from an audio recording.

Doug Tygar of the University of California, Berkeley and his colleagues used a standard microphone to record 10 minutes of noise generated by computer typists. Because the sound generated by each keystroke is slightly different, the researchers were able to generate a computer program to decode what was written. Using statistical learning theory, the computer can categorize the sound of each key as it’s struck and develop a good first guess with an accuracy of 60 percent for characters, and 20 percent for words. Using spelling and grammar check to refine the result, which increased the accuracy to 70 percent and the word accuracy to 50 percent.

*Source: Sciam.org*

**Red Blood Cells Fitted with Artificial Tails**

They might look like sperm swimming backwards, but red blood cells have become the first living cells to be fitted with an artificial tail. As the tail whips back and forth, the cell moves tail-first at a cool 6 micro metres per second - about 10 times as slow as sperm swim.

The secret to the cell’s motion lies in the composition of the tail - a filament of tiny magnetic beads held rigidly together by strands of DNA. When an oscillating magnetic field is applied to the cells, they move through the fluid as their tails bend to align themselves with the constantly reversing direction of the magnetic field.

The microscopic swimmers might one day provide a way to direct medicines through the bloodstream to exactly the right spot, says Remi Dreyfus, who created the device with colleagues at France’s Ecole Supérieure de industrial physics and chemistry in Paris.

*Source: Nature (vol 437, p 862)*

**Elderly Probe Nails Gamma-ray Bursts**

Fleeting bursts of gamma-rays from the depths of the Universe have puzzled astronomers for more than 30 years, but a slew of evidence has now confirmed that they originate from almighty collisions between the remnants of dead stars.

Surprisingly, the data that clinched this discovery have come from an old NASA probe, HETE-2 (High Energy Transient Explorer), which has been in orbit since October 2000. NASA recently launched another satellite, called Swift, explicitly to solve the mystery of short gamma-ray (γ-rays) bursts. But Swift has been beaten to the best results by the lucky HETE-2. Bursts of γ-rays come in two flavors. Long bursts lasting more than two seconds or so are generated by the collapse of young, massive stars as they give birth to black holes. But astronomers had very little information about the short bursts, which are difficult to observe because of their transient nature.

The leading theory suggested that short bursts are released when a pair of neutron stars, or a neutron star and a black hole, crash into each other. Neutron stars are the dense, burned-out cores of stars that are left behind after supernova explosions.

But short bursts might also be released from the same sources as long ones, or by flares from highly magnetized neutron stars called magnetars.

*Source: nature.com*

**Indo-US Workshop**

From US, eight experts representing NASA and/ or NASA sponsored projects participated in the workshop. From India, twelve experts representing DECU, VP, IGNOU, NCERT, HBCSE, Indian Space Research Organisation (ISRO), teachers from a few schools and colleges participated in the workshop. During the workshop, two way audio – two way video communication link between Aurangabad and Ahmedabad was set-up using the Edusat transponders. Experts conducted workshop at Aurangabad and Ahmedabad while students at the Science City, Ahmedabad, participated and interacted with the experts live. Some teachers form Aurangabad also participated in the workshop.

The workshop demonstrated how Edusat system could be utilized for Science and Technology communication to reach different corners of the country in an interactive way.

Presentations made included demonstration of educational resources developed by US (NASA and NASA sponsored projects) and India (VP, HBCSE, IGNOU, NCERT). Dr. V. B. Kamble and Shri Rintu Nath represented Vigyan Prasar. Dr. V. B. Kamble explained how science club network could be utilized for science education. Science Club movement initiated by VP was highly appreciated. He also explained the role of ham/Amateur radio, HAMSAT and World Space radio for science communication and VP’s initiatives in using these infrastructure. VP and DECU (ISRO) are in the process of setting up twenty talk-back terminals in different parts of the country to facilitate two ways audio and video communication using Edusat infrastructure for science and technology communication including awareness/education on natural disasters in disaster-prone areas. Science serial “Aisa Hi Hota Hai”, jointly produced by VP and DECU (ISRO) was highly appreciated. Shri Rintu Nath gave a presentation on activity based science curriculum and demonstrated a few activities developed by VP.

The participants of the workshop later formed three working groups to address 1) Instructional Resources 2) Non-formal Science education and 3) Teacher Preparation. As a follow-up action it was proposed to organise a workshop to develop a detailed plan of action in which NASA, DECU (ISRO), VP (DST) and other organizations like NCERT, NCTE and NGOs could participate.