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Monthly Newsletter of Vigyan Prasar

DREAM 2047

April 2003 *Vol. 5* *No. 7*

VP News

VIPNET regional meeting at Indore

Vigyan Prasar has been organizing a series of Regional level meetings of key activists of Vigyan Prasar Network of Science Clubs (VIPNET) with a view to expand the reach as well enhance the activities. As part of this effort, and with a view to promote VIPNET initiatives in the States in central region, viz, Madhya Pradesh, Chattisgarh, Uttaranchal and Uttar Pradesh, a three-day regional meeting and workshop was held at Indore during March 6-8, 2003. The regional meeting was inaugurated by the Director of the Soyabean Research Centre, Dr. O. P. Joshi. Shri Rajendra Singh, Fellow, Vigyan Prasar, introduced the activities of VIPNET to the audience. Dr. O. P. Joshi chaired the meeting and Dr. Raghu, Dean, University of Agriculture, was the chief guest. Dr. Raghu in his inaugural address recalled his association with the past activities of VP in Madhya Pradesh and lauded VIPNET's efforts to take science to villages. A brief overview of Vigyan Prasar and VIPNET activities was presented by Dr. T. V. Venkateswaran, PSO. Shri J. K. Tripathi and Shri H. S. Shergill also participated in the programme. Subsequent to the inaugural function, technical sessions were held and Dr. O. P. Joshi made a presentation on the theme of 'Nutrition and Food' wherein he highlighted the role played by ICAR and its institutions in making India self-reliant in food sector.

The regional meeting deliberated on issues such as what organizational structure could be adopted by VIPNET and activities that could be taken up by VIPNET clubs keeping in view the local needs. In an inspiring narration on the activities being undertaken by the VIPNET clubs at Ratlam region, it was announced that every school in that district will have a VIPNET club shortly. It was reported that VIPNET clubs in this region have also mobilized community to build water-harvesting masonry in the district, which is well appreciated by the people. Participants of the regional meeting, enthused by the positive experience of the Ratlam VIPNET clubs, discussed about undertaking concerted efforts for locally relevant and low cost activities.

In addition to the discussions on VIPNET activities, Shri Alam from Nature Club, Bihar, introduced the basics and techniques of Hydroponics. An exhibition of VP books was also arranged as well as demonstration of WorldSpace Digital Radio. Ham radio was introduced through a talk. Dr T V Venkateswaran made a presentation on Venus Transit. Participants were also given a brief overview on the method of science reporting for newspapers.

The participants at the VIPNET regional meeting at Indore

About 60 key activists participated in the meeting and it was resolved that each participant would form at least 25 VIPNET clubs in their region. Also, participants expressed their keen interest in taking up massive science popularization efforts built around Venus transit 2004. Delegates from the different states also had meetings and agreed to have better coordination as well as share resources and ideas.

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Inside

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

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At War with SARS

Throughout history, epidemics have been responsible for a sizeable portion of the fatalities suffered by the world. As long as people lived in small groups, isolated from each other, such incidents were sporadic. But, as civilizations progressed, people began clustering into cities. As cities became crowded, they also became nesting places for water-borne, air-borne, insect-borne, and skin-to-skin infectious diseases that spurted out unchecked, and seemingly at will. Today, while some of the dreaded diseases have been either eradicated (say small pox) or effectively controlled (say polio or plague), diseases like malaria, influenza (also known as flu) and gastro-enteritis still continue to haunt us again and again with renewed resistance and severity every time they strike. A few diseases have spread to such an extent that lakhs of people die every year. For example, tuberculosis claims roughly 1500 people every day in India, that is, about half a million every year.

The worst epidemic in the twentieth century was probably caused by the influenza (flu) virus that now-a-days has relatively low chances of fatality if contracted. The worst case of this flu was in 1918 which started during the World War I in USA. It could be better described as pandemic—an infectious disease that affects many people over a large region or continent. Within a few months, most of the 1.5 million American soldiers who crossed the Atlantic to fight the war in Europe carried across the flu virus and infected others when they joined the front line. Further, the microbe mutated as it spread adopting to new environments, and soon moved across Britain, Italy, Germany, France and Spain, and many other regions in Europe. In total around 20 million people were killed by the time the epidemic went into retreat.

We are now on the brink of yet another pandemic with symptoms which are extremely general and non-specific. For want of any specific symptoms, it is called Severe Acute Respiratory Syndrome (SARS), and is a new viral inflection. Like in pneumonia or flu, the illness usually begins with a high fever greater than 100.4^0 F, dry cough, shortness of breath or difficulty in breathing. Some people may get a headache, stiff or achy muscles, rash and diarrhea. High fever is accompanied by cough initially, respiratory distress may occur then, and finally the patient may go into an acute respiratory syndrome and may even die. If appears that close contact with someone who has SARS is necessary to contract the disease; namely when someone sick with SARS coughs or sneezes releasing droplets into the air and someone else breathes them in.

It seems it all started in the Guangdong Province of China with cases of atypical (unusual) pneumonia reported since 16 November, 2002. By the second week of April 2003, China has reported 1418 cases of SARS and 64 deaths, followed by Hong Kong with 1232 cases and 56 deaths. Till the time of writing this editorial (i.e. 15 April, 2003) SARS has spread to 24 countries in four continents with total number of cases being 3235 and 154 deaths. Research attention is increasingly focussing on the hitherto unrecognized coronavirus. Incidentally, coronaviruses are a group of viruses that a halo or crown-like (corona) appearance when viewed under a microscope. They are a common cause of mild to moderate upper-respiratory illness in humans and are associated with respiratory, gastro-intestinal, liver and neurological diseases in animals. They can survive in the environment up to as long as three hours. Viruses from the paramyxovirus and other families are also being considered as scientists cast the widest possible net in their search for the cause for SARS. Indeed, hypotheses include a virus known to cause a disease in an animal host that has jumped the species barrier to infect humans, or a known human virus that has mutated to acquire properties that cause much more severe disease in humans.

SARS being a disease caused by a virus, no antibiotics are effective. Hence patients with SARS are recommended the same treatment as that for atypical pneumonia of unknown cause. Medicines for fever and syrups for cough relief are recommended. Antiviral agents like ribavirin or oseltamivir, and even steroids have been tried, but, their, efficacy remains unproven. Most patients eventually recover from SARS, but about three to four per cent die. It is, therefore, important that the patients must be kept in segregated environments to prevent other people from being exposed to them.

Although the SARS virus has yet not found its way into India, how do we prevent its spill over? Well, probably the most cost effective prophylactic against SARS would be information sharing. Undoubtedly, information sharing is crucial to ward off the coming danger—whether for the health service authorities or the general public. Ignorance only aggravates panic and fear. It was because of ignorance, fear and lack of sharing of information that SARS migrated from Guandong to Hong Kong, Singapore, Thailand, Vietnam, Canada and other countries across the globe. Most countries with occurrence of SARS are dealing with it on a war footing. Besides WHO, Governments of several countries provide excellent and up-to-date information on their websites about symptoms, precaution,

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Thomas Alva Edison

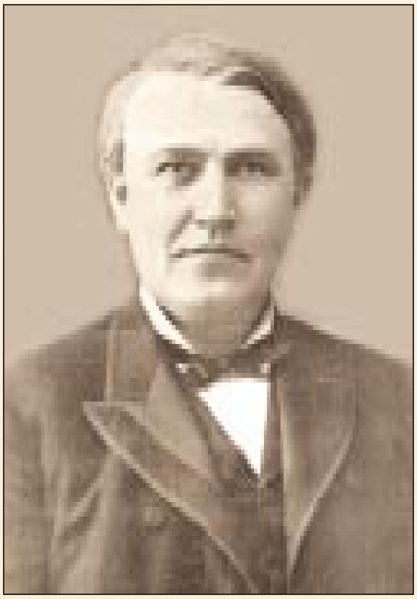
The Wizard of Menlo Park

Subodh Mahanti

> "Proof, Proof! That is what I always have been after; that is what my mind requires before it can accept a theory, as fact."
> Edison
>
> "Opportunity is missed by most people because it is dressed in overalls and lookes like work."
> Edison

Thomas Alva Edison, one of the greatest innovative minds of all time, achieved his greatest success while working at his laboratory and machine shop in Menlo Park, New Jersey and for this reason he was dubbed the "Wizard of Menlo Park". Even in his life time Edison had become a folk hero of legendry status.

Alva Edison, *Life Magazine's* Number One Man of the Millennium is credited with holding 1093 US patents, a record number for one person that still holds. Perhaps Edison is the only person to have patent granted every year for sixty-five consecutive years (1868-1933). Today it is not possible to imagine life without Edison's inventions. He is certainly one of the greatest inventors in history. Among his many inventions included incandescent electric light bulb, phonograph, the motion picture projector, the automatic multiplex telegraph, the carbon telephone transmitter and the alkaline storage battery. When Edison was born there was no electric light but by the time he died, entire cities were lit by electricity. Much of the credit for this goes to Edison. Besides electric light he created and contributed to movies, telephones, records and CDs. All his inventions are sill in use in some form or other. Throughout his life he tried to invent products that everyone could use. His inventions deeply affected the shaping of modern society. Some people go to the extent of saying that Edison single-handedly invented the 20th century. He was the most prolific inventor the world has ever seen. He was tireless at experimentation but always practical and commercial in his goals. Since his childhood he had an insatiable appetite for knowledge and the skill of intense concentration. Edison believed in team work. He could motivate people and encourage creativity. For Edison a person's formal educational qualifications did not matter. What mattered was talent. He chose people he thought were more knowledgeable on a subject than he. He had the uncanny ability to take ideas and put them into practical results. He was never stopped by failure, rather he saw every failure as a success. We are told that he failed 10,000 times in his storage battery experiments. But then Edison said: "Why, I have not failed. I have just found 10,000 ways that won't work". Edison was often able to see possibilities others missed. This was because he never stopped learning. He was always looking for solutions to problems. He simply loved the challenge of inventing. For Edison science was a fun.



Thomas Alva Edison

Edison was born on February 11, 1847 in Millan, Ohio, USA, youngest of seven children born to Samuel and Nancy Elliott Edison. When Edison was seven his family moved to Port Huron, Michigan after his father hired was as a carpenter at the Fort Gratiot military post. Edison lived there till the age of sixteen. Edison had a very little formal education as a child. He attended school only for three months, the only formal schooling he ever had. He was taught reading, writing and arithmetic by his mother, who was a school teacher. Edison's mother encouraged his curious son to learn things for himself. When Edison was nine years old his mother gave him an elementary science book which explained how to do some chemistry experiments at home. Edison not only did all the experiments described in the book but also developed an interest in chemistry. He spent all his spare money buying chemicals from a local pharmacy and he also collected bottles, wires and other items for experiments and he built some kind of a science laboratory in the basement of the family's home when he was 10. In his later life Edison said that his mother was greatly responsible for his success. He taught himself by reading constantly and trying experiments. He never attended any technical school or university. From his parents he developed a test for good literature and history. Before he was 12 he had read works by Charles Dickens (1812-70) and William Shakespeare (1564-1616), Edward Gibbon's (1737-94) *Fall of the Roman Empire and Decline* and more.

Throughout his life he believed in self-improvement. He also strongly believed in hard work, sometimes working 20 hours a day.

It is interesting to note that Edison had been expelled from school as retarded perhaps because of his deafness. No one is really sure how Edison lost most of his hearing. However, one story goes that Edison had began to lose his hearing after having scarlet fever as a young child. It has also been reported that he lost his hearing after being pulled by the ear from certain death from in front of a speeding train. Whatever may be the reason his deafness increased as he grew older until finally he was totally deaf in left ear and had only ten percent hearing in his right ear. Edison once said: "I have not heard a bird sing since I was 12 years old". He did not repent for his deafness. Rather it seems that he saw advantage to being deaf. He was of the opinion that it helped him to concentrate on his work. He once said "Deaf people should take to reading. It beats the babble of ordinary" conversation".

Edison started working at an early age – at 13 he took a job as a newsboy selling candy and newspapers on the local railroad that ran through Port Huron to Detroit. Edison was involved in printing, publishing and selling his own newspaper on a moving train when he was just 15 years old. This newspaper included local news and advertisement for his father's store. While selling newspaper along the railroad, something happened that changed his life. One day on noticing three-year-old Jimmie Makenzie, the son of the stationmaster, wandering onto the train tracks he moved the child to a place away from danger. The boy's father J.U. Mackenzie was so grateful that he taught Edison how to use a telegraph. Edison during 1862-68 worked as a telegraph operator throughout the Central Western States of USA as well as Canada. Throughout this period he constantly studied and experimented to improve the telegraphic equipment. "In 1868 Edison arrived in Boston and where he changed his profession from telegrapher to inventor. He got a job as an expert night telegraph operator. Though he had night duty but he hardly slept during the day. He kept himself busy in experimenting with electrical currents. He worked hard to improve a telegraph machine that would send many messages at the same time over the same wire. He borrowed money from a friend and quit his job to spend all his time in inventing.

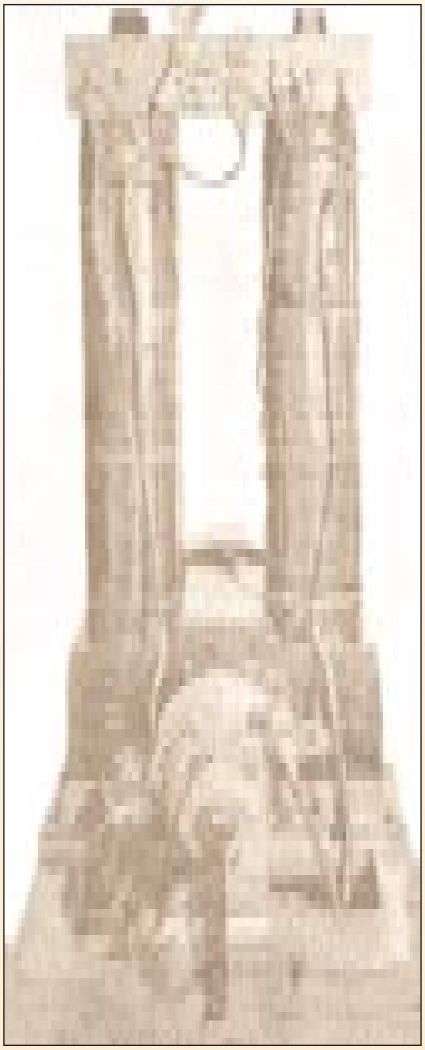
Edison with two of the electric bulbs which in 1880 produced the 'Edison effect' - the outflow of electrons into vacuum from a heated conductor. (Also known as thermionic emission)

Edison moved to New York City in 1869. He had no job or money. A friend let him sleep in a basement office below Wall Street. While Edison was living in this basement he was called in to carry out an emergency repair on a new telegraphic gold-price indicator in the Gold Exchange. He repaired it so well that he was taken as a supervisor to build a better one. Later he remodelled the equipment and subsequently he was commissioned to improve other equipment and his skill became legendary.

Edison's first patented invention was the Electrical Vote Recorder, a device intended to be used by Elected bodies such as the US Congress to speed the election process. This he patented in 1868. Edison could not find a buyer for his first invention. The US Congress did not show any interest in purchasing this as it counted vote too quickly. It is said that Edison vowed not to invent anything unless there was a 'commercial demand' for it or in other words he would only invent things that he was certain to have a market. The first invention that Edison was able to sell was the Edison Universal Stock Printer. This alongwith other related inventions was sold to General Lefferts, the Chief of the Gold and Stock Telegraph company. There is an interesting episode associated with it. Edison felt that his invention was worth US $ 5,000 and he was ready to sell at US$ 3,000 but to his utter surprise Lefferts said, "How would $40,000 strike you?" In later years Edison reported that he almost fainted but somehow he managed to stammer that the offer seemed to be fair enough. The proceeds from this sale enabled Edison to set up his first small laboratory and manufacturing facility in Newark, a city in northeast of New Jersey, on Newark Bay, in 1871. During the next "five years Edison worked at Newark. During this period he invented and manufactured devices that greatly improved the speed and efficiency of the telegraph . In 1876 Edison sold his Newark manufacturing concern and moved to the small village of Menlo Park, 40 km South West of New York City. Here he established the world's first research and development laboratory outside the university system. It had all the equipment necessary to work on any invention and an impressive library. It became a model for later modern facilities such as Bell Laboratories. It is from here that Edison changed the world for ever and it is sometimes considered to be the greatest invention made by Edison.

The first great invention made by Edison at Menlo Park was the Tin Foil Phonograph - a machine that could record and reproduce sound. His original instrument used a cylinder coated with tin foil. The phonograph patented in 1878 is sometimes considered to be the most original invention made by Edison. The machine was assembled by Johan Kruesi and Charles Batchelor based on the sketch prepared by Edison. When the machine was made Edison took a tin foil and wrapped it around the cylinder in the middle and casually said, "This machine is going to talk" and he recited "Mary had a little lamb" into the strange device. Low and behold! To everyone's amazement (even Edison's) Edison's machine repeated the words exactly. In its original version you needed to shout a short message into the piece on one side of the cylinder while you turned the handle. Inside this piece was a needle. Your voice would make the needle shake or vibrate and the sound vibrations would go through the needle and make a line or groove into the tin foil. A needle on the other side would reproduce what you had recorded. The tin foil could not be used for more than a few plays. Later phonographs played records. Early records were in the shape of a cylinder with the music on the outside. Later records were shaped like discs or large CDs. The phonograph created a sensation and brought Edison international fame. He traveled widely with his tin foil phonograph. He was also invited to the White House to demonstrate it to President Rutherford Hays in April 1878. The tin foil phonograph was sold to the public from 1878-80 at prices ranging from US$10 to US$200.

After the phonograph Edison undertook his greatest challenge – the development of a practical incandescent electric light. It may be noted that the idea of electric lighting was not new. In fact before Edison undertook this problem a number of people had worked on it and even developed forms of electric lighting. Inventors before Edison who tried to light the world using electricity worked with two kinds of electric light-arc and incandescent lighting. In electric arc lamp the light is produced by an arc made when current flows through ionised gas between two electrodes. An icandescent lamp is an electric lamp that produces light when a filament is heated white-hot in a vacuum by passing an electric current through the filament. Charles Brush started his arc lighting business in 1877 two years before Edison's breakthroughs with incandescent lighting. But nothing had been developed which could be used in home. The light bulbs developed before Edison burnt out after a few minutes. In his effort to produce electric light Edison studied the entire history of " lighting. He filled 200 notebooks with over 40,000 pages on gas illumination alone. Edison started searching for a suitable 'filament' or wire that would be stable and give good light when electricity flowed through it. To achieve this he sent his people to the jungles of the Amazon and forests of Japan. He tested over 6,000 vegetable growths (baywood, boxwood, cedar, hickory flax, bamboo etc.) as filament material. In 1879 after spending US$40,000 and performing more than 1,200 experiments Edison succeeded. And so there is no wonder that Edison one day would say: "Genius is one percent inspiration and 99 percent perspiration." Edison developed an incandescent lamp with a filament of carbonised sewing thread which burnt for long enough to be of practical value. Edison not only developed a practical incandescent lamp but he also developed an electric lighting system with all the necessary components like dynamos to make the electric power, wires and fuses, electric meters switches to turn the lights on and off and soon to make the incandescent light practical, safe and commercially viable. The first public demonstration of the Edison's incandescent lighting system was in December 1879, when the Menlo Park laboratory complex was electrically lighted. Once this was accomplished Edison tried to create the electric industry. In 1880, Edison started the World's first electric power company in a warehouse at Wall Street, New York. The power station located on Pearl Street in Lower Manhattan started functioning on September 6, 1882 and provided light to the first offices JP Morgan and the New York Times that had been linked by underground wire. He thus invented the electric power system.



Edison's mill dynamo which powered a textile mill in Paisley, Scotland, from 1866 to 1913

Edison worked in Menlo Park for over 10 years. He could persuade some of the richest people of New York like John Pierpont Morgan (1837-1913) and the Vanderbilts to become his business partners. Together they formed the Edison General Electric Light company in 1889. When Edison General Electric merged with its leading competitor Thomson-Houston in 1892, Edison was dropped from the name, and the company became simply General Electric.

In 1887 Edison built a bigger invention laboratory or 'invention factory' in West Orange, New Jersey, where he worked until his death in 1931. It had fourteen buildings and six of which were devoted to the "business of inventing" . It had space for machine shops, glass-blowing operations, electrical power generation and other facilities. It was such a huge laboratory that it not only allowed Edison to work an any sort of project but also allowed him to work as many as ten or twenty projects at once. The entire laboratory and factory complex covered more than 20 acres and employed more than 10,000 people at its peak during first World War (1914-1918). It was at West Orange that Edison improved the phonograph using wax records, the alkaline storage battery, the electric pen, the copy machine, the dictating machine and developed the motion picture camera and silent and sound movies.

Stock ticker - the first invention sold by Edison

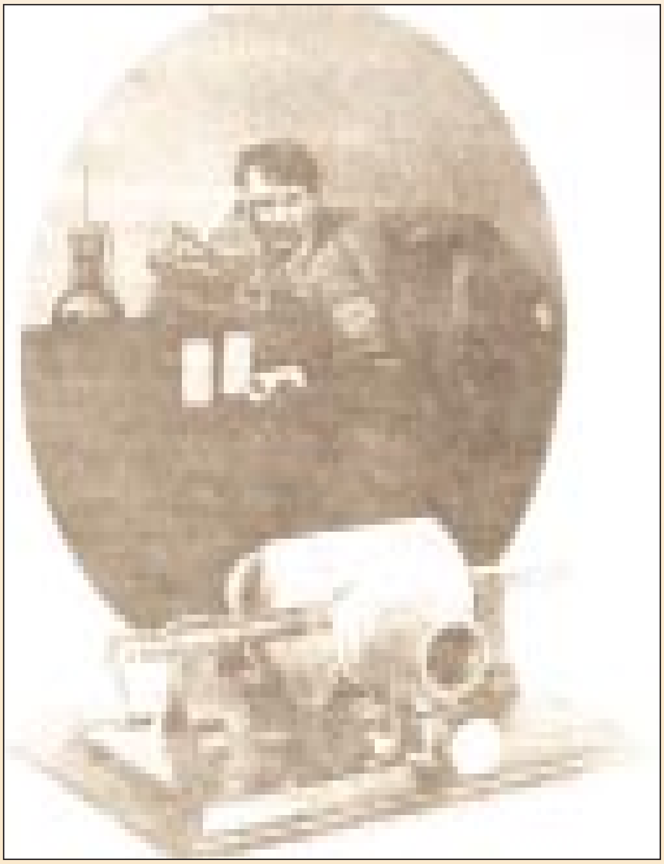
At times one invention may give an idea for another. From phonograph Edison moved to motion picture. In October 1888 Edison wrote: "I am experimenting upon an instrument which does for the Eye what the phonograph does for the Ear.....". Edison and his coworkers, built the strip kinetograph, which was a very early movie camera. The 'strip' was a piece of long, flexible film that had been invented for regular camera which could be wrapped around a wheel or a spool. The strip kinetograph took pictures so fast that they seemed to move. Edison and his coworkers built a Kinetoscope, a machine to watch these movies. The first kinetoscope parlour or movie theater, opened on April 14, 1894 in New York City. Edison also built a stage for filming these movies.

If should be noted here that Edison was one of the inventors of motion pictures. Many other inventors helped find pieces of the puzzle. But Edison put the pieces of the puzzle together. 'Motion' picture do not really move but they only seem to move. In fact a modern movie camera takes still pictures like a regular camera does but it takes 24 of these pictures or frames per second. When one sees these pictures at a very fast rate they look like moving. Edison also connected a motion picture camera to a phonograph so that he could put sound with motion picture. In 1913 Edison introduced the first talking moving pictures.

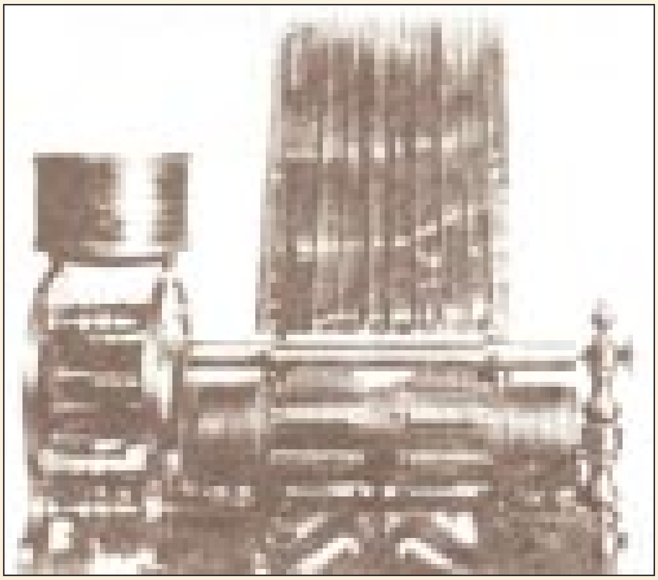
Whatever Edison invented was written down in excellent detail in 3,500 notebooks. Edison's notebooks included laboratory records, early drafts of patent applications, letters, photos of models and so on. A person can see the entire process of invention - the emergences of the finished product from idea through experiments.

Edison applied for his first patent for 'the Electric Vote Recorder', on October 28, 1868 at the age of 21 and his last patent 'Holder for Article to be Electroplated' was filed in 1931 the year he died at the age of 84. The last patent was granted after two years of Edison's death. In 1882 Edison completed 106 successful patent applications. A patent protects any invention that is not common knowledge. An inventor is awarded a patent for his invention only if it is novel or unique. It means inventions should not be described in printed publication before the patent is awarded. Otherwise the inventor might lose the patent application. It may be noted here that one invention may require several patents. Sometimes an invention may have many smaller parts and in such case each part has to be invented and patented separately. Further every time an invention is improved, the inventor must apply for another patent. There are three important steps in obtaining a patent.

* Date of execution when the paperwork applying for a patent is completed and signed by the inventor.
* Date of application--the date the Patent office received the patent application -Date of issue-- when the Patent Office officially awards the inventor a patent for a new invention. Most of Edison's patents were utility patents. A utility patent can cover an invention - product or process-that is electrical, mechanical or chemical in



Edison's first phonograph patented in 1877 nature. He had also a dozen of design patents. Edison both made and lost millions of dollars during his life. Henry Ford (1863-1947), the automobile industrialist said: "Mr. Edison was comfortably well off. He always



Vote Recorder - the first invention patented by Edison

had what he needed. He was not a money maker ... his own portion was mere nothing compared with the wealth he created for the world".

Thomas Alva Edison died on October 18, 1931 at the age of 84. He was experimenting till he died. In tribute to this great inventor electric lights in the USA were dimmed for one minute on 21 October 1931.

In 1956 the US President Dwight D. Eisenhower (1890-1969) made the research laboratory in West Orange, New Jersey, a national monument. In 1962 Edison's home, Glenmont (which had 29 rooms) and his West Orange Laboratory Complex were renamed the Edison National Historic Site.

At the end it should be emphasised that Edison was basically a problem solver and he had scant respect for ideas for thier own sake. To quote -Time-magazine (December 31, 1999). 'His inventions not only reshaped modernity but also promised a future bounded only by creativity'.

For Further Reading

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Letters to the Editor

I am reading your unique and interesting magazine “Dream-2047” for last 2-3 months. I found this magazine very informative and full of knowledge specially for students. I am a student of B.Sc. I think your magazine is very different from others. Feb 03 issue was full of information. The editorial “A Blueprint of life” and the article “Fifty years of the Double Helix” were very good.

Naresh Kumar
2834/2 Jagadhuri Gate, Ambala

I always read the ‘Editorial’ in every issue. It is very interesting for me. Sir, I want to request you kindly, if possible, publish one topic about ‘Green House Effect’ in “Dream-2047”.

Sailen Kalita, Co ordinator
Child Science Forum, Makhibaha, Assam – 781 374

Monthly Newsletter of Vigyan Prasar, “Dream-2047” offers full satisfaction to our students and teachers about new scientific information.

Librarian,
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I became very excited with joy when I received the newsletter “Dream-2047” on 7th January 2003. It was the first message and first prize of new year 2003 for me.

S.N. Hussain Bukharie
R/o Midoora The. TRAL,
Distt. Pulwama (Kmr), Jammu & Kashmir

The November 2002 issue of “Dream-2047” was really wonderful. It helped in creating interest among the children and teachers who love science. The article on ‘Meghnad Saha’ was inspiring to the children. Equally interesting was the article on ‘Neutrinos and X-ray sources’. Its language was simple enlightening and thought-provoking.

Sumita Dey, Principal
Army School, Bhuj Cannt, Kutch (Gujarat)

“Dream-2047” stands out among other magazines of a pride for myself. I read about Satyendra Nath Bose in the January 2003 issues. It has been presented quite well.

Anil Jyoti Buragohain
Rhino Eco Club, Rajabahar
Rajabahar ME School , Jorhat, Assam – 785631

Fuzzy Logic

❒ Kinkini Dasgupta Misra

" So far as the laws of mathematics refer to reality, they are not certain. And so far as they are certain, they do not refer to reality".

Albert Einstein

We deal with lots of imprecise and uncertain information in our day-to-day communication. We often encounter many qualitative and subjective words and phrases such as "quite expensive", "very young" "pretty fast" and so on in our conversation. When we process such information, we apply an approximate reasoning and we accommodate varying degrees of imprecision and uncertainty in the concepts and information that we deal with. Fuzzy logic is a powerful problem solving methodology with a great number of applications in embedded control and information processing. Fuzzy logic provides a remarkably simple way to draw definite conclusion from vague, ambiguous or imprecise information. Fuzzy logic resembles human decision making with its ability to work from approximate data and find precise solutions.

Classical or Boolean logic has two values or states often expressed as 'yes or no', 'true or false', 'on or off', '0 or 1' which require a deep understanding of a system, exact equations and precise numeric values. Yet in the real world we know that there are many situations where events are not black or white but some shades of gray. Fuzzy logic is a continuous form of logic that allows us to describe the shades of gray.

Fuzzy logic deals with uncertainty in engineering by attaching degrees of certainty to the answer to a logical question. Why should this be useful? Commercially, fuzzy logic has been used with great success to control machines and consumer products. In the right applications fuzzy logic systems are simple to design, and can be understood and implemented by non-specialists in control theory. Fuzzy Logic has been gaining increasing acceptance during the past few years. There are over two thousand commercially available products using fuzzy logic, ranging from washing machines to high-speed trains. Nearly every application can potentially realize some of the benefits of fuzzy logic, such as performance, simplicity, lower cost, and productivity. .

The Beginning

The term Fuzzy logic was first introduced and coined by Prof. Lofti A. Zadeh in 1960 at University of California, Berkeley, USA. But his early work on developing the concept was severely criticized by many of his colleagues in the field and did not gain much acceptance in the scientific community. By the early 70's some European researchers have started applying fuzzy logic and made successful implementation of it in industrial process and control. In the 1980's, Japanese researchers became interested in it and the Japanese government and academic institutions as well as the big Japanese firms were involved not only in fuzzy logic R&D but also in the mass marketing of fuzzy logic based products. This resulted in widespread use of simple fuzzy logic components to control various home appliances such as washing machines and rice cookers. Even the bullet trains of Japan made use of such technology. In the year 1987, the first subway system was built which worked with a fuzzy logic based automatic train control system in Japan.

In the early 1990s, major European companies realized that they had almost lost another key technology to the Japanese. Major efforts were made to produce numerous fuzzy logic based applications and launched many successful products. It was only in the 1990s when many US companies, who are in big competition with Europe and Asia, gained interest in fuzzy logic. This has made fuzzy logic come to full circle: US, Europe, Japan, Europe, US.

Although fuzzy logic originated in America, some scholars claim that fuzzy logic has remained essentially an eastern philosophy and phenomena. The explanation offered by some people argues that eastern philosophy, as expressed in Buddhism is more compatible with the notion of fuzziness than the European tradition of Aristotle. 300 years B.C., Greek philosopher Aristotle came up with binary logic (0,1), the law of bivalence, which is now the principle foundation of mathematics. Two century before Aristotle, Buddha had the belief that contradicted the law of bivalence (0,1) and sees the world as it is with concept of certain degree. He stated that a rose, could be a certain degree of completely red, but at the same time could also be at a certain degree not red. Bart Kosko, a pioneer in fuzzy logic, said, "My claim is that Buddha was really the world's first fuzzy theorist". This concept of certain degree of multivalence is the fundamental concept, which propelled Zadeh Lofti to introduce fuzzy logic.

In India, much research is being carried out in various scientific institutions and universities. A Centre for Study, Research and Applications of fuzzy logic has been set up in Kolkata. The Indian Statistical Institute in Kolkata has a separate centre and group doing very high level theoretical research in the area of fuzzy logic and neural networks. They have acquired a tremendous capability in image processing applications of fuzzy logic and neural network and claimed out research in the application of these to medical field. There are many other universities and institutions like IITs, Defence Research Development Organisations (DRDO), Indian Institute of Science, National Council for Software Technology (NCST) which are carrying out basic research concerning aspects of machine intelligence, pattern recognition, natural language understating, artificial neural networks etc. Machine intelligence signifies the work associated with attempting to make a machine behave like human beings.

Fuzzy Logic Concept

Many decision-making and problem-solving tasks are too complex to be understood quantitatively, however, people succeed by using knowledge that is imprecise rather than precise. Fuzzy set theory resembles human reasoning in its use of approximate information and uncertainty to generate decisions. It was specifically designed to mathematically represent uncertainty and vagueness and provide formalized tools for dealing with the imprecision intrinsic to many problems. By contrast, traditional computing demands precision down to each bit. Since knowledge can be expressed in a more natural by using fuzzy sets, many engineering and decision problems can be greatly simplified.

Fuzzy set theory implements classes or groupings of data with boundaries that are not sharply defined (i.e., fuzzy). Any methodology or theory implementing "crisp" definitions such as classical set theory, arithmetic, and programming, may be "fuzzified" by generalizing the concept of a crisp set to a fuzzy set with blurred boundaries. The benefit of extending crisp theory and analysis methods to fuzzy techniques is the strength in solving real-world problems, which inevitably entail some degree of imprecision and noise in the variables and parameters measured and processed for the application.

The concept of fuzzy logic controls is based on the "fuzzy estimation" or "chunking" human thinking rather than precise mathematical computation. A control system based on fuzzy logic has the following advantages: 1) It is easy to implement since it uses "if-then" logic instead of sophisticated differential equations; 2) It is understandable by people who do not have process control backgrounds; and 3) Software and hardware tools are readily available for applying this technology.

A fuzzy expert system consists of four components namely, the fuzzifier, the inference engine, and the defuzzifier, and a fuzzy rule base.

A fuzzy controller works similar to a conventional system: it accepts an input value, performs some calculations, and generates an output value. This process is called the Fuzzy Inference Process and works in three steps illustrated in Figure 1: (a) Fuzzification where a crisp input is translated

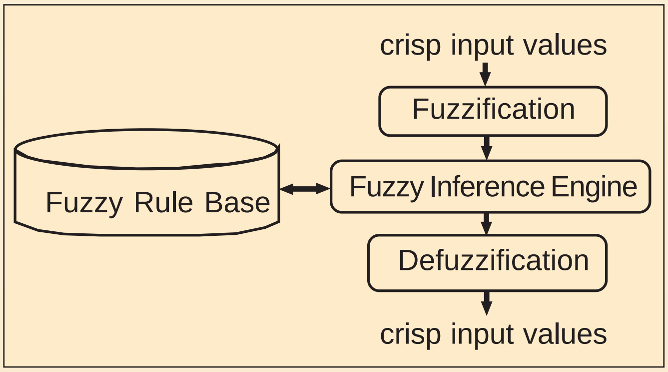

Figure 1: Fuzzy Expert System Model

into a fuzzy value, (b) Fuzzy Rule Base, where the fuzzy output truth values are computed, and (c) Defuzzification where the fuzzy output is translated to a crisp value.

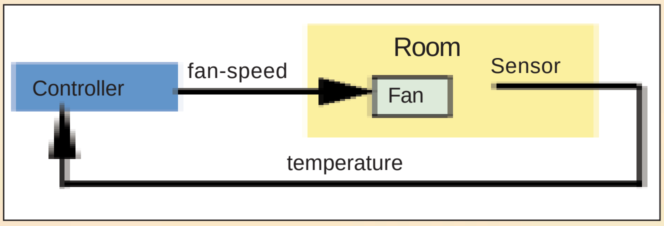

Figure 2: A Simple Temperature Controller

In order to illustrate some basic concepts in Fuzzy Logic, consider a simplified example of a thermostat controlling a heater fan illustrated in Figure 2. The room temperature detected through a sensor is input to a controller, which outputs a control force to adjust the heater fan speed.

A conventional thermostat works like an on-off switch (Figure 3). If we set it at 78º F then the heater is activated only when the temperature falls below 75º F. When it reaches 81º F the heater is turned off. As a result the desired room temperature is either too warm or too hot.

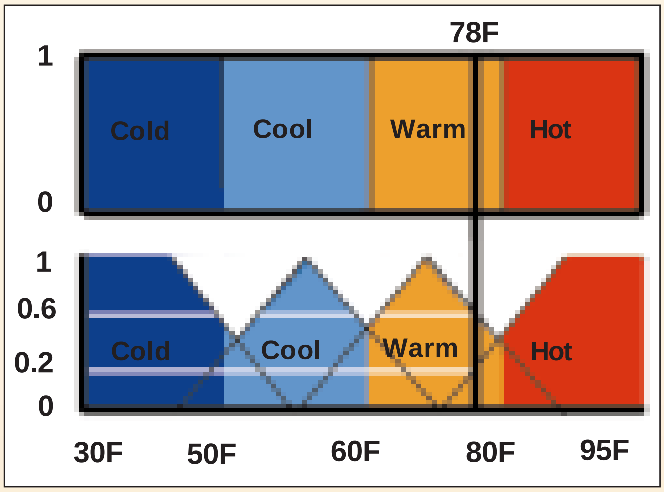

Figure 3: Conventional and Fuzzy Sets

A fuzzy thermostat works in shades of gray where the temperature is treated as a series of overlapping ranges. For example, 78º F is 60% warm and 20% hot. The controller is programmed with simple if-then rules that tell the heater fan how fast to run. As a result, when the temperature changes the fan speed will continuously adjust to keep the temperature at the desired level.

The first step in designing such a fuzzy controller is to characterize the range of values for the input and output variables of the controller. Then the labels are assigned such as cool for the temperature and high for the fan speed, and a set of simple English-like rules to control the system are written. Inside the controller all temperature regulating actions will be based on how the current room temperature falls into these ranges and the rules describing the system behavior. The controller's output will vary continuously to adjust the fan speed.

Here during fuzzification step, the crisp temperature value of 78º F is input and is translated into fuzzy truth values of 60% for warm and 20% for hot. During the rule evaluation step the entire set of rules for temperature control is evaluated. The rules are given below. For 78º F, only the last two of the four rules will fire i.e. using third rule the fan speed will be low with degree of truth 60% and using fourth rule the fan speed will be zero with degree of truth 20%.

IF temperature IS cold THEN fan-speed IS high

IF temperature IS cool THEN fan-speed IS medium

IF temperature IS warm THEN fan-speed IS low

IF temperature IS hot THEN fan-speed IS zero

Here the linguistic variables cool, warm, high, etc. are

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Omar Khayyam

The Genius who Stitched in the "Tents of Science"

❐ P.K. Mukherjee*

A great Persian Poet

Omar Khayyam is known to us as a great Persian poet of medieval times (600-1500 A.D.), who composed many romantic and mystic poems known as *Rubaiyat*. His contributions to astronomy and mathematics are now largely forgotten. However, in his own days, the scenario was just the reverse; he earned more name and fame for being an astronomer and mathematician rather than a poet. Before delving with his achievements in the fields of astronomy and mathematics it will be worthwhile to know something about his *Rubaiyat*.

Omar Khayyam

Omar's *rubai* or quatrain is, in fact, a four-line verse whose first two lines are like the major and minor premises of a syllogism in logic, that state the indisputable truths. The third line of his *rubai* states either a moral dilemma contradicting the accepted position, or a conclusion from the premises. The fourth line merely repeats the conclusion, however with greater emphasis.

The verses of Omar Khayyam, which were translated into English in 1859 by Edward Fitzgerald, state the human situation that our life is brief; we have only a short time on Earth and will never return. This is amply reflected in the following verse (as translated by Fitzgerald) which reads:

The dawn is here; arise my lovely one
Pour the wine, but slowly, and touch the lute,
For those who are here will not stay long
While those departed never will return,

The mortals, according to Omar, should therefore enjoy the God's gifts while they may. These gifts are, above all, love of a beautiful woman and the power to forget the mudane strifes and worries, if only temporarily, by wine.

It is remarkable that, in spite of the fanaticism of religious orthodoxy, Omar was able to write of such matters in a sceptical and rationalist vein. There is no evidence to the effect that he shared his thoughts with anyone or that he felt the need for such support.

Ironically, however, Omar's *Rubaiyat* failed to generate any interest among the people of medieval times. This was largely because the literary tastes of Persia were quite different in those days. This most surely have pained Omar. But, the silver lining was that he did enjoy good reputation for being an outstanding astronomer and a mathematician.

Stitching in the "tents of science"

Omar Khayyam (his full name was Gheyas ud-Din Abu al-Fath Omar Ibn Ibrahim al-Khayyami) was born in 1048 at Khorasan, in the capital city of Nishapur or Nysabur (Now in Iran). Interestingly, a part of his name 'al Khayyami' means 'the tent maker' May be this happened to be the profession of his distant ancestors. But his immediate forefathers certainly belonged to the literary profession. As far as Omar was concerned he wanted to be described as "Khayyami who stitched in the tents of science." It will be worthwhile to find out how much "stitching" could Omar do "in the tents of science."

The noted science historian George Sarton, in his book *Introduction to the History of Science*, has described Omar as "One of the greatest mathematicians of medieval time." Not only this, to recognize his contributions to other branches of science, Sarton named a part of the Middle ages, viz., the second half of the 11th century, as "The time of Omar Khayyam."

When Omar was hardly 22, he got the invitation of the Sultan Shams ul Muluk of Bukhara to grace his royal court. He was made the courtier and was offered a seat next to the royal seat. However, he quit Bukhara in 1074 when he was invited by Sultan Jalaluddin Malik Shah, the ruler of his own homeland Khorasan.

Omar's work on astronomy

Omar was made the in-charge of the royal observatory built by Sultan Malik Shah at Isfahan (some scholars however raise a dispute regarding the exact location of the observatory saying that it was probably in Nishapur or a place called Ar-Rye). Working in the observatory, Omar prepared a star catalogue enlisting a hundred odd bright stars, their positions, relative Luminosities etc. This catalogue, Zij-i-Malik Shah, named after his royal patron, was based on Omar's own and Babylolian observations.

Omar is, however, best known for devising a new calendar, Tarikh-i-Jalali. In Persia, a solar calendar was originally in vogue. However, after its conquest by Muslims, the Islami lunar calendar, based on the phases of moon, was introduced. This lunar calendar, which takes into consideration the rites and rituals of the Muslim, allowed only 354 or 355 days in a calendar year. It is, therefore, highly unsatisfactory so far as keeping the track of time, specially with reference to the changing seasons, is concerned.

At the instance of Sultan Malik Shah, Omar carried out the reform in the then existing lunar calendar. The revised calendar took the mean length of the year to be 365.24242 days and was introduced in 1079 A.D. The Omar's calendar, it may be mentioned, surpassed the Julian calendar (that considered the year length to be 365.25 days) and was close to the Gregorian calendar (year length being 365.2425 days) in accuracy.

It is a pity that Omar's caldendar was shunned soon after the death of Sultan Malik Shah which took place in 1902. The death of his royal master also changed Omar's fate. The

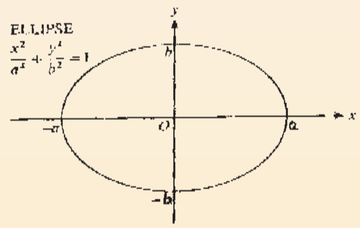
Sultan's widow incited by her advisers, who accused Omar of holding skeptical and rationalist views, took the decision of closing down the observatory. Even she stopped paying him the salary. It was indeed a hard time for Omar. However, to convince the widowed Sultana that he was a sound Muslim believer, he performed the pilgrimage to Mecca. This yielded the desired result and Omar was, therefore, reappointed by the Sultana.

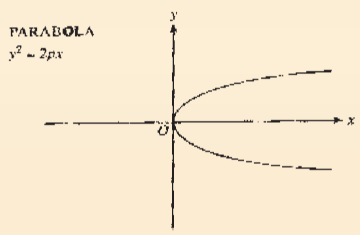
It is interesting to note that Omar used to cast horoscopes for his royal master on his request. He was, however, quite, skeptical about the ability of such horoscopes to predict the future. But, he was not averse to predicting the weather for the Sultan who needed this information to decide about the days best suited for hunting.

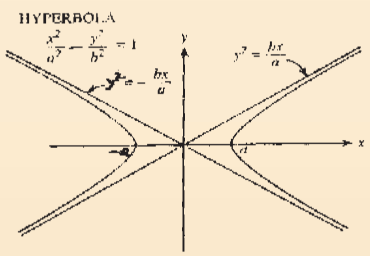
While in the royal court of Sultan, Omar also wrote on philosophy (in the course of which he disagreed with Aristotle) along with Islamic law, history and medicine. Of these, a few pieces of philosophy have only survived.

Omar's work in the field of algebra

Omar was also in Smarkand for some time where he wrote a book on algebra. Later, he wrote a commentary on Euclid and a treatise on the methods of finding square roots and other roots of numbers. Although his commentary on Euclid has survived the treatise has been lost for good. However, the techniques of finding the roots of numbers appearing in this treatise were actually borrowed by Omar from the works of Hindu mathematicians for which he also expressed his indebtedness.







Omar's most distinguished work was however, in the field of algebra. When Omar began his work, arithmetic and algebra were still not clearly distinguished. This was notwithstanding al-Khwarizmi's book on algebra that was already about 400 years old. Omar made the formal distinction of defining algebra as the use of equations to find the unknown numbers by means of complete polynomials (the work 'polynomial' refers to the expression that involves letters as symbols and that may involve more than one power of these letters.)

Omar blatantly disagreed with the Greek's refusal to recognize irrational numbers (which are not expressible as fractions, one like the square root of 2) as numbers per se. His unique contribution, however, was to recognize 25 types of equation as against 6 types of al-Knwarizmi.

Omar studied various types of cubic (third-degree) equations and gave a list of those which have positive roots. His approach was, however, mainly geometrical and involved taking intersections of conics. These could be represented by quadratic equations, which stood for such geometrical figures as the circle, ellipse, parabola, and hyperbola; or solid bodies such as the cube, dodecahedron and tetrahedron.

Let us take, for example, the following cubic equations:

$$X^3 + ax = b$$

Where a and b are both positive numbers.

Omar converted the above equation in the standard form

$$X^3 + p^2 x = p^2 q$$

$$(\text{where } p^2 = a,\ q = b/c)$$

This was then split by Omar in terms of two quadratic equations that respectively represented a circle and a parabola:

$$X^2 + y^2 = q^2 \text{ (circle)}$$

$$X^2 + py \text{ (parabola)}$$

To show how Omar's method actually works we take a cubic equation of the form

$$X^3 + 4x = 16$$

We begin by putting this in the Omar's standard form

$$X^3 + 2^2 x = 2^2 4$$

This gives us the values of p and q as 2 and 4 respectively. This tells us that the circle and the parabola have respectively the quations

$$X^2 + y^2 = 4x$$

$$X^2 = 2y$$

We now draw graphs of the two geometrical figures as shown in Fig. 1. As can be seen the two figures intersect at the points x=y=0 and x=y=2/ . So, these are the possible solutions of the two equations. However, as x=y=0 cannot be a solution to the original cubic, x3+4x = 16, the sought for solution is x=y=2. Thus, x=2 is a solution to the cubic equation.

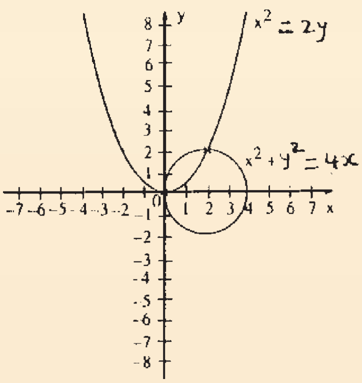
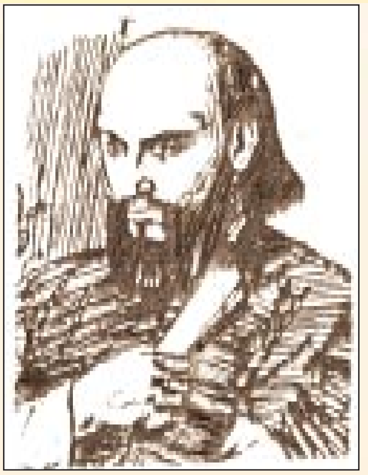


Fig-1

Omar Khayyam gave methods for solving other types of cubic equations too. The general method used by him was to put the equation in one of his standard forms. For instance, the cubic x3+a = bx can, in Omar's scheme, be solved by combining the parabold $x^2=y\sqrt{}\,b$ and the hyperbola $x^2-(a/b)\ x = y^2$

Omar fully understood that a cubic equation may have more than one root or solution and that one of the solutions could be negative as well. However, he showed no interst in such solutions. To Omar, negative numbers were impossible to deal with and even to conceptualise and, therefore, they have no role in problem solving. This is strange as, in drawing graphs of conic sections, one has to use both positive and negative numbers; and their intersections may also automatically lead to negative roots. But, Omar just failed to appreciate the point. He also failed to recognize that if it is possible to divide borth sides of the cubic by the unknown x (thus converting it into a quadratic), this meant that x=0 was also a root.

Omar Khayyam also extensively used the binomial theorem in his book on algebra. As is well known this theorem was discovered by Newton. The coefficients of the expanded polynomial $(a+b)^n$, where n is a whole number, can be obtained from the successive horizontal rows of the well-known Pascal's triangle that was once very popular in Europe. It is not clear whether Omar reinvented this theorem or borrowed it from others. Incidentally, the Chinese mathematician Chu Shi-Chieh is known to have derived an algorithm for finding the coefficients of the expanded polynomial $(a+b)^n$.



Omar Khayyam

A satisfied and contended soul

Some scholars of history of mathematics are of the view that if Omar had only gone a little farther in his mathematical pursuits he could have made niche for himself, particularly in two important branches of modern mathematics, namely analytical geometry and non-Euclidean geometry. In the process, say the scholars, he could have got much more applause from posterity. However, Omar was a versatile man with multifaceted personality. Mathematics was only one of his loves. He, in fact, loved to delve in many diverse fields.

This made him write on history, philosophy, medicine and a host of other subjects including geography, mineralogy, physics, and chemistry. Had he channalised his is efforts in a particular branch, he could have been more lauded and recognized for his work. But, this was not to be as Omar was a man of different mettle. It seems that more or less he was a contended soul although he remained a bachelor throughout his life.

Omar breathed his last in 1122 in his hometown Nishapur. At the time of his death he was holding in his hands a book written by Abu Ali Ibn Sina (980-1037 A.D.). The latter was a reputed physician of his time known for his magnum opus *Al Quanum* (The cannon of Medicine) which, until the birth of modern medicine, remained the standard text in the world of medicine.

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labels, which refer to the set of overlapping values shown in Figure 3. These triangular shaped values are called membership functions

In the defuzzification step the 60% low and 20% zero labels are combined using a calculation method called the Centre of Gravity in order to produce the crisp output value of 13.5 RPM fro the fan speed.

Conclusion

Fuzzy logic is an important emerging technology and is undoubtedly becoming one of the most successful of today's technologies for design and development of complex control systems. Fuzzy logic has found many applications in diverse fields such as pattern recognition, image and signal processing, hardware design and artificial intelligence, expert and decision support systems, business and social studies and so on. Fuzzy logic has been used in fuzzy controllers which are widely used in control applications including refrigerators, washing machines, welding machines, cameras and robots; Fault and failure diagnosis, image processing, pattern classifying, traffic problems, collision avoidance, decision support, project planning, fraud detection and in conjunction with neural nets and expert systems.

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and preventive care of SARS. As of today, no Indian website (other than Vigyan Prasar) is providing detailed information on SARS. Well, let us not be caught unawares. Since the symptoms of SARS are extremely general or non-specific, it is possible that it is confused with other ailments. This is a risk which is much higher in countries such as India where levels of awareness are low, and where ordinary viral fevers with similar symptoms are prevalent. Indeed, we already have had a precedent. The first case of AIDS was detected in India in 1986. Thanks to the inadequate medical infrastructure and lack of information, AIDS infects some four million people in the country today.

SARS has already spread to North America, Europe and Australia. Some countries, including India, have started screening passengers coming by international flights, especially those coming from China, Singapore and Vietnam. But, just exactly where else and how quickly SARS would strike are questions one cannot answer. Countries like India with a lack of medical infrastructure and low levels of public awareness face the greatest risk from the disease that resembles ordinary fevers and which can spread on close contact. What is required is the knowledge and awareness about how it spreads and what people need to do to protect themselves. Needless to say, media need to be utilized to the fullest extent. In addition, seminars should be organized to spread awareness at every level, and discussion groups formed. Indeed, SARS is spreading with the speed of jetliners. Let us not be complacent. Let us be fully prepared lest we find ourselves at war with SARS.

❒ **V. B. Kamble**

Transits of Mercury and Venus

N. Rathnasree*

A good number of celestial events beckon us even in the day time. Most of these are various forms of hide and seek that celestial bodies play and most daytime events have something to do with the Sun. Solar eclipse is one event that immediately swims into one's ken, of course, when we think of daytime celestial events. The other events are similar - Solar System bodies moving across the face of the Sun - the only possibilities are the two inner planets Mercury and Venus or an asteroid that wanders inside the orbit of the Earth.

On an average, there are 13 transits of Mercury each century. In comparison, transits of Venus are very rare, occurring in pairs, with more than a century separating each pair. More specifically, pairs of them occur separated by 8 years, but the pairs are themselves separated by either 105.5 years or 121.5 years. Only six such events have taken place, since the invention of the telescope - in 1631, 1639, 1761, 1769, 1874 and 1882. Obviously, the thrill of watching a Venus transit will be much more - no one currently alive has so far seen one! To prepare us for the event next year, there is an upcoming Mercury Transit - on the 7th of May 2003 to be followed by the Big Event - Transit of Venus across the face of the Sun - on the 8 June, 2004.

The most exciting event during the month of May 2003 will be the transit of Mercury that will be visible on the morning of the 7th. The last time a Mercury transit was visible from some regions on Earth, had been during November 1999, and was visible from parts of Australia, but not from India. The last transit of Mercury, visible from India had been during November 1993. What exactly is a transit anyway? It is not very different from an annular eclipse of the Sun which would be visible this same month - an Annular Eclipse of the Sun takes place when Moon is at a relatively farther distance from the Earth, in its elliptical orbit around the home planet. At such times the disc of the Moon does not cover the disc of the Sun fully and at the time of the maximum eclipse, an outer ring of the sun remains un-eclipsed.

The discs of the planets Mercury or Venus, as seen from Earth, are much smaller than that of the moon, of course. Therefore they make no more than a small black dot when they move in front of the face of the Sun. With every transit, depending on the geometry involved, this dot may traverse a different path across the face of the Sun. You will see that Ingress - the point of entry of the Solar disk, for Mercury and Venus is always from the east and exiting on the western edge.

The plane of the Earth's orbit round the Sun is known as the ecliptic. Since we are on the Earth, the ecliptic is the apparent path followed by the Sun through the stars. The orbits of other planets round the Sun are tilted at small angles to the ecliptic and hence planets will usually be either above (north) or below (south) the ecliptic. Transits of the Sun will occur if the inferior conjunction occurs within a day or two of the date at which the planet crosses the ecliptic.

All transits of Mercury take place within several days of either May 8 or November 10. Since Mercury's orbit is inclined seven degrees to Earth's, it intersects the ecliptic at two points or nodes which cross the Sun each year on those dates. If Mercury passes through inferior conjunction at that time, a transit will occur. During November transits, Mercury is near perihelion and exhibits a disk only 10 arc-seconds in diameter. By comparison, the planet is near aphelion during May transits and appears 12 arc-seconds across. However, the probability of a May transit is smaller by a factor of almost two. Mercury's slower orbital motion at aphelion makes it less likely to cross the node during the critical period. November transits recur at intervals of 7, 13, or 33 years while May transits recur only over the latter two intervals. The next Mercury transit will be a November transit again and it will not be till the year 2006.

Anyway, so much for technicalities. What exactly is in store for us this May? First let us concentrate on the upcoming Mercury transit. If you wish to have a look at Mercury, before the transit, try spotting it on the 2nd of May. Towards early morning hours on that day, it has a close encounter with the crescent Moon straying barely 2 degrees away from it, in the sky. Mercury is rather elusive, fluttering close to the Sun, always. The best times to spot it are when it is either close to Venus or the Crescent Moon, in the evening or morning skies.

If you do glimpse it in the morning skies on the second of May, make an appointment to meet it again on the 7th. You can see it in broad daylight on this day. On the 7th of May, 2003, exactly at 10:42:56 IST it will pop across the eastern limb of the Sun at first contact, as a small black dot, traverse the entire face of the Sun, westwards from this point, and disappear on the western edge, at 4:01:46 PM IST. These are contact times as seen from the center of Earth. The actual contact times will differ, by a very little, from place to place.

There are four important points of time, during the transit, that astronomers would like to measure. These are called 1st, 2nd, 3rd, and 4th contact. 1st contact, which is very hard to observe, is the point in time when Mercury first touches the disk of the sun. 2nd contact is the time at which Mercury is fully engulfed within the sun's disk. 3rd contact is when the disk of Mercury just begins to leave the face of the Sun, and 4th contact is when the disk of Mercury has just completely left the sun's disk. Every location on earth had it's own contact timings. Figure 1 clarifies these concepts.

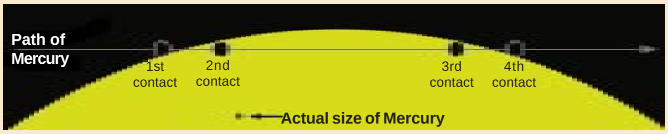


Fig. 1

The actual path of the planet, across the disk of the Sun will not really appear so straight. Figure 2 shows the way the motion would appear as Mercury moves across the disk of the Sun during the May 7 Mercury transit. Figure 3 is a view of

Mercury just before the third contact, during the Mercury Transit of November 1999.

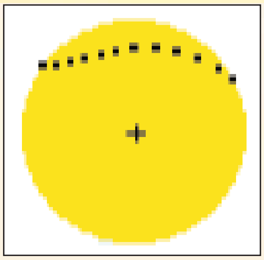


Fig. 2

In 1609, the astronomer Johannes Kepler (1571-1630) demonstrated mathematically that planets move around the Sun in elliptical orbits. On the basis of his calculations, Kepler predicted that a transit of Venus would occur on 6 December 1631. Pierre Gassendi, who was familiar with Kepler's Astronomical tables, observed a transit of Mercury that happened in November of the same year (also predicted by Kepler). However the Venus transit of that year, was not visible from Europe and no expeditions had been organized to observe it from elsewhere.

Fig. 3

By 1639, Jeremiah Horrocks, an English cleric and astronomer, reworked Kepler's calculations and concluded that transits of Venus occurred in pairs spaced eight years apart roughly every 120 years. Horrocks and his friend William Crabtree observed the 24 November 1639 transit, and, from these observations, Horrocks calculated the Earth-Sun distance as about 56,000,000 miles (90,123,000 kilometres).

Edmund Halley also realized that transits could be used to measure the Sun's distance. Kepler's laws gave relative distances between all the planets and the Sun, but, the absolute distances were not known. Halley did not live to see Venus transits in his lifetime, but, his efforts gave rise to many expeditions in 1761 and 1769 to observe the transits of Venus which gave astronomers their first good value for the Sun's distance from Earth.

Captain Cook had observed a transit of Venus from Tahiti in June of 1769 and one of Mercury from Mercury Bay in New Zealand in November of the same year, during his exploration of the coastline of New Zealand. In fact, the first trip of Captain Cook, in the Endeavor, had been commissioned for the observations of the 1769 venus Transit from Tahiti.

In India too, there had been some observations of transits, but, unfortunately, no rigorous measurements, to have been of much scientific value. The earliest recorded use of telescope in India was by an Englishman, Jeremiah Shakerley. He was one of the earliest followers of Kepler and viewed the transit of Mercury in the year 1651 from Surat. He could, however, time neither the ingress nor the egress.

Observations were planned from Pondicherry, for the Venus transit of 1761 by Le Gentil of France. He set out on a long sea voyage to India, in order to be in time for this transit. Unfortunately, Britain and France were at war during this period and when he was about to land in Pondicherry it had been taken over by British forces and he was forced to change his course leading to his observing of the 1761 transit from the sea under conditions that were not conducive to doing accurate measurements. He planned to stay on for the June 3rd 1769 Venus transit and spent the time in studying the flora and fauna of these regions. Tragically, he was prevented from observing this event due to clouds that moved in front of the Sun just during the transit!

However, there were several successful observations of the 1761 and 1769 transits, from widely separated locations, geographically. Observers had to be sent to widely separated places on the World map because, the longer the baseline between them, the more accurate would have been the calculated Earth-Sun distance.

Merucry transits are frequent. All mercury transits visible in this century are listed below (time in UTS):

TRANSIT	starts	at	7	May	2003	5:11
	ends	at	7	May	2003	10:36
TRANSIT	starts	at	8	Nov	2006	19:12
	ends	at	9	Nov	2006	0:12
TRANSIT	starts	at	9	May	2016	11:11
	ends	at	9	May	2016	18:45
TRANSIT	starts	at	11	Nov	2019	12:35
	ends	at	11	Nov	2019	18:06
TRANSIT	starts	at	13	Nov	2032	6:41
	ends	at	13	Nov	2032	11:09
TRANSIT	starts	at	7	Nov	2039	7:17
	ends	at	7	Nov	2039	10:18
TRANSIT	starts	at	7	May	2049	11:03
	ends	at	7	May	2049	17:48
TRANSIT	starts	at	8	Nov	2052	23:54
	ends	at	9	Nov	2052	5:08
TRANSIT	starts	at	10	May	2062	18:16
	ends	at	11	May	2062	1:01
TRANSIT	starts	at	11	Nov	2065	17:25
	ends	at	11	Nov	2065	22:51
TRANSIT	starts	at	14	Nov	2078	11:43
	ends	at	14	Nov	2078	15:43
TRANSIT	starts	at	7	Nov	2085	11:44
	ends	at	7	Nov	2085	15:30
TRANSIT	starts	at	8	May	2095	17:22
	ends	at	9	May	2095	0:55
TRANSIT	starts	at	10	Nov	2098	4:37
	ends	at	10	Nov	2098	10:01

Charles Mason and Jeremiah Dixon were chosen by the Royal Astronomical Society of England, to study the 1761 Venus Transit from Sumatra. However, an attack by a French frigate found them at the Cape of Good Hope during April of that year, it being too late for them to sail for Sumatra. They, did observe the transit successfully from the Cape of Good Hope. Alexandre-Gui Pingré observed the 1761 transit from Madagascar.

Captain Cook and Sir Joseph Banks made successful observations of the 3 June, 1769 Venus transit from Tahiti. Chappe d'Auteroche, had observed the 1761 transit from Siberia and was sent by the French government to observe the 1769 transit from Baja, California. Chappe d'Auteroche was successful in observing the transit, but, the expedition ended in tragedy later when many of its members including Chappe d'Auteroche contracted fever and died. John Bevis was a Physician and Amateur Astronomer who had discovered the Crab Nebula. In 1769 he observed the Venus Transit from Richmond and published his observations in Philosophical Transactions.

William Crawford observed the 1874 transit from Mauritius.

Ernst Emil Becker of the Berlin Observatory made observations of the 1874 transit from an expedition to Isaphan. The first scientific observations made by the Yale Heliometer, in its time, the largest in the world, were of the 1882 Venus transit.

A transit will start and end at slightly different times when viewed from different places on the Earth. By timing the events from various places on the Earth and the "parallax" involved in these measurements, the distance to the Sun can be determined. More accurate methods are available now, but careful measurements in the 18th and 19th centuries gave distances to within 1% of that currently accepted.

The paths across the face of the Sun, taken by Venus, during the 18th and 19th Century Transits, as well as the paths that will be taken during the two upcoming transits, are shown in Figure 4.

During the June 2004 transit, the entire event will be visible from all of Asia, except the extreme eastern portion, Africa except the western portion, Europe except Portugal and Western Spain, Greenland except the southern portion, and most of the Indian Ocean - that is, about half the globe will be able to see this event, together. A Caution - DO NOT TRY TO LOOK AT THE DISK OF THE SUN DIRECTLY, THIS COULD LEAD TO BLINDNESS - the only safe way of viewing this event will be to project the image of the Sun on to a screen and view the projection. One will need a moderate aperture telescope to be turned towards the Sun and its image projected on to a screen (Figure 5), preferably some darkening provided around the projection area.

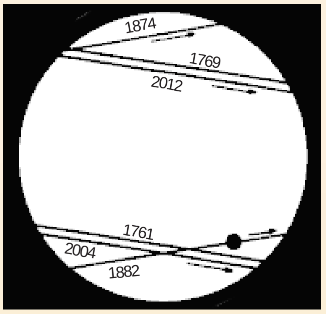
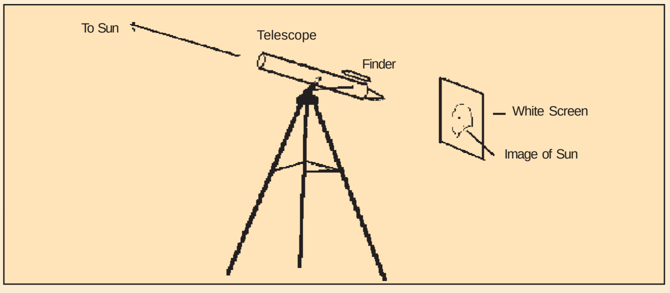


Fig. 4

Using such a projection equipment, at other times, you can view sunspots on the disk of the Sun. Try with the sunspots first, to get a feel for setting up the projection apparatus, and then make your appointment with the Sun and Mercury, on the 7 May, 2003, and of course the Sun and Venus on the 8 June, 2004!



If you are now ready with your telescope and projection apparatus, you will need one additional equipment before you can set out to do useful observations of the coming transits. You will need a very accurate clock - the best possible accuracy you could achieve would be if you own a GPS receiver. But, do not despair even if you do not own one. A stop clock with 1/100 second accuracy would be a reasonably adequate tool for these measurements. By accurately measuring the timings of the four contacts (as defined above) and submitting your observations to one of the world wide centers co-ordinating these observations, you can take part in a world wide effort to measure a fundamental distance unit, underlying all cosmic distance scales - the Astronomical Unit - the distance between the Earth and the Sun. We know the answer - it should be 149,597,870 km, but, these are efforts to reproduce these results, accurately, from students' measurements.

What is the geometry underlying this calculation?

What we need to do, if we wish to calculate the exact Earth Sun distance, is to estimate what is called the Solar Parallax. What is this quantity? It is the angle subtended by half a diameter of the Earth at the Sun(Figure 6). If this angle and the Radius of the Earth can be estimated, we can use simple trigonometry to calculate the Earth Sun distance.

How does one estimate the Solar Parallax?

To determine the length of the chord followed by Venus during transit exactly, time of Ingress and egress must be measured accurately. In making this estimate, it is necessary to make corrections, not only the motion of the Earth and Venus in their orbits, but also the rotation of the Earth. Similar observation is taken from another latitude on the Earth with both stations separated as much as possible. For both the stations, the chords followed by the transitting Venus would be obviously different. Using geometry, and Kepler's laws of planetary motion, it is then possible to determine the perpendicular distances between the two chords both in minutes and kilometers. This would also tell us how much 1 arc second corresponds to in terms of kilometers at the distance of the Sun. It is then easy to deduce the solar parallax leading to the Sun - Earth distance (1 AU) in terms of kilometers.

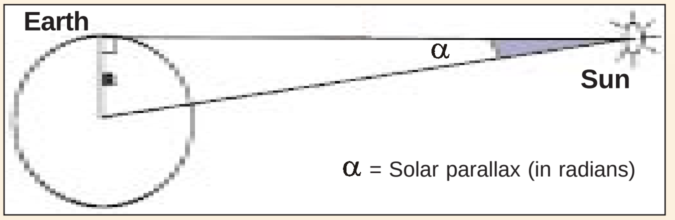


Fig. 6

This then, was the excitement that underlay all the expeditions in the 17th and 18th centuries to observe Venus transits. The outcome involved was of paramount importance and hence all out national efforts from England, France and later from America. Now we know the Earth Sun distance accurately and yet, there is still the thrill of participating in all out global efforts to remeasure this historic quantity and participate in Global togetherness through scientific efforts! So keep your rendezvous with Mercury in May 2003 and with Venus in 2004 and 2012!

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Useful URLs

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http://www.lunar-occultations.com/iota/2004venus/2004venus.html
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http://www.jcu.edu.au/aff/history/southseas/biogs/P000085b.htm

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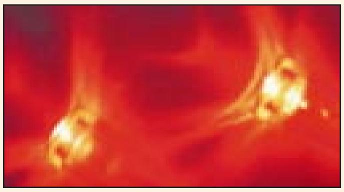
Recent Developments in Science & Technology

Red Light Saves Sight

Till now it has been known that accidental ingestion of methanol, a common ingredient in antifreeze and windshield wiper fluid, can cause blindness within two days. Researchers believe that formic acid, a product of methanol metabolism, effect a victim of sight by attacking the mitochondria of cells in the retina and optic nerve. Now the results of a rat study published in the Proceedings of the National Academy of Sciences suggest that shining red light on affected eyes may stave off methanol's blinding effects.

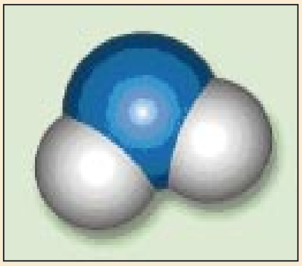


Janis T. Eells and her colleagues at the Medical College of Wisconsin exposed both control rats and animals that had ingested methanol to a red light-emitting diode (LED) in a process known as photobiomodulation. Ells' found that irradiation treatments promoted the recovery of retinal function and prevented damage to photoreceptor cells in the poisoned animals. The light caused no damage to the eyes of the control rats. The results indicate that light in the far-red to near-infrared spectral range can help wounds heal more quickly and stimulate growth in cultured cells.

Source : Scientific American, March 2003

Water Activates Compound's Superconductivity

Scientists are continuously on the lookout for new superconductors materials that conduct electricity perfectly in the hopes of finding ones that operate at ever-higher temperatures. The first substances found to facilitate resistance-free electron flow did so only at temperatures around absolute zero. The subsequent discovery that certain copper oxide ceramics can superconduct at higher temperatures gave researchers a new avenue to explore. Ever since then, they have been investigating oxides containing metals similar to copper. According to a report published in Nature, it seems that some of these oxides should have come with the instructions "to make a superconductor, just add water."



Kazunori Takada and his colleagues at the National Institute for Materials Science in Ibaraki, Japan, started with a compound comprising layers of cobalt oxide with sodium ions sandwiched between them. The team found that when water was added to the mix, the resulting thick layer of sodium ions and water molecules led to superconducting behavior. But although the superconducting properties of the water- mix cobalt oxide and copper oxide ceramics are quite similar, the temperature at which they perform the trick is not. Whereas copper oxide ceramics remain superconducting to temperatures in the tens of kelvins, the cobalt compound had a critical temperature of 5 kelvins. The scientists say they need further studies to determine the mechanism behind the newly discovered superconductivity, but they hope that the novel material represents a class of superconductors whose properties can be modified by changing the characteristics and spacing of their component layers.

Source : Nature, March 2003

Scientists See Sand's Future

People who live near sea have noticed that sometimes the beach is big and sandy, whereas other times it seems to have all but disappeared. For years scientists have understood how waves during violent storms suck sand offshore. How it reappears on beaches once the stormy seas have passed, however, remains a mystery, and without that information, accurately predicting beach evolution had been impossible. However, now it seen that predicting beach evolution is possible.

Nearly a decade ago, Steve Elgar of the Woods Hole Oceanographic Institution (WHOI) set up a series of floating pressure gauges, sonar devices and water velocity meters on a beach in Duck, N.C., in an attempt to determine what changes in wave action bring sand back onshore. For two months he measured the changing currents and sand distribution from a point on the shoreline out to a water depth of five meters. Based on those measurements, Elgar and Fernanda Hoefel, a graduate student at the Massachusetts Institute of Technology and WHOI, have spent the past few years developing a mathematical model that accounts for changes in wave velocity and predicts sandbar migration. Their model is the first to accurately anticipate observed changes in onshore and offshore sandbar movements, and it did so successfully over 45 days.

Scientific American. March, 2003

GM blood kills human cancer cells

Scientists have revealed that genetically modifying a patient's white blood cells turns them into potent cancer killers .The team modified T-cells of the immune system's which is able to destroy cancer cells in test tube experiments. Both the cell types were taken from patients with advanced bowel cancer. The technique had destroyed the cancer cells in every experiment so far, says team member Robert Hawkins, a medical oncologist at Cancer Research UK's Paterson Institute in Manchester Hawkins. The effectiveness of the new treatment will next be assessed in about 30 advanced bowel cancer patients, starting next year. White blood cells will be taken from the patients, genetically modified, and then transfused back into the patients. The body's immune system effectively fights off many diseases because it recognises the bacteria or viruses that cause them as foreign. However, because cancerous cells are rogue versions of a patient's own cells, the body fails to recognise them as dangerous: "There's still a long way to go in the development of this new technique, but it does seem to hold promise for the treatment of cases which are out of reach of conventional medicine.

Source : New Scientist, March 2003

Compiled by: Kapil Tripathi