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Monthly Newsletter of Vigyan Prasar

DREAM 2047

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VP News

Vigyan Rail on Track

Come December, and a special exhibition train carrying a thematic exhibition will start moving across the country spreading scientific awareness about various scientific and technological achievements of the country. This science exhibition on wheels is named Vigyan Rail, and is an ambitious project of Vigyan Prasar. The train will have 51 stops of 2-5 days at important cities/locations in different States/Union Territories depending on the population and geographical size. The train will carry exhibits/activities depicting India's achievements in various fields of Science & Technology, say, India's scientific heritage, environment, space, defence, communication and information technology, atomic energy, health and medicines and so on. The project has been put together by Vigyan Prasar, Department of Science & Technology and Ministry of Railways in collaboration with Scientific Departments & Ministries of Government of India. The train will have 12 coaches carrying exhibits. The train will move throughout the country for eight months. Incidentally, Vigyan Rail – Science Exhibition on Wheels Train is the same train that carried the Exhibition on Wheels commemorating 150 years of Indian Railways during August 2002 to April 2003. A meeting of the Nodal Officers of participating Departments/Ministries was held on 06 October 2003. The fabrication work of the exhibition has already begun. Vigyan Rail is likely to be flagged off from New Delhi in the first week of December 2003. More details can be found in the editorial.

A meeting of Nodal Officers of participating Ministries/ Departments. In the background is the Vigyan Rail being readied up

Inside

Science Popularization through Indian Languages

A National Seminar to discuss various issues related to Science Popularisation through Indian Languages was organised by Vigyan Prasar at India International Centre, New Delhi, on 18–19 October 2003. Eminent scientists/science communicators deliberated on a number of issues for 2 days. Professor Yash Pal Inaugurated the seminar, while Dr. R.R. Kelkar, DG, IMD, was the Guest of Honour. The valedictory session was presided over by Professor V.S. Ramamurthy, Secretary, DST and Chairman, Governing Body of Vigyan Prasar. A report on the seminar appears in this issue of "Dream-2047".

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

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Vigyan Rail – Science Exhibition on Wheels

Railways have played an important role in the social and economic development of the country for over one and a half centuries, besides being a means of communication and transportation. Till date, it remains the most important network for travel and transportation throughout the country. The railways have brought people living in far flung areas of the country into the mainstream and hence have also played a major role in cultural integration of the country. Further, India stands at the crossroads between science, technology and industrial development - more so in the present scenario of economic liberalization and rapid developments in the fields like information technology and biotechnology. Indeed, modern technology has been connecting the people from far flung areas of the country together; however, a direct contact with the people with an aim to spread scientific awareness and help them develop a scientific outlook is what will eventually help India emerge as a technologically powerful and culturally cohesive nation.

Thoughts like these prompted Shri M. V. Kamath, President, Vigyan Prasar Society over a year ago to ask a question in one of its General Body Meetings: "Can we have a train moving throughout the country carrying an exhibition depicting the achievements of the country in different fields of Science and Technology?" Well, the idea, strongly supported by Dr. Murli Manohar Joshi, Hon'ble Minister of Science and Technology, Human Resource Development, and Ocean Development, and Shri Nitish Kumar, Hon'ble Minister of Railways, has now culminated into "Vigyan Rail – Science Exhibition on Wheels", a prestigious project conceived, formulated and implemented by Vigyan Prasar jointly with the Ministry of Railways, and with active support from the Department of Science and Technology (DST) – in particular Professor V. S. Ramamurthy, Secretary, DST, and Chairman Governing Body, Vigyan Prasar.

The project has been undertaken with the active participation of Scientific Departments / Ministries / Councils of Government of India. After several rounds of discussions with the officials of the Ministry of Railways, the Vigyan Rail project finally evolved and modalities worked out. Vigyan Prasar jointly with National Council of Science Museums prepared a detailed project report with inputs from Ministry of Railways. To discuss the various aspects related to the Vigyan Rail Project, and to seek the views, suggestions and commitment to the project, a coordination meeting of Scientific Departments / Ministries / Councils was held in July 2003.The response was truly overwhelming. DST, Vigyan Prasar, and other participating Departments / Ministries will share the costs for putting together the Vigyan Rail - Exhibition on Wheels.

Vigyan Rail would carry exhibits / activities depicting India's achievements in various fields of Science and Technology, say, India's scientific heritage (National Council of Science Museums), environment (Ministry of Environment and Forests), space (ISRO), communication (Department of Communication), Information Technology (Department of Information Technology), scientific and industrial research (Council of Scientific and Industrial Research), ocean development (Department of Ocean Development), water resources (Ministry of Water Resources), defence (Defence Research and Development Organisation), agriculture (Indian Council of Agricultural Research), non-conventional energy sources (Ministry of Non-Conventional Energy Sources), health and medicine (Indian Council of Medical Research), atomic energy, (Department of Atomic Energy), meteorology (India Meteorological Department) and survey of India (Survey of India). Technology Development Board (TDB) and Technology Information, Forecasting and Assessment Council (TIFAC) are also expected to participate.

Indeed, the inspiration for the project came from the "Exhibition on Wheels" train of the Ministry of Railways celebrating 150 years of Railways in India which had a run of eight months from August 15, 2002 to April 15, 2003. This made the job easier since the train was already available! As in the case of the Exhibition on Wheels Train of the Railways, Vigyan Rail too would have twelve exhibition coaches and move throughout the length and breadth of the country for about eight months in different parts of India.

The Vigyan Rail – Exhibition on Wheels is likely to be flagged off in December 2003. The train will move in different parts of India having 51 stops of 2-5 days at important cities / locations in different States / Union Territories depending on the population and geographical size. No doubt, emphasis will be on motivating the people through exhibits, working models and slide / multimedia shows. There will be experts / volunteers to explain to visitors the exhibits in the local language. The experts / volunteers would be chosen and trained from the local areas as far as possible. To motivate the people and to generate an interest in science among them, different science popularization programmes are also expected to be organized.

We intend to publish a full fledged article on Vigyan Rail in *Dream 2047* which would include information on exhibits, itinerary, and other important details. We also intend to bring out a booklet describing the various exhibits in each coach for wider dissemination. True, there are limitations while chalking out of the route and itinerary – the train would run on the broad gauge track, halt at only limited stations and only for a limited period. But, we do hope you would make it a point to visit the Vigyan Rail when it halts at a place closest to your town / village – and take as many as you can with you. Vigyan Rail may prove to be a landmark in the history of Science and Technology Communication in the country – probably in the world!

❒ V. B. Kamble

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Robert Hooke

The Greatest Experimental Scientist of the Seventeenth Century

❑ Subodh Mahanti

One science only will one genius fit;
So vast is art, so narrow human wit.

Alexander Pope while writing about the specialized science Newton was creating.

Together Malpighi, Grew, Swammerdan. Hooke and the estimable Leeuwenhoek brought not only an added dimension to the investigations into the life sciences, but a new and unbiased approach to those investigations. While none could be said to be without a philosophy, for the most part each peered into his microscope to discover and record what he saw there rather than to prove or disprove some ancient or new theory.

Ray Spangenburgh and Diane K. Moser in The History of Science: From the Ancient Greeks to the Scientific Revolution. Universities Press (India) Limited, 1999.

Hooke had no rival as a deviser of instruments; the microscope, telescope and barometer were all much improved by him and his other inventions included a revolving drum recorder for pressure and temperature, and a universal joint. His contribution to science is unusual; he did much, but his devices and ideas were largely developed by others.

The Cambridge Dictionary of Scientists (2nd edition). Cambridge University Press, 2002.

One of the most brilliant and versatile scientists of his day, he (Hooke) was also an argumentative individual who became involved in a number of controversies, including several priority disputes with Isaac Newton. He anticipated the development of the steam engine….He also anticipated Newton's law of the inverse square in gravitation (1678), constructed the first Gregorian or reflecting telescope…"

Chamber Biographical Dictionary (Centenary Edition), Chambers Harrap Publishers Ltd. 1997

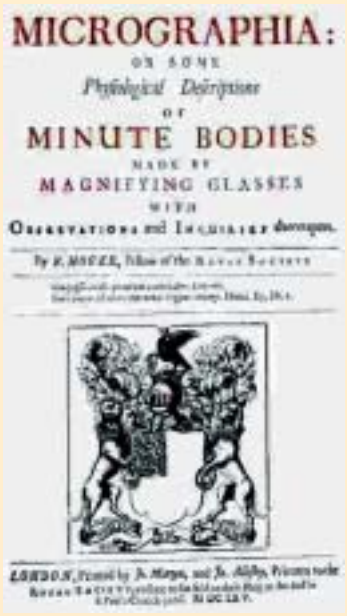
Robert Hooke was one of the greatest inventors of the seventeenth century. Hooke's interests knew no bounds. He made important contributions in many areas namely astronomy, optics, mechanics, geography, geology, architecture, materials, clock-making, naval technology, chemistry, microbiology and palaeontology. He correctly formulated the theory of elasticity. His mechanical skill was unparalleled. He was unsurpassed in the seventeenth century as an inventor and designer of scientific instruments. It was Hooke, who first introduced the use of balance spring for the regulation of watches. He also made improvements in pendulum clocks and invented a machine for cutting the teeth of watch wheels. He greatly improved the microscope, telescope and the barometer. He invented a revolving drum recorder for pressure and temperature and a universal joint. His other inventions included an odometer, an 'otocousticon' as an aid to hearing, a reflecting quadrant, a land carriage, a diving bell and a method of telegraphy. He ascertained the number of vibrations corresponding to musical notes. He anticipated the method for showing nodal lines in vibrating surfaces, the motion of the Sun among stars, correct notions as to the nature of fossils and the succession of living things on Earth. He published his extraordinary book *Micrographia* in 1665, which proved to be a major milestone in the history of science. Hooke was the first meteorologist to keep records. He was also first to use freezing water as zero. Hooke was first to suggest that in general all matter expands on heating and that the air is made up of particles separated from each other by relatively large distances. He left many of his devices and ideas to be developed by others.

Hooke Memorial window, St Helen's Bishopsgate, London.

Hooke was one of the founders of the Royal Society of London. Hooke's contribution in making the Royal Society a professional body from a 'club of virtuosi' is quite significant. A vituoso, the plural of which is virtuosi, refers to a learned person with broad interest in arts and science. It was Hooke, who worded the Royal Society's credo, "To improve the knowledge of natural things, and all useful Arts, Manufactures, Mechanic practices, Engines and Inventions by Experiments (not meddling with divinity, Metaphysics, Morals, Politics, Grammar, Rhetoric or Logic)". Hooke worked with Robert Boyle (1627-91) as his paid assistant. He also collaborated with scientists as diverse as Christian Huygens (1629-95), Anton van Leeuwenhoek (1632-1723), Chrisotpher Wren (1632-1723) and Isaac Newton (1642-1727).

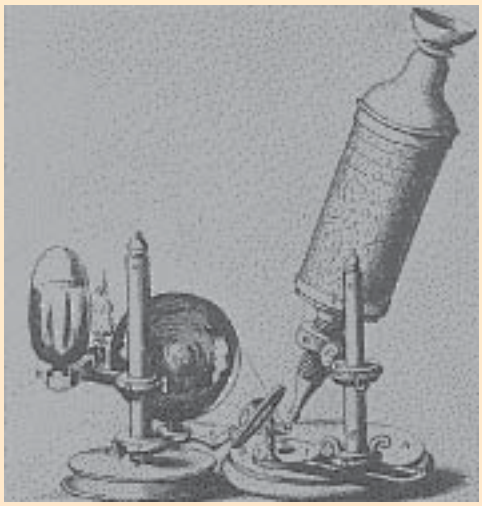
Hooke's reputation suffered from his many controversies with other scientists over question of priority. The most prominent among those with whom Hooke quarreled was Isaac Newton. There is no doubt that Newton's genius far outshined Hooke's. But Hooke's achievements were also quite impressive. However, unfortunately if today Hooke is known it is because of Hooke's Law of Elasticity and for his quarrels with Newton and not because of his varied contributions, which greatly helped to shape the seventeenth century science. No portrait of Hooke is in existence. Even the location of his grave is not known today.

Hooke was born in the little town of Freshwater in the Isle of Wight on July 18, 1635. His father John Hooke was a clergyman at All Saint's Curch. The church stands at the end of what is now Hooke Road. In his childhood Hooke suffered a lot, both physically and emotionally. One was not very sure about his survival during his first 7 years. He suffered headaches, insomnia, indigestion and several other ailments. He could hardly eat anything except milk. As a child he was inflicted by smallpox. Though he survived but he was scarred physically and emotionally for life. Since his childhood, Hooke displayed considerable skill in mechanical things. As a child he not only made a model warship (3 feet long) with rigging and guns that could be fired but also sailed it on the broad stretch of water, the river Yar. He made a working clock out of wood and sundial. He had copied the local painter's work.


MICROGRAPHIA:
ON SOME
Physiological Descriptions
OF
MINUTE BODIES
MADE BY
MAGNIFYING GLASSES
WITH
Observations and Inquiries thereupon.

The title page of Micrographia

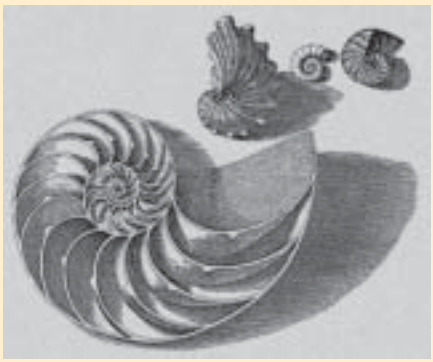
When Hooke was thirteen, his father hanged himself. Hooke received 100 pound inheritance from his father. After the death of his father, Hooke went to London as an apprentice to the painter Sir Peter Lely. It is with Lely, Hooke developed his artistic skill. However, Hooke did not remain long with Sir Lely as he could not withstand the fumes of the pigments. Hooke entered the Westminister School of Richard Busby. Students dreaded Busby, who had the reputation for "flogging sense into them". Busby recognized Hooke's genius and he finally took young Hooke into his own home. Hooke's intelligence combined with his unusual mechanical skill brought him to the notice of Busby. Hooke was on good terms with Busby throughout his life. It has been reported that Hooke mastered the first six books of Euclid's *Elements* in his first week at the Westminister School. He also learnt to play the organ and to speak Latin, Greek and a bit of Hebrew. Hooke left Westminister in 1653 and moved to the Oxford, where he acquired a place as chorister at the Christ Church. As chorister Hooke received a modest endowment. In Oxford, Hooke came in contact with some of the best scientists in England and some of whom would go on to establish the Royal Society of London. They were impressed by Hooke's skill at designing experiments and building equipment and they encouraged him in many scientific endeavours. At Oxford he studied astronomy with Set Ward and he assisted Thomas Willis (1621-75), the English anatomist, who made important studies of anatomy of the brain. Willis recommended Hooke to Robert Boyle, who appointed him as his paid assistant. Hooke assisted Boyle in constructing the air pump. While working as Boyle's assistant, Hooke performed experiments in which he immobilized a dog's lungs but kept the dog alive by blowing air into them. These experiments were the first demonstrations of artificial respiration. By conducting experiments with an air pump, Hooke demonstrated that it was the air in the blood and not the actual movements of the lungs, which kept an animal alive.



The compound microscope and illumination system devised by Hooke

On November 12, 1662 Hooke was appointed Curator of Experiments at the Royal Society. He was the first person to hold this post. The post, which was initially temporary, was made permanent in 1665 at a salary of 30 pounds per annum with apartments in Gresham College, Bishopsgate St. He lived there for the remainder of his life. As a Curator of Experiments, Hooke was to report or demonstrate three to four major experiments in every weekly meeting of the Royal Society. It was a highly challenging task. Hooke performed this task excellently for thirty-one years. He was also nominated Professor of Geometry, Gresham College. On October 25, 1677, Hooke became Secretary to the Royal Society, a post he held till 1682.

Today there is no way of knowing of how Hooke looked like as no portrait of his or likeness exists. He is often described as an ugly–looking person. Here we quote two persons closely associated with Hooke—his co-worker-cum-biographer and a close friend. Richard Walker who published a biography of Hooke in 1705 wrote: "…in person but despicable, being crooked and low of stature, and as he grew older more and more deformed. He was always very pale and lean, and latterly nothing but skin and bone, with a meager aspect, his eyes gray and full, with a sharp ingenious look whilst younger. He wore his own hair of dark brown colour, very long, and hanging neglected over his face uncut and lank, which about three years before his death he cut off and wore a periwig. He went stooping and very fast, having but a light body to carry, and a great deal of spirits and activity, especially in his youth. He was of an active, restless, indefatigable genius, even almost to the last, and always slept little to his death, oftenest continuing his studies all night, and



(a)

(b)

(c)

Illustrations given in Micrographia (a-c)

taking a short nap in the day. His temper was melancholy, mistrustful, and jealous, which more increased upon him with years."

His close friend John Aubrey wrote: "…of middling stature, something crooked, pale faced, and his face but little below, but his head is large; his eye full and popping, and not quick; a gray eye. He has a delicate head of haire browne, and of an excellent moist curle."

In 1670 Hooke discovered his law of elasticity. It states that the stretching of a solid body is proportional to the force applied to it. Hooke's law of elasticity laid the foundation for studies for stress and strain and for understanding of elastic materials. He made use of these studies in his designs for the balance springs of watches.

Hooke was a keen observer of fossils. He was the first person to observe fossils under a microscope. He observed close similarities between the structures of petrified wood and fossil shells on the one hand, and living wood and living mollusk shells on the other. The fossils were known and discussed since the time of Aristotle. It was generally believed that fossils were formed and grew within the Earth. The stones (fossils) that looked like living beings were actually not the remains of living beings but were created by a shaping force, or "extraordinary Plastick virtue". During the Renaissance (the great revival of art, literature, and learning in Europe in the 14th, 15th, and 16th centuries based on classical sources) scholars such as Konrad Gesner collected and displayed fossils in museums and cabinets. However, the scientists had no idea regarding the nature and origin of fossils till the late 17th century. Even in the seventeenth century, a number of hypotheses had been proposed for the origin of fossils. Hooke's studies on fossil made him realize that fossils are not "sports of nature" but they are remains of once-living organisms. Other naturalists like Bernard Pallisy (1510-90) and Nicolaus Steno (1638-86) that fossils were petrified animal and plant remains that had been infiltrated into solid rocks by floods. The theory proposed by Hooke for explaining the origin and nature of fossils was later proved to be correct. However, when Hooke proposed his theory of fossils, time was not ripe for its acceptance. A section of naturalists were particularly disturbed by the existence of fossils of species no longer seen. They argued that God the Creator being perfect would not allow a species created by Him to perish. This group tried to explain the existence of fossils in many ways. Some of these explanations were:

i) Like crystals, fossils are also the direct products of nature. They form in their own right and are not remains of other species.

ii) They may be seen as Plato's ideal forms—free floating and they simply got embedded themselves into rocks.

iii) Fossils were seen as tests of God. They were placed in rocks by God to test the faith of humankind with their riddle.

Air pump built by Robert Boyle and Robert Hooke for creating a vacuum (Bancroft Library, University of California, Berkeley)

Hooke had anticipated, 250 years before Charles Darwin, that the fossil record documents changes among the organisms on the Earth. He had realized that species have both appeared and gone extinct throughout the history of life on the Earth.

Hooke's *Micrographia ("Tiny Drawings)* was published in 1665. The book covered a variety of fields. It was a book with elaborate drawings of various things viewed by Hooke with a compound microscope and illumination system (a device that concentrated light on the viewing area of his double lensed microscopes), which he himself devised. Hooke observed organisms as diverse as insects, sponges, bryozoans (minute water animals that form

branching, mosslike colonies and reproduce by budding), foraminifera (marine protozoans with calcareous shells full of tiny holes through which slender filaments project), and bird feathers. *Micrographia* was an accurate and detailed record of his observations. Most of the 57 illustrations contained in the book were drawn by Hooke himself and some might have been done by the famed Christopher Wren. The illustrations were so exacting that one could see the eye of a fly, the shape of the stinging organ of a bee, the anatomies of flea and louse, the structure of feathers and the form of molds. In *Micrographia*, Hooke described his wave theory of light. He compared the spreading of light vibrations to that of waves in water. *Micrographia* also included a series of observations of lunar craters and Hooke's speculations as to the origin of these features. Hooke thought moon craters were caused either by collisions or boiling mud. Crystallography had its birth in this book. The book contained illustrations of the crystal structure of snowflakes. He discussed the possibility of manufacturing artificial fibres by a process similar to the spinning of the silkworm. In *Micrographia*, Hooke coined the word cell to describe the features of plant tissues he was able to discover under the microscope. He called them "cells" because they resembled the mosaic cells that monks lived in at the time. Hooke had no definite idea about the function of the cells found in plant tissues. He thought that like arteries and veins in animal body the cells might serve as channels to carry fluids through the plant material. The *Micrographia* also contained Hooke's theory of fossils.

Isaac Newton

The book was a best-seller of its day. It has been reported that one government official named Samuel Pepys stayed up till 2:00 AM one night to read *Micrographia*, of which he said, "the most ingenious book that I ever read in my life." As it normally happens all did not like the book. Some even ridiculed. One satirist of those dayd poked fun at Hook as "a Sot (a fool), that has spent 2000 pounds in Microscopes, to find out the nature of Eels in Vinegar, Mites in Cheese, and the Blue of Plums which he has subtly found out to be living creature." A condensed version of *Micrographia* was published in 1745. It was titled *Micrographia Restaurata.* It had shorter explanation but it contained all the figures, which were reproduced from Hooke's original plates.

Robert Boyle

Hooke spent a great deal of time in understanding the mysteries of the universe. It was Hooke, who first reported the Great Red Spot of Jupiter and he also established the rotation of this giant planet. In 1664 Hooke discovered the fifth star in the Trapezium, an asterism in the constellation Orion. Hooke's detailed drawings of Mars (1666) enabled its period of rotation to be found more than 200 years later. Hooke made the earliest attempt (July-October 1669) at measuring the parallax of a fixed star. Hooke's results led to Bradley's discovery of stellar aberration. In 1674 Hooke published 'An Attempt to Prove the Motion of the Earth by Observations.' This was the first recorded observation of a star in daylight. Around 1666, Hooke published a book entitled *Cometa*. It contained Hooke's close observations of the comets of 1664 and 1665 and also data of other astronomers. It also included a statement of the Law of Inverse Squares and the effect of Sun on comet tails. A great deal of interest was sparked in Newton by this book. He mentioned about this book in his notes and also in his correspondences. Hooke noted one of the earliest examples of a double star. He made pioneering contribution to designing of astronomical instruments. He built the first reflecting telescope. He was first to insist on the importance of resolving power and the advantage of using hair lines in place of silk or metal wire. In 1666 Hooke suggested that the force of gravity could be measured by utilizing the motion of a pendulum and he also attempted to demonstrate that the Earth and the Moon follow an elliptical path around the Sun. In 1672 Hooke discovered the phenomenon of diffraction and he proposed the wave theory of light to esplain this phenomenon. In 1678 Hooke anticipated the inverse square law to describe planetary motions.

Hooke was an important architect of his times. After the Great Fire which destroyed the City of London, Hooke had exhibited a model for rebuilding the City. Hooke's model was not adopted. However, the City authorities appointed Hooke a City Surveyor together with Edward Jerman and Peter Mills and also (appointed by the King) Wren, Hugh May and Roger Pratt. Hooke and Wren jointly were responsible for The Monument to the Great Fire. Hooke was not given due credit for his architectural works.

Hooke designed the Bethelhem Hospital, Montague House and the Royal College of Physicians. All these structures were demolished in the 19th century. He also designed the Ragley Hall (Warwickshire) and Willen Church in Buckinghamshire.

No account of Hooke's life can be complete without mentioning his much discussed confrontations with Newton. The first confrontation between Newton and Hooke took place in 1672 when the former was presenting his paper on his demonstration of white light being a composite of other colours. Newton thought very high of his demonstration. He referred to it as "the oddest if not the most considerable detection we hath hitherto been made in the operations of Nature." But Hooke

felt it otherwise. Hooke had his own theory of light and he had written about it in his *Micrographia*. He claimed that more details were necessary to prove Newton's claim. Hooke was not alone in challenging Newton's claim. Christian Huygens, Ignace Pardies and the Jesuits of Liege joined Hooke. Particularly Hooke and Huygens rejected Newton's claim that his theory was simply derived with certainty from experiments. Newton was furious with Hooke. Since his childhood Newton was extremely vulnerable to criticism. Throughout his life Newton challenged authority. He even decided to give up the Fellowship of the Royal society. However, after a lot of persuation by Henry Oldenburg, the then Secretary of the Royal Society, Newton changed his mind. Oldenburg not only offered an apology for the behaviour of an "unnamed member' but also agreed to wave Newton's dues to the Society. Newton scored a victory over Hooke. The next major confrontation between Hooke and Newton that publicly erupted in 1684 had something to do with the publication of Newton's *Principia*. Hooke claimed priority in the formulation of the inverse square law of gravitation. Contrary to Hooke's claim Newton thought that Hooke had nothing to do with it. Many science historians have accepted Newton's claim. However, Hooke's claim was not totally unfounded. Hooke had indeed anticipated the law of square inverse. At the suggestion of Hooke, Newton agreed to exchange correspondence to sort out the problem. Several letters exchanged between Hooke and Newton on the subject. But when Hooke made their correspondence public Newton refused to correspond any further. Hooke in one of his letters to Newton, talked about the theory of gravity but he had no answer from Newton acknowledging Hooke's theory. On not getting any response from Newton, Hooke appealed to Halley saying that Newton had taken the entire credit for the theory of gravity inspite of the fact that it was Hooke who had given the idea to Newton. Halley was in a fix. It was Halley who had persuaded Newton to publish *Principia* and he himself was paying for its publication. So Halley was worried that Newton may change his mind and stop its publication.

Christpher Wren

Edmond Halley

Halley wrote to Newton : "He (Hooke) says you had the notion from him... how much of this is so you know best , as likewise what you have to do in this matter, only Mr. Hooke seems to expect you should make some mention of him in the preface, which, it is possible, you may see reason to prefix." Newton simply refused to accept any claim of Hooke. Halley wrote a second letter to Newton in which he pointed out that Hooke was not trying to lay claim to the entire theory. He also pointed out that Hooke had not made a formal complaint of the matter. But Newton did not change his mind. He refused to share his credit with anyone and most certainly not with Hooke. He even refused to write the third book of *Principia*. Halley had no option other than to go along with Newton. He had already invested much of his own resources in the publication of the first two books. The *Principia* was formally presented to the Royal Society in 1687. Again Newton scored a victory over Hooke. The book had no mention of Hooke. Newton's aversion to Hooke did not end by not giving credit to Hooke for the theory of gravity. During his Presidentship of the Royal Society Newton had severed all ties that bound the Society to Hooke. Hooke's portrait, the only one known to exist in the Royal Society, disappeared. Most of Hooke's instruments, papers and scientific contrivances, which Hooke had fashioned with his own hands also disappeared. This has deprived the posterity to know all the contributions to the advancement of science Hooke really made. Newton's antipathy towards Hooke was so great that even 20 years after Hooke's death, Newton could not speak of Hooke without loosing his calmness. Before he died, Hooke wanted to give his life savings (Hooke spent very little of his money and kept it locked in an iron chest) to the Royal Society for constructing new quarters, meeting rooms and a library. Though he did not make any will for this purpose but e had expressed his desire to Richard Walker. Based on Walker's testimony the Royal Society could have claimed the money but Newton decided to the contrary.

Anton van Leeuwenhoek

Hooke had certainly negative traits in him. But he certainly deserved a better treatment in the hands of Newton. As Kathy A. Miles has written: "Robert Hooke

Marcello Malphighi (1628-94)

Nehemiah Grew

Jan Swammerdam

may have had his faults, and he may have been too quick to make assertions, but he most certainly does not deserve his fate or lack of his recognition. Newton's action in severing all ties between Hooke and the (Royal) Society did nothing to further the knowledge of science and its development and denied the rest of us of the opportunity to know all the contributions to the advancement of science Hooke really made. Newton once said: "if I have seen further, it is by standing on the shoulders of giants". There can be little doubt that one of these giants was Robert Hooke. It seems that it would apparently be more appropriate to consider Hooke as the sower of many of the seeds in Newton's garden."

Hooke died on March 3, 1703, at Gresham College having been blind and bedridden the last year of his life. He was buried at St Helen's Bishopsgate. His remains were exhumed and reburied somewhere in North London sometime in the 19th century ans so his final burial place is unknown. The Hooke Memorial Window was destroyed in the Bishopsgate bombing in the 1980s. There is a small museum devoted to Hooke at his Father's church in Freshwater.

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Letters to the Editor

I read the article about "DNA" and "Double Helix of DNA" in Dream 2047. The article was full of information.

Mir Syed Mohsin Andrabi, R/o Midroo, P/o Midroo (TRA), Jammu & Kashmir

Every issue of Dream 2047 is an encyclopedia in itself giving the most useful and pinpoint information in the field of science. The well researched and superbly presented articles help readers to gain insight into the various dimensions of a subject. The editorial itself is very inspiring and thought provoking. The need of today is to impart and inculcate basic scientific thought among the people of India

Rajesh R., Ampady House, Kappil mekku, Krishnapuram P.O. Kayamkulam, Kerala-690533

This newsletter is an ocean of scientific and technological knowledge and is very beneficial for readers interested in science, particularly students. It will help to create scientific temper and curiosity among the young people. The article "Fizz and the Pesticides" was worth reading. In fact whole matter was very interesting.

Balwinder Singh, Govt. Polytechnic, Guru Teg Bahadur Garh, Dist. Moga (PB)

Although I have been reading this very magazine for last six months just having gone through page by page. I reached to the conclusion that your contribution in all area of this magazine is a matter of proud.

Swapnal Sonal, South of University, Ward No. 1, Nadhepura, Bihar-852113

DREAM 2047 issue of August 2003, a rich article on D.S. Kothari. This magazine has been a good source of inspiration for science education to myself and my friends.

K.M. Madhusudan, II T.C.H., DIET. Vasanthmahal, Mysore, Karnataka-570010

National Seminar on Science Popularization : A Report

A two day National Seminar on science popularization was held during September 18-19, 2003 at India International Centre organized by VP. Thirty six participants participated in the seminar.

Dr. V.B. Kamble, Director, Vigyan Prasar could not attend the seminar because of sudden demise of his mother. In his absence Dr. S. Mahanti, Scientist 'F',VP, welcomed the participants and briefly described the objective of the seminar. Inaugurating the seminar, Prof. Yash Pal, Eminent Scientist and Science populariser, told that learning science should be joyful and should not be prescriptive in nature. He also stated that science popularisation may not be a good terminology to use – science is the way of life, it can't be popularised like a commodity. He pointed out how children construe imaginative questions from their interaction with nature. He observed that science is all about asking insightful questions.

Inaugural session : *(Lto R) Shri Krishna Lal, Dr. R.Parthasarathy, Shri Siddharth Kak, Dr. R.R. Kelkar, Prof. Yash Pal, Prof. J.S. Yadava & Dr. H.K. Devsare.*

Guest of Honour, Dr. R.R. Kelkar, Director General, India Meteorological Department (IMD) in his remarks explained the extensive use of science in everyday life. He also explained the difference between scientific research and understanding of science. We will be able to popularize science only if we can make it available in a form that is readable. It should be in a language that could be understood by anyone. Dr. Kelkar lamented over the disturbing trend of converting science into spicy news by presenting scientific results out of context, creating controversies out of nothing and accepting or rejecting scientific work on the basis of incomplete data or review. He also said that science can appear to be exciting but it is in fact hard work, and should not be downgraded to entertainment alone.

The seminar was divided into four sessions, namely; 'Science Coverage in Print Media', 'Science Coverage in Electronic and Folk Media', 'Popular Science Writing in Regional Languages', and ' Translation to and from Indian Languages and use of Technical Terms'.

(Lto R) Mr. Rintu Nath, Shri J.J. Rawal, Shri Pradeep Shrivastava, Mrs. Diksha Bisht, Dr. R. Parthasarthy, Mrs. Sudha Gowriker

The first session on Science Coverage in Print Media was chaired by Prof. J.S. Yadava, formerly Director, Indian Institute of Mass Communication and Member, Governing Body, Vigyan Prasar.

The first speaker in this session was Dr. R. Parthasarathy, Science & Technology Adviser, *The Hindu*. He discussed about the science coverage in *The Hindu*. He said that aim of science popularization is to prepare young minds so that enough curiosity can be generated.

Shri Kuldeep Sharma, Chief Editor (Hindi), Indian Council of Agricultural Research, a Children Science Writer emphasized that children are the future of nation. There is hardly any children's science magazine which may be considered to have good science material. Even if it is there, those are not written in interesting manner. Science articles written for children's science magazine also have limited topics like planets, how things work etc. He urged all science writers to contribute atleast one article per month to children's science magazine(s).

Shri C.R. Mishra, R&D Department, National Aluminiun Co. Ltd. (Bhubaneswar) discussed science popularization through magazines, daily newspapers, electronic & mass media with special emphasis on Orissa. He informed that Bigyan Diganta, the bi-monthly science magazine, published by Bigyan Prachar Samiti, is the oldest registered body for science popularization in Orissa. There is also significant contribution from other magazines (like Sahakar), Daily/ weekly newspapers, regional TV/Radio programmes. Activities of NGOs like Srujanika were also highlighted.

Dr. A. Biju Kumar, Chief Editor, *Science India* (a popular science magazine published from Thiruvananthapuram) mentioned that science magazine a has very special role to play for science popularization. This becomes more important when we see that science coverage in newspapers is very insignificant (3-5%). Some of the advantages of science magazines that he mentioned are: magazines can go for in-depth study on any topic and can be easily preserved for future use. However, he told that

most of the science magazines are struggling hard for existence. For increasing circulation, the publishers of these magazines go for juicy stories. If at all science magazines for students are merely exam oriented. Most of the magazines even do not have full time trained science reporters. Some of his suggestions were : orientation for scientists so that they can communicate science to common people, creating common platform to share views of science communicators and interpret abundance of data & formulate it systematically.

(Lto R) Mrs. Patnaik, Shri Nikhil Patnaik. Shri C.R. Mishra, Shri D.C. Goswami, Mrs. Kinkini Dasgupta, A. Bjukumar, Prof. Shyama Prasad

T V Jayan, Science Special correspondence, *Down to Earth* discussed about the problems commonly faced by science journalists. He said that there is no easy access to information regarding research done at the Indian scientific institution & research laboratories. He suggested common platform may be evolved so that information is available to all science journalists.

Smt Diksha Bisht, National Institute of Science Communication and Information Resources, discussed about popular science writing in Hindi magazines. She stated that there is sufficient demand for Hindi science writing. She gave examples of few popular women's magazines which cover a wide range of topics.

Shri Biman Basu, former Editor, Science Reporter, discussed about cost effectiveness of print media for science publication specially in regional languages. He emphasized more science coverage in regional languages and newspapers is desirable. He mentioned that Indian Science Writers Association may take lead to write on science in regional languages. It is also possible to pay good remuneration for the writers by syndicating Indian Science Writers Association.

Front row *(L to R) Dr. D. P. Singh, Shri Shyam Sushil, Dr. Amit Chakravarty, Shri V. Krishnamoorthy & Dr. T.V. Venkateshwaran*
Back row *(L to R) Tarun, J. K. Tripathi, Kapil Tripathi & V. K. Joshi*

Next session of the seminar was on Science Coverage in Electronic and Folk Media. This session was chaired by Dr. O.P. Kejariwal, Former Director General, All India Radio, and presently Director, Nehru Memorial Museam and Library at Teen Murti, New Delhi.

The first speaker in this session was Shri Siddharth Kak. He emphasized that science programme should be made for main stream viewers. Programme should be made in such a way that it is for empowerment of common masses. He mentioned the success of *Gyan Vigyan* in *Surabhi* serial. He also talked about the dedicated science channel to be launched by ISRO.

Dr. R. Sreedher, Director, Audio Visual Research Centre, Anna University, Chennai, briefly sketched the history of science popularization through electronic media with special emphasis on radio in India. He narrated the success stories of AIR programme like Manav ka Vikas, and agricultural programme. He also informed about low power radio communication which is known as community radio station.

Prof. Shyama Prasad, Expert in Folk Theatre, Guwahati explained how science may be popularized through performing arts. His special emphasis was on science plays in Assamese. He informed that apart from adult and children's groups, there is a women's group also that performs street plays to popularise science.

Prof. P.K. Bhattacharya, NCERT, discussed about technology component of S&T in school text books. He discussed about the role of ICT (Information and Communication Technology) in education.

Dr. Pradeep Srivastava of Central Drug Research Institute, Lucknow, explained a new method of science communication called science toons. He made an exciting presentation and science toons prepared by him.

Shri B.K. Tyagi, Scientist, NCSTC, explained how puppets can be used for science communication and narrated his experience in using puppets for science communication. He also narrated different Indian folk form for science communication.

Dr. Amit Chakarvorty, formerly with Prasar Bharati and presently follow, Vigyan Prasar, narrated how radio is being used for science communication both nationally and internationally and also explained how science programmes in TV emerged as genre.

In his remark as Chairman, Dr. O.P. Kejariwal, Director, Nehru Memorial Museum and Library, Teen Murti Bhawan, New Delhi, observed that one need not to be cynical that science programming will not have any audience. If programming is made appealing, people like it. He gave examples of some successful science programme during his tenture an Director General of All India Radio.

The second day of the seminar started with a session on *Popular Science Writing in Regional Languages*. The session was chaired by Prof. Shiv Gopal Mishra, Geenral Secretary, Vigyan parishad, Prayag.

The first speaker in the session was Shri. A.P Deshpande who spoke on Science popularisation activities in Marathi language through various media like radio, TV, docu-drama, theaters, newspapers and magazines. He gave an overview of science popularization in Marathi that started long before India attained its independence and progress made in post-independence period. Shri. Deshpande urged to have more science based progammes in prime time slots on TV.

(L to R) Mrs. Diksha Bishta, Dr. Shiv Gopal Mishra, Dr. R.D. Sharma, Shri Satyavrit, Shri Kamal Kant Budhkar

Dr. Nikhil Pattanayak of Srujanika, a voluntary organization based at Bhubneshwar, was the second speaker in the session who presented science activities in Oriya language. He began with the development of Oriya literature, printing of first science text book in 1830-31 and the children's encyclopedia in 1930s (Shishu Sankhali). Dr. Pattanayak raised some of the issues that are causing difficulties in this movement. Some of these were (a) Science Writers are isolated in the state (b) Distribution Network is weak (c) Science Writers have remained passive popularisers (d) There is a need for Glossaries integrating all the branches of science (e) library facilities to be made available to the science communicators as well as to the masses.

Mohd. Khalil, editor, "Science Ki Duniya", an Urdu Popular Science Magazine addressed the science popularisation issues through Urdu language. He said that it was Dr. Abdul Haque, who started a magazine called 'Science' in 1938, and also brought out a Science Dictionary in Urdu. Though there are plenty of newspapers in Urdu, yet there is not enough science coverage in Urdu. He said that unless language of science becomes a language of common man, the popularization of science can not take place.

The next speaker was Shri Devender Pal Singh from Punjab who gave an overview of the development of Science Popularisation activities in Punjabi Language.

The presentation of Dr. Dinesh Chandra Goswami, from RRL, Jorhat, gave a good and promising picture of science popularization work in Assamese. He gave an exhaustive coverage and statistical figures of the science popularisation activities that are going in the State in print as well as in electronic media.

Dr. Manoj Patairiya, Scientist "F", NCSTC, DST, began his discussion with the first magazine on science "Dig Darshan" that was printed in Sreerampore, West Bengal, in 1818, which was the most popularly read magazine across the country during that time. The magazine was available in Bengali, Hindi and English. Dig Darshan paved the path for subsequent printing of popular science books in Hindi and other Indian languages.

Dr. T. V. Venkateswaran discussed about Children's Science books in Tamil during the period 1800-1857. He said that the books published during this period were mainly on astronomy, catechisms (question and answer form), dialogues (narration form), dictionaries and upanayas (novels).

The science popularization through Gujarati language was discussed by Shri J.J. Rawal, from Mumbai from 1950 till date and various means and mods through which science is being made popular in Gujarati. He said that newspapers play a major role in popularizing science in Gujarati by carrying one or two science articles, news items and features.

Dr. Amit Chakravorty talked about science writings in Bengali which dates back to 1807 and how it progressed over the years.

The session ended with a presentation of Vigyan Prasar website www.vigyanprasar.com by Shri V. K. Krishnamoorty.

(L to R) Mrs. Sudha Gowarikar, Shri A.P. Deshpande (Marathi writerr) Dr. S. Mahanti & Shri Biman Basu

The last session of the seminar was on *Translation to and from Indian Languages and use of Technical Terms*. The session was chaired by Shri Biman Basu, former Editor, 'Science Reporter'.

Mrs. Sudha Gawarikar, Science Writer in Marathi, was the first speaker and discussed the importance of translation. She highlighted the various problems associated with translation due to the cultural and ethnic barriers. She said that translators might have faced difficulties even while translating general literature that originated in a distant culture and intended for a target group belonging to another culture. She emphasized the importance of 'standardisation' of the technical/scientific terms in various regional languages. "There are possibilities of standardization in the languages which originated from Sanskrit" – she said. She said that

ambiguity craps in due to the use of different terms to describe the same thing.

The next speaker was Dr. R.D. Sharma Shri Sharma spoke on the 'Essence of Good Translation'. While referring to the qualities of a good translator, Shri Sharma mentioned that a good science translator/communicator should have understanding of the subject, command over the language, ability to form idioms, ability to avoid confusion (that may arise due to inappropriate use of scientific terminology).

Validictory Session : (L to R) Dr. S. Mahanti, Shri Biman Basu, Prof. V.S. Ramamurthy, Secretary, DST, Dr. Om Vikas Dr. H.K. Devsare

Shri R.D. Rikhari, Editor, *Invention Intelligence*, delivered his lecture on the issues involved with science communication through news media. He said that the science communicators/science news writers should not try to mystify science. The impact of science may be left in different dimensions extending from philosophical/spiritual to materialist attainment. Though the scientific advancement of a society is manifested mainly through its 'material' gains, in a society like ours, the economic inequalities among the various sections of the society needs to be considered while preparing a news item on science.

Dr. Om Vikas, Scientist and Head, Computer Development Division, Ministry of Communication & Information Technology, spoke on the 'Challenges of Science Popularisation in Indian languages'. He gave an account of the Indian efforts towards formulation of S&T terminologies mentioning the various approaches like 'purist', 'anti purist' and 'retentive' (favourers of retention of English terminologies).

Prof. Shiv Gopal Misra, General Secretary, Vigyan Parishad Prayag, Alllahabad, spoke on the difficulties involved in translation from English to Hindi. He said that it is inappropriate to use 'terminologies' in popular science writings. Instead, the science communicators involved in '*lokapriya vigyan*' should emphasize on the use of '*upamaas*'.

In the valedictory session, Chairman, Prof. V. S. Ramamurthy, Secretary, DST, emphasized the need of science communication in all the Indian languages. According to him when understanding science is the goal, approach, grammar or language become secondary. He opined that there is a need to make available equivalent words in different Indian languages which convey the same meaning. The same may be made available on a website and science communicators may use that as resource while communicating science. He pointed out that sufficient resource material for science communicators is not available and observed that seminar of this kind is very useful where difficulties in creating scientific awareness may be discussed and possible solution worked out.

Report by: Subodh Mahanti, Rintu Nath, Kinkini Dasgupta, TV Venkateshwaran, Sandeep Baruah

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Noble Prize Year 2003

Physics:

Alexei A. Abrikosov
USA and Russia
Vitaly L.Ginzburg
Russia
Anthony J. Leggett
United Kingdom and USA
"For pioneering contributions to the theory of superconductors and superfluids"

Chemistry:

Peter Agre
USA
Roderick Mackinnon
United Kingdom
"For discoveries concerning channels in cell membranes"
"For the discovery of water channels"
"For structural and mechanistic studies of ion channels"

Physiology or Medicine:

Paul C. Lauterbur
USA

Sir Peter Mansfield
United Kingdom
"For their discoveries concerning magnetic resonance imaging"

Literature:

John Maxwell Coetzee
South Africa
"Who in innumerable guises portrays the surprising involvement of the outsider"

Peace :

Shirin Ebadi
Iran
"For her efforts for democracy and human rights"

The Bank of Sweden Prize in Economic Science in Memory of Alfred Nobel:

Robert F. Engle
USA
"for methods of analyzing economic time series with time-varying volatility (ARCH)"
Clive W. J. Granger
United Kingdom
"for methods of analyzing economic time series with common trends (cointegration)"

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An Interview with Dr. Harish Kumar Kaura

Harish Kumar Kaura is Head, Computer Division, Bhabha Atomic Research Centre, Mumbai. He has been involved in R & D in computer hardware and software at BARC. Shri Kaura is life member of Computer Society of India, Indian Physics Association, Indian Nuclear Society and Hindi Vighyan Parishad. He is also the founder member of Special Interest Group on Virtual Reality (SIGVR) and Fellow member of - The Institute of Electrical and Communication Engineers (IETE). He has published a number of papers in the fields of supercomputing, virtual reality, communication and image processing.

Dream 2047: Sir, can you tell our readers the major milestones of achievements in high speed computing by BARC?

H.K. Kaura: Our first ANUPAM parallel computer was developed in 1991 with 4 Intel 860 processors, using a Multi-bus as interconnection, with a sustained speed of 30 Million Floating Point Instructions Per Second (MFLOPS). Later on, 16, 32, and 64 processor of ANUPAM models, using same Intel 860 processors and interconnection technology, were built during the period 1992 - 1995. The 64 processor model had 32 i860 XR processors and 32 i860XP processors giving a sustained performance of 400 MFLOPS.

The next generation of ANUPAM was based on Alpha 21164 processor based servers, interconnected using an ATM switch. A 10 processor cluster performed at a speed of 1.5 GFLOPS (1000 MFLOPS). This was in 1997-1999.

Later on, ANUPAM systems were built using Intel processors. We had Pentium-II, Pentium-III and Pentium-IV based clusters interconnected using Fast and Gigabit Ethernet. Performance wise, the speeds ranged from 3, 15 to 45 GFLOPS. The latest version of ANUPAM is built using 128 Intel Xeon processors interconnected using a Scalable Coherent Interface network providing a total sustained performance of 202 GFLOPS. This is about 6000 times faster than the first model of ANUPAM built in 1991.

Dream 2047: Where we are placed in global arena in super computing with - ANUPAM-XEON/128 supercomputer - 202 Giga Floating Point Operations Per Second (GFLOPS)?

H.K. Kaura: The 500th supercomputer in the latest Top 500 list has a performance of 245 GFLOPS. ANUPAM-Xeon will be somewhere after 500.

Dream 2047: What about software supports to such systems - the operating system, languages and application software - they are developed/tuned within BARC?

H.K. Kaura: The operating system is Linux. Languages available are C, C++ and Fortran (77,90,95). Parallel applications in various fields of science and engineering are run on ANUPAM. Some applications are developed by BARC scientists themselves and some are standard commercially available or open source packages. ANUPAM supports standard parallel APIs like MPI and PVM apart from ANULIB, the parallel environment developed in BARC.

Dream 2047: When newer models are introduced how do you coup up with peripherals and software compatibilities?

H.K. Kaura: All ANUPAM models run some variant of UNIX (AT&T System V Release 4, Digital UNIX and now Linux). Peripherals are also standard ones, so there is no problem about incompatibilities.

Dream 2047: How do you find the open source Linux operating system that is used and other languages being used, your user group namely your scientists, are they comfortable with software development?

H.K. Kaura: Linux is a robust, complete OS with all advanced features you would expect to find in any modern OS. Plenty of tools and utilities needed for software development and scientific computing are available on the Linux platform. Users of BARC have been using some or the other variant of Unix for the last 15 years and hence they are quite comfortable with Linux.

Dream 2047: What about system reliability of Anupam-Xeon ?

H.K. Kaura: The reliability of Anupam-Xeon is very high. Since these supercomputers are used for processing very large, compute intensive scientific jobs requiring very long time for the execution, the system reliability has been the very important aspect of the design of the ANUPAM series of parallel computers, from the very beginning. These parallel computers are made of large numbers of interconnected components, for achieving very high reliability of operation industry standard, off-the-shelf components are used in the ANUPAM series of supercomputers.

Dream 2047: Do you have plans to export the technologies to other countries or it is only for internal use?

H.K. Kaura: These systems were primarily developed for in-house use of BARC. For exporting the technologies to other countries there will be need for a much elaborate infrastructure.

contd. on page...21

You are born with your password

❑ Kinkini Dasgupta Misra

With the advance of computing technology, networks of smart connected devices make it possible for us to do business, communicate, learn and be entertained using everything from full-featured PCs to smart, handheld devices. For computers to be taken for granted, they must always be available wherever and whenever people need them. They must reliably protect personal information from misuse and give people control over how their data is used, and they must be unfairingly secure. With the recent onslanght of hackers and virus attacks, security administrators are requiring more stringent security measurements. Frequent password changes that could create other problems. People forget passwords. It can be shared by dozen of users or stolen or discovered. And people trying to protect personal information with passwords know the ease with which a password can be stolen or discovered. Most people tend to use a limited number of passwords over and over, compromising all duplicates if one is discovered.

Therefore we need some accurate way of proving identity without using passwords for everything. One promising area where technology has made considerable progress is to identify people using their physiological or behaviourable characteristics. This technology popularly known as Biometrics. It is the automated methods of recognizing a person based on his/her physical attributes or features with the aim of being able to identify that person from others. There are number of attributes that can be used for finding out an individual's identify. These include fingerprint, an iris scan, facial appearance, signatures, hand geometry, the way a person walks and even a person's speech pattern.

In general, biometric technology follows the same principle of password technology; a user has a personal user profile stored on the system – when a user presents himself (signs on or log in) for authentications – the new scan is compared to be stored for a match, if the scan is matched, the access is granted. This is really no different from password technology. The different is not in the process, but the method and there are quite a number of biometric methods. Biometrics allows the replacement of PIN numbers and passwords, so that you do not have to remember all the passwords. It is more secure and convenient, the fear of forgetting or losing your password usually do not exist – you are born with your password.

Biometrics is the process of collecting, processing and storing details of a person's physical characteristics for the purpose of identification and authentication. It has widely been used for security and verification purposes as well as to fight crime. Throughout history, simple forms of biometrics have been used (such as face recognition), but now with the complexity and accuracy of computers there has been a flourish of new technologies that are ever more accurate and easy to put into operation.

The term "biometrics" is derived from the Greek word; bio means life and metric to measure. Biometrics is becoming an interesting topic now in regards to computers and network security, however the ideas of biometrics have been around for many years.

One of the first known cases of humans using biometrics to identify one another was by early Chinese merchants. Joao de Barros, an explorer and writer, wrote that the Chinese merchants used a form of biometrics by stamping children's palm prints and footprints on paper with ink. In doing this, the Chinese solved a way to distinguish young children from one another.

Though biometrics have been used throughout the history of the world, it never became a distinct field until an anthropologist named Alphonse Bertillion sought to fix the problem of identifying convicted criminals. The problem with identifying repeated offenders was that the criminals often gave different aliases each time they were arrested. This would prevent them from receiving the larger sentence for being a repeated offender. "Bertillion realized that even if names changed, even if a person cut his hair or put on weight, certain elements of the body remained fixed". This led him to form a method of measuring the distinguishable parts of a person's body, which never changed throughout their life such as the size of the skull or the length of their fingers. This system was called anthropometrical signalment and was very basic in its implementation. Whenever persons were arrested they were sent through a series of measurements that recorded the length and distinguishable marks of their bodies. These were all recorded on a card and filed away in groups with similar measurements. Whenever a new criminal was brought off of the streets, instead of taking down his/her name, the authorities would subject him/her to a series of measurements as maintained above and look for a matching card. This system was a huge breakthrough and was adopted by prisons and police stations

across the country and world, though it did have some drawbacks.

Anthropometrical signalment was found not to be a totally unique biometric. This was discovered when they found that some people shared the same measurements.

Eventually quicker and more accurate forms of biometrics, such as fingerprint analysis, were developed and which eventually led to the end of anthropometrical signalment. As technology gets more and more advanced, the ways to distinguish the different biometrical signalments become more and more precise. This has led to field of biometric technologies that we live in today.

Biometrics Technologies

With today's technologies becoming faster and more precise everyday, there is a need in the biometric field for new devices that are ever more accurate, cost effective, and simple in their implementation. Some of the major biometric technologies that are available today, and ones that may be available in the near future are, finger/thumb print, facial recognition, DNA identification, retina scan, vein pattern identification, ear shape identification and so on.

DNA Identification - DNA identification is becoming popular because it is perhaps the most precise system of identification known, and is widely accepted as absolutely accurate. This is good from the standpoint of identification purposes but could prove to be a major problem in the future. For instance, the one of the most popular methods of taking DNA is by taking blood samples. People must label and do the job of entering the sample into a database, but people may make mistakes. Hypothetically, your name could forever be associated with the blood of a criminal. When they commit a crime the DNA sample that is discovered at the crime scene will point to you.

Finger/Thumb Print -This is the most widely used biometric technology and is well known for its affiliation with law enforcement and the world of entertainment. This technology is very reliable and accurate, and has been backed up by many studies that verify that fingerprints are indeed unique. Fingerprints are fixed by birth and remained fixed for life. The marks truly are a unique signature: there is so much room for variation that no two people ever have shared, or ever will share, the same pattern. Fingerprints are not stored by picture but by measurements of the distances between the ridges and loops of the thumbprint.

Retina Scan - Retina scans have become very popular with corporations who use biometrics because of the accuracy and speed in which they can be implemented. Retina scans test the pattern of blood vessels lining the retina of the individual human eye. Another advantage of retina scans is that they are not revealed to the casual observer, and we do not leave behind traces of its detail as we might with fingerprints or DNA.

Face Recognition - Face recognition is a technology that tests the distinguishing marks and measures of an individual human face. This technology has become popular in recent years due to the increased speed of computers. Also, it can be implemented quickly and is one of the least physically intrusive biometrics.

Some Future Biometric Technologies-

Vein Pattern Identification - This technology is like a retinal scan in that it uses special light to produce an image of one's vein pattern in their face, wrist, or hand. An advantage to this technology is that veins are stable throughout one's life and cannot be tampered with.

Ear Shape Identification - In recent years, some have came to recognize that the ear is as unique as a fingerprint. This technology merely measures the geometry of one's ear.

Body Odor Identification - This system uses a sensor that takes your hand to identify your body odor. It then stores it in a digital database. This product is still in testing and when released may be too expensive for normal commercial use.

Body Salinity Identification - This technology exploits the natural level of salinity in the human body, which is accomplished by an electric field that passes a tiny electrical current through the body. As of now, an individual's salinity levels are believed to be unique, but biometric identification is not the only use that we may benefit from this emerging technology. The electrical current, which passes through the body, can also carry data. Transfer rates, equivalent to a 2400-baud modem have been claimed. This technology could include interaction between communication devices carried on the body such as watches or mobile phones .

The biometric encryption is a mathematical process that helps to disguise the information contained in messages that is either transmitted or stored in a database, and there are three main factors that determine the security of any crypto system; the complexity of the mathematical process or algorithm, the length of the encryption key used to disguise the message, and safe storage of the key, known as key management.

The complexity of the algorithm is important because it directly correlates to how easy the process is to reverse engineer. One would think that this is the area of encryption that is the easiest to break, however most crypto systems are extremely well constructed and these are the least of the three factors that are vulnerable to attack.

The length of the encryption key used to disguise the message is the next important piece of the encryption process. The shorter the encryption key length, the more vulnerable the data is for attack. In non-biometric encryption processes such as passwords or PIN numbers, depending on the length of the key, the information may be vulnerable to access by unauthorized users. For example, a key that is three characters long would be much more prone to attack than one that is ten characters long because the number of possible permutations that must be run to find the right key are much higher in the key that contains three characters. With current computer power, it is estimated that it would take four hundred years to find the right access combination for a sixty-four character key. Biometric encryption makes standard character encryption obsolete by replacing or supplementing the normal key characters with a personal identifier of the user that there can only be one perfect match for. Without this biometric key the information is inaccessible.

Safe storage of the key is the most vulnerable area in the encryption process. What would seem to be the easiest to manage becomes the most difficult because passwords or

PINs can be lost or stolen. Good encryption keys are much too long for normal individuals to remember easily so they are usually stored on paper, smart cards, or diskette which makes them accessible to non-authorized users. Biometric encryption systems allow the user to transport the access key around without the need to make it vulnerable to be lost or stolen.

There are two broad categories of encryption systems; single key (symmetric) systems and two key (public) systems. Symmetric systems utilize a single key for both the sender and receiver for the purpose of coding and decoding data. Electronic commerce requires that transactions be conducted over open networks instead of dedicated networks and single key systems do not offer a high enough level of security for such transmissions. This issue of security is why public key systems have been developed. Two-key systems use a public key to encrypt the data and a private key to decrypt the data. The public key systems allows better encryption than single key systems, however certification of the recipient of messages becomes an issue, which causes a hierarchy of certification to be developed resulting in a much slower processing time. Biometrics can aid in this process due to the inherent nature of using a physical trait of the desired recipient to decipher the message. It is this issue that has caused biometric encryption techniques to be valued for electronic commerce.

Biometrics is a technology that will either greatly benefit or burden us in the near future. With a boost in security and surveillance in the past few years, the only step can take is to implement biometrics into our everyday lives. Instead of paying cash after shopping, you could simply have a retina scan, and the shop keeper will put it onto your account. There would be no reason to carry around wallets with credit cards and drivers license. Everything would be stored digitally on a nation wide network. Forget about remembering passwords and PIN numbers, your fingerprint will do. Not only could everything be much easier and streamlined in a world of biometric technologies, but also identity theft would be a thing of the past. Everyone would be totally accountable for their own actions, and their own actions alone. This could send crime rates to an all-time low. There appear to be countless benefits that biometrics can help us achieve.

Biometric-based authentication applications include workstation, network, and domain access, single sign-on, application logon, data protection, remote access to resources, electronic transactions, transaction security and Web security. Utilized alone or integrated with other technologies such as smart cards, encryption keys and digital signatures, biometrics are set to pervade nearly all aspects of the economy and our daily lives.

Biometrics have many hurdles to get by in order to become as present and common as they are in the world described above. Problems that face biometric growth is the fact that the cost of identification devices are, presently, much too high and "people are hesitant to trust giving a 'piece of themselves' to a machine". Another problem is that biometrics have always been used in the case of criminals, and when we start using these identification technologies on innocent civilians, it gives the innocent civilians a presumption of guilt. There would be perhaps reservations against implementing biometrics into our everyday lives is that people would have to enter the information into machines, and human beings make mistakes. In a world where your name would be tied to nothing but your biometric fingerprint, a mix-up could be disastrous and place false guilt on you. As in a world of extreme surveillance, may not allow us to breathe and be ourselves. We may go through the whole day knowing that the only place that we can truly live, is at home.

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Dream 2047: Are these system made commercially available to private/government customers like India meteorological Department, Hindusthan Aeronautics?

H.K. Kaura: We have ANUPAM systems installed in the National Centre for Medium Range Weather Forecasting, New Delhi, the Aeronautical Development Agency, Bangalore, Vikarm Sarabhai Space Centre, Thiruvanthapuram, Nuclear Power Corporation, Mumbai and many other institutions like IITs and other universities. The ANUPAM machine at NCMRWF was installed in 1999, as a replacement for the CRAY-XMP supercomputer used for weather forecasts.

Dream 2047: How do development costs compare with such system elsewhere in the World?

H.K. Kaura: Since the ANUPAM series of supercomputers are based on the parallel processing architecture and built using industry standard components, the development costs are significantly lower. However as compared to the development cost of conventional supercomputers like CRAY it is much, much lower because of the architecture of the system.

Dream 2047: Can we say now, that, in super computing we are not depending on western sources, I mean, we are self sufficient in our computing needs in Research & Development?

H.K. Kaura: Supercomputers of these high speeds are not available from abroad due to export restrictions on high performance systems by advanced countries. ANUPAM series of computers have been used for solving some the very large computational problems which otherwise could not have been solved. At present we have the technology for building supercomputer for meeting computational speed requirement of any specific application in the country. These parallel computers are built using large number of processors and other components which in turn come from western companies. But these processors and other components are commercially available in the market.

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Recent Developments in Science and Technology

INSAT-3E Launched successfully

ISRO's latest communication satellite, INSAT-3E, was successfully launched on September 28, 2003 by the Ariane-5 launch vehicle of Arianespace. INSAT-3E is the fourth satellite in the INSAT-3 series..

Ariane (Ariane-5), with ISRO's 2775 kg INSAT-3E, e-BIRD of EUTELSAT and SMART-1 of European Space Agency, lifted off at 4.44 am IST from Kourou, French Guyana. INSAT-3E was injected into a Geosynchronous Transfer Orbit (GTO), at 5.14 am. The satellite is at present orbiting the earth with an orbital period of about 10 hours 50 minutes.

The Master Control Facility (MCF) at Hassan in Karnataka acquired the first signals from INSAT-3E at 05.14 am IST. The initial health checks on the satellite indicate that the satellite's performance is normal.

In the coming days, INSAT-3E will be raised to its final geostationary orbit, which is about 36,000 km above the equator, by firing its 440 Newton Liquid Apogee Motor (LAM). When the satellite reaches near geosynchronous orbit, deployment of its solar panels and the two antennas will be carried out and the satellite put in its final 3-axis stabilised mode

Source : *www.isro.org*

Bacterial Battery Converts Sugar into Electricity

A tiny bacterium recovered from sediment may power batteries of the future. According to report published in *Nature Biotechnology,* researchers describe a primitive microbial fuel cell that can convert simple sugars into electricity with 81 percent efficiency. Unlike previous attempts to manufacture such batteries, the novel design does not require unstable intermediaries to shuttle electrons and thus holds promise for producing energy from sugar-containing waste materials. Swades K. Chaudhuri and Derek R. Lovley of the University of Massachusetts used *Rhodoferax ferrireducens,* a bacterium first isolated from sediments collected from an aquifer in Virginia, for their bacterial battery. When the researchers exposed *R. ferrireducens* to a solution of glucose in a chamber containing a graphite electrode they found that when the bacterium fed on the sugar, it transferred electrons directly to the electrode, producing a current. In addition, the sugar-fed *R. ferrireducens* continued to grow, resulting in stable, long-term power production. The scientists also tested the bacterium's ability to convert other sugars, including fructose, sucrose and xylose (present in wood and straw), and found it to be equally efficient.

The new findings should help scientists harness the abundant energy currently stored in waste from agricultural, municipal and industrial sources.

Source : *Scientific American Sept 2003*

Charge Cell Phones in two wheelers

A former Navy man and an ""amateur scientist" here has claimed a device invented by him could be helpful to mobile phone users who primarily travel by two wheelers, because they need not worry about charging their cellular communication device.

Hitherto, if a mobile phone owner wanted the instrument's batteries to be charged, then a facility was available in a car, but A.N. Manoharan has claimed that with the device invented by him charging the mobile phone in two-wheelers would also be possible.

He made the claim recently at a "Made in Madurai" exhibition, while interacting with newsmen. Manoharan, who was incharge of repairing communication equipment in Navy, said he had applied for a patent. He claimed that he was now training members of a self help group at Sedapatti in the district for manufacturing the charger, which could cost as less as Rs. 60 a piece. He said the device could easily be plugged into dynamo or alternator devices in all two wheelers and it took the same time as charging on electric mains

Source : *PTI News, August 2003*

Helmet that communicates

STMicroelectronics STLC2410 Bluetooth chipset has been chosen by LensLogica USA for an innovative motorcycle helmet that allow hand-free wireless call with any Bluetooth-enabled mobile phone and easy communication with a helmet that is within the Bluetooth transmission range of a few meters, enhancing safety and comfort.

A conversion between two helmet can be automatically interrupted to answer an incoming call and then resumed at the end. In addition the superior noise immunity of the chip allow the halmet to reject interfering radio signal, improving audio quality.

The helmet has dedicated user friendly interface to offer comfortable access to intercom and GSM functions.

Source : *Scientific American Aug Sept 2003*

Compiled by : Kapil Tripathi

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