

## Monthly Newsletter of Vigyan Prasar



## DREAM 2047

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## VP News

## Inside

## Popular Science Lecture



Prof. Naresh Gupta delivering his lecture

A popular science lecture on **Anaemia – Causes, Effects and Remedies** was organized by Vigyan Prasar on 14 July 2003 at Technology Bhawan, Department of Science & Technology (DST), New Delhi. The lecture was delivered by Prof. Naresh Gupta, Professor of Medicine, Lady Hardinge Medical College and Head, Department of Medicine in Ram Manohar Lohia Hospital,

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## VIPNET Activities in Orissa

Vigyan Prasar (VP) organized a two day VIPNET workshop at Dhenkanal (Orissa). The workshop organised at the Dhenkanal Science Centre (DSC) was attended by over a hundred participants from 5 districts of Orissa. The local host were SUPRATIVA, an NGO from Cuttack. The programme took place on 7 & 8 June 2003.

The workshop was inaugurated by Shri K.P. Singh Deo (Member of Parliament) with the traditional lighting of the lamp. The function was presided by Shri Mohanty, DC of Dhenkanal. Other dignitaries present were Dr. Prem Singh, Director, Indian Institute of Mass Communication (Dhenkanal). Dr. Sasmal, Sr. Scientist, CRRRI and Ms. Archana Khosla, Curator, DSC. Shri Harvinder Singh Shergill Fellow, VP, represented Vigyan Prasar. In his inaugural speech, Shri K. P. Singh Deo emphasized the need to bring about a scientific orientation amongst the people. He felt Vigyan Prasar Network of Science Clubs (VIPNET) was a good medium to do so.

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Shri K.P. Singh Deo, Member of Parliament interacting with the participants at the workshop

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

## A Jheel and a Lagoon

I recently read two inspiring success stories in the *Survey of the Environment 2003*. Not long ago, in Jadavpur, Kolkata, there was once a rubbish-infested, choked dump. Only a few decades ago, it had been a sprawling jheel (natural water body bigger than a pond) with some 9,000 square metres of area, and was the hub of community activity. It had transformed into the dumping ground of the locality. Hyacinths choked the banks. Mosquitoes and the stench of garbage dumped made life miserable for the people living in the area. This stirred the conscience of a group of middle aged men who were born on the Jheel Road. Incidentally, the road got its name from the several jheels which were once upon a time closely intertwined with the life of the people in that area. They were gradually filled up and multi-storied structures came up on the 'reclaimed' land.

The group of these men took up the challenge, and thus began a saga in March 1999 to rejuvenate the dying jheel. Soon the Jheel Road Sangrakhyan Committee was formed with the local councillor as its president. The mobilization began in full steam and contributions from the office-goers and the residents began filling their kitty. Their priority was to remove the hyacinths asphyxiating the jheel and to pump out the polluted water. As the word spread, more and more locals and the environmental enthusiasts volunteered. Now there was a growing hill of water hyacinth on the jheel road that required 200 truckloads to clear the muck! The question was to raise the huge funds, labour and a fleet of trucks for the purpose. But, help came in from numerous quarters in terms of funds, manpower and the technical expertise. The committee successfully roped in eminent individuals, engineers, and people of all shades of political parties. Today, the clear waters of the jheel surrounded by the beautiful trees are a source of pride and inspiration for the local people. What is more, the members are aware that now they have to maintain and protect the jheel, and pay adequate attention to fish cultivation, aquatic life, immersion of idols and so on. Indeed, this is a saga of a group of people concerned about the need to conserve their immediate environment.

Here is yet another saga. The Chilika lagoon is situated along the East Coast of India in Orissa. A lagoon is a sheet of salt water separated from the open sea by a low sandbank, coral reef etc. Chilika is a unique assembly of marine, brackish and fresh water ecosystems. It shelters a number of endangered species and is a favorite resort for millions of migratory birds. Chilika sustains some one million people - fishermen and those who live on its catchment areas. However, for decades the lagoon had been facing tremendous pressure due to the change in the land-use pattern and construction of hydrological structures – say, dams on the major rivers draining into the Bay of Bengal. The net result was the loss of biodiversity

and productivity that affected the livelihood of local community. This is what prompted the Government of Orissa to establish Chilika Development Authority in 1993.

The major problems of the Chilika lagoon were siltation, fall in salinity due to the blockage of the channel that allowed the entry of sea water (as a result of siltation), decline in fish yield, proliferation of fresh water weeds, poor discharge of flood waters leading to water logging in the peripheral crop land, and the way sea water entered into the lagoon and moved back into the sea.

The most important feature of the plan was the village level meetings to consult the people - the stakeholders - for their suggestions and recommendations. It also extensively involved the scientific and professional bodies. On their suggestions, an artificial mouth was opened to let in the sea water which reduced the length of the inlet channel by 18 kilometres. The resultant increase in salinity drastically brought down the spread of weed thus increasing the weed-free area. This helped the brackish water species like fish, prawn, and crab to grow, and the endangered species to receive a fresh lease of life. The average fish yield improved from a bare 1600 metric tonnes ten years ago to 11, 877 tonnes in 2000-2001, or a sevenfold increase in comparison to the average yield prior to opening of the mouth. This gave rise to an effective collaboration between the Chilika Development Authority and the community. Indeed, awareness campaigns, environmental education, capacity building programmes, networking with the local non-Government Organisations, a newsletter in Oriya with community members contributing most of the articles have been instrumental in the restoration of the Chilika lagoon. It also involved intensive monitoring and assessment systems.

These stories emphasize the fact that a change is possible. It could be through an initiative of a group of people interested in improving their immediate neighborhood as in the case of the jheel in Kolkata or the Government as in the case of the Chilika lagoon. Often a change is possible through the initiatives and efforts of an individual, the examples being that of Anna Hazare at Ralegaon Siddhi in Maharashtra and Rajendra Singh in Rajasthan – both pioneers of watershed management (editorial, *Dream 2047*, August 2002). Be it an initiative from an individual, a group of people, or a Government Department, but for it to grow into a success story, it is imperative to ensure stakeholders' participation. This is how the Thames was cleaned and this is how Dhaka became free of polythene bags, and this is how we shall be able to clean up the Ganga and the Yamuna. Those who are affected and those who are concerned must decide and act together and in harmony.

□ **V. B. Kamble**

Editor : V.B. Kamble

Address for correspondence : Vigyan Prasara, C-24, Qutab Institutional Area, New Delhi-110 016; Tel : 26967532; Fax : 26965986  
e-mail : vigyan@hub.nic.in  
website : <http://www.vigyanprasara.com>

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# Philo Taylor Farnsworth

## The Forgotten Genius

□ Subodh Mahanti

"In a simple laboratory on this site, 202 Green Street, Philo Taylor Farnsworth, U.S. pioneer in electronics, invented and patented the first operational all-electronic "television system" on September 7, 1927. The 21-year old inventor and several dedicated assistants successfully transmitted the first electronic television image, the major breakthrough that brought the practical form of this invention to mankind. Further patents formulated here covered the basic concepts essential to modern television. The genius of Green Street, as he was known, died in 1971."

*The above statement is inscribed on the plaque at the invention site, where Farnsworth invented television.*

One of the greatest inventions of the twentieth century was conceived in a muddy hayfield on a farm in Rigby, Idaho. The invention was television and the inventor was Philo Taylor Farnsworth. Television has changed the world, but its inventor remained largely unknown. The names of Edison, Marconi and Bell are invariably associated with light bulb, radio and telephone respectively. But if we ask: Who invented television? The answer may not be that forthcoming. Many names have been associated with the inventing of television—Nipkow, Baird, Jerkins, Zworykin, and dozen others. However, many forget that 'none of these names would be remembered if Farnsworth had not breathed life into the dream that obsessed them all'. Unfortunately the name of Philo Taylor Farnsworth, who first demonstrated the electronic television is not a very familiar name like Edison, Marconi or Bell. Although best known for his development of television, Farnsworth did research in many other areas. He worked on the development of electron microscope, radar, peacetime uses of atomic energy and nuclear fusion process. He invented the first infant incubator. Farnsworth held 300 US and foreign patents. Farnsworth died in 1971 out of depression, drinking and illness. At the time of his death he was a bankrupt man and he was anything but famous. He died in obscurity. History is making amends and Farnsworth is now getting recognition that he deserved. His statue was erected in Utah and Washington, D.C. The peak in the Oquirrh Mountains where Utah's television station antennas sit was named after him. The US Postal Service commemorated him with a stamp in 1983. The *Time* magazine named Farnsworth as one of the 100 great



*Philo T. Farnsworth*

scientists and thinkers of the 20<sup>th</sup> century. The US News & World Report called him one of the world's greatest inventors, alongside the Wright Brothers and J. Robert Oppenheimer.

Farnsworth was born on August 19, 1906 to Lewish Edwin and Serena Bastian Farnsworth at Indian Creek, near Beaver City, Utah in a community, which was settled by his paternal grandfather in 1856 under instructions from the Mormon Church leader Brigham Young himself. Philo Farnsworth was named after his grandfather. When Farnsworth was 11, his family moved to his uncle Albert's farm near Rigby, Idaho. And the story of television began here. In the spring of 1919, the Farnsworth family reached the crest of a hill overlooking their new home, after a difficult journey over the mountains from their native Utah. At the reins of one of the three covered wagons was Philo. He surveyed the scene before him and after seeing wires running between the different buildings, he shouted excitedly, "This place has electricity!" None of the other family members had noticed this. Before this

Philo had never seen electricity. He had only read about this invisible force in books. It did not take more than a few weeks for young Philo to figure out what made the electrical system work. And what is more he did it all by himself. One day seeing his son coming forward to repair the disabled generator at the farm, when all the adults had no clue, Lewis Farnsworth realized that his son had a natural affinity for the system. After this incident the boy-electrician was made the official chief engineer of the Farnsworth farm. Now it was no more a pastime for Philo. It became his own field of work. Using the spare parts lying around the farm,

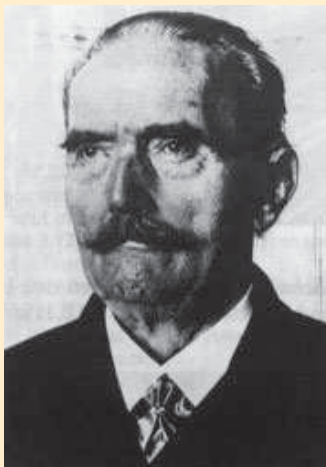
young Philo constructed over a dozen devices. He built electric motors for running his mother's washing machine. Farnsworth's mother wanted him to be a violinist, and he remained an avid violin player all his life.

In the attic above the house, Philo created his own world. Whenever he found spare time Philo would come to this place to explore electricity in whatever books or journals his father could afford. The stories of scientific inventions and discoveries used to fire his imagination. He thought inventors possessed a special power that allowed them to see deep into the mysteries of nature and use her secrets to make man's life more comfortable. He also thought himself a born inventor. At the age of 12 he won a \$25 prize from one popular science magazine for inventing a thief proof car lock.

In the fall of 1921, Farnsworth entered high school as a freshman. The school was six kilometers away from his home. He rode to high school on a horseback. He found the teaching at school too dull. Somehow, he managed to find his way into the senior chemistry class. Even this advanced course proved inadequate for young Farnsworth's thirst for knowledge. Since his school days Farnsworth was intrigued with the electron and electricity. He read his high school's electronics encyclopedia from cover to cover. He paid special attention to two of its entries—the one on the photoelectric cell and the other on the cathode ray tube. The chemistry teacher in the school named Justin Tolman took special interest in this young prodigy. He took extra time after class each day to tutor Farnsworth.

One cold night in January 1922, Farnsworth, while reading in his attic hideaway, stumbled upon an article about something very new: "Pictures That Could Fly Through the Air." The writer of the article talked about a speculative electronic device, an electronic magic carpet, a hybrid of radio and movies, capable of simultaneously projecting both image and sound into homes of people around the world. Farnsworth's imagination was captivated by this idea. After reading the articles a number of times he was convinced that he was uniquely equipped to solve this problem. He began to read whatever he could lay his hands on the subject. In this process he came to know that several inventors had achieved limited success with a mechanical television system.

Between 1914 and 1918 radio was primarily used for two-way communication, but by 1920 broadcast radio was a commercial reality. Now the next logical step was the broadcast film. Large corporations were quickly moving to



*Paul Nipkow*

research in this new technology. George Carey, an inventor from Boston, had proposed a system for transmitting images and sound. According to Carey each element or piece of the picture was to be simultaneously carried over separate circuits. W. E. Sayer of the USA and Maurice Leblanc of France in 1880 proposed an operating principle for all forms of televised transmission. Unlike Carey, who needed separate circuits, Sayer and Lablanc proposed that each element in the final picture could be rapidly scanned, line-by-line and frame-by-frame. However, the resulting image would appear as a coherent whole and not as a succession of black-and-white dots. This is because of the limitations of human eyesight. So Sayer and Leblanc theoretically established the feasibility of using a single wire or channel

for transmission. So now the problem was to achieve it practically. In 1873, the photoelectric properties (that is electrical conduction varies with the amount of light) of selenium paved the way for development of a practical television. In 1884, Paul Nipkow, a German inventor, received a patent based on rotating disc with a spiral-shaped aperture. Nipkow's device was able to scan images simply and effectively at both the scanning and receiving ends. This synchronization of the scanning speed of the camera and receiver remains essential to all television systems in use.

The major disadvantage of Nipkow's television was the means of transmission. Selenium was not a suitable photoconductor as it responded to changes in light too slowly. Potassium hydride-coated cell created by the German scientists in 1913 offered heightened sensitivity to light. Moreover it was able to follow rapid changes of light as well. The invention of this cell made it possible to construct a working television for the first time. In 1897 Karl Ferdinand Braun developed an early receiver based on a cathode-ray tube and a fluorescent screen. It may be noted that a cathode ray tube is a device that converts electrical signals into a pattern on a screen and forms the basis of the television receiver.

In 1907 Boris Rosing not only proposed the use of Braun's receiver but also improved upon it by introducing a mirror-drum scanner that operated at the transmitter end. By doing this he succeeded in transmitting and reproducing some crude geometrical patterns. Between 1908 and 1911 A.A.Campbell Swinton proposed a method that eventually formed the basis of modern television. He proposed the use of cathode ray tubes out be the camera and receiver ends. However, Swinton, method was too advanced in his time for practical application. Daniel McFarlan Moore, an American inventor, created the first neon gas-discharge lamp,



*Brigham Young*

which made it possible to vary the light intensity at the receiver end. It was Farnsworth, who realized when he was student in school that there was an inherent problem in trying to convert light into electricity using whirling disc and mirrors. This is because discs could not be whirled fast enough to transmit a coherent light. He thought that means of transmission should be such which could work at the speed of light. And this he achieved finally.

But Farnsworth correctly could guess that these rudimentary systems would not work fast enough to capture and reassemble anything but shadows and flickers. It is said that Farnsworth conceived the idea of electronic television while he was tilling a potato field back and forth with a horse drawn harrow. Farnsworth realized that an electron beam could scan images in the same way, line by line, just you read a book.

His father advised Philo not to reveal his idea to anyone because he thought ideas were too valuable and fragile, and could be easily pirated. But then Philo needed someone other than his father to tell him that his idea would work. Finally he shared his idea with his chemistry teacher. One late afternoon in March 1922, Tolman found that Farnsworth was drawing complicated figures and equations across the blackboard in his classroom. Tolman did not find any connection between these figures and diagrams and his chemistry teaching. So he asked Farnsworth: "What has this got to do with Chemistry?" "I've got this idea," said Farnsworth. "I've got to tell you about it because you're the only person I know who can understand it." Then after taking a deep breath he said: "This is my idea for electronic television." Tolman was naturally startled to hear it as the concept of television was totally unknown to him. So he said: "Television?" "What's that?"

After this incident both the teacher and the pupil spent the next several weeks developing and elaborating on Farnsworth's concept. At the end they were both convinced that Farnsworth's idea would work. What they did not know was that when Farnsworth would get an opportunity to prove his idea.

With the loss of his uncle's farm in 1923, Farnsworth's family moved to a place near Provo, Utah where Philo's father found work hauling freight over the mountains in mule-driven wagons. Farnsworth got admitted himself in the Brigham Young University as a special freshman. For this he had to work hard. Once admitted, he had the vast resources of a major university in terms of library and laboratory facilities. He did his own private research about cathode ray tubes and vacuum tubes.

He could spend only two years at the University. He was forced to leave the university to look after his family after his father's death. His father died of pneumonia, which he contracted just before Christmas 1923. He was caught in a violent snowstorm while he was crossing the mountains. He had no specific employment. He did whatever he could

get. He worked as a member of logging crews, as a salesman of electrical products and as an electrician on the railroad. He also repaired radios and delivered them to their owners.

The Farnsworth family moved to Provo, where they shared a house with another family, the Gardeners. Cliff, the oldest of the two Gardener boys, was nearly the same age as Farnsworth. They became close friends because like Farnsworth, Cliff was also interested in radio and other electrical things. Cliff became a close associate of Farnsworth in the development of electronic television. Farnsworth also got attracted to one of the six daughters of the family, Elma Gardener, whom he later married.

Both Farnsworth and Cliff subscribed to a correspondence course in Radio maintenance. In the spring of 1926 the two boys decided to start their own business installing and repairing radios. And to materialize their plan they set off to Salt Lake City. However, their first venture was a failure. During this time Farnsworth thought about writing his ideas for designing and developing an electronic television and submitting it to *Popular Science Magazine*. He hoped that by this way he would be able to earn about 100 dollars. However, Cliff persuaded him not to do this. Cliff returned to Provo and Farnsworth signed up with the University of Utah Placement Service with the hope that they might find him work. Through the University Placement Service, Farnsworth came in contact with George Everson and Les Gorrell, professional fundraisers from California. Everson and Gorrell wanted to organise a community chest campaign in Salt Lake City. They used to hire native college students to staff their operations. So they contacted the University of Utah Placement Service. Farnsworth was also an applicant. While he was being interviewed for one of a number of jobs for conducting a community survey, Farnsworth



Karl Ferdinand Braun

straightway offered himself to be the Survey Manager. He told them that he was the most suited candidate for the job as he was so familiar with the area. He was selected. Farnsworth's first responsibility was to complete the job of hiring the campaign staff. Among his first recruits were Cliff and Elma Gardener, his future wife. His association with Everson and Gorrell proved to be a long lasting one. Towards the end of the survey Everson asked Farnsworth whether he would go back to school again. To this Farnsworth replied: "No, I can't afford it. I've been trying to find a way to finance an invention of mine but it's pretty tough. I've been thinking about it for about five years, though, and I'm quite sure it would work. Unfortunately, the only way I can prove it is by doing it myself; but I don't have any money." On being asked by Gorrell that what was his idea, Farnsworth replied: "It's a television system." The concept of television was totally new to them. So they asked Farnsworth to explain his idea. While describing his ideas, his speech found new eloquence. It seemed as some special power came to him, as his

genius suddenly found a way of expressing itself. Though Everson and Gorrell had no idea what he was talking about but they were touched by his passion. But still Everson remained skeptical. He could not believe that either General Electric or Bell Labs had not already accomplished what Farnsworth proposed to do. As an attempt to convince Everson, Farnsworth presented a summary of the progress that had been made till then in realizing a viable television system. Everson became more and more intrigued and finally he asked Farnsworth how much it would cost to build a model of the machine. Farnsworth suggested a figure of about \$5,000. Everson said: "Well, your guess is as good as any. I surely have no idea what is involved. But I have about \$6,000 in a special account in San Francisco. I've been saving it with the idea that I'd take a long shot on something and maybe make a killing. This is about as wild a gamble as I can imagine. I'll put the \$6,000 up to work this thing out. If we win, it will be fine, but if we lose, I won't squawk." Finally an association of Everson, Farnsworth and Gorrell was formed. It was decided that for the contribution of his invaluable genius, Farnsworth would control half the equity in the company and the remaining half would be equally divided between Everson and Gorrell for raising the funds required to implement the project.

Following the suggestion of Everson, it was decided to set up the operation in Los Angeles. It was thought that the resources of a vast metropolis like Los Angeles would be much more suited to finding and fabricating parts for the exotic apparatus of Farnsworth. But before moving out of Utah, Farnsworth and Elma decided to get married. Their parents were not in favour of a marriage in such a haste. However, in spite of their parental objections the young couple got married by a Mormon bishop at Provo. At the time of marriage Farnsworth was 19 and Elma was 18. The newlywed couple rode the Pullman train from Salt Lake City to Los Angeles. Before this journey Elma had never been out of Utah. After reaching the destination, their first priority was finding a suitable place in which to set up housekeeping and an electronics laboratory. Eventually they found a cozy one bedroom apartment with a small yard at 1339 New Hampshire Avenue in the heart of glamorous Hollywood of 1920s. Farnsworth set up shop in the dining room.

Farnsworth started working. But it was an extremely challenging task. Virtually everything had to be made from scratch. He had to design and build many of the basic tools required for the machine. He had to teach himself a number of new areas like electrochemistry and radio electronics. Even he had to learn the ancient art of glass blowing because most of the glass blowers he met said that the tubes he wanted were impossible to make.

As the work progressed it became obvious to Everson that Farnsworth's first estimate of \$5,000 would not bring him close to completing a working model of the machine. So more money needed to be raised. Before getting money from other sources, Everson wanted to be assured about the feasibility of the idea by a more reliable source. Accordingly he contacted the firm of Lyon and Lyon, local patent attorneys, for advice. After listening to George, Leonard Lyon, one of the partners of the firm, said: "If you have what you think you have, you've got the world by the tail. If not, then the sooner you find out, the better." Following this, arrangements were made for Farnsworth to meet with Lyon and Dr. Mott Smith of the California Institute of Technology, who would pass judgment on the merits of Farnsworth's idea. The meeting lasted for hours. Lyon's reaction was expressed in the following words: "It's monstrous! Just amazing . . . the daring of this boy's mind!"

After the meeting was over, Everson asked Dr. Smith the following three terse questions:

"Is this thing scientifically sound?"

"Is it original?"

"Is this thing feasible? Can it be worked out to make a practical operating unit?"

Smith's answers to the above three questions were:

"Yes."

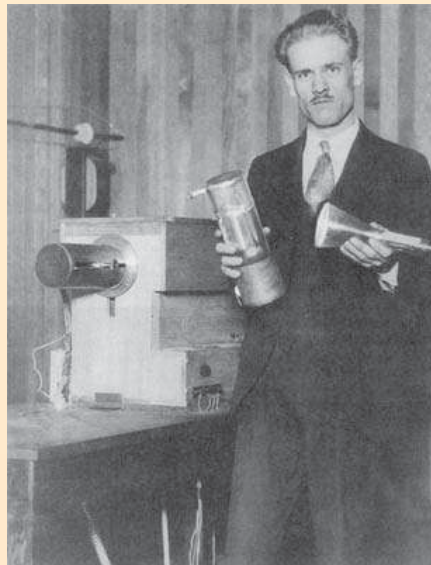
"I'm pretty well acquainted with recent electronic developments, I know of no other work that is being carried out along similar lines."

"You will encounter great difficulty in doing it, but I see no insuperable obstacles at this time."

After listening Dr. Smith's answers Everson was fully convinced. He decided to raise \$ 25,000, though Farnsworth thought that with another \$ 12,000 he would be able to come up with a working model of the machine. Raising money was not an easy task. Everson found that the wealthy people very whimsical.

For example somebody told him that he would support the project if it had something to do with bacteriology. Some other person told that he would support it if it was a colour television..

There was another problem. Farnsworth was a stranger to the locality. The work being done in Farnsworth's apartment seemed to be unusual. Someone thought that perhaps a still was being operated. There was prohibition in those days. So one day men in uniforms descended to search the apartment. They could not find any alcoholic product. However, the sergeant heading the investigating team was really amazed by seeing the things assembled in the apartment and he started wondering whether something more sinister than a still was going on there. So he asked Farnsworth what all the staff was. "This is my



*Farnsworth with his image dissector (1920) and one of his picture tubes*

idea for electronic television,” replied Farnsworth. The sergeant was so startled to listen this that he simply asked: “Tell a what?”

In August, 1926, George Everson, while looking for investigators met a banker affectionately called as “Daddy” Fagan at Crocker National Bank in San Francisco. He went there to meet Jess McCager, whom he knew earlier. Not finding him there, Everson was totally disappointed. Observing Everson’s disappointment, Fagan, who at the time was considered the most conservative banker on the West Coast, asked if he could help him. “I don’t think it is anything that would interest you in the least,” Everson told Fagan. “It’s not an investment, it’s not even a speculation. It is wildcatting, and very wildcatting at that.” For some reasons “Daddy” Fagan became interested and he persuaded Everson to explain why he had come to the bank. After listening Everson, Fagan said: “Well, that’s a damn fool idea, but somebody ought to put money into it,” Fagan said, adding, “Someone who can afford to lose it.” After two days of his conversation with Fagan, W.W. Crocker himself advised Everson to summon his young genius to San Francisco to meet Roy Bishop, a successful capitalist and an engineer of some standing. Farnsworth met Bishop to explain his ideas. While Bishop became convinced about the soundness of the idea but he was not sure of Farnsworth’s ability to work out commercially. Before taking any decision, he wanted to consult with Harlan Honn, another “hardboiled” engineer. He said: “If you can convince him (Honn) that your proposition is sound, then I think we can find a way

of backing you.” Honn was satisfied with the scheme. He said: “Why sure this system will work. I think very well of it.” Finally the matter was discussed in the Directors’ Room of the bank. Farnsworth was asked to explain his ideas before the principals of the bank. The bank decided to provide \$25,000 (at that time it was a substantial sum) and one half of the second floor over a garage at 2002 Green Street in San Francisco where he could set up a laboratory to implement his ideas. Roy Bishop said: “Young man, you are the first person who has ever gotten anything out of this room without putting up something in return.” Then Bishop addressed the rest of the group and delivered an ironic benediction: “We’re backing nothing here but the ideas in this boy’s mind. Believe me, we’re going to treat him like a race horse.” This was the beginning of Crocker Research Laboratories.

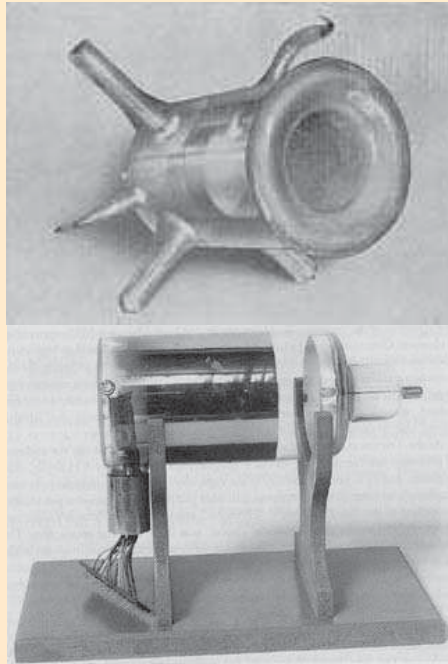
After finalizing the plans for his television system and drawing detailed diagrams, Farnsworth decided to file for his first patent. The application was submitted on

January 7, 1927. As the documents disclosed an invention that would work, January 7, 1927 may be considered as the date on which television was invented. However, patents could not be officially granted until the device had been proven to work or “reduced to practice”. On September 7, 1927, Farnsworth and his friends became the first humans to gaze into the shimmering eye of electronic television. For Farnsworth it was just a beginning. The crude, flickering image of a white straight line drawn on a black background only proved that the idea, that struck him when he was 13, would work. He was aware of the magnitude of the job that now lay before him before he would be able to take this fragile invention from the laboratory to the living room. Work

continued for another year funded by the Crocker group. As time passed the expenses increased. Nearly \$60,000 was spent by the Spring of 1928. This was more than twice the original limit. So it became essential that Farnsworth showed his invention to the people who were paying for its development. So a date was set for a demonstration. The Crocker group reassembled at 202 Green Street in May of 1928. When, 16 months earlier, they supported the idea of a 19-year-old boy who told them that he could invent television, they really understood very little of what Farnsworth meant by that. Only reason why they supported was that for some unexplainable reason they thought it was bound to be a winner. So 16 months later they had no idea what to expect. They had no idea what a television would look like. However, they were amazed to an apparition of a dollar sign (\$) materialized out of the darkness. After the demonstration, Roy Bishop said: “It will take a pile of money as high

as Telegraph Hill to successfully conclude this work.” Then he further added, “I think we should take immediate steps to sell this invention to one of the large electrical companies that can afford to provide more adequate capital and facilities.” Farnsworth was not surprised by the Bishop’s proposal. He described what he thought about the future of the project. He reasoned, everybody who wanted to get into the television business would have to come to Farnsworth to license his patents. Thus, the patents would earn from royalties many times more than what they could get if they tried to cash out now. The Crocker group agreed to continue finding money to support Farnsworth work.

On Sept. 3, 1928, *The San Francisco Chronicle* published an article titled “SF MAN’S INVENTION TO REVOLUTIONISE TELEVISION”. The article was accompanied by a front page photo of Philo T. Farnsworth, posing as he would a hundred times with his magic jars in hand. “In any method of transmitting moving images at a distance, some means must be evolved of breaking the



*Farnsworth image disectors (1926-27)*

image into pin points of light. These points are translated into electrical impulses, the electrical impulses are collected at the receiving end and translated back into light, and the image results. All television systems now in use employ a revolving disc, two feet in diameter, to break up or "scan" the image. A similar disc is at the receiving end, and the two discs must revolve at precisely the same instant and at precisely the same speed or blurred vision results. Farnsworth's system employs no moving parts whatever. Instead of moving the machine, he varies the electric current that plays over the image and thus gets the necessary scanning...The laboratory model he has built transmits the image on a screen one and one-quarters inches square. It is a queer looking little image in bluish light now, one that frequently smudges and blurs, but the basic principle is achieved and perfection is now a matter of engineering. The sending tube which is the heart of Farnsworth's transmitting set is about the size of an ordinary quart jar that a housewife uses for preserving fruit, and receiving tube containing the screen is even smaller."

Not long after the *Chronicle* article appeared, fire swept through the second floor of 202 Green Street, charring all of Farnsworth's equipment. The disaster highlighted the hazards involved in the Farnsworth's project. The chemicals like potassium used for the project were highly volatile; vacuum tubes being still very fragile occasionally imploded without warning, and of course there were the strong currents and high voltages that were always present. Farnsworth and his co-workers quickly rebuilt the laboratory.

In March 1929, Everson and McCargar reincorporated the venture as Television Laboratories Inc. and McCargar was declared president and chief executive. Everson was named treasurer and Farnsworth, who continued to own a substantial share of the enterprise, was named the Director of Research. Farnsworth accepted the new circumstances and started working with a new zeal. He was particularly happy about the fact that the threat of a sell out had been averted, though temporarily.

Inventors engaged in developing television systems of their own, failed to appreciate the significance of Farnsworth's invention. They preferred to rely on mechanical methods. However, David Sarnoff, the Vice President and General Manager of the RCA started taking great interest in what was going on at 202 Green Street. In 1930 Sarnoff contacted the services of Vladimir Kosma Zworykin, a Russian-born research engineer. Zworykin had filed for a patent in 1923 for a camera tube called an iconoscope. Zworykin had achieved significant research results with a

receiver similar to Farnsworth in 1929. However, he was unable to duplicate Farnsworth's success with a suitable electronic camera. Zworykin's system could not produce more than 40 or 50 lines per frame.

Zworykin visited Farnsworth at San Francisco. He introduced himself as a fellow researcher interested in television. Farnsworth welcomed him. Zworykin spent three full days at Farnsworth's laboratory. He became familiar with many of the most confidential aspects of Farnsworth's invention. On returning to RCA's laboratory Zworykin began to reverse engineer Farnsworth's invention. When Zworykin did not succeed Sarnoff tried to buy Farnsworth out. He offered Everson about \$100,000 with the condition that Farnsworth's service will go along with it. It was a staggering sum in those days. However, Everson and Farnsworth did not accept the offer.

In the Spring of 1931, when the Philco Radio Corporation in Philadelphia became the first bonafide licensee of the Farnsworth company. Philco was a respectable firm that did a fair share of the radio business during the 1920s for which they paid the usual patent royalties to RCA. Still Philco survived on the periphery of the "Radio Trust," in which large companies like RCA, AT&T and General Electric all pooled their patents. To strengthen their position in the industry Philco decided to support Farnsworth's ongoing research. In exchange, Farnsworth agreed to move his entire operation to Philadelphia to get Philco started in the television business. The working environment in Philadelphia was totally different from the environment in which Farnsworth and his co-workers worked in San Francisco. Though they found difficulty in adjusting the new environment they continued to work.

During 1933, Farnsworth acquired enough investment capital to restructure the venture, which was renamed as Farnsworth Television, Inc. Farnsworth found a suitable location at 127 East Mermaid Lane, in a suburban neighborhood near Philadelphia, and with the underpaid help of Cliff Gardener and Tobe Rutherford, began rebuilding. Their task was formidable. Most of the important equipment that they needed for their work was the property of Philco and had to be left behind. So they had to build from scratch again.

Unfortunately for Farnsworth, the Radio Corporation was not so favorably disposed. The competition began intensifying early in 1934, when RCA began demonstrating their own new electronic television system which Zworykin succeeded in producing three years after his visit to Farnsworth's lab. In 1933, after Farnsworth abruptly terminated his arrangement with Philco and struck off once again on his own, he resumed his efforts to find another company willing to support his research with a patent license.



Vladimir Kosma Zworykin



Logie Baird

Through contacts in the industry, Farnsworth and his backers learned why none of the most likely candidates would offer Farnsworth a license for his patents. All these companies were actively engaged in the manufacture of radio equipment, and so were dependent on patent licenses with the Radio Corporation of America for their livelihood.

Farnsworth and his backers did the only thing they could do: they mounted a challenge before the examiners of the U.S. Patent Office. The ensuing interference proceedings focused primarily on Claim 15 of Farnsworth's 1930 patent # 1,773,980, which describes the simple, elegant concept of an "electrical image," which is the critical step in the process of converting light into electricity.

"An apparatus for television which comprises means for forming an electrical image, and means for scanning each elementary area of the electrical image, and means for producing a train of electrical energy in accordance with the intensity of the elementary area of the electrical image being scanned."

This paragraph, which was first composed in 1927, announces the arrival of television on the Earth. It was essentially the idea that 13-year-old Farnsworth, visualised in his mind's eye while tilling the potato fields in Rigby, Idaho. This paragraph describes the essence of Farnsworth's invention. Yet in 1934, RCA's lawyers contended that Zworykin's 1923 patent had priority over any of Farnsworth's patent including the one for his image

dissector. Farnsworth spent many weeks answering questions posed by a battery of RCA's legal experts. Farnsworth's case was handled by a sharp young attorney, Donald K. Lippincott, who was every bit as much an engineer as he was a lawyer. Lippincott and Farnsworth together built clear, concise and uncompromising arguments that methodically demolished RCA's claim. RCA's legal experts particularly challenged Farnsworth's claim that he conceived the idea of electronic television when he was in a school. His chemistry teacher, Justin Tolman came forward to testify that Farnsworth had indeed conceived the idea when he was a high school student. What is more Tolman also produced the original sketch of an electronic tube that Farnsworth had drawn for him at that time. The sketch was almost an exact replica of an image dissector Farnsworth had gone on to invent.

In April of 1934, the United States Patent Office delivered its first milestone decision in the case of Zworykin vs. Farnsworth. In its final ruling the patent office summarily dismissed RCA's claim and priority of invention was awarded to Farnsworth. However, RCA had an option of appeal within

16 months. RCA appealed and lost. However, litigations on different aspects continued for years.

In the summer of 1934 the prestigious Franklin Institute of Philadelphia invited Farnsworth to give a full scale public demonstration of television. It was first such demonstration in the world. Farnsworth accepted the invitation. This gave him an opportunity to forget his problems with RCA. During the preparation for his demonstration he was introduced to Russell Seymour Turner, an engineer and businessman whose father had accumulated a large chunk of Farnsworth stock. Turner developed a great liking for Farnsworth since the moment he saw him. He ensured that Farnsworth had enough funds to build a completely new system for the Franklin Institute exhibit. A picture tube of the size of a ten gallon jug was made and the camera was compact even by today's standards. The exhibit was an unprecedented success. There was little advanced publicity. However, when the exhibit was opened in August, 1934, the response was so strong that the event, which was originally planned to last ten days continued for three weeks.

The tremendous success at the Franklin Institute was a great morale booster for Farnsworth and his men. It was their first contact with so large an audience. The Franklin Institute demonstration attracted considerable international attention. Many scientists and dignitaries from all over the world started visiting Farnsworth's lab at 127 Mermaid Lane in the Philadelphia suburbs.



*Farnsworth was an avid violin player*

In the fall of 1934, Farnsworth sailed for Europe hoping to form an alliance that would enable him to overcome his difficulties at home. He was invited by Baird Television of England. Baird Television was named after John Logie Baird, who invented a mechanically-scanned television device. He was the first independent inventor to earn money from sending pictures through the air. The British Broadcasting Corporation had permitted Baird to use their radio channels at night to broadcast pictures on a temporary, experimental basis. In 1934, the BBC expressed dissatisfaction with Baird's system and asked him to conclude his experiments. The British Gaumont, a large conglomerate, which was supporting Baird Television financially asked Baird to abandon his mechanical device and go for Farnsworth's device. They were highly impressed by the demonstration of Farnsworth in England. And finally a deal was made for a patent license. As part of the deal Farnsworth was paid \$50,000 in cash.

After the expiry of Farnsworth's key patents, RCA started producing and making television sets on a large scale. It has been reported that the corporate giant instigated



Farnsworth flanked by Les Gorrell (left ) and George Everson (right)

an aggressive public relations campaign to promote both Zworykin and Sarnoff as the fathers of television. Farnsworth had no resources left to counter this campaign. He sold the assets of his company to International Telephones and Telegraph. He was totally devastated. He suffered a nervous breakdown that left him bedridden for months. After coming out of television business he worked as a consultant in electronics and a researcher in atomic energy for sometime. Being totally disillusioned, he withdrew his family to a house in Maine. He became a victim of depression and alcoholism.

Farnsworth became so unknown to the public towards the end of his life, that he was made a mystery guest on

the television programme *What's My Line?* None of the panelists was aware of his work. Being asked by one of the panelists whether Farnsworth had invented somekind of a machine that might be painful when used, Farnsworth's answer was : "Yes, sometime it's most painful."

Farnsworth died on March 11, 1971.

In its obituary on march 12, 1971, the *New York Times* described Farnsworth as "a reserved, slender, quite and unassuming man tirelessly absorbed in his work. At the age of 31 he was rated by competent appraisers as one of the 10 greatest living mathematician.

#### For further reading

1. Burns, R. W. *Television: An International History of the Formative Years*. London: Peregrinus, 1998.
2. Everson, George. *The Story of Television: The Life of Philo T. Farnsworth*. New York, 1949.
3. Farnsworth, Elma G. *Distant Vision: Romance and Discovery of an Invisible Frontier*. Sal Lake City, 1990.
4. Fisher D.E. and M. J. Fisher. *Tube: The Invention of Television*. Washington: Counterpoint Press, 1996.
5. Horvitz, Leslie Alan. *The Forgotten Inventor: Philo Farnsworth and the Development of Television in Eureka!: Scientific Breakthroughs that Changed the World*. New York; John Wiley & Sons, Inc, 2002.
6. Keller, Peter A. *The Cathode Ray Tube: Technology, History and Applications*. New York: Palisades Press, 1991.
7. Postman, Neil. Philo Farnsworth. *Time*. March 29, 2000.
8. *The Farnsworth Chronicles* (Part 1-12) by Paul Schatzkin, available on the net.



#### Popular Science Lecture (VP News contd. from page... 36)

New Delhi. The lecture began with defining blood – its ancient and modern views of composition, transfusion, identification of blood groups, haemoglobin etc. Dr. Gupta described that anaemia can be caused by deficiency of haemoglobin in blood or may manifest on account of other disesses. He explained various causes of anaemia, its diagnosis, investigation and prevention. He said that a balanced nutrition diet was perhaps the best solution to keep your blood in good health. In case the blood count falls below the required balance i.e. adult male <14gms/dl, adult female <12gms/dl and child <11gms/dl then a proper investigation of general health nods to be carried out. At the end of the lecture, a team of doctors from Lady Hardinge Medical College conducted blood tests on individuals to determine their blood group and haemoglobin content in blood.

#### VIPNET Activities in Orissa (VP News contd. from page... 36)

He also suggested that to motivate people, the achievements of the local pioneers of science should be highlighted.

Shri Shergill spoke about the objectives and programmes/activities of Vigyan Prasar including the activities undertaken under the aegis of VIPNET.

A number of activities such as scientific explanation of miracles performed by Godmen, ham radio demonstration, developing low cost teaching aids—and apparatus, a portable planetarium were the highlights of the workshop. Night sky viewing was also organised.

A nature walk in the nearby forest to study flora and fauna and to identify food chains and webs and to collect samples was organised. A session on testing food adulteration was also organized.

#### Chat Session on Vigyan Prasar Homepage

Vigyan Prasar organized a one hour chat session on "Joints & Bones – Diseases and Disorders" on its homepage ([www.vigyanprasar.com](http://www.vigyanprasar.com)) on 15 July 2003. Dr. R.K. Chopra, Professor of Orthopaedics in Safdarjung Hospital, New Delhi, was the expert who answered various queries related to the topic. The questions ranged from specific problems of an individual to general queries like formation of bones, various diseases of bones, bone cancer, osteoporosis, osteomalacia, osteonecrosis, etc. The chat session evoked a good response and there were about fifty questions from thirty five participants in one hour session.



Dr. Rakesh Chopra answering questions online

# Technology for all, Science for some

□ P.K. Bhattacharyya\*

## Introduction

The child who is the decision-maker of tomorrow is to be educated so that s/he develops capabilities, which will enable her/him to be a creative agent for a better quality of life. The twentieth century has seen extraordinary growth of information base and revolutionary development in technology. 80% of the technologies we shall work with by the year 2050 have not even been invented yet! Today's technological knowledge will be only 1% of the knowledge that will be available in 2050. In seventies Alvin Toffler told us that half-life of knowledge that time was ten years. Today knowledge is doubling every three years. That means, the knowledge base for a seven year old today will grow one million times at the time of her/his attaining the age of seventy. In a decade or two virtually every job in the country will require some skill in information processing technology. So children of today must be technologically literate if they are to live productive lives and participate effectively in the workplace.

Technology is the best example of manifestation of human creativity. The student engaged in acts of technical creation can understand it better. Technology as the context of any creation is an important area of research. Research on problem-solving revealed that types of activities in problem solving can be clubbed in terms of complexity and goal clarity. Problem-solving activity in one case may not be of the same level of creativity in another. Problem shooting is not of the same order of creativity as problem solving. Creative aspects of problem-solving is problem-finding or problem-posing. Researchers say that problem-posing in teaching of the subject promotes constructivism and builds conceptual frames that can be utilised as backdrops for such subjects. There is flexibility in framing and reframing problems by children and the process is not linear.

## Technology Education

Prior to the first industrial revolution, technological development had been through handicrafts. The third quarter of 20<sup>th</sup> century has seen the peak of advancement of technology so far. This technology has come to stay with its proliferation in our social culture, economic development and every walk of life whether we are in urban or rural environment. Around the era of first industrial revolution 'science' started claiming its place in the curriculum for scholastic development. Gradually the society transforms with development of technology; experience of manual work and acquisition of some skill were required for employment. So formal education having technology bias had to be evolved. Modern civilisation requires knowledge of technology to some extent as a pre-requisite for leading a modest life in today's information society. Therefore **along with engineers, scientists and technologists the society**

**also needs a population which will be able to make choice of available technologies and generate demand of technology to solve the emerging needs of the society.**

Science and Technology are the chief agents of change in our society. Though science is the corner-stone of technology, science education is not the foundation of technology education. There are some interrelations between the two. Science stresses on 'knowing' while technology tries to find new ways to solve old problems.

After studying more than one hundred definitions of technology, Gebhart et al (1979) suggested that **"Technology is the know-how and creative process that may utilise tools, resources and systems to solve problems to enhance control over the natural and man-made environment in an endeavour to improve human condition"**.

So technology education helps one to 'decide' and 'make' after examining state-of-the-art technology issues, its potential and limitations, long-term consequences etc. Technology education is then to make use of technology. Control it, make decision, give direction. Thus it is **more appropriate for the non-science students** as it incorporates an element of social responsibility to enable them to make use of technology, control it, make decision, give direction.

Some literature suggest that 'Technology' precedes 'Science'. Scientific knowledge has a little influence on development of product. Design of a pot or a corkscrew was based on clever application of knowledge of natural phenomena. "Technology is applied science" paradigm is no more acceptable. Can we say now that **"technology for all, science for some"** in place of "science for all". De Vries classifies technology: **one – experience-based technology, two- macro technologies and three – micro technologies**. Design of horse-drawn chariots with the distance between wheels at four feet eight inches suitable for running at forty miles an hour is more than five thousand years old. The design was purely experience-based. Rules of thumb are seen in all such technological innovation like bridges, houses, big palaces, sea going vessels and canoes made of reed or wood, water wheel, weapon, plough, wind mill, etc. Knowledge of natural phenomena dictated these designs. Macroscopic technologies prompt designs of macroscopic structures with the application of fundamental and classical theories in mechanics, thermodynamics and electromagnetism. Micro technologies involve atomic level complexities as in cybernetics, transistor, chips etc.

In the global village of today where culture and language separate people, technology is the powerful cement. Though one country can't speak the language of another, still they communicate through common technological designs and

system. Even they integrate their efforts to solve design problems over Internet today.

Technology is an eminent example of applied '**problem-solving**' which is also the generic benefit. Technological intervention in the form of flush toilets-septic tank-sewer system, water treatment plants have transformed the society by freeing a section in the society from untouchability and ensuring a cleaner environment free from diseases.

### Technological Literacy as one of many 'literatecies'

Generally speaking, literacy is not a panacea for all ailments of the society, it is only a nutrient in the regular diet. If literacy of any type is not integrated into community activities, it will mass manufacture literate individuals and not literate communities.

Today the term literacy has been linked with certain programmes and catchy slogans: Information literacy, cultural literacy, adult literacy, computer literacy, geographic literacy, ecological literacy, critical literacy, visual literacy (the study of film.), scientific literacy and technological literacy, and so on. Those are all honest intentions to make people more conversant with wealth of information about the world and the way in which people should function in it. The term technological literacy does not carry with it an understanding of its meaning. In some countries anyone who has completed fifth grade is literate. Any educator knows that it is a faulty definition. The governmental definition of literacy may serve political purposes, but from a functional point of view it is useless. Literacy is the ability to encode and decode a message. If one encodes and decodes very well, one is well-educated. In other words, there is a minimum level of attainment if one is required to code and decode technological messages.

Encoding and decoding in language means being able to understand and use words and their meanings. In discussing literacy, Csikszentmihalyi (1990) says – "**literacy presupposes the existence of a shared symbol system that mediates information between the individual's mind and external events**". Some maintain that the shared symbol system of technology is either quality consciousness or mastery of tools, or both. The fact of the matter is that we have no clear identification of the shared symbol system that may be unique to technology. This brings in an element of confusion in understanding technological literacy.

Hayden (1989) is of the view that technological literacy centres around selecting and applying appropriate technologies in a given context. Steffens (1986) claims that technological literacy involves knowledge and comprehension of technologies and their application. Owen and Heywood (1986) say that there are **three components to technological literacy; the technology of making things; the technology of organization; and, the technology of using information**. Croft (1991) evolved a panel of characteristics of technologically literates: abilities to make decisions about technology; possession of basic literacy skills required to solve technology problems; ability to make wise decisions about uses of technology; ability

to apply knowledge, tools and skills for the benefit of society and ability to describe the basic technology systems of society. Literature on technological literacy place emphasis on conceptual material, e.g., *understanding, knowledge, decision making, and much less emphasis on tool skills, shaping materials, and modelling, though raison d'etre of technology education is the use of tools, machines and materials*.

### Salient points for development of a technology education curriculum for school children

*"Raphael paints wisdom, Handel sings it, Phidias carves it, Shakespeare writes it, Wren builds it, Columbus sails it, Luther preaches it, Washington arms it, Watt mechanises it".*

(Emerson)

The reason for including technology education in the primary curriculum is vital because of the propensity of this age group to interact themselves in technological activities with curiosity. Here is an optional opportunity for self-development which is driven by curiosity and motivation for creation while experimenting with materials as well as conceptual world.

**Curriculum design** in technology education centres around mainly five categories:

- Technical performance or processes.
- Academic focus on the specific body of knowledge relating to industry and technology.
- Intellectual processes around critical-thinking and problem-solving.
- Social reconstruction through realistic or real world situation.
- Personal learner- centered focus on individual needs and interests.

If it is possible to define a body of knowledge and skill called 'technology', technology education **merits the status of a separate subject**. We need to create a new, reflective (and not reflexive) attitude towards technology. At the elementary level we should expose children only **to experience-based and macro technologies and not beyond**. Children should be able to identify the linkages in design-manufacture-packing-sales-maintenance-recycling for any modern product. Technology today is embracing computers increasingly and we see a sudden shift to 'brain' from 'brawn'. Most production systems are designed with digital CAD which generates code to drive machining equipment, power, energy, transportation, etc. The concepts and process of technology can be taught through digital technology.

Technology teacher should be trained to design activity-based classroom transaction and how to address "a directive versus a more *laissez-faire* approach". Computers and related technology will unite teachers and students of various backgrounds for a richer learning experience. Learning technologies will facilitate teachers, students, parents, community centres to participate in learning.

The technology education curriculum is different from the vocational model which concentrates on technical aspects of selected tools and materials and vocational

training on trade specific areas. Technology education should encourage **students to study the processes used by technologists, to think critically, to solve problems, to study impact of technology on society and environment, not simply to use hacksaws, screw drivers or spanners.**

Vocational curriculum prefers introverted step-by step approach to learning and teaching. Technology curriculum is inclined to more extroverted intuitive approach. **Curriculum developers in technology education should not follow placing of one concept or skill over another linearly.** This is not ideal for learning. Most learning takes place through social interaction. Teachers of technology will have enough scope to become proactive in the use of technology to solve problems rather than training isolated technical skills. The types and degrees of tools skills is another challenging area, but tool skill should not dominate technology education. Perhaps a mix of tool skill with the processes used by technologists to solve problems would be the right solution. **Technical skills have historical roots within the field of technology education. Historical component of technology is essential for complete understanding of present day status of technology. One has to appreciate mankind's confrontation with nature and learn.** Understanding of technology is related to time and culture and the student learns important lessons from the chronological development of technology. Thus the study of technology becomes thoroughly entertaining and provides much food for thought. Unsolved mysteries is one area, which if placed in proper perspective, will set the young mind thinking why they have remained unsolved.

**The different elements in curriculum at the elementary level must cohere. Lessons learnt in one subject should find application in another, Science and Mathematics are typical allies. Such alliance should extend with more natural allies like agriculture, social studies and then with English, performing arts, etc.**

One Country has made technology education compulsory at the elementary stage, but elective at the secondary stage, with identification of the following areas of technology:

*Communication technology, construction technology, technological Design, Hospitality Services, Manufacturing Technology, Technology in Agriculture, Personal Care, Transportation technology.*

Design process is integral in project based course in technology education. A design process as a part of course curriculum should need attention of the teacher so that students are properly guided through the process. Design does not happen by default. Students need serious information from the community to address design problems. This information is needed to conceptualise ideas in two or three-dimensional forms. The findings from these problems provide interest in project-based (preferably community project) approach to technology education. Successful

school programmes have viewed learning as cooperative venture where a group and not individuals are important and where the knowledge is distributed among all members of the group. This conforms to the practice of most workplaces where pursuing common goals cooperatively is most important for success.

Weight of the school bag is already a hot topic in India. Technology education in no way should add even a gram to the existing weight.

So technology education has to be incorporated in the existing time-table meant for SUPW (socially useful productive work), WE (work experience) and Art education at the elementary level. This should be integrated with annual science exhibition, science quiz and other extra curricular and out-of-school activities.

**Technological Integrity** implying development of values and ethics as well as mastery of concepts and skills is to be incorporated in the curriculum. One perhaps can't live in a technological society without being mechanised, if not robotised. The attributes like personality, ideology, honesty, freedom, responsibility, ethics, dignity, duty, necessarily require to be redefined in a set-up which is geared to sizeable profiteering at any cost. As every move in life today tends to be steered by personal gain or profit, individual is likely to forget humanity. No manufacturing process in the industry is pollution-free or harmless. There are many moral checklists before technology education. People in the industrial age as well as in the information age have a common tendency to keep aside the obvious moral question. The value system in India practiced through ages are constantly interacting with these era-related questions in the form of research in value education.

*\*(The author is Professor in Technology in the NCERT. The views expressed here are his own; he has written it to project the global trend in the subject). Tel.6852773; e-mail:jointdirector@hotmail.com*



### Letters to the Editor

May, 2003 issue of "DREAM 2047", Mr. Rintu Nath has written a nice article entitled 'Operation Zero'. Ideas of infinity, undefined and indeterminate and distinction between them has been explained very clearly and in a lucid way. The box 'Mighty Not' showing powers of ten is also useful. As a reader as well as a teacher of mathematics, I expect more articles on mathematics in the coming issues of 'Dream 2047'.

Utpal Mukhopadhyay  
Barasat Satyabharati Vidyapith

"DREAM 2047" has been a good source of inspiration for science education for myself and our students. Your contribution in this regard is highly praiseworthy and notable.

P.C. Rath

433, Molecular Biology Lab. SLS.J.N.U., New Delhi-17  
"DREAM 2047" issue of May, 2003 a rich article on Louis Pasteur was published on that issue. At very first reading I became fond of this magazine. This type of science magazine is very useful and essential for students and general educated people.

Tamojit Saha  
Public School Road, Silchar-5, Assam

# National Dairy Research Institute, Karnal

## Stimulating and participating in the White Revolution

□ Dilip M. Salwi

Before the first Indian woman astronaut Kalpana Chawla shot into fame, the small town of Karnal in Haryana was known more for the only prestigious research institute situated in her bosom – the National Dairy Research Institute (NDRI). Spread over a huge campus of more than 560 hectares of land containing experimental fodder farms, cattle yard, breeding complex, animal health complex, research laboratories and divisions, experimental dairy plant, bio-informatics center, auditorium, administrative complex, guesthouses and housing quarters, it is a place where rivers of milk literally flow! “Today, NDRI is the Deemed University of Indian Veterinary Research Institute, Izatnagar, for dairy studies,” said proudly Dr Nagendra Sharma, Director, N.D.R.I., Karnal, sitting in its posh and well furnished guesthouse, “Our graduate and post-graduate students are watched by national and multi-national companies, like Amul, Nestle, Mother Dairy, etc, and are offered jobs before they complete their courses.” Indeed, today, a white revolution is in progress in the country and NDRI has played one of the major roles in bringing it about over the decades, thanks to the dedicated team of student-trainees, research fellows, extension workers, teachers, scientists and technologists who have been quietly pursuing this field without much recognition and applause.

Today, NDRI, Karnal, is a unique institute catering exclusively to dairy research, technology and development in the country as well as in entire Asia. It has already been recognized as a Center for Advanced Studies in Dairy Cattle Breeding and Dairy Technology as well as in Nutrition, Physiology, Animal Products Technology and Biotechnology. Established by the Britishers at Bangalore in 1923, it was then called ‘Imperial Institute for Animal Husbandry and Dairying’ and subsequently ‘Imperial Dairy Institute’. In 1955,

it was shifted to Karnal at the former Central Cattle Breeding Farm and renamed ‘NDRI’. Today, NDRI has Southern Regional Station at Bangalore, Karnataka, and Eastern Regional Station at Kalyani, West Bengal, and is today an autonomous research institute working under the Indian Council of Agricultural Research. In 1989, it also acquired the status of Deemed University to develop human resources and manpower in dairy development. In recent years, the institute has also made inroads into various related fields, such as, animal products, aquaculture, nutrition and biotechnology and has also reached the rural masses through its various training and extension programmes.

The exemplary research work that brought NDRI, Karnal, into national and international limelight was done in 1990 when the world’s first buffalo calf ‘Pratham’ was born

here through the novel embryo transfer technology developed here. Today, more than 100 calves have been produced through the technology. “To be frank, the western techniques for developing the local livestock does not work here,” said Dr R.S.Manik, the Senior Scientist associated with this newly emerging technology in his sophisticated laboratory of Animal Biotechnology Centre. This embryo transfer

technology has been standardized over the years and is now being used to improve the breed of buffalo in the rest of the country. Earlier, two high milk producing breeds of cattle, called ‘Karan Fries’ and ‘Karan Swiss’, have also been developed by NDRI scientists by crossbreeding and selection. While the national average of milk production of a single cow is about 3 kilograms, these breeds produce on an average 12 kilograms of milk per day!

Apart from improving the milk-producing capacity of cattle and propagating their kind throughout the country, the NDRI scientists have also developed a simple diagnostic kit ‘Praman’ to detect



*The main administrative building of National Dairy Research Institute, Karnal*



*‘Pratham’ – the world’s first buffalo calf born through embryo transfer technology*

pregnancy in buffaloes; developed milk replacer for calves to save milk for human consumption; have evaluated several agro-industrial products for their use as animal feed; studied the nutrient requirements of cattle, buffalo and goat for their optimal health and milk production abilities; studied their methane exhalations and suggested control measures, and found cure for their diseases, such as, Degnala. Besides, the scientists have also developed tests which can detect the mixing of cow milk with buffalo milk, a malpractice common in the countryside.

'Whey-Jal-Jeera', a sour-sweet drink, is the latest milk product under trial at the Experimental Dairy Plant at NDRI. Made of the spicy and digestive 'Jal-jeera' and the nutritious water thrown away as waste when *whey* is manufactured, it is a delightful summer drink. "We put our novel products on trial at our shop 'Dairy Parlour'," said Dr A.K.Sharma, the Dairy Incharge, "From the feedback of our customers, we modify our products to suit their tastes". 'Dairy Parlour' is located right at the entrance of the main gate no.1 of NDRI, where anybody can just walk in and can buy a wide range of milk products developed indigenously by NDRI scientists – from sweet milk, ice cream, lassi, cheese, curd, ghee to khoa, kalakand, milk powder, gulabjaan powder and shrikhand powder. Apart from developing techniques and recipes and their standardization methodologies for a wide variety of each of these products, the Dairy Engineering Division of NDRI has also designed and built machines used for processing of various milk products, namely, ghee, khoa, dewatering of curd, etc, heat exchangers and other equipment for use in dairy industries. Studies on the minimization of dairy waste and their use in other products as well as a source of energy are also in progress.

"Our Experimental Dairy Plant is at present under renovation," remarked Dr U.C.Govil, the Production Incharge of the Plant, showing the huge factory-like yet very neat and clean air-conditioned plant. It was full of huge processing vats, cream separators, milk chillers, conveyor belts and packaging equipment all smelling nice and sweet. He added, "We're updating it as per the ISO-2000 norms". Young boys and girls clad in white aprons were running around and handling equipment. These were the students of B.Tech. who were getting the hands-on training in the plant. Some limited seats

for M.Tech and Ph.D. are also offered at the institute. Besides, NDRI also conducts several short duration diploma courses and workshops in dairy science. With the white revolution at the doorsteps and the rise of dairy industry all over India, the creation of manpower in this much neglected field is one of the mandates of NDRI. Today, NDRI has become a major training center in Asia, where students from countries like Nepal, Sri Lanka, Vietnam, Ethiopia, Holland, Egypt, etc, are trained in dairy science and technology.



*Inside view of the Model Dairy Plant*

NDRI has its own Krishi Vigyan Kendra and Trainers' Training Centre, which act as a go-between the rural masses and the research and development in progress at the institute. Both are working towards integrated rural development in the sense in addition to training the farmers in animal husbandry and dairy through workshops, Dairy Melas, Field Days, Calf Rallies, etc, NDRI scientists are training them in

aquaculture, bee-keeping, agriculture and food-processing. Even some vocational home science courses for rural women are conducted at the Kendra. Every year 1,200 to 1,500 farmers are trained here. In recent times, NDRI scientists have made a breakthrough in aquaculture. Talking about the breakthrough, the Principal Scientist and Chief Training Organiser of the Kendra Dr Jagdish Markanday said, "We've developed a technique which could breed fishes like Catla, Rohu and Mrigal in captivity two months ahead of their scheduled breeding season in northern India". And it is not mere a lab breakthrough. The technique has been successfully utilised in a Haryana village, Butana. A winner of the Swami Sahajanand Saraswati Extension Scientist Award for 1999-2000, Dr Markanday said happily, "A region where fish was once not eaten is now fast becoming a fish-producing one - with additional revenue for farmers!"



*A 'Dairy Mela' in progress, where elements of dairy science and technology are being communicated to the rural masses*

Talking about the future extension programmes of NDRI, its tall and stout-looking Director, Dr Sharma said, "We're planning to

establish Rural Dairy Centres in six villages of U.P. where basic dairy extension facilities, such as, veterinary health cover, artificial insemination, training aid, etc, will be provided at the doorsteps of the farmers". With its various infrastructure and facilities being fast modernized and computerized, NDRI is all set to further stimulate the on-going white revolution in the country.



# Cloves

□ T.V. Vanketswan

The people Maluka island used to plant a clove tree to celebrate the birth of each child and would wear a necklace of cloves as a protection from evil spirit and illness. Though we are not certain as to cloves ability to keep away sprits, cloves that added to your cooking, though chiefly garnished for flavour, in fact, may probably inhibit the growth of pathogen *Escherichia coli* (*E. coli*) and thus protect us from possible food contamination.

Believed to be indigenous to the Malacca or Spice Islands (now called as Maluka), of Indonesia, cloves, small, reddish-brown flower bud of the tropical evergreen tree. Clove, *syzygium aromaticum*, are strongly aromatic and posses a very intensive fragrance; fiery and burning taste. Cloves are an ancient spice and, because of their exceptional aromatic strength, have always been held in high esteem by cooks all over the world. Actually, name *clove*, as well as names in Roman languages, ultimately derives from Latin *clavus* "nail" since the shaft and head of the clove bud resembles a nail. The word made its way to English via Old French *clou*. Buds of Cloves are the most offen used parts, while, essential oil is also produced from the leaves.

The clove tree is an evergreen that grows to about 8 to 12 m in height. Its gland-dotted leaves are small, simple and opposite. The trees are usually propagated from seeds that are planted in shaded areas, and the plant needs lots of water to grow well. It blooms only when it is 5-8 years old and lives for about 80 years. The white buds remain closed turning green then pinkish. The buds, just before the flowers open, are handpicked in late summer and again in winter and are then sun-dried. On large plantations, movable elevated platforms are used. On smaller plots the branches are struck and fallen buds gathered. The collected buds are quickly plunged in boiling water, then dried in the sun or near a fire after which they turn into hard brown nails. If left on the tree, the buds turn a bright red and opens into a fragrant flower. The fruit is a berry with one seed. The fruit doesn't have a strong clove flavour and is not traded commercially. The whole tree is fragrant, including its leaves. A tree may annually yield up to 34 kg of dried buds. Cloves vary in length from about 13 to 19 mm.



Clove plant and its morphology

## Main constituents

The content of essential oil in cloves of good quality may exceed 15%. The oil itself is dominated by eugenol (70 to 85%), eugenol acetate (15%) and  $\alpha$ -caryophyllene (5 to 12%), which together make up 99% of the oil. Cloves also contain about 2% of the triterpene oleanolic acid. Eugenol oil is extracted from clove buds, stems and leaves by distillation.

## Origin

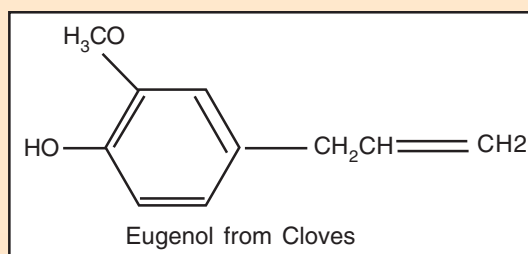
The clove tree is endemic in the North Moluccas (Indonesia) and was cultivated on the islands of Ternate, Tidore, Bacan and the West coast of Halmahera. The Dutch extended cultivation to several other islands in the Moluccas, but only after the end of the Dutch monopoly (18.th century), clove trees were introduced to other countries. Today, Zanzibar and Madagascar are the main producers, followed by Indonesia.

## Spice trade

The clove tree (*Syzygium aromaticum*, or *Eugenia caryophyllis*) is also indigenous to the Moluccas, and they were probably imported from the Spice Islands into China more than 2000 years ago. Cloves were first referred to in Han Chinese literature (206 BC to 220 AD) as "tongue spice" because courtiers were required to hold cloves in their mouths when addressing the Emperor to prevent any undesired smell. Clove flowers were also used to decorate the court. The Chinese obtained cloves directly from the Ternate (an island in Malacca, Indonesia) and today, the island is teaming with Chinese porcelain from this trade. Arab traders brought cloves to Europe in the time of the Romans; they were very expensive. During the late Middle ages, cloves were used in Europe to preserve, flavour, and

garnish food. From the 8th century, cloves became increasingly popular in Europe, and the importation of this coveted spice helped the enterprising Venetians become extraordinarily wealthy. The lure of cloves and nutmeg attracted the Portuguese to the Spice Islands in 1514; the Dutch followed them in 1605. Magellan's fateful circumnavigation of the world (1519-1522) started off with five ships

and over 250 men. Although only one ship and 18 men returned to Spain, nevertheless its cargo of about 50 tons of cloves and nutmeg were considered to have made the expedition a financial success. Cloves and nutmeg were



Chemical structure of Eugenol derived from cloves

among the most precious of items of Europe of the 16th and 17th centuries, and they were worth more than their weight in gold.

Clove cultivation was almost entirely confined to Indonesia, and in the early 17th century the Dutch eradicated cloves on all islands except Amboina and Ternate in order to create administered scarcity and sustain high prices. On the small island of Ternate (9 km diameter), at least 10 fortresses of Portuguese, Spanish, English and Dutch origin can today be visited. In the latter half of the 18th century the French smuggled cloves from the East Indies to Indian Ocean islands and the New World, breaking the Dutch monopoly. Currently, clove trees are grown in such far away places as Zanzibar, Madagascar and Mauritius, as well as in Ternate, Tidore and a couple of other of the northern Spice Islands and in Indonesia.

#### Cloves and cuisine

Cloves are ingredients in many classic spice mixtures. Whole cloves are frequently used to flavour cooking liquids for simmering fish, poultry, game and meat. They feature in

While Indonesia produces most of the cloves consumed in the world, it is rather rarely used in the cuisine except only for sweets. Actually, in whole Indonesia, they are not an important spice. Nonetheless, Indonesians are the main consumers of cloves and use up nearly 50% of the world's production. But, alas!, not for cooking but for smoking: Cigarettes aromatized with cloves (*kretek*) are extremely popular and nearly every (male) Indonesian enjoys them. Their sweet, incense-like aroma pervades Indonesian restaurants, busses, markets and offices !

classic sauces and are used in the bakery industry and the processed meats industry as a ground spice. It is impossible to mention all cuisines where cloves are used; they are much loved by the Chinese; play an important rôle in Sri Lankan cooking. Cloves are extensively used in the Moghul cuisine of Northern India, enjoy high popularity in the Middle East and many Arab countries and are a common spice in Northern Africa. In all these countries, they are preferred for meat dishes; frequently, rice is aromatized with a few cloves. Europeans seem to dislike their strong flavour and use them mostly for sweets, stewed fruits and bread; sometimes, rice is boiled together with one or two cloves. In England, cloves are popular in pickles. Many spice mixtures contain cloves. They form an essential part in the Chinese *five spice powder* frequently appear in *curry powders*, determine the character of the Moghul variant of *garam masala* and are a component of the Arabic *baharat*. The taste of the famous *Worcestershire sauce*, an Indo-British contribution to international cuisine, is markedly dominated by clove aroma.



Corn of cloves

#### Chemistry

2-Methoxy-4-(2-propenyl)phenol ( $C_{10}H_{12}O_2$ ), or commonly called as Eugenol is an important constituent of essential oil of Clove belongs to chemical group Phenols. In fact, Phenols are usually stimulating, bactericidal, and immune boosting essential oils. Phenols are water-soluble and evaporate more quickly than oils that do not contain phenols. Because of their strength they can be irritating to the skin and possibly damaging to the liver.

#### Medicinal properties

Clove bud oil is distilled from the flower buds and is exported by Indonesia. It has a spicy, fruity, warm and sweet aroma. In traditional home remedies, cloves were used for toothache, colds, flu and fungal infections, as a mosquito

repellent, to relieve fatigue and melancholy and also as an aphrodisiac. Eugenol contained in the clove bud, is an effective local anesthetic, and consequently is still used to treat cavities and for dental fillings (e.g., to disinfect root canals). Clove Bud oil has been reported in the scientific literature to have antioxidant, antibacterial and antifungal properties, including against acne, athlete's foot and other skin infections, as well as beneficial activity



Clove tree

supporting the healing of burns, cuts, ulcers and wounds, however it should not be used on damaged or sensitive skin.

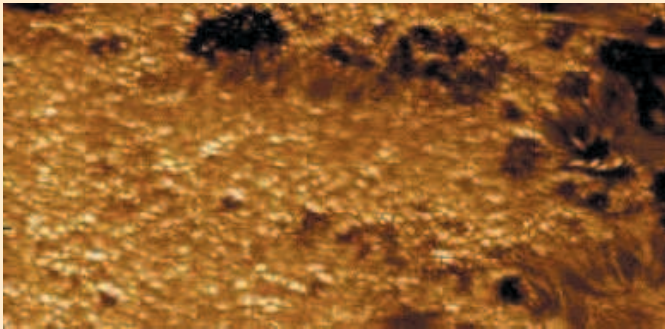
Clove Bud oil has also been shown to have antiseptic, antiviral, larvicidal and vermifuge activity. Excessive quantities of eugenol can cause vomiting and contact dermatitis (itching, blistered skin). But in small quantities, eugenol is a strong germicide and powerful antiseptic. Eugenol is used in mouthwash and toothpaste, and in pomanders to repel insects. Some other strange uses for eugenol include as the base for high quality synthetic vanilla flavouring and to prepare microscopic slides for viewing. Clove oil is also used in perfumes and cosmetics. It is used to treat flatulence, colic, indigestion and nausea.



## Recent Developments in Science and Technology

### Scientists Image Sun's Surface in 3-D

Till now it was known that the Sun surface is even but according to new images taken by astronomers reveal that the Sun's surface to be surprisingly uneven. These images are recently shown at American Astronomical Society's Solar Physics Division in Laurel which are twice as clear as previous images.



Researchers led by Tom Berger of Lockheed Martin's Solar and Astrophysics Lab (LMSAL) in Palo Alto, California, USA, used the Swedish 1-meter Solar Telescope (SST) on the island of La Palma to inspect the visible edge of the Sun, known as the solar limb. Till now it was known that solar surface is flat and have sunspots. New observations show dark sunspots nestled among mountainous 450-kilometer-high peaks. The surface's irregular pattern is made up of so-called granules—formed by the convection of heat—with each granule covering an area the size of Texas (692,405 Sq.km). In addition, the team determined the detailed structure of bright spots on the Sun known as faculae (meaning "little torches"), which can reach between 150 and 400 kilometers in length.

The scientists also collected magnetic data from sunspots and compared it to the new 3-D images. They found that the more intense faculae aligned exactly with the magnetic field, supporting the link between faculae brightness and increased solar radiation during periods of high solar magnetic activity.

Source : *Scientific American*, June 2003

### Skulls of Oldest *Homosapiens* Recovered

Scientists have unearthed in Ethiopia three 160,000-year-old skulls that they say are the oldest near-modern humans on record. Telltale marks on the bones suggest that the hominids engaged in mortuary rituals.

A team led by Tim White of the University of California, Berkeley, Giday WoldeGabriel of Los Alamos National Laboratory and Berhane Asfaw of the Rift Valley Research Service in Ethiopia recovered the fossils near a village known as Herto in Ethiopia's Middle Awash region.. The

researchers found them, together with bone fragments and teeth from seven other individuals, among hippopotamus bones and a variety of blades and other tools. The three skulls—belonging to two adults and a six- to seven-year-old child—share a number of traits in the face and braincase with modern humans. But slight differences in the



morphology convinced the scientists to assign the fossils to a subspecies, *Homosapiens idaltu*. These findings have been reported in *Nature*. Chris Stringer, Natural History Museum in London commenting on the findings wrote that "despite the presence of some primitive features, there seems to be enough morphological evidence to regard the Herto material as the oldest definite record of what we currently think of as modern *H. sapiens*."

Source : *Nature*, June 2003

### Nanotube chip could hold 10 gigabits

A computer memory chip based on carbon nanotubes has passed a manufacturing milestone. The prototype chip which is developed by Nantero company, USA can store 10 gigabits of data

The company says Nanoscale Random Access Memory (NRAM) could hold more data than existing types of RAM and would also be non-volatile that is data would not be lost even after the power is turned off. Computers using such memory could boot up almost instantly. Nantero also claims that NRAM would be much faster than current non-volatile memory, such as Flash.

Nantero is not the only company hoping to use carbon nanotubes to making improved types of computer memory. But the company believes its advantage lies in the fact that its chips can be made using existing silicon manufacturing methods and would therefore be relatively cheap to make .

Source : *New Scientist*, June 2003

Compiled by: Kapil Tripathi

