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DREAM 2047

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VP News

Vigyan Rail — on the move

Vigyan Rail was stationed at Delhi Safdarjung Railway station from 15-21 December 2003 after being flagged off by Shri Atal Bihari Vajpayee, Hon'ble Prime Minister of India, on 15 December 2003. Nearly 25,000 people visited the exhibition during this period. Some 25 schools brought their students to have a look at the exhibition.

Visitors flock Vigyan Rail at Kathgodam

The first halt of Vigyan Rail was Chandigarh, where it was stationed during the period 22-24 December, 2003. The exhibition was inaugurated by Shri Arun Kumar, Deputy Commissioner, Chandigarh. Over 30,000 people visited Vigyan Rail during its halt at Chandigarh.

Vigyan Rail was at Ambala during the period 25-27 December 2003. Shri M.L. Kaushik, Additional Deputy Commissioner, Ambala, inaugurated the exhibition. Over 60,000 people visited Vigyan Rail at Ambala. The exhibition was widely covered by electronic and print media. Next halt of Vigyan rail was at Haridwar. Over 30,000 people visited Vigyan Rail during its halt at Haridwar from 28-29 December 2003. Heavy fog, however, delayed the arrival of the train at Haridwar by nearly six hours. Due to heavy rush, exhibition had to be kept open up to 2000 hrs instead of 1900 hrs.

After Haridwar, Vigyan Rail travelled to Dehradun where it was stationed from December 30, 2003 to January 02, 2004. Mrs. Manisha Pawar, District Magistrate, Dehradun inaugurated the exhibition. Dehradun, witnessed a heavy rush of visitors. Some 1,00,000 people visited the exhibition there.

Vigyan Rail reached Kathgodam on January 3, 2004 and was stationed there up to January 5, 2004. Mrs. Indira Hirdesh, Minister of Public Works, Uttaranchal, inaugurated the exhibition. Mrs. Hirdesh stated that the Vigyan Rail was an effective medium to reach the masses to spread awareness on science & technology. Some 1,00,000 people visited the exhibition at Kathgodam. The event was widely covered by electronic and print media.

Engrossed – School students visiting Vigyan Rail at Chandigarh

Inside

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

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Editor : Dr. V.B. Kamble

Quest for Excellence

Vigyan Prasar wishes its readers a very happy, prosperous and peaceful 2004.

The year 2003 was remarkable for several landmark discoveries and achievements in Science and Technology. Scientists unearthed in Ethiopia three 1,60, 000 year old skulls that they say are the oldest near-modern humans on record. The new find lends support to the so called Out of Africa hypothesis, which states that Homo Sapiens arose as a new species between 150,000 and 200,000 years ago in Africa and subsequently replaced archaic humans such as the Neanderthals. Researchers developed a super-sticky adhesive modelled on the foot of gecko lizard that grips even the slipperiest of surfaces. As it turns out, the sole of the gecko foot is covered with millions of submicron hairs that apparently stick the animal to the substrate by way of intermolecular van der Vaals forces. NASA's Wilkinson Microwave Anisotropy Probe helped compile a full sky map that reveals our universe in its earliest stages pinpointing the age of the universe at 13.7 billion years. Astronomers detected thousands of light years away in the globular cluster known as M4 the most ancient planet yet known orbiting a binary system with a mass 2.5 times that of Jupiter. A foal born in Italy earlier in the year and named Prometea was the first successfully cloned horse. Another exciting story reported related to the landmark experiment through which the speed of gravity was measured for the first time confirming Einstein's predictions that gravity travels at the speed of light. We celebrated the 50th anniversary of the discovery of the double helix structure of DNA by James D. Watson and H. C. Crick, and a hundred years of powered flight by Orville and Wilbur Wright. China's great leap into space towards the end of the year was yet another landmark. The year 2003 also marked 75 years of the discovery of Raman Effect.

If there were triumphs in the year gone by, there were tragedies too. On 01 February, 2003, the crew of seven astronauts of the Space Shuttle Columbia was lost when it exploded on re-entry when they were only sixteen minutes from home. One of them was Kalpana Chawla, who dreamed stars, but did not return home. The outbreak of SARS (Severe Acute Respiratory Syndrome) in several countries that migrated from the Guangdong province of China caught the entire world off the guard. However, it taught us a lesson. Information sharing is crucial to ward off the coming danger. It was because of ignorance, fear and lack of sharing of information that SARS migrated from China to several countries across the globe. The war in Iraq brought about great upheavals in the world order, and a devastating earthquake in Iran claimed over 30,000 people razing to the ground the historic city of Bam.

It is important to realize that many tragedies can be avoided or their effect mitigated by sharing information and spreading awareness among the people about the environment - both physical and social – and development of a scientific outlook. Incidentally, scientific awareness and scientific outlook have been emphasized in the Science and Technology Policy released in 2003. Further, in view of the changing economic and social scenario, we need to deliberate on the complex issue of scientific awareness and scientific outlook all afresh and evolve a suitable strategy and ways and means for its implementation. This demands excellence at every stage – say, conceptualization, planning, coordination and implementation. May be this is why the focal theme of the 91st session of the Indian Science Congress held in Chandigarh during 3-7 January 2004 was "Science and Society in the 21st Century: Quest for Excellence", and the year 2004 declared as the Year of Scientific Awareness.

Quest for excellence does not necessarily imply huge investments in terms of money. Indeed, excellence can be achieved even with very limited resources. Excellence implies encouragement to experiment, freedom to tinker around, think freely and express oneself without fear. We need a conscious, systematic and a sincere effort to achieve "excellence" in our schools and universities. Let us make this "heaven of freedom" available to our children in our homes, schools and universities. Coming years then would bring more triumphs than tragedies.

❒ V. B. Kamble

Editor : **V.B. Kamble**

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The Sun

❒ V. B. Kamble

The transit of Venus will take place on June 08, 2004 and will be seen throughout the country. This article is the first in the series of articles on Venus Transit. The material appearing in this article is compiled from various sources. Since, it is the Sun we need to observe to study planetary transits, we begin the series with an article on the Sun. The resource persons, depending on the level and interest of the participants, may cull out the necessary information for the training programmes on Venus Transit. We have heavily drawn on a chapter with the same title from the book titled "Our Solar System", authored by A.W. Joshi and the Late N.C. Rana. We hope the articles in this series would serve the purpose of satisfying the need as resource material. This article was written for the training programmes related to Total Solar eclipse of 1999. It is being reprinted here with a few modifications.

Editor

The Sun is the nearest star and the source of most of the energy which we need and consume on the earth. It is a huge ball of gas. Due to very high temperature, there is no material in the Sun in the solid or liquid form. It is a fireball with a diameter of nearly 1.4 million km. Its angular diameter is about ½° of arc. Its temperature at the core is about 15 × 10^6 Kelvin. Its surface is at a relatively lower temperature, about 6000 Kelvin.

Salient Physical Features

When the Sun's disk is totally covered by the moon (as it happens during a total solar eclipse), one can see a faint halo around the Sun. This is called the solar corona, or the solar atmosphere (Fig.1).

Fig. 1 : Solar corona visible during a total solar eclipse

The principal physical characteristics of the Sun are summarized in Table 1. The density of the Sun's core is about 150 gm/cm^3, i.e. it is about 150 times heavier than water when measured on earth. This happens due to the high gravitational compression of the Sun leading to a very high pressure, density and temperature in the core.

The mass of the Sun is estimated to be approximately 2 × 10^{30} kg., which works out to nearly 333000 times that of the Earth.

The Sun rotates around itself once in about 25 days. Since it is not a solid body (it is gaseous), its different parts rotate with different speeds. There are times when the Sunspots (cooler and hence darker areas on the surface of the Sun) could be seen using a solar filter. By noting the shift of their positions on a day-to-day basis, one can easily convince oneself that the Sun is in fact rotating about its own axis. The axis of rotation of the Sun is inclined to the plane of the ecliptic by about 83°, that is inclined to the normal to the plane of the ecliptic by about 7°. The Sunspots are described later in the article. **Never look at the Sun with naked eye, it could cost you your eye-sight.**

Structure and Composition

Unlike the earth, the Sun is gaseous throughout and so does not have any solid surface. The structure of the Sun can be thought of as a series of concentric spherical shells or layers, each characterized by a unique combination of physical processes. At the center of the Sun is the nuclear burning core, as illustrated in Fig.2. Traveling outward, one encounters first the radiative zone, then the convection zone, then the photosphere, the chromosphere, the transition zone, and finally, the corona. All of these regions are powered by a nuclear burning core from which energy is transported outward through successive layers by radiation and convection. The temperature is 15×10^6 K, in the core and decreases monotonically outward to a minimum of approximately 4 ×10^3 K in the chromosphere. The transition from radiative to convective energy propogation occurs in the region in which the temperature drops below 2×10^6 K, whereby convection becomes a more efficient transport mechanism than radiation. This defines the boundary between radiation and convection zones.

The innermost layer of the Sun that can be observed in visible light is called the photosphere. The photosphere is more luminous than the optically thin outer portions of the solar atmosphere and defines the size of the Sun as observed in visible light. The height, temperature, and density of various layers of the solar atmosphere are given in Table 2.

The atmospheric layer that lies just outside the photosphere is the chromosphere. The visible emissions from the chromosphere are over-powered by the full light of the photosphere when observed without special filters and are blocked by the moon during the totality of a solar eclipse. They are, however, visible with the unaided-eye as a flash of red light just before totality. This red light, known as H_α

Table 1: Principal physical characteristics of Sun

Characteristics	Value
Mean distance from Earth (one astronomical unit)	$(1.4960 + .0003) \times 10^8$ km
Radius	$(6.960 + .001) \times 10^5$ km
Mass	$(1.991 + .002) \times 10^{33}$ g
Mean density	$(1.410 + .002)$ g/cm^3
Surface gravity	$(2.738+.003)\times10^4$cm/sec^2 (28 × terrestrial gravity)
Total energy output	$(3.86 + .03) \times 10^{33}$ erg/sec
Energy flux at surface	$(6.34+.07)\times10^{10}$erg/cm^2 (sec)
Effective surface temperature	$5780^0 + 50^0$ K
Stellar magnitude (photovisual)	– 26.73 + .03
Absolute magnitude (photovisual)	+ 4.84 + .03
Inclination of axis of rotation to ecliptic	7^0
Period of rotation	About 27 days. The Sun does not rotate as a solid body: it exhibits a systematic increase in period from 25 days at the equator to 31 days at the poles.

Table 2 : Characteristics of the Solar Atmosphere

Region	Height above of photosphere (Km)	Base Temperature (K)	Density (atoms/m^2)
Photosphere	0-320	6500-4500	$10^{23} – 10^{22}$
Chromosphere	300-2000	4500-28000	$10^{21} – 10^{16}$
Transition zone	2000	10^5	10^{16}
Corona	7×10^6	1.8×10^6	10^{12}

Table 3: Major elements on the Sun

Element	Percentage by mass
Hydrogen (H)	70.52
Helium (He)	27.57
Oxygen (O)	0.96
Carbon (C)	0.31
All other elements put together	Less than 1%

emission, is emission at a wavelength of 656 nm due to an atomic transition in hydrogen (1nm=10^{-9} m). Prominences are large-scale chromospheric features with an arch-like structure, visible in H_α at the edge of the solar disk against dark sky. Because these structures absorb light from the underlying photosphere, they appear as dark features when observed on the solar disk. (Fig. 2)

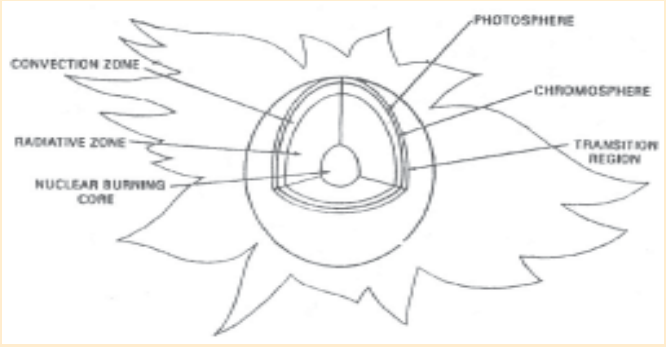

Fig. 2 : Inner layers of the Sun, with the solar corona in the background

Perhaps the most puzzling feature of the outer solar atmosphere is its temperature structure. Instead of a continued decrease in temperature with distance outward, an increase is observed. The gradual increase observed in the chromosphere becomes a steeply rising increase in the transition zone, so named for the abrupt change in the thermal gradient. The temperature continues to rise well out into the corona. While this temperature increase in the corona appears to violate the elementary thermodynamic principle that a body cannot supply heat to a hotter body without external work being done, the paradox is resolved with the understanding that the photosphere heats the corona from the non-thermal source of energy stored in its magnetic fields. Two mechanisms are thought to be involved: One is currents generated by changing magnetic fields; the other is magnetohydrodynamic waves. The relative importance of these two mechanisms is presently the subject of intensive investigation.

What elements is the Sun made of?

In specifying the chemical composition of the Sun, one can be at leaset 98% correct by saying “Hydrogen and helium”. In spite of the fact that these are the two lightest elements in the periodic table, this statement is true not only for abundance by number of atoms but also for abundance by weight. The next most abundant elements, in decreasing order, are oxygen and carbon (Table 3). The rest comprise less than 1% of the Sun by weight and less than 0.03% by number. It may be of interest to note that the element Helium was discovered on the Sun during spectroscopic observations of the solar corona during the event of total solar eclipse in 1968 from the tobacco fields of Guntur in Andhra Pradesh. It may also be interesting to note that Helium was discovered much later on the Earth, in the year 1895 to be precise!

Fig. 3 (A) : Sunspots on the surface of the Sun. The lower figure is the magmified view of the sunspots observed in the upper one

What is the source of energy in the Sun?

The Sun has been shining for about 5 billion years radiating 4×10^{26} watts of power, and may continue to shine for another 5 billion years! How does the Sun (or any other star) produce such vast amounts of energy? According to current belief, a star contains mainly hydrogen, some helium and a small fraction of other chemical elements. Incidentally, the composition of an average star is like that of the Sun.

The large mass of the Sun results in a high gravitational pull and gives rise to a high pressure at the centre. This can be balanced on by the temperature in its central parts becoming high, (say, about 15×10^6 k). At such high temperatures, hydrogen nuclei get converted into helium nuclei. This is called a thermonuclear reaction. Four hydrogen nuclei get fused to form a helium nucleus in this reaction releasing vast amounts of energy. Hence it is also called a fusion reaction.This fusion reaction in the core of the Sun converts about 4.25 million tonnes of hydrogen into helium every second! This is the mechanism responsible for the energy produced in the Sun, or in any other star.

Hydrogen in the Sun is depleted every moment and helium is formed. When the hydrogen in the Sun will get exhausted, there will be no more fusion and the Sun will stop supplying the energy it now does. This would mark the death of the Sun (and also of the Earth!). When the hydrogen supply is exhausted, it would swell, become cooler and expand to become a red giant. The Sun will probably grow to about 250 times its present size taking in Mercury, Venus and Earth in the process. Then it will get small again, turning atoms of helium into heavier atoms, releasing further energy. The Sun would grow so small that finally all its matter will be packed into space not much larger than the Earth, it would then be called a white dwarf. With the passage of time, the white dwarf will stop shining and finally become a dead black dwarf. It is believed that the Sun has existed for about five billion years and will continue to exist for another ten billion years.

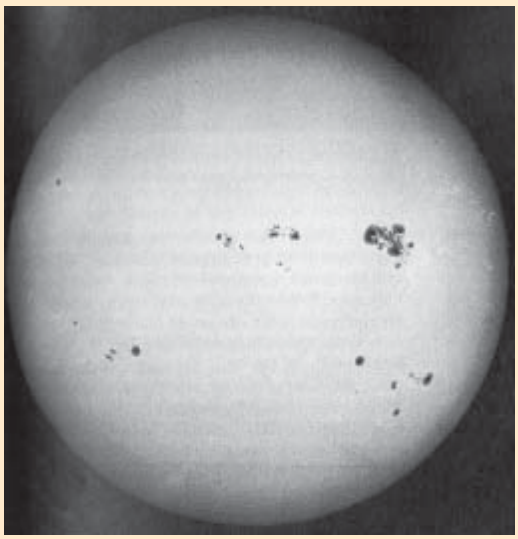

Fig. 3 (B) : Sunspots when the solar activity is high

Sunspots

Observation of the Sun shows several dark spots on its surface. The number of spots and their sizes vary from year to year [Fig. 3 (A) and 3 (B)].

It has been observed that the growth of Sunspots occurs in a periodic cycle of 11 years. Every eleven years, the Sunspot activity would be at a maximum. It may be of interest to note that 1990 was a year of solar maximum. The region of the Sun near a high magnetic field gets cooler and, therefore, appears dark against a bright background giving the appearance of a spot.

In a magnetic field and at high temperatures, the charged particles like electrons, protons and ions of various atoms move along complex paths. In addition, there is the eleven year cycle of Sunspots, i.e. the magnetic activity. As a result the shape and size of the solar corona changes from time to time. When the magnetic activity on the star is high, the corona is symmetric (Fig.1). However, when the magnetic activity is low, the corona consists of

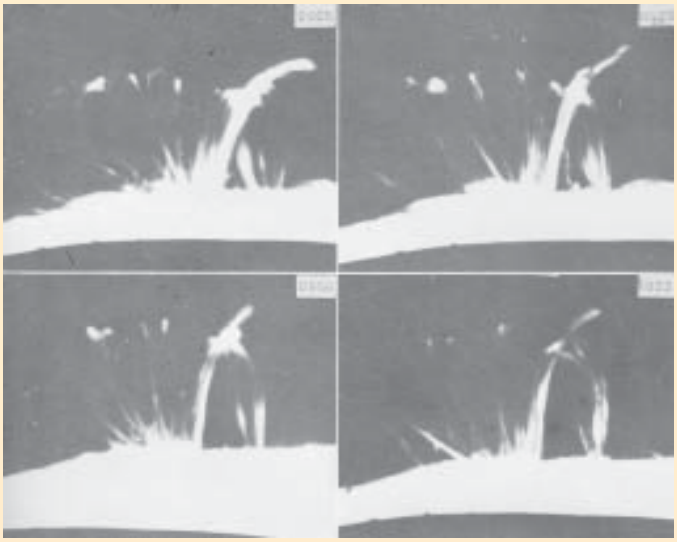

Fig. 4 : Prominence activity on the Sun, a spectacular loop prominence on the SE-limb (November 26, 1982), USO

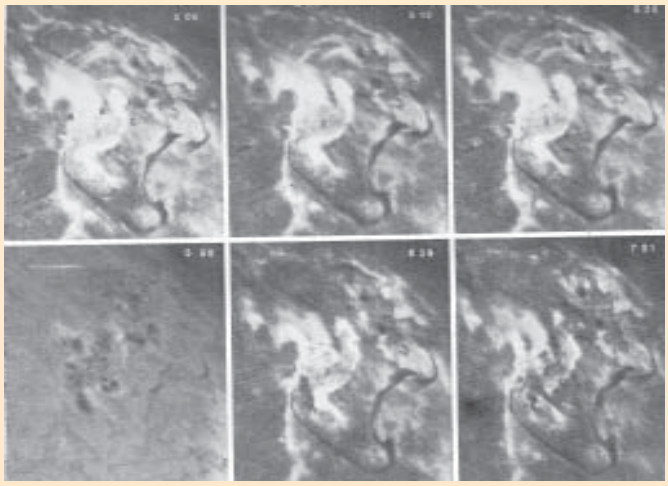

Fig. 5 : Mulit-ribbon flare observed on May 13, 1981 during 0505 UT to 0701 UT, USO

streamers. The streamers appear due to the Sun's magnetic fields and extend far into the interplanetary space. The nature of Sunspots and magnetic field of the Sun are not yet very well understood.

Fig.4 shows a prominence on the surface of the Sun. A prominence is a large eruption of gas from some part of the Sun. An abrupt increase in the emission of light from a Sunspot region is called a flare. Fig.5 shows a multi-ribbon flare, so known due to its appearance, in high resolution.

Observing the Sun

The Sun cannot (and should not) be observed with naked eyes due to its brilliance. Hence, different techniques have been developed by physicists to learn about the various aspects of the Sun.

One can observe some features of the Sun with simple telescopes. However, one should never look at the Sun through a telescope unless fitted with a proper solar filter. Otherwise, there is every chance of damaging the eyes. The best way to view the Sun is to project the image of the Sun as an illuminated disk with Sunspots on it, (if they are there!), by holding a white screen about a metre away from the eye-piece of a telescope.

The Sun can also be observed in infrared and ultraviolet radiation, as well as radio waves with instruments sensitive to a particular kind of radiation.

Observations of the Sun during a total solar eclipse have their own importance. They give information on the solar emissions from its atmosphere. That is why scientists from all parts of the world flock, along with their instruments, to a suitable place from where the total eclipse can be observed surely and easily.

Several manned and unmanned spacecrafts have also been used to study the Sun. Observations from a spacecraft have the advantage that radiation falling on it does not have to pass through the Earth's atmosphere. During the total solar eclipse of October 24, 1995, MiG 25, Canberra and AN-32 aircraft of the Indian Air Force carried on board several scientific experiments chasing the umbral shadow and took pictures of solar corona.

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Letters to the Editor

Many thanks for the brief biography of Prof. Daulat Singh Kothari in the August 2003 issue of your Newsletter. I had the good fortune of meeting him a few times in the INSA library during the late eighties of the last century. A frail old man in his eighties, browsing through learned tomes, he was the epitome of civility and optimism. I have not seen anyone else so far, who played such a critical role in science education in the country and scaled such height in theoretical physics, and yet retained such humility, untainted by the vulgarity of State power. From Jagadish Chandra to Daulat singh, renaissance of Indian science enjoyed a period of intense nationalism. Sadly their successors sold themselves to SCI, foreign jaunts and membership of World Wide Webs of UNESCO. It is necessary for our successors in science profession to know that there were seers and saints in our midst in the first half of the last century. In this citation-driven, high-tech world of "virtual" reality, tales of such simple men are purifying for our soul.

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I have seen DREAM-2047 (August 2003 issue). It is a very valuable and useful magazine to the research scholars and educated people. It is also very useful to science students and science teachers.

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Your "Dream-2047" newsletter may be small in size but very informative and important to recent time. I wish it long life.

Prof. Sahabuddin Ahmed
Narodaya Puthibharal, Kalgachia, P.O. Kalgachia, Dist. Barpeta (Assam)

The Wright Brothers

The Inventors of the first Power-driven Flying Machine

❑ Subodh Mahanti
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"Before the Wright Brothers, no one in aviation did anything fundamentally right. Since the Wright Brothers, no one has done anything fundamentally different."

Darrel Collins, US Park Service, Kitty Hawk National Historical Park

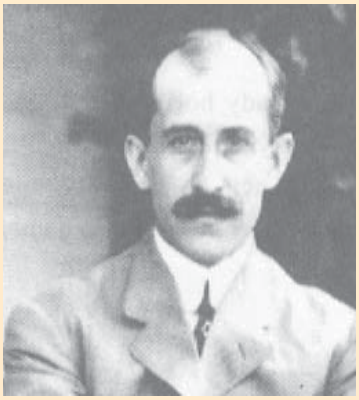
"That Wilbur Wright is in possession of a power which controls the fate of nations is beyond dispute."

Maj. Gen. Baden Powell, the then President of the Aeronautical Society of Britain

The power-driven flying machine was one of the greatest inventions of the 20th century. The dream to be able to fly like a bird was a collective dream of the entire humankind. And the dream is as old as humankind itself. There is no doubt that the flying machine is one of the greatest technological marvels in human history. This extraordinary feat was accomplished by two young bicycle mechanics, Wilbur and Orville Wright, by inventing and building the world's first power-driven flying machine. They called it a "Flyer". For thousands of years the flying of a `heavier-than-air' machine was considered impossible. Neither of the two Wright brothers had graduated from school. They had neither formal education nor wealth. Yet, they did not hesitate to attack one of the most difficult science-cum-engineering problems of their time. The Wright brothers became the first great public celebrities of the 20th century. The Wright brothers deserve great credit as Darell Collins observed the attempts made by the predecessors of the Wright brothers were inaccurate and those of their successors to be natural developments from the Wright brothers' work. The Wright brothers solved the fundamental problems of flying and left only the need for refinements. "Indeed one can say that the Wright brothers set the style and method of aircraft design that is followed to this day; only the tools are now vastly more powerful, " wrote Roddam Narasimha.

Wilbur Wright

The other members of the Wright family wholeheartedly supported the unusual activity of Wilbur and Orville. R. Narasimha wrote : "…in many ways the Wright Flyer was a family project. First of all the two brothers were so deeply involved in it that much of the world thinks of them only jointly. Further the project had the blessings of the father, a remarkable bishop and teacher himself; the sum of $ 1000 he gave to Wilbur and Orville was used as a corpus fund by the brothers,

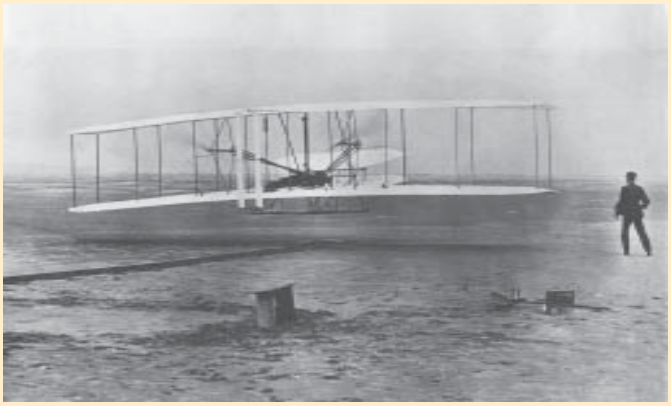


Orville Wright

who drew on its interest and on their own other resources for their expenditure on the project. Then there was their very intelligent sister Katherine, the only graduate in the family, who not only tended house after the mother passed away (when only 36) but gave intense and warm support to the brothers and kept worrying herself about their progress."

While the dream of flying is as old as humankind itself but the concept of the airplane has only been around for two centuries. Before the concept of airplane gained ground, humans attempted to fly by imitating the birds. It was thought when birds can fly in the air effortlessly then why not humans. So machines with flapping wings called 'ornithopters' were built. But for obvious reasons the plan did not succeed. So other methods were tried. Beginning in 1783, a few daring individuals made uncontrolled flights in 'lighter-than-air' balloons. But this was not the practical way to fly. There was no way for going from one place to another unless the wind was blowing in the desired direction. Sir George Cayley conceived the idea of a flying machine in 1799. It was a kite mounted on a stick with a movable tail. This paved the way of building glider and from these humble gliders eventually evolved the amazing flying machines.

The story of the invention of the airplane is one of the most fascinating parts of human culture. So there is no wonder that it is so often repeated. And as it happens, a dozens of 'myth conceptions' about the Wright brothers and early aviation have also grown up. One of the best accounts of the process of invention of the airplane is given in the book titled *How We Invented the Airplane* by Orville Wright. The deposition given on January 13, 1920, as a witness for the United States Government in a law suit forms the main part of the book. Other components of the book are: an article titled "After the



The first flight of the Wright Flyer at Kitty Hawk on 17 December 1903. Undoubtedly this is one of the most famous photographs of history of human civilisation

First Flight" written by Orville Wright around 1920 and a concluding essay by Fred C Kelly, the authorised biographer of the Wright brothers. An article jointly written by the Wright brothers that appeared in 1908 issue of the *Century Magazine* was also reproduced in the book as an appendix. The book had 76 photographs with commentary by Fred Kelly.

Wilbur was born on a small farm called Milville near Indiana on April 16, 1867, while Orville was born on August 19, 1871 in Dayton. They had two older brothers (Reuchlin and Lorin) and a younger sister (Catherine). Their father Milton Wright was a bishop in the United Brethren Church. Bishop Wright moved frequently from job to job. And so the Wrights shifted houses frequently. Moreover Bishop Wright was often away from home on church business. He was deeply committed to moral reform. He was a man of independent and strongly held views. He was opposed to then existing slavery, rum traffic, secret societies and other moral ills of the society. Their mother Susan Wright was gifted with a flair for mechanical things. With her mechanical skill, she could build simple household appliances and toys for children. There is no doubt that Wilbur and Orville inherited their mother's mechanical skill. Both Bishop Wright and Susan Wright were teachers and so their children grew up in an atmosphere, which encouraged learning and doing. Commenting on his childhood Orville wrote: "We were lucky enough to grow up in an environment where there was always much encouragement to children to pursue intellectual interests; to investigate whatever aroused curiosity." The Bishop's house had two libraries—books on theology were kept in the bishop's study, while the downstairs library had a large and diverse collection.

Wilbur was fond of reading and he read extensively from his father's library. He wanted to be a teacher and to realise his goal he wanted to go to a college. From his father, Wilbur had imbibed a critical and independent attitude. Whatever he did, he did systematically. He was very careful while writing his letters and papers. He loved doing research. He never lost his cool. On his death, his father Bishop Wright wrote in his dairy: "A short life, full of consequences. An unfailing intellect, imperturbable temper, great self reliance and as great modesty, seeing the right clearly, pursuing it steadfastly, he lived and died."

Orville was not interested in continuing in school. He was inventive and he was quite ingenious in making and fixing things. He was a shrewd businessman and he knew how to make money.

For their living, the Wright brothers operated a printing press and a bicycle shop in succession in Dayton. In 1890, Wilbur joined Orville in the printing business as an editor for *The West Side News*, a weekly newspaper for their west Dayton neighbourhood. It was a modestly successful venture. In 1891, the brothers started a daily, *the Evening Item*. However, they could not compete with the established newspapers and eventually they had to abandon it and remain satisfied as simple job printers. In 1894, the Wright brothers started repairing and selling bicycles. The idea was to augment their income from the printing business. Initially they repaired bicycles for other boys. Soon they had their own bicycles shop. They even started manufacturing their own bicycle in 1896. The Wright Bicycle Company started making good profit. However, they were not satisfied with earning money from the bicycle business. They were looking for new challenges. They decided to build flying machines and to fly them.

The Wright Brothers' interest in flying machines began in their childhood. It was a toy helicopter driven by rubber band set the Wright brothers thinking about flight. The toy was a gift from their father. This kind of toy still may be seen in the market. It was first made by Alphonse Penaud, a French engineer. However, its principle goes back to Leonardo da Vinci. While describing the impression of this little toy in their mind they wrote in an article written for the 1908 issue of *The Century Magazine*: "Our personal interest in it dates from our childhood days. Late in the autumn of 1878, our father came into the house one evening with some object partly concealed in his hands, and before we could see what it was, he tossed it into the air. Instead of falling to the floor, as we expected, it flew across the room till it struck the ceiling, where it fluttered

Wright Brothers' 1902 camp kitchen. The neat arrangement of the kitchen shows their obsessive attention to detail

awhile, and finally sank to the floor. It was a little toy, known to scientists as a "helicoptere", but which we, with sublime disregard for science, at once dubbed a "bat". It was a light frame of cork and bamboo, covered with paper, which formed two screws, driven in opposite directions by rubber bands

under torsion. A toy so delicate lasted only a short time in the hands of small boys, but its memory was abiding." They made a number of copies of the toy. However, they failed to scale up it. They were experts in kite flying. In 1895 after reading about the gliding experiments of Otto Lilienthal (1849-96) in Germany, their interest in flying machine were revived. Lilienthal, who may be called the world's first true aviator, studied bird-flight in order to build `heavier-than-air' flying machines resembling the birdman designs of Leonardo da Vinci. Lilienthal himself built eighteen different hang glider models over a period of five years. And he flew or glided over 2500 times. Lilienthal believed that human is capable of flying truly like a bird. He spent most of his life to make a hang glider fly. This idea did not die with him. Today, hang gliding is a thriving industry. He crashed to his death near Berlin in 1896. After reading the news of Lilienthal's death, the Wright brothers wondered whether they could start from where Lilienthal had left. They decided to collect all the available articles written on the problem of flying. After collecting whatever they could get from the Public Library in Dayton, Wilbur wrote to the Smithsonian Institution in Washington requesting them for more information. The Smithsonian Institution not only sent them many reprints but also a list of titles on the subject. One of the titles in this list was *Progress in Flying Machines* by Octave Chanute (1832-1910). This book published in 1894 was a collection of articles written by Chanute in *The Railroad and Engineering Journal*. The book provided an excellent account on the state of the art on flying machines developed till then. The Wright brothers procured a copy of Chanute's book and studied it. Wilbur also started corresponding with Chanute. Wilbur made an exhaustive study of the work of Lilienthal and of the pioneering British civil engineer John Smeaton (1724-94), who won the Copley Medal for his researches into the mechanics of waterwheels and windmills. As a first step after their study, the Wright brothers concluded that Lilienthal's control system was faulty. Lilienthal shifted his own body weight to achieve side-to-side balance of the glider. Commenting on Lilienthal's work, Wilbur wrote to Chanute: "Assuming then that Lilienthal was correct in his ideas of the principles on which man should proceed, I conceive that his failure was due chiefly to the inadequacy of his method, and of his apparatus. As to his method, the fact that in five years' time he spent only about five hours, altogether, in actual flight is sufficient to show that his method was inadequate. Even the simplest intellectual or acrobatic facts could never be learned with so short practice, and even Methuselah could never have become an expert stenographer with one hour per year for practice. I also conceive Lilienthal's apparatus to be inadequate not only from the fact that he failed, but my observations of the flight of birds convince me that birds use more positive and energetic methods of regaining equilibrium than that of shifting center of gravity."

Alexander Graham Bell

After critically going through the available literature, Wilbur concluded that achieving human flight was only 'a question of energy and skill.' Wilbur found that 90 per cent of the available literature was unreliable. The Wright brothers decided to make their own tests. That the Wright brothers were very passionate for flying is obvious from following excerpt of Wlbur's letter to Chanute: "For some years I have been afflicted with the belief that flight is possible to man. My disease has increased in severity and I feel that it will soon cost me an increased amount of money if not my life. I have been trying to arrange my affairs in such a way that I can devote my entire time for a few months to experiment in this field. My general ideas of the subject are similar to those held by most practical experimenters, to wit: that what is chiefly needed is skill rather than machinery. The flight of the buzzard and similar sailors is a convincing demonstration of the value of skill, and the partial needlessness of motors. It is possible to fly without motors, but not without knowledge & skill. This I conceive to be fortunate, for man, by reason of his greater intellect, can more reasonably hope to equal birds in knowledge, than to equal nature in the perfection of her machinery."

One important step in realising their goal was their study of buzzards in 1899. This made it clear to them that three-axis control was needed – to bank, turn and elevate or descend. They also realised that the bird achieved control over roll by twisting its wings.

Samuel P. Langley

Kitty Hawk, a non-descript village in North Carolina, was chosen by the Wright brothers to play host to one of the most momentous events in the history of aviation and science. There were reasons for choosing this place. Wilbur had anticipated that they needed a steady wind of about 15 miles per hour for a smooth flight. Keeping this fact in view they started exploring various locations for conducting their experiments. They had obtained a list of windy places from the US weather bureau. Kitty Hawk was sixth in this list. Besides being a windy place, Kitty Hawk had other advantages. It had vast stretches of sand and water and thus the place was ideal to cushion the impact in case of a crash. It had few trees (which meant less obstruction) and reasonably good weather. They started their field experiments in Kitty Hawk in 1900 (September-October) and they continued their experiments over the next three years—1901 (July-August), 1902 (September-October) and 1903 (October-December). The Wright brothers did not succeed in their first manned glider flight. The wings did not provide the lift that Lilienthal's tables predicted. The Wright brothers concluded that Lilienthal's table must be wrong. The Wright brothers were very much disappointed with their early results. Wilbur wrote: "When we left Kitty Hawk at the end of 1901, we doubted that we would ever resume our experiments. Although we had broken the record for distance in gliding, and although Mr. Chatune, who was present at that time, assured us that our results were better than had ever before been attained, yet when we looked at the time and money which we had expended, and considered

the progress made and the distance yet to go, we considered our experiments a failure. At this time I made the prediction that men would sometime fly, but that it would not be within our lifetime." Though, they were disappointed but they continued to pursue their interest in flying. They built their own wind tunnels to test systematically wings of different shapes for the pressures and forces acting on them. After making careful analysis of their data they could find out where the earlier experimenters went wrong. By using their own aerodynamic data, the Wright brothers built new gliders. In 1902, the Wright brothers tested their new gliders and broke all earlier records on gliding. The 1902 glider developed by the Wright brothers was the first aircraft that solved the fundamental problems of flight—lift and three-axis control. After their successful tests with their new glider at Kitty Hawk, the Wright brothers built a new wind tunnel for making more tests. They designed new propellers, which significantly outperformed the previous designs. They made their first application for patent on March 23, 1903. In 1903 they also made a larger version of their 1902 glider. They added a power plant to it. As usual they took it to Kitty Hawk for testing. At this stage the Wright brothers suddenly found themselves in a race. Samuel P Langley, Secretary of the Smithsonian Institution had also built a powered aircraft. This he had patterned after a small, unmanned "aerodrome", built and flown by him in 1896. They were also delayed by problems with their propeller shafts and bad weather. Langley tested his aircraft twice in late 1903. However, on both occasions Langley failed miserably and he left the field to the Wright brothers. On December 17, 1903, the Wright brothers made the first sustained, controlled flights in a powered aircraft. Thus an ageless dream of humankind was realised. Both the brothers flew alternately. The last flight made on that day by Wilbur covered a distance of 852 feet and lasted for 59 seconds.

Orville (left) and Wilbur repairing one of their early aircraft

After their successful experiments on December 17, Orville sent a telegram to his father: "Success four flights Thursday morning all against twenty one mile wind started from level with engine power alone average speed through air thirty one miles longest 57 seconds inform Press home Christmass." It has been reported that on being shown the message by the father, an Associated Press Reporter remarked: "fifty-seven seconds, hey? If it had been fifty-seven minutes then it might have an news item."

Although the Wright brothers succeeded in flying on December 17, 1903, the flying machine was underpowered and difficult to control. The Wright brothers realised that they had much to do to perfect their invention. To conduct sustained experiments, the Wright brothers established the world's first test flight facilities at Huffman Prairie. They made flight after flight for two years. They fine tuned the controls, engine, propellers and configuration of their airplane. Initially they could fly only about a minute and that too in a straight line. However, by the end of 1905, they were able to fly for over half an hour or until their fuel ran out. The 1905 Wright Flyer is considered as the world's first practical airplane. After their successful flying sessions in 1905 they decided to sell their flying machines. For this they contacted the United States War Department, as well as governments and individuals in England, France, Germany and Russia. Everywhere their offer was turned down. As it happens, the government bureaucrats thought the Wright brothers were simply crackpots. Perhaps some also thought that if two bicycle mechanics could build a successful airplane, they could do it themselves. But the Wright brothers continued their efforts to convince prospective buyers. Finally in late1907, the US Signal Corps ordered for an aircraft and a few months later in early 1908, a French Syndicate of businessmen offered to purchase another. Subsequently both the buyers asked for an airplane capable of carrying a passenger. To meet these orders, the Wright brothers quickly adapted their 1905 Flyer with two seats and a more powerful engine and tested these modifications in secret at Kitty Hawk. To demonstrate their products Wilbur went to France and Orville to Virginia. Their flights went well until Orville lost a propeller and crashed. Orville's leg was broken and his passenger got killed in this accident. Wilbur did not meet any accident. He kept flying in France breaking record after record.

To meet the growing demands, which increased as their fame grew, the Wright brothers set up airplane factories and flight schools on both in Europe and the USA. However, it was not a smooth sailing for the Wright brothers. After the public demonstration of their aircraft it was not very difficult for other to copy their invention. In fact many did. The Wright brothers were dragged into time-consuming, energy-draining patent fights both in Europe and USA. Glenn Hammond Curtiss (1878-1930) argued that Langley's Aerodrome could have flown before the Wright Flyer. To prove his point, Curtiss borrowed Langley's unsuccessful aircraft from the Smithsonian Institution and rebuilt it. However, as Curtiss had made too many modifications to get Langley's aircraft in the air, the court ruled in favour of the Wright brothers. It may be noted here that Curtiss was an aviation pioneer and inventor in his own right. He was awarded the Scientific American award in 1908 for the first public flight (1 km) in the USA with his third aeroplane, the June Bug, flying at 64.4 kilometre per hour. He also won the James Gordon Bennet Cup in France in 1909 for flying his Golden Arrow at 75.1 kilometre per hour. He had invented the aileron (1911), and also flew the first practical seaplane, as well as the flying boat. Curtiss, jointly with Alexander Graham Bell, formed the Aerial Experiment Association. Litigations were not the only

woes of the Wright brothers. In those days the aircraft business was not only uncertain but also dangerous. Most of the money came from the exhibition flying. But then the audience had to be satisfied by performing death-defying feats or airmanship. And by carrying out such daring flights the pilots began to die in accidents. These incidents increased the mental stress of the Wright brothers. Legal troubles and other business problems distracted the Wright brothers from invention and research. As a result by 1911, Wright aircraft were no longer the best flying machines. All these developments had a negative effect on Wilbur's health. He died of typhoid on May 30, 1912. After Wilbur's death Orville also lost interest in the airplane business. The Wright patent was to expire in 1917. Orville sold his interest in aircraft business in 1916. He went back to inventing. He built a small laboratory in his old West Dayton neighbourhood. He worked there on anything that interested him. He helped to develop a racing airplane, guided missile and 'split flaps' to help slow an aircraft in a dive. He did many other things. For example he worked on an automatic record changer, a toaster and toys. Though, Orville virtually retired from the aircraft business, he continued to be honoured widely by the world for his role in inventing the first practical airplane. On January 20, 1920, the US president Woodrow Wilson appointed Orville on the US National Advisory Committee for Aeronautics (NACA). Orville remained on the Committee for twenty years. The NACA is the predecessor of today's NASA (National Air and Space Administration). He was also given responsibility for overseeing the Guggenheim Fund for the Promotion for Aeronautics. He also worked for bringing the ideas of unknown inventors to the Market.

Octave Chanute

Orville also continued a long-drawn battle with Smithsonian Institution over the priority issue. This had started when the Smithsonian Institution supported Curtiss in his battle against the Wright brothers over priority. They lent Curtiss Langley's aircraft for this purpose. Though, Curtiss was defeated in court, the matter did not end there. After the First World War, the Smithsonian exaggerated Langley's contributions. The Smithsonian Institution refused to recognise that the first powered flight was made by the Wright brothers. They claimed that it was Langley, who had shown the capability of flight though he could not demonstrate it. Being disgusted by the development Orville sent the original Wright Flyer to the Science Museum in Kensington, London. This created a public uproar in the USA. In the1930s, Charles Augustus Lindbergh (1902-74), the first aviator to fly from New York to Paris, tried to mediate between the two parties to end the dispute. His efforts did not succeed. In 1942, Fred Kelly, a friend of the Wright brothers and also their authorised biographer prevailed over the authorities of the Smithsonian Institution to make appropriate amendments and publish the truth. Once the dispute was over, Orville decided to bring back the original Wright Flyer to the USA. However, the Second World War delayed its return. It was finally returned in 1948. Presently it is kept at the National Air and Space Museum in Washington. Orville's last big project was the rebuilding of their 1905 Flyer III, the first practical airplane that was perfected by the Wright brothers at Huffman Praire. Orville died on January 30, 1948.

Otto Lilienthal

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Fenugreek

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Venthiam in Tamil and malayalam, *Trigonella* in Greek, *Methi* (for seeds) and *Sag methi* (for leaves) in Hindi, Fenugreek is one of the oldest spices to be used by humankind and belong to Fabaceae (bean) family is considered to be indigenous to Mediterranean yet was known to India from historical time. Fenugreek is an ancient spice, was grown as a medicinal plant in Europe during the Middle Ages yet now a days mostly used as a fodder in the West. Though not much is use in Western countries who seem to dislike its flavour, is now mostly used in all parts of Asia; in India, is popular for pickles.

Figure 1: Fenugreek plant and seeds

In Latin species name foenum graecum, which means 'Greek hay'; the dried plant (leaves or seeds) indeed emanates a strong hay-like scent and probably was used as feed for horses, is a reminder that the Romans imported it from Greece as a cattle food. Trigonella in Greek is a latinized diminutive of Greek trigonon (triangle), composed of treis (three) and gony (knee), angle it probably refers to the triangular shape of the flowers. The brownish-yellow seeds of rhombic shape (about 3 mm) as well as its leaves are used. In India the fresh leaves are also used and are eaten as a very tasty vegetable and prepared like spinach, or dried and used as flavouring.

Uncooked, raw fenugreek seeds have an unpleasant, bitter taste, so the seeds are usually roasted and ground before use to mellow the bitterness. The seeds are very hard, and difficult to grind. Although bitterness arises unpleasant associations in most people, culinary use of bitter taste is a theme found all over the globe. It is worth noting that bitter taste is strongly appetizing and bitter herbs do enhance the food's quality; that they stimulate bile secretion and thereby aids digestion, which is especially advantageous for fat meat. Bitter taste is also typical for spices containing glycosides, which are found in abundance in Fenugreek.

Botany

Fenugreek is an erect 0.75 to 1 m tall annual herb (lives only for one year) with light green leaves and small white flowers. The fruit, seed pods, compressed, malodorous legume are small, pale, reddish-brown seeds with small pods. Each pods contains 10 to 20 small, flat, yellow-brown, pungent, aromatic seeds to a pod. The seeds have a strong aroma and somewhat bitter taste, variously described as similar to maple syrup, or burnt sugar. Fenugreek is an annual plant and needs full sun and rich soil. A long taproot sends up a round stem with few branches. The leaves are trifoliate, on hairy petioles, with obovate leaflets. In June or July, axillary, sessile, yellowish flowers appear.

Figure 2: Leaves

Culinary uses

Small amounts of fenugreek is indispensable for a good curry powders and Fenugreek is also popular in the South of India and appears in the ubiquitous Tamil spice mixture *sambaar podi*. This bitter-aromatic seeds is essential part of the Bengali five spice mixture *panch phoron* and the *methi naan* made out of the dried fenugreek is a delicacy. Leaves also appear in the spice mixture from Georgia, *khmeli-suneli* and Iran has a particularly rich tradition in cooking with fenugreek leaves; among the most famous examples is *ghorme sabzi*, a thick sauce made from fresh or dried vegetables and herbs wherein Fenugreek is an essential ingredient. Fenugreek is also known in Northern and Eastern Africa; Ethiopian spice mixture *berebere* contains small amounts of fenugreek. Seed extract is used in imitation vanilla, butterscotch and rum flavorings, and is the main flavoring in imitation maple syrup. Also used in breads in Egypt and Ethiopia. Ground seeds add a nice lift to some bland vegetarian dishes.

Main constituents

Figure 3: Seeds

Fenugreek is rich in vitamins and minerals, and because it is a seed and a legume, it is high in protein that makes it very useful in vegetarian diets. Substances such as Biotin, choline, inositol, iron, lecithin, mucilage, volatile oils, PABA, phosphates, protein, trigoneline, trimethylamine, and vitamins A, B1, B2, B3, B5, B6, B9, B12, and D are some of the compounds found in chemical examination of the Fenugreek seeds. The seeds are also rich in phosphates, lecithin, nucleo-albumin, vitamins A & D and containing also considerable quantities of iron in an organic form, which can be readily absorbed (similar in composition to cod liver oil).

The seeds when analyzed shows about 28 per cent mucilage; 5 per cent of a stronger-smelling, bitter fixed oil, which can be extracted by ether; 22 per cent proteids; a volatile oil; two alkaloids, Trigonelline and Choline, and a yellow colouring substance. The presence of trimethylamine, neurin and betain; like the alkaloids in cod-liver oil, stimulate the appetite by their action on the nervous system, or produce a diuretic or ureo-poietic effect. In toasted fenugreek seeds, pyrazines are formed as the main flavour compounds.

Fenugreek contains only minute quantities of an essential oil. In the essential oil, 40 different compounds were found, of which a hemiterpenoid α-lactone, sotolon (3-hydroxy-4,5-dimethyl-2(5H)-furanone), seems to be the most important aroma component; furthermore, n-alkanes, sesquiterpenes, alkanoles and lactones were reported.

Among the non-volatile components, the furostanol glycosides are probably responsible for the bitter taste; among the several more compounds yet identified, sterol- and diosgenin derivatives (of potential interest for the

pharmaceutical industry) and trigonellin (N-methyl-pyridinium-3-carboxylate, 0.4%) are most worth noting.

Fenugreek as an herbal remedy:

Through history, fenugreek has been prized not only as a spice and cattle feed but also for its medicinal uses. Evidence of its cultivation dates back to 1000 BCE at Nile valley and the Egyptian Ebers papyrus (c. 1500 BCE) records a prescription for burns that included fenugreek seeds and also mention the plant as one necessary for the mummification process. " When the Body is rubbed with it, the skin is left beautiful with out any blemish" notes the medical papyrus. Externally, the seeds are applied as a paste to treat abscesses, boils, ulcers, and burns, or used as a douche for excessive vaginal discharge. The oil in the seeds is used as a skin softener and emollient, or paste is used to treat chapped lips.

Diabetics and Fenugreek

The hypoglycemic activity of fenugreek seeds in experimental animals and humans has been well documented. Fenugreek was administered at 2 and 8 g/kg dose orally to normal and alloxan induced diabetic rats. It produced a significant fall ($P < 0.05$) in blood glucose both in the normal as well as diabetic rats and the hypoglycemic effect was dose related. Fenugreek seeds contain alkaloids (mainly trigonelline) and protein high in lysine and L-tryptophan. Its steroidal saponins (diosgenin, yamogenin, tigogenin, and neotigogenin) and mucilaginous fiber are thought to account for many of the beneficial effects of fenugreek. The steroidal saponins are thought to inhibit cholesterol absorption and synthesis, while the fiber may help lower blood sugar levels. One human study found that fenugreek helps lower cholesterol and blood sugar levels in people with moderate atherosclerosis and non-insulin-dependent (type 2) diabetes. Preliminary and double-blind trials have found that fenugreek helps improve blood sugar control in patients with insulin-dependent (type 1) and non-insulin-dependent (type 2) diabetes. Double-blind trials have shown that fenugreek lowers elevated cholesterol and triglyceride levels in the blood, This has also been found in a controlled clinical trial with diabetic patients with elevated cholesterol. Generally, fenugreek does not lower HDL ("good") cholesterol levels, thus an ideal additive diet for diabetic patients.

Fenugreek is said to be a bulk laxative and considered to improve the secretion of breast milk, albeit the reason why it is also a preferred feed for milch cattle. It is also used to lower blood sugar and blood cholesterol levels. Intake of Fenugreek is also said to lubricate the intestines. They were also used to induce childbirth. Decoctions are used as warming drinks for menstrual pain, stomach upsets, and to stimulate milk flow for breast-feeding mothers and the bitter taste disguised with a dash of honey. The leaves are dried and used as an insect repellent in grain storage in some parts of the world. In various areas of North Africa, including Libya, the seeds (ground into a paste) were traditionally eaten by women to gain weight, in combination with sugar and olive oil.

In the 5th century BCE, the Greek physician, Hippocrates, considered fenugreek a valuable soothing herb. His fellow countryman in the 1st century CE, Dioscorides, recommended fenugreek as a remedy for all types of gynecological problems, including infection of the uterus and inflammation of the genitals.

Modern pharmacological uses

The seed is a source of the steroidal saponin diosgenin, which can be used to manufacture many pharmaceuticals, such as progesterone. The chemical trigonelline is converted into niacin (another name for vitamin B3) when the seed is roasted. The seeds also provide a mucilaginous fiber content that may benefit the bowel. Researchers have reportedly found that the seeds contain substances that stimulate the pancreas to release digestive enzymes, thereby aiding in digestion. The seeds' soothing effect makes them of value in treating gastritis and gastric ulcers.

Of more current interest is the evidence that fenugreek has a minor hypoglycemic effect, thus suggesting it may, in fact, help with diabetes. Fenugreek has been shown to reduce fasting and post-prandial blood glucose levels in diabetic patients. However, it is not clear whether the improvement in glucose tolerance is due to the effect of fenugreek on the absorption or metabolism of glucose. Clinical studies of fenugreek have been conducted in subjects with both type 1 and type 2 diabetes. Although inadequate descriptions of study design and patient characteristics make it difficult to assess the quality of the research, nonetheless, studies have shown a decrease in both fasting (up to 30%) and postprandial blood glucose levels (20-35%), hemoglobin A1c (12%), and in some cases cholesterol and triglyceride levels. Bioactive compounds isolated from fenugreek seeds include saponins (ie: fenugreekine, diosgenin), alkaloids (ie: trigonelline, gentianine, carpaine), amino acids, some of which act as insulin secretogogues (ie: 4-hydroxyisoleucine, arginine), coumarins, mucilaginous fibers (galactomannan), nicotinic acid and other vitamins and minerals. Much of the hypoglycemic effect of fenugreek seeds in clinical studies is likely due to the inhibitory effects of mucilaginous fibers on glucose absorption. They are also an important source of diosgenin, which is widely used in the production of steroids (which probably accounts for the weight gain), sex hormones, oral contraceptives and veterinary medicines. Diosgenin and tigogenin (saponins) are chemically similar to estrogen and steroidal hormones. These help balance female hormone levels and perhaps help compensate for the lack of them after menopause.

Pharmacological drugs from Fenugreek

Progesterone and Niacin are two most important chemicals extracted from Fenugreek for pharmacological use. Progesterone is one of the steroid hormones. It is secreted by the corpus luteum and by the placenta and is responsible for preparing the body for pregnancy and, if pregnancy occurs, maintaining it until birth.

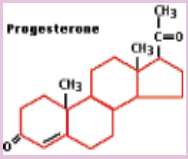

Figure 4: Progesterone

Vitamin B3 is required for cell respiration, helps in the release of energy and metabolism of carbohydrates, fats, and proteins, proper circulation and healthy skin, functioning of the nervous system, and normal secretion of bile and stomach fluids. It is used in the synthesis of sex hormones, treating schizophrenia and other mental illnesses, and a memory-enhancer. A deficiency of niacin (Vitamin B3 also called as niacinamide, nicotinic acid) can cause a skin rash on areas exposed to the sun, but you would also notice a lot of swelling in your legs from the knee on down as well as a painful flush and rash all over the skin. Niacin is used to help lower high cholesterol and fat levels in the blood. This may help prevent medical problems caused by cholesterol and fat clogging the blood vessels. Nicotinic acid (but not nicotinamide) given in drug dosage improves the blood cholesterol profile, and has been used to clear the body of organic poisons, such as certain insecticides. People report more mental alertness when this vitamin is in sufficient supply.

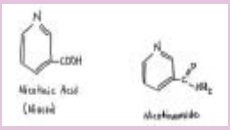

Figure 5:Niacin chemical structures

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Bose Institute

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The establishment of Bose Institute in 1917 in Kolkata (then Calcutta) was an event of immense importance in the annals of a nation trying to break the shackles of foreign rule. It was not an institute to cater to the personal research requirements of the founder Acharya Jagadish Chandra Bose. Rather, it was founded with an aim to provide a free and fair arena to all the Indian scientists for nurturing their talents and come up with result that would tell the world what India, on its own could achieve. But to put it correctly, the first thrust for setting up this institute came from an incident where Jagadish Chandra was himself insulted by the British. Let us go back down the history lane to get an account of that happening.

The year was 1897, the month December. Jagadish Chandra had just returned from a foreign tour in which he lectured at different prestigious institutions including the Royal Institution in England. He had mesmerized the audience there with his impeccable presentation. Back home he focused himself on his research on "Coherer", an instrument for receiving electrical waves. In a bid to improve the instrument he was trying to introduce crystals of seminconductor into the system. At such a time Lord Rayleigh, Fellow of the Royal Society and a great scientist came to Kolkata on an official visit. Lord Rayleigh had taught Bose in England. One day he found time to visit his student's laboratory. He came straight to Presidency College and studied Bose's work in detail. Lord Rayleigh was very pleased to see the work and praised Bose. He inspired Jagadish Chandra to work harder. But Bose's spell of satisfaction at having impressed Lord Rayleigh did not last long after the scientist had left. In the afternoon of that very day Jagadish Chandra received a letter from the Principal of Presidency college which read like a chargesheet. It had the following lines in it :

"I learn from Lord Rayleigh that he visited the Presidency College this morning and inspected the laboratory over which he was shown by you. I should be glad to hear by what authority you have received outsiders into the laboratory…"

Bose protested and that angered the authorities more. They tried to stifle Jagadish Chandra's research efforts terming it a private affair. It was a very trying time for the genius. However, the conditions forced him to think of setting up an independent institution where he and the likes of him could pursue their scientific goals without any hindrance. Bose consulted Rabindra Nath Tagore. The poet was in pain to hear about the ill treatment Bose received from the Presidency College authorities. The two chalked out the required expenses for setting up a research institution. The initial financial requirement was thought to be about twenty thousand rupees. Tagore took the responsibility of raising half of that sum.

But then the plan did not materialize immediately. Many years, in fact two decades, passed before it could take shape. In the meantime Jagadish Chandra had retired in 1915 but stayed on as Emeritus Professor for five more years in Presidency College. However, formal retirement gave him the time to turn his dream into reality. He pooled all his resources including his wife's belongings towards setting up of the institute.

A view of the main building of Bose Institute

The day of glory came in 1917. On 30th November Jagadish Chandra dedicated the institute to the welfare of the nation. In the following days he went on to set up an executive committee consisting only of Indians. No British was included. Tagore became a member of that committee. Now started the real hard work. Lot of money is required to run a research institution. Jagadish Chandra appealed to his countrymen for funds. The response was unprecedented. Not only wealthy persons like Maharaja Mahindra Chandra Nandy, Maharaja Gaekwad, Mulraj Khatau came forward with monetary help but even the toiling masses contributed whatever they could. Jagadish Chandra innovated a number of ways to raise funds. From 1918 he arranged serial lectures where the public had to pay to be in the audience. Records say, not a single seat remained empty when Jagadish Chandra lectured. Some of these lectures titled "Life Unvoiced", "Invisible Light", "Universal Sensitiveness of Matter" have become classics.

Continuing with his fund raising process Jagadish Chandra set out for Mumbai (then Bombay). Mahatma Gandhi wrote in his "Young India" : "The Bose Institute of Calcutta is destined to fill a great place in the world. Now it is for the citizens of this great city to give the Indian Scientist. ….such a welcome as will redound to the honour and glory of Bombay".

This appeal had a great impact. Jagadish Chandra and his wife Abala Bose was greeted by a huge gathering at Victoria Terminus station in Mumbai when they arrived by the Nagpur mail. The scientist was scheduled to lecture at the "Opera House". Not only did the citizens of Mumbai throng the auditorium in huge numbers, they donated generously which totaled fifty thousand rupees. The newspapers, "Hindi Punch" reported the event in the following words…."Such wild enthusiasm has never been recorded. Bravo Sir Jagadish, Bravo the Bombay worshippers of knowledge, bravo the Bose Research Institute".

Thus the Bose Research Institute truly became a national Institution as the effort of the whole nation helped it to stand on its own. In 1924 the Editor of the famous magazine 'Nature' wrote. "The growth of the Bose Institute proves also that India possesses men of great public spirit…."

The Government of India did help with some financial allotment but that was paltry and even that sometimes was reduced citing unavoidable reasons,

Jagadish Chandra himself and all the research scientists, students and staff members of Bose Research Institute left no stone unturned to fulfill the aspirations of the nation. It is here that Jagadish Chandra, a physicist by training and profession, later turned into a plant physiologist. His works on the response of living cells under external stimuli were ground breaking and set the foundations of modern day biophysics.

The great scientist, a national hero, breathed his last on 23rd November, 1937. His death marked the end of a great epoch. However, the process of seeking & striving to reach at the heart of scientific truth did not end with his death. Debendra Mohan Basu, Palit professor of Calcutta University and nephew of Jagadish Chandra became the Director. The Institute blossomed through the 30 years of his leadership. New branches of research were added and the works received International acclaim.

With the march of time the Bose Institute has undergone a sea of change but it still remains true to is original goal of national welfare and upholding a high standard of scientific research. In addition to the original or main campus at Rajabazar, Kolkata and the A.J.C. Bose Centenary Building at Kankurgachhi, the Acharya J.C. Bose High Altitude Research Centre at Darjeeling and experimental field stations at Falta, Madhyamgram & Shyamnagar are now parts of the Institute.

A glimpse of the different research departments and sections along with some of their recent research and other activities may help one to construct an idea about the present Bose Institute.

Biochemistry

The department was created in 1974. Since its inception, the research activities of this department have been directed primarily towards an understanding of the process of gene expression in plants and bacteria. In the late eighties, these studies were continued using extensively the recombinant DNA technology and several new research programmes were initiated including plant and animal biotechnology, yeast and parasite molecular biology and structure activity relationships of gene regulatory porticos.

Botany

The major research goal of this department established in 1917 is to improve crop production using conventional and modern techniques, where genes with elite characters, particularly those endowed with biotic and abiotic stress tolerance are identified and located in wild relatives. This is done with objective to incorporate those in cultigens of rice, Brassica, Beta and chenopodium using breeding, tissue culture and genetic engineering techniques.

In recent years, anti-hepatitis activity of *in-vitro* raised organs and tissues of *phyllanthus amarus (Bhui Amla)* has been studied by researchers of this department. Among other researches are, developing strategies to understand the resistance mechanisms against microbes, as well as to develop resistant transgenic plants, transgenic approach to delay fruit ripening, improvement of aromatic rice etc.

Chemistry

The chemistry department is one of the oldest departments of the Institute since its inception in 1917. Over the years the department has diversified its work keeping pace with the recent developments. At present the department has concentrated its work broadly on (i) chemistry of natural products; (ii) structure – function- interaction of proteins and (iii) medical biotechnology including drug targets.

Studies on hepato-protective proteins from herbal sources. Drug targets and drug resistance mechanisms in bacterial pathogens. Human red-cell membrane are some of the recent activities.

Microbiology

Started in 1942, this department is engaged both in basic and applied research. The research activities of this department address the problems in the areas of parasitic and bacterial infections, drug design and detoxification, plant-microbe and mineral microbe interactions.

Bio-transformation by microbes, controlling damage in tomato, bio-technologically improved bio-hydrometallurgy etc. are some of the latest activities of this department.

Physics

This is one of the oldest departments, as the founder himself was a physicist and thus research in physics has been carried out from the inception of the Institute till today. The main objective of this department is to improve our understanding of the basic laws of nature, in the realm of both macro and micro worlds. Current research programmes are in the areas of radiation physics, condensed matter physics and materials science, physics, astrophysics, cosmology, foundational aspect of quantum mechanics, quantum information and communication.

Research Sections

Animal Physiology

Established in 1930, the Animal physiology section is manly engaged in applied research related to Animal Biotechnology and cancer chemo-prevention. In the early years

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Interview with the Director, Prof. Maqsood Siddiqi

Q. How do you rate the performance of your institute in recent times?

Ans. Performance of Bose Institute has been one of the best in India. Scientists, working here in different branches have excelled in their pursuit. We have published 1115 papers in the last ten years. These papers have covered everything from astrophysics to plant genomics. The benchmark has definitely been very high. In my two yeas as Director I have reviewed the whole system to make it more efficient and more effective.

Q. What are the hurdles to a better performance from your viewpoint.

Ans. In any developing country, the hurdles facing a research institute are the same. Finance and manpower are certainly problem areas. But the ultimate problem is that science cannot prosper in a restricted environment. Here a scientist is subjected to the same rules applicable to just any other sector. This is not a very encouraging situation.

Q. What has been Bose Institute's achievement in the field of procuring patents in recent times?

Ans. The institute is in the mould of basic academic fundamental research. However, my predecessor and me thought that there is no point in generating knowledge only if the country does not benefit. Dr. Roy, the former Director started contract-based research, consultancy etc. I, myself think that good science must always be transferred to technology sector. We are striving towards that and at present, we are going for a patent the moment a discovery or an invention is made. In the last 2 years or so we had procured three patents.

Q. Tell us about your societal goals.

Ans. We have to be useful to the society. In Madhyamgram we are running a project for cultivating good quality mushrooms. People from the area are being trained. They are benefiting from the project. We are doing this with help from an NGO. After successful completion we would transfer the technology to appropriate body.

In association with Department of Science and Technology, Govt, of West Bengal, we are trying to develop the first Bio-technology Park in West Bengal, This will not only be for commercial purpose. I feel, commerce should also support social development. Bose Institute's innovations in plant biotechnology would certainly be supported by investors. But the blessings will be transferred to the village people where the investor will make applications in the field to earn profits. Thus, both the sides will benefit from our effort.

Q. What is your message to the future scientists of India who might some day work under your leadership?

Ans. Do good science and creative science. The goal should be, economic development through science.

Interviewed by : M.P.D.

Standing Tall

Maximise your height potential

❑ Dr. Yatish Agarwal
e-mail: dryatish@yahoo.com

Even though giraffes should never be the benchmark, everybody loves to grow tall. That's why not just tonics, but pills and capsules which claim to increase height sell like hot cakes. Young people try all kinds of recipes in order to add inches to their frame. They swing from cross bars, take expensive capsules, think about taking growth hormone and do just about everything to match the height of Sush Sen and Bachhan Junior.

Yet any effort at growing tall must be rational to be of any use. Won't you like to take a closer look at the possibilities? If so, read on.

Eat well. Take a balanced diet rich in essential nutrients, including protein, vitamins and minerals, and sufficient calories. The body needs this to grow to its optimum. If you are finicky about your food habits, live on junk food or eat irregularly, you are sure courting growth failure.

Girls and boys who go on crash diets and end up with *anorexia nervosa* can also lose on height. Thus, if you wish to optimise your height, eat regular food without too much fuss.

Be regular about exercise. Almost everybody advises teenage hopefuls to use the gym, climb on to the crossbar and swing from it. If you wish, you may also take the advice. Research studies suggest that exercise can increase growth hormone in the body marginally. This would help you grow some, but not much. You should therefore not lose your head doing it all the time. The straight fact is: if you come from a family of short-statured people, swinging from the cross bar or doing sit ups is not going to change your genes.

Keep an eye on your weight. Do not allow yourself to grow fat. You may think you are taller than your peers but here you would be completely wrong. An obese child is normally tall for his age in the beginning, because of secondary overactivity of the adrenal gland. But the joy soon turns to sorrow because the bones undergo premature closure at the growing ends, and you end up having a shorter stature than your genetic potential.

Hormones are rarely useful. Growth hormone, a product of the pituitary gland, is essential for normal growth. Its deficiency states are uncommon. Only if somebody falls in the deficient category, would he benefit by taking shots of synthetic growth hormone.

Some unscrupulous physicians (quacks), however, don't hesitate in advising these shots to even normal young people keen on growing tall. Be wary of them. Such shots can derange the body's hormone system and lead to serious complications. Excess of growth hormone can also make a person diabetic.

A deficiency state of thyroid can also limit a person's height. It must be compensated for by proper endocrine treatment. This is essential not just for physical growth, but also mental growth and well being.

Sleep adequately. Taking good seven-to-eight hours sleep every night helps. It is a physiological stimulus to the growth hormone. There is good scientific evidence that children, who sleep less, may not do well in achieving their height potential.

Don't fall for health foods and tonics. Even though several food manufacturers sell their ware as health foods capable of making you tall as a giraffe, the truth is they hold no such magic. Do not be mesmerised by their unfair claims and enticing advertisements. A natural, healthy, balanced diet is always a better option.

Know your genetic potential. A person's height is determined to a large extent by the Mendelian genes. If you and your parents come from a family of short-statured people, there is a very little chance that you will ever reach the sky. Unless of course, an errant gene with the code of tall attributes from a forefather suddenly reappears in you. But that would be like hitting a jackpot and few people have that luck.

Since you have no choice about which family you're born into, the idea should be to achieve the height you could best hope to reach. It is the height you are genetically programmed for. To think of anything more is plain fantasy.

Beyond eighteen, just be happy. There is also a time frame to growing tall. Whatever be your height, nothing can quite increase it once the growing ends of the bones fuse. This fusion is generally complete at sixteen or seventeen

years of age in girls and at eighteen years in boys in this country.

Once you go past this age, accept things as they are and be happy. Stand straight and learn to wear clothes and shoes that suit you. Big checks can make a short person look shorter, while long stripes and heels can apparently work to advantage. Yes, they can make a big difference. Try it out!

Steer clear of quacks. A number of quacks and drug companies sell many pills and capsules with bogus claims that they can increase your height at any age. Don't believe them. I receive any number of letters from young people who try these capsules with no result and feel very upset and frustrated. The only way to increase one's height after the fusion of the growing ends of the bones is through painful surgery—a procedure called Illizarov's method—but believe me, it simply isn't worth it.

Be a happy child. A happy home is vital to a child's normal development. Parents must understand that poor psychosocial environment and lack of emotional warmth and security can adversely affect the child's growth and hamper his normal growth.

Treat birth defects early. If a child has a birth defect, the parents should take an initiative for an early timely treatment. A birth defect, such as a hole in the heart, if uncorrected for long can restrict the growth. All parents should make a note of this.

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significant contributions were made from various physiological studies on different types of spiders, ants, caterpillars, butterflies, tadpoles, fish and silkworms. Studies on endocrine manipulation for better production of small animals, thyroid hormone action in adult brain etc., are presently going on.

Environmental Sciences

The Section was created in 1992. During the last few years this section played a major role in monitoring various environmental pollution samples from different industries/ foundries.

Immunotechnology

Created in 1992 its present activities include phage induced modification of bacterial machinery, host virus interaction in giant black tiger prawn etc.

Plant Molecular and Cellular Genetics

The section was established in 1989 with an aim to study basic and applied aspects of plant processes through modern molecular approaches. The aims of the section are to produce high yielding crops with less input to fulfill the increasing demands placed on agriculture. The major emphasis has been given to identify the basic components coding for desirable traits through molecular approaches and its application using conventional breeding and genetic engineering technology.

Service Departments

Distributed Information Centre

The Bio-informatics centre of Bose Institute was started in 1988 as one of the nine centers under the Biotechnology Information System (BTIS) progrmme of the Department of Bio-technology, Govt of India, with genetic engineering and molecular modeling as major thrust areas. The centre has become the main source of information related to bio-informatics and its dissemination in Eastern India.

The main areas of research using this facility are genome analysis, molecular modeling, plant genomics and proteomics, protein folding and threading and bio-molecular structue and recognition.

J.C. Bose Unit and Museum

These have been built up and furnished, over the years the furnish information regarding Acharya J.C. Bose and his work to various organisaitons, eminent persons and common men on request. Special displays in the Museum are organized on the Foundation Day of the Institute (10th November) and on Science Day (28th February).

Library

The Bose Institute Library was established in 1917 in the main campus. A wing of the Library has been opened at A.J.C. Bose Centenary Building in 1983. Taken together, the Institute Library System is one of best Science Reference libraries in Eastern India.

Madhyamgram Experimental Farm

About 30 Kilometre from the main campus at Rajabazar, Kolkata stands the Experimental Farm at Madhyamgram. Experimental crops and plants are grown here which include rice, mung, palang, castor, bamboo etc. A demonstration medicinal garden is being maintained here since 1999.

Regional Sophisticated Instrumentation Centre

This centre provides instrumental and consultancy services to the scientific and industrial communities. Sophisticated instrument here include Electron Paramagnetic Resonance Spectrometer, Fluorescence spectrophotometer, Transmission Electron Microscope, High Pressure Liquid Chromatograph etc. The non-utilisation of some of these have caused concern for the authorities in recent years.

Many of the research activities of Bose Institute are oriented to benefit agriculture. The other important areas are understanding of nature of diseases and development of drugs. While the team of dedicated scientists generally work silently within the confinements of their laboratory they do come in contact with the society through different science popularization programmes. The institute gives special emphasis on such programmes. They also accept invitations from other institutes to deliver popular and scientific lectures almost regularly.

Needles to say, Bose Institute has a team of highly qualified scientists, many of whom have already been rewarded for their excellent work at the national level through various prizes including the Bhatnagar award. The scientists strive under an able management to uphold the glory of the institute and fulfilling the founder's original goal — making the nation prosperous. ◆◆◆

Recent Developments in Science and Technology

Chimp genome draft completed

The draft of genetic sequence of our closest relative, the chimpanzee has been prepared.

The differences between the chimp's genetic code and ours should reveal what makes us human, scientists hope. The disparities might, for example, lie in genes that control the development of the brain and language, or of human-specific diseases such as Alzheimer's, AIDS and malaria.

The consortium of scientists has already lined up the chimp sequence, which is around 90% complete, with the human genome and placed it in public databases for other researchers to use. The chimp sequence is thought to be almost 99% identical to ours in some regions at least, and its full code is roughly the same size as ours: 3 billion base pairs.

A team of scientists took on the job of coding the chimp's DNA, led by Eric Lander at the Broad Institute in Cambridge, Massachusetts, and Richard Wilson at Washington University School of Medicine in St Louis, Missouri. The consortium took less than a year to prepare the draft.

Source : Nature, Jan 2004

Predicting miscarriage

A simple protein might predict the chances of a pregnancy ending in miscarriage, say researchers in Australia.

About half of all fertilized eggs are aborted, often before the woman knows she is pregnant. Among known pregnancies, roughly 10-15% of pregnancies are spontaneously lost. Yet doctors often can't foretell which ones will fail. One of the few known hints is a hormone called human chorionic gonadotrophin (hCG), whose levels fall around the time of a miscarriage.

The Australian study now shows that levels of a protein called MIC1 - one of a host of immune-system proteins that exist during pregnancy and which are thought to be critical for a healthy pregnancy - drop by 70% as early as three weeks before a miscarriage, long before hCG levels fall.

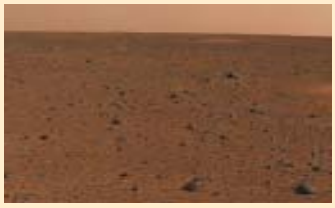
Stephen Tong at Monash University in Clayton, Australia, and his team tested the blood of 200 women who were 6-13 weeks into a healthy pregnancy and another 100 women who subsequently miscarried. The results make M1C1 the earliest indicator that things are going away.

Researchers hope that this and other studies might eventually lead to drugs that prevent miscarriage by, perhaps, boosting levels of MIC1 back to normal. This might be particularly helpful for women who suffer recurrent pregnancy loss.

Source : Nature, Jan 2004

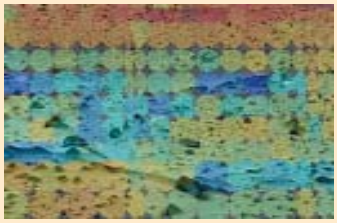
Mars rover's first colour image released

NASA's Spirit probe has send some snapshots from Mars. Scientists at NASA celebrated the arrival of the rover, which will search for signs that the red planet was once capable of supporting life. NASA last landed a spacecraft on Mars in 1997, when the Sojourner rover of the Pathfinder mission explored the planet's surface.



Martian surface

Spirit is the first of a pair of rover devices due to land on Mars this month. Its sister probe, Opportunity, is now approaching Mars at the end of its seven-month flight from Cape Canaveral in Florida, and is scheduled to touch down on the opposite side of the planet on 24 January 2004.



This image of the Martian surface from Spirit's thermal emission spectrometer shows warmer regions in red, cooler ones in blue (Image: NASA/JPL/ ASU/Cornell

The martian picture shows a rich diversity of colours and shapes of rocks, a promising prospect for the rover's excursions.

The images taken by the craft's mini-Thermal Emission Spectrometer - an infrared instrument capable of indicating the composition of nearby soils and rocks - show evidence of carbonates and hydrated minerals. Both of these are usually, though not exclusively, produced in long-standing bodies of water.

Source New Scientist.com

Oldest Known Ancestor of Marsupials Discovered in China

Scientists say, a mouse-size, tree-climbing animal that lived with the dinosaurs is the oldest known ancestor of modern marsupial mammals, A report published in the journal *Science* describes the fossil, which is 15 million years older than the previous record.

Zhe-Xi Luo of the Carnegie Museum of Natural History (CMNH) and Nanjing University and his colleagues discovered the largely intact skeleton in China's Yixian rock formation, which dates to 125 million years ago. The find included well-preserved impressions of fur and carbonized soft tissue, which aided the reconstruction of what the animal looked like (*see image).* The creature was about 15 centimeters long and weighed about 30 grams. Its foot structure, in particular, indicates that it was capable of climbing trees.

Source : Scientific American, Dec 2003

Compiled by: Kapil Tripathi

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