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DREAM 2047

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# VP News

## Venus Transit – Training Programmes

As part of the country-wide programme on Venus Transit,Vigyan Prasar in association with National Council for Science and Technology Communication conducted a series of four training programme for Master Resource Persons in different zones of the country. Training programmes conducted for the Southern and the Western zones were reported earlier. For the Eastern zone, the Master Resource Persons' training programme was conducted at Guwahati during 29-30 April, 2004. Assam State Council for Science, Technology and Environment (ASTEC) were the local hosts. Forty five participants representing Assam, West Bengal, Meghalaya, Nagaland, Arunachal Pradesh, Sikkim, Tripura, Mizoram and Manipur participated in the programme. Dr. A. K. Goswami, Director, Guwahati Planearium, inaugurated the programme. Also present was Dr. A. K. Baruwa, Director, ASTEC.

Training Programme for the Northern Zone was organized at Shimla during 03-04 May, 2004. Forty participants representing Himachal Pradesh, Punjab,

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# Inside






## Vigyan Rail – Science Exhibition on wheels

Vigyan Rail made its journey in the month of April 2004 to six locations; Nagpur, Secunderabad, Tirupati, Chennai, Kanyakumari and Thiruvananthapuram. In all the places extensive press and electronic media coverage was given by Newspapers, DDK, AIR and private TV channels. Live webcasting of the exhibition was carried out from Tirupati and Chennai through the exclusive website of Vigyan Rail, viz. www.vigyanrail.com.

Vigyan Rail was stationed at Tirupati from 12 to 15 April 2004. The exhibition at Tirupati was inaugurated by Shri Anjeya Kallan, IAS, Executive Officer, Tirumala Tirupati Devasthanam in the presence of Shri V. Charmelus, Divisional Railway Manager, Guntakal Division. In four days, some 35,000 people visited the exhibition. Regional Science Centre, Tirupati, conducted science quiz on all four days of halt.

*Vigyan Rail at Thiruvananthapuram*

The next halt of Vigyan Rail was at Chennai during 16-22 April 2004. Prof. E. Balaguruswamy, Vice Chancellor, Anna University inaugurated the exhibition. Shri V. Anand, General Manager, Southern Railway, presided over the function. During its halt at Chennai, Doordarshan and AIR made special programmes

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

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Editor : Dr. V.B. Kamble

# Gearing Up for the Transit Day

As our date with Venus transit draws closer, so does the crescendo in enthusiasm to observe it. We, at Vigyan Prasar, are flooded with numerous enquiries regarding information on various aspects of the transit, availability of software like the Venus transit activity kit, articles, slide sets etc, along with requests for popular talks on transit phenomena. It has been a challenge coping with the enquiries - from the method to calculate the Astronomical Unit through the transit observations to observing the transit safely and whether the transit could have any adverse effect on the human life!

Surely, there is no gainsaying the fact that there exists a much higher level of scientific awareness today among the people than did only about a decade ago, when Doordarshan brought the entire sequence of the Total Solar Eclipse of 1995 in our homes. Concerted countrywide campaigns by organizations like Vigyan Prasar and National Council for Science and Technology Communication to promote scientific awareness and inculcate scientific outlook seem to be yielding results only now.

Indeed, there exists an inherent curiosity in the human mind to explore the unexplored. Often people want to ask questions and understand the various phenomena taking place around them, but are prevented from doing so due to shyness. Then, there is a fear of being rebuffed at the naivety of the question. "How can I ask so naïve a question to a learned person" is the common refrain. But with little encouragement, there follows a volley of questions - often important and often not so easy to answer even for an expert! It happened recently in Shimla during the Master Resource Persons' training programme on Venus Transit for the North Zone.

As part of the training programme, we had organised sky viewing for the participants on the night of May 04, 2004 when the total lunar eclipse was due. The sight of the crescent Venus, rings of Saturn, belts of Jupiter and its satellites, and the craters of Moon through a small telescope opened the flood gates to the questions hitherto unasked either due to shyness or fear. "Oh, they are so beautiful, so wonderful and so majestic! How could they ever have any ominous effect on our lives?", exclaimed one participant! It was full Moon, and as the Earth's shadow gradually engulfed the Moon, the intensity of the Moon-light dropped and many faint stars and constellations became visible including the Milky Way! At totality, it became completely dark with copper-red Moon and the sky flooded with stars. All participants unanimously agreed that they had never witnessed such a wonderful and awe-inspiring sight before. The participants continued to watch the various phases of the lunar eclipse till the last contact and asked questions on a variety of topics on astronomy till almost 3.00 AM! Now they have their eyes set on the observations of the Venus Transit!

What is described above clearly brings out the importance of utilizing the natural phenomena or events in arousing an interest in science. On-coming transit of Venus is one such event and must be utilized for popularizing science - astronomy in particular. Besides being so rare, it has a historical significance too. From how two warring nations - England and France - signed a pact not to attack each other's expeditions sailing for the observation of the Venus transit in different parts of the globe in the eighteenth century to the travails and tribulations of astronomers setting out with the sole goal of measuring the solar parallax are a wonderful and inspiring saga about the enormous efforts that go into the search of scientific truth.

History abounds with examples when interest in science was triggered due to the observation of celestial phenomena - Tycho Brahe being one such example. His interest in Astronomy was aroused by the observation of a total solar eclipse! Actual observation of the Venus Transit on 08 June 2004, of course with all the precautions to observe it safely (as described in the April 2004 issue Dream 2047), is bound to fire the imagination of our children and grown-ups alike and trigger an interest in science. Having realized the potential of science clubs in providing a platform to children to pursue their interest in science, we also intend to provide the Venus Transit activity kit to the 5600 members of the Vigyan Prasar Network of Science Clubs. Further, as reported in these columns earlier, Vigyan Prasar and National Council for Science and Technology Communication have jointly chalked out a nationwide science popularization programme with activities built around the Venus Transit of 08 June 2004. Vigyan Prasar is also making arrangements to webcast the entire event live on its website.

The Shimla experience is not unique to astronomy. It would equally be true in any field or discipline. It is possible to arouse an interest in science and witness enthusiastic reactions even with a small microscope given to observe leaf-cells of various plants or observe small organisms. We only need to provide an opportunity.

Gear up then! Do not miss the great opportunity. But remember! Never look at the Sun directly or through a telescope without tested filters. Projection of the Sun's image on a screen or a wall through a binocular or a telescope would be the safest way to observe the transit. Observe the transit yourself and also help others observe.

Wish you an exciting "T-day"! Happy viewing!

**❒ V. B. Kamble**

**Editor** : **V.B. Kamble**

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# Archimedes

## One of the Greatest Greek Mathematicians of Antiquity

❒ Subodh Mahanti
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Give me a place to stand and rest my lever on, and I can move the Earth.

*Archimedes*

Archimedes, who combined a genius for mathematics with a physical insight, must rank with Newton, who lived nearly two thousand years later, as one of the founders of mathematical physics.

*Alfred North Whitehead*

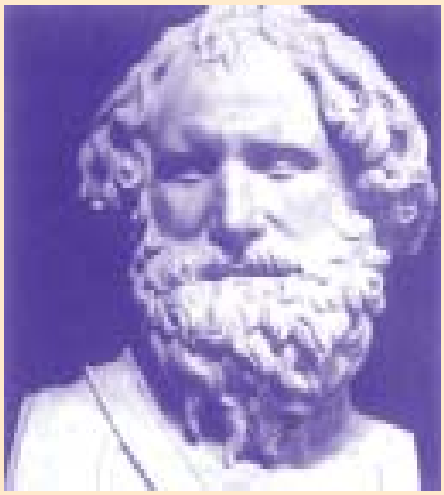
Archimedes was the finest scientist and mathematician of the ancient world but little firmly known of his life, although legends exist. He is known to have used experiments to test his theories, which he then expressed mathematically.

*The Cambridge Dictionary of Scientists* (Second Edition) 2002

It is no exaggeration to describe Archimedes as the creator of the science of mechanics. Naturally before his time many isolated facts had been discovered, but it was only with him that mechanics became a unified body of theory capable of yielding new and unexpected practical applications.

*A Dictionary of Scientists*, Oxford University Press, 1999.

The word "Eureka" is a Greek word (heureka) for "I have found". Today it means "to find", "to discover" and used as an exclamation inserted into an utterance without grammatical connection to it. As a noun it means an important discovery. The word has found place in English dictionary because of exclamation supposedly uttered by Archimedes when he discovered a way to determine the purity of gold by applying the principle of relative density or specific gravity. Archimedes is regarded as one of the greatest "working scientists" and mathematicians of the antiquity. His approximation of ($\pi$) between 3×1/2 and 3x10/71 was the most accurate of his time and he devised a new way to approximate square root. He had anticipated the invention of differential calculus as he devised ways to approximate the slope of tangent lines of his figures. Archimedes revolutionized mechanics, founded the scientific discipline called hydrostatics and established the precise study of more complex solids. He invented an early form of calculus and developed an advanced understanding of numerology. Archimedes was as much an applied mathematician as a pure mathematician.



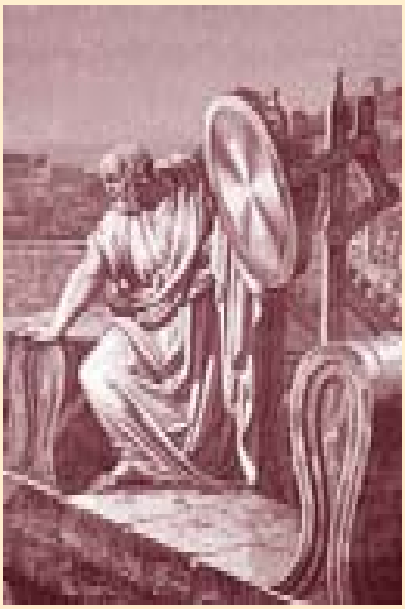
*Archimedes*

In his own time he used to be known as "the wise one", "the master" and "the great geometer." The fame of Archimedes in his own time was mainly due to his proximity to King Hieron II, the then ruler of Syracuse and his son Gelon. It is believed that Archimedes was related to the monarch. He was also the tutor of Gelon. It seems Archimedes made a hobby out of solving the king's most complicated problems to the utter amazement of the sovereign. Today Archimedes is best known for the following:

i. For his discovery of the relation between the surface and volume of a sphere and its circumscribing cylinder.
ii. For his formulation of a hydrostatic principle known as Archimedes' principle.
iii. For his invention of the Archimedes' screw—a device for raising water by means of a rotating broad-threaded screw or spiral bent tube within an inclined hollow cylinder.

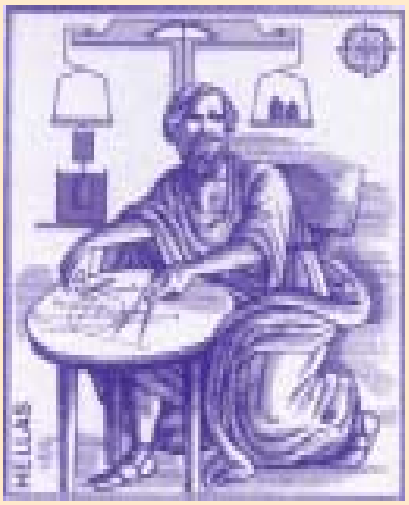
Archimedes designed all sorts of pumps and the Archmedean water screw is still in use in some parts of the world. The story of Archimedes jumping from the bath naked is usually linked with his discovery of the principle of hydrostatics. One really does not know whether this incident was actually responsible for formulating his hydrostatic principle. The story has several sources and we do not know which is the correct one. The description of the incident by the Roman architect Vitruvius is considered as the most reliable one by many. But then we should remember that Vitruvius wrote two centuries after the event took place. According to the version of the story given by Vitruvius, King Hieron decided to get a gold wreath prepared for dedicating it to the gods. (Some version says it was a crown). This way he had decided to celebrate his continuing good fortune. The king gave a lump of gold to a local artist for the purpose. However, when the artist returned with the completed gold wreath the king felt that the artist did not use all the gold given to him. The weight of the gold wreath was same as that of the gold given to him by the

king. The king thought that the artist had mixed less expensive silver with gold. The king asked Archimedes to look into the problem. Archimedes also did not have a ready-made answer for the king but he promised to think about it. The legend says that one morning, several days later, Archimedes was still thinking about the problem when lowered himself in a bath. While doing so Archimedes noticed that some of the water was displaced by his body and flowed over the edge of the tub. In a flash he understood how to solve the problem posed by the king. Archimedes solved the problem by grasping the concept of relative density. He was so excited at his sudden discovery that he leapt from the bath and started running naked through the streets while shouting "ureka! Eureka!" (I have found it). He requested the king to make him available a lump of gold weighing the same as the wereath. After receiving the piece of gold, he immersed it in a tub of water filled to the brim and measured the water displaced by it. In the same way he immersed the wreath and measured the overflow. The water displaced by the wreath was more than the gold. In this way Archimedes found that the wreath was mixed with other metal of lower density.



*Archimedes burning enemy ships with his mirrors*

Archimedes discovered the laws of levers and used pulleys. After the discovery of the laws of the levers, he boasted "Give me a place to stand and rest my lever on, and I can move the Earth." As such it was not possible to challenge the statement directly. So he was asked to move a ship which had required a large group of labourers to put into position. Archimedes moved the ship easily by using a compound pulley system.

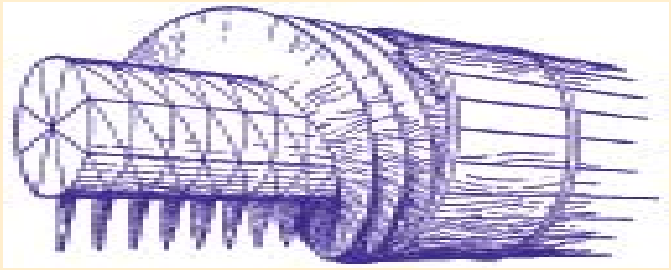


*Archimedes on a Greek stamp*

Archimedes was born in 287 B.C. in a noble family of Syracuse, Cicily. Syracuse was the most powerful city-state in Cicily. Besides being an aristocrat, Archimedes' father was an astronomer and a mathematician. This information comes from one of Archimedes' works, *The Sandreckoner*. Most of the information about Archimedes' life comes from the writing of Plutarch (in Greek Plutarchos c.46-c.120 AD), who lived three centuries later. Plutarch's best known work *Parallel Lives* compares eminent Greeks with their Roman counterparts. Plutrach's *Lives* concentrate on the moral character of each subject rather than on the political events of the time. As a result a minor incident or anecdote will acquire a greater importance in the narrative than it would in a standard history or biography. Plutarch in his *Life of Alexander* wrote: "I am writing biography, not history, and the truth is that the most brilliant exploits often tell us nothing of the virtues or vices of the men who reformed them, while on the other hand a chance remark or a joke may reveal far more of a man's character than the mere feat or winning battles in which thousands fall, or of marshalling great armies or laying siege to the cities." In Plutarch's writings Archimedes finds mention as a mere insertion in the biography of the Roman General, Marcus Claudius Marcellus (c. 268-c.208 B.C.), who was known as the Sword of Rome. Of course, there were other sources including Archimedes' own stray comments here and there in his prefaces to the treatises he wrote.

Archimedes studied at Alexandria in Egypt. The city of Alexandria was founded in B.C. by the Alexander the Great. It is at Alexandria that Alexander the Great was buried in a resplendent gold coffin in BC. Its location is not known today. By the early 2nd century BC Alexandria was emerging as the greatest centre of learning in the Mediterranean world. In this regard it surpassed even Athens. The famous library of Alexandria attracted scholars from all over Hellenistic world. Its collection of manuscripts included Aristotle's extensive collection—the greatest private collection of the Greek era. Euclid worked at Alexandria. However, Euclid probably had died before Archimedes arrived at Alexandria. But then Archimedes would certainly have read Euclid's geometry textbook *Elements*. This famous book laid the foundation of geometry. It was also likely that Archimedes had studied with one Euclid's pupils. At Alexandria, Archimedes befriended two fellow students with whom he was to remain in correspondence throughout his life. These two friends—Conon of Samos and Eratosthenes of Cyrene were fine mathematicians.

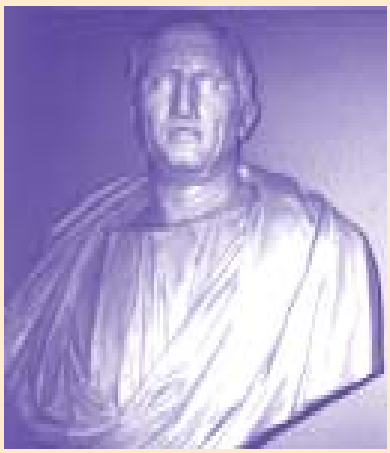
According to one legend Archimedes visited Spain after leaving Alexandria. A story, mentioned by Leonardo da Vinci in his notebooks, narrates that Archimedes acted as a military engineer for King Ecliderides of Cliodastri. Diodorus, a historian of Cicily and who lived in the first century BC, speaks of Archimedes' Screw being used for pumping water from the silver mines of Rio Tinto in southern Spain. According to Diodorus, Archimedes invented his screw just



*Archimedes' Screw*

for this purpose. Some other legends speak of Archimedes returning to Egypt for a second time. During his second trip to Egypt he was said to have employed on the large-scale irrigation works as a measure to control the flooding of the Nile Delta. And as per these reports Archimedes screw was invented during this time.

Among the treatises of Archimedes which have survived are: *On Plane Equilibriums* (two books), *Quadrature of the Parabola*, *On the Sphere and Cylinder* (two books), *On Spirals*, *On Conoids and Spheroids*, *On Floating Bodies* (two books), *Measurement of a Circle* and *The Sandreckoner*. Another of his work titled *The Method* has been found in a tenth century manuscript discovered by J L Heiberg, a Professor of Philology at the University of Copenhagen. There are references to Archimedes' other works which have been lost. The surviving works of Archimedes give a unique insight the workings of him. Most of these works are easy to follow even for non-mathematicians. All of his known works were of a theoretical character. He left no written work on his practical inventions. As he had a very low opinion about these inventions he did not consider it worth writing about them. Thus Plutarch wrote: "Archimedes possessed so high a spirit, so profound a soul, and such treasure of scientific knowledge, that though these inventions had now obtained him the renown of more than human sagacity, yet he did not leave behind him any commentary or writing on such subjects…". However, it is certain that his interest in mechanics deeply influenced his mathematical thinking. He not only wrote works on theoretical mechanics and hydrostatics but he also used mechanical reasoning as a heuristic device for the discovery of new mathematical theorems as evident in his *Method Concerning Mechanical Theorems*. He published his works in the form of correspondence with important mathematicians of his time. The only manuscript that Archimedes wrote on practical matters was *On Sphere-making*. The manuscript, which is now lost, is referred to by the Greek mathematician Pappus of Alexandria, who lived in the 4th century AD.



*Cicero*

Archimedes used to remain engrossed in some problem or the other all the time. He was most interested in geometry. Even while taking bath (which used to be a rare occurrence for Archimedes), he used to draw geometrical figures even on his naked body. Thus Plutarch wrote: "oftimes Archimedes' servants got him against his will to the baths, to wash and anoint him, and yet being there, he would ever be drawing out of the geometrical figures, even in the very embers of the chimney. And while they were anointing of him with oils and sweet savours, with his fingers he drew lines upon his naked body, so far was he taken from himself, and brought into ecstasy or trance, with the delight he had in the study of geometry."

Archimedes invented many machines, which were used as engines of war. Among his war machines were enormous mirrors to focus the Sun's rays and set fire to the Roman ships, and a variety of catapults. His huge catapults hurled 500 pound boulders at the enemy soldiers. He played an important role in the defense of Syracuse against the siege laid by the Romans in 213 BC by effectively deploying his war machines. His single handed effort long delayed the capture of the city. This is how Plutarch described the impact of Archimedes' war machines. "…when Archimedes began to ply his engines, he at once shot against the land forces all sorts of missile weapons, and immense masses of stone that came down with incredible noise and violence; against which no man could stand; for they knocked down those upon whom they fell in heaps, breaking all their ranks and files. In the meantime huge poles thrust out from the walls over ships and sunk some by great weights which they let down from on high upon them; others they lifted up into the air by an iron hand or beak like a crane's beak and when, they had drawn them up by the prow, and set them on end upon the poop, they plunged them to the bottom of the sea; or else the ships, drawn by the engines within, and whirled about, were dashed against steep rocks that stood jutting out under the walls, with great destruction of the soldiers that were aboard them. A ship was frequently lifted up to a great height in the air (a dreadful thing to behold), and was rolled to and fro, and kept swinging, until the mariners were all thrown out, when at length it was dashes against the rock, or let fall." Syracuse was eventually captured by the Roman General Marcellus in the autumn of 212 or spring of 211 BC.

It is believed that Archimedes created two spheres, which were brought to Rome by Marcellus. Among these two spheres, one was a solid one on which were engraved or painted the stars and constellations. It should be mentioned that Archimedes was not the first to construct

such a celestial globe. Perhaps the Greek geometers Thales and Eudoxos first constructed such globes. Marcellus placed this sphere in the Temple of Virtue.

The second sphere was an original and ingenious work. It was a miniature planetarium—a mechanical model showing the motions of the Sun, Moon, and planets as viewed from the Earth. Archimedes' planetarium was an intricate device. While constructing the planetarium, Archimedes accepted the Earth-centred view of the universe—the universe, with the Earth at its centre. Archimedes' device was capable of tracing the motions of the Sun, Moon and planets about the Earth with reference to the spheres of fixed stars during the course of the day. With its help the successive phases of the Moon and the lunar eclipses could also be illustrated. Cicero (106-43 BC), the Roman statesman, philosopher, and a great orator, was very much impressed by this ingenious device by Archimedes. Cicero thought that Archimedes was "endowed with greater genius that one would imagine it possible for a human being to possess" to able to construct such a device. Archimedes' planetarium has been quoted by many ancient writers in prose as well as in verse. Many considered it as one of the first Christian proofs of existence of God or a divine creator. The logic was very simple for such an argument—just as Archimedes's planetarium required a creator, there must be a creator of greater intelligence to be capable of producing the cosmos—the object which the human intelligence attempted to imitate.

*Hieron-II*

*"Give me a place to stand and rest my lever on, and I can move the Earth"*

Archimedes was killed by a Roman soldier when the City of Syracuse was taken by the Romans. The year was 212 B.C. It is said that Marceless, the Roman General in charge had issued orders to his soldiers not to harm Archimedes and to treat him with respect. The legend goes to state that Archimedes was found while engaged in drawing a geometrical diagram in the sand, the city burning around him. Archimedes was unaware of the taking of the city by the Romans. There are many versions of the story of his killing. Plutarch recounts three versions which had come down to him.

The first version says: "Archimedes…was…, as fate would have it, intent upon working out some problem by a diagram , and having fixed his mind alike and his eyes upon the subject of his speculation, he never noticed the incursion of the Romans, nor that the city was taken. In this transport of study and contemplation, a soldier, unexpectedly coming up to him, commanded him to follow to Marcellus; which he declining to do before he had worked out his problem to a demonstration, the soldier, enraged, drew his sword and ran him through."

The second version: "…a Roman soldier, running upon him with a drawn sword, offered to kill him; and that Archimedes, looking back, earnestly besought him to hold his hand a little while, that he might not leave what he was then at work upon inconclusive and imperfect; but the soldier, nothing moved by his entreaty, instantly killed him,"

The third version: "…as Archimedes was carrying to Marcellus mathematical instruments, dials, spheres, and angles, by which the magnitude of the sun might be measured to the sight, some soldiers seeing him, and thinking that he carried gold in a vessel, slew him."

The Romans placed on his tombstone the figure of a sphere inscribed inside a cylinder and the 2:3 ratio of the volumes between them, the solution to the problem Archimedes considered his greatest achievement. Cicero, while describing how he searched for Archimedes tomb wrote: "…and found it enclosed all around and covered with brables and thickets; for I remembered certain doggerel lines inscribed, as I had heard, upon his tomb, which stated that a sphere along with a cylinder had been put on top of his grave. Accordingly, after taking a good look around…, I noticed a small column arising a little above the bushes, on which there was a figure of a sphere and a cylinder…Slaves were sent in with sickles…and when a passage to the place was opened we approached the pedestal in front of us; the epigram was traceable with about half of lines legible, as the latter portion was worn away."

## For Further Reading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# Tamarind : Tree of life

❒ T.V. Venkateswaran
e-mail: tvv123@rediffmail.com

Tamarind actually means- Indian date palm; the name tamarind is derived from the Arabic *Tamar-ur - Hind.* because the dark brown pulp of the fruit was thought to resemble dried dates 'Tamar'. Therefore the name "date of India". The figurative use of "date" is possibly due to use of the word to denote fruits of various palm trees in Arabia. This inspired Linneaus in the 18th century to name the tree as *Tamarindus indica*- indica meaning the species belongs to India. On the contrary, Tamarind, is neither indigenous to India nor is it related to palm trees. In spite of this misnomer, loan translations of this name have made their way into English, German (Indische Dattel) and Russian (Indiyskiy finik).

Tamarind is an evergreen, native to tropical Africa, from there introduced into India. Today, it is a much-valued food ingredient in many Asian or Latin American recipes. Tamarind is the only important spice of African origin. Tamarind is a versatile fruit, which can be used for many purposes. The brown, sticky, sour-sweet pulp is popular in cooking and flavouring. Sensoric quality of Tamarind is usually described as sour, tart and acidic.

*Flower and Pod*

The usefulness of the tamarind tree does not end with its fruit. Sometimes compared to the coconut as another "tree of life", it is widely adaptable and easily managed. It produces many valued food, medicine, wood and construction products. Drought resistant and strong, it performs well as a windbreak, preventing soil erosion and protecting people, crops and animals in harsh environments. Virtually every part of the tree (wood, root, leaves, bark and fruits) has some value in commerce and particularly in the subsistence of rural people.

## History

If Bhudha had his revelation under a Bhodhi tree, Namazhvar, a vaishnavite saint had his *dharshana* under a Tamarind tree. Cultivation of tamarind occurred in Egypt as early as 400 BC. The tree is also mentioned in the Indian Brahmasamhita Scriptures between 1200 and 200 BC and in Buddhist sources from around the year 650 AD. Cirupanartrupadai, a classic in Tamil of Sangam period has reference to Tamarind and informs that the pregnant women carve for it. Besides, another Sangam literature 'Malaipadukadam' report that Tamarind was added to milk to turn it into curd. Large ships laden with "Tamarind which was mixed up with jaggery and salt and dried mutton chops" is said to have sailed to the Yavana Land (Greek) from Tamilagam. The people of Asia have therefore known tamarind for a very long time. Arab and Persian traders are thought to have encountered the tree while trading in India, from where they carried the seeds to Southeast Asia. Marco Polo, it is reported to have recorded in 1298, that Arab traders also made tamarind an important commercial item in Medieval Europe.

In Sanskrit, Tamarind is called Chincha and Amlica. The latter term Amlica means acidic. This name is given to Tamarind due to the acidic odour and juice that it has. In the same vein, the Tamil name for Tamarind- Phuli- also implies acidic taste. The Hindi word 'imli' is a corrupt of the Sanscript word 'Amlica'.

India is the world's largest producer of tamarind products. Since ancient times, India has been exporting processed tamarind pulp to western countries, mainly the European and Arab countries and more recently the United States of America. The production in India is mainly concentrated in the drier southern states, and the produce is collected by the villagers and sold in the open market. It is particularly abundant in drier warmer areas of the South and Central region such as the States of Madhya Pradesh, Bihar, Andhra Pradesh, Karnataka, Tamil Nadu and West Bengal. Tamarind is not grown on a plantation scale but trees in patches are common in the villages in many states. In some parts of India, it is naturally regenerated on wastelands and forestlands. The tree mostly grows wild, although it is cultivated to a limited extent. Tamarind is frequently planted as a shade tree and is commonly found in woodlands, and is well adapted to the arid and semi-arid zones. It is an attractive shade and ornamental tree and forms a meeting place for people in the villages. It is presently cultivated in home gardens, farmlands, on roadsides, on common lands and on a limited plantation scale in India and the species is more economically important.In Bajapur, in the Deccan Plateau, the tree is famous for its fine varieties and although it is planted as far North as Punjab, where the fruits do not ripen. Sometimes tamarind groves are seen in India, these are thought to mark deserted villages.

## Culinary use

The tangy, citrus-like flavor of tamarind pulp lends zest to many dishes from around the world. The sour and fruity taste of tamarind merges well with the heat of chiles and gives many South Indian dishes their hot and sour character, and their dark colour. In India, tamarind is mostly combined with meat or legumes (lentils, chick peas or beans). The pulp is sold dry and must be soaked before usage. Only the water is then added to the food. Alternatively (and more comfortably), tamarind extract may be used with the same effect.

*Leaves*

A well-known example of a Southern Indian dish employing tamarind Rasam and Sambar; while in North India tamarind is seldom used even in the preparation of Sambar. Imli chutney, is to which in the North Tamarind is often put to use wherein sweetness is more pronounced than acidity. *injipuli* , a tamarind and ginger sauce is a South Indian delicacy. Puliyotharai /pulihora/puliogure a dish prepared with rice and Tamarind paste is a must for celebration of Ugadhi, the Telugu New years day. Jawanese food is unique for its sweet-sour compositions, but the sweet-sour taste is much less dominant than in Chinese recipes. For the sour taste, tamarind is preferred to lemons. On Jawa, Indonesia's most populous island, tamarind is taken as basis for spicy and sometimes sweet sauces used to marinade meat or soy bean cheese (tahu) before frying. Although rarely Western cultures use tamarind today, there is still one product containing tamarinds that has gained some importance in international cuisine: Worcester sauce, which may be called "Indian inspired" in the same way as curry powder. In peninsular Southeast Asia (Vietnam and Thailand), the pods are preferred unripe and used in tart soups or stews. These cannot be dried without aroma change. Tamarind pulp is made into a soft drink known as refresco de tamarindo in Latin America, and tamarinade in Jamaica. It's also the basis of a popular drink in the Middle East.

*Leaf, Pod, and Flower*

## Botany

Tamarind belongs to Caesalpiniaceae plant family (a tropic family closely related to the bean family) and subfamily of legumes. Tamarindus is slow growing but long lived. Individual trees commonly remain productive for 150 years or longer. It is large tree averaging 20 to 25 meters in height and 1 m in diameter. It has a wide, spreading crown and with a short massive trunk and has dark-gray, rough, fissured bark but smooth on the branches. The mass of bright-green, fine, feathery foliage is composed of pinnate leaves alternate (feather-formed) each with 9 to 12 pairs of small leaflets. The leaflets are about 2 cm long and oblong which fold at night. Inconspicuous small yellow flowers about 2.5 cm across, with a red stripe are borne in small clusters of 5 to 10 in drooping racemes 3 to 5 cm long. The pods are typically leguminous in appearance, oblong, straight or slightly curved, turning from green to dark brown as they ripen.

The dark brown fruit is a plump flattish, beanlike pod 7.5-24 cm long that does not split open. It contains 1 to 12 large, flat seeds embedded in a soft, brownish pulp both sweet and extremely sour. The pods may be cinnamon-brown or grayish-brown externally and, at first, are tender-skinned with green, highly acid flesh and soft, whitish, under-developed seeds. As they mature, the pods fill out somewhat and the juicy, acidulous pulp turns brown or reddish-brown. Thereafter, the skin becomes a brittle, easily-cracked shell and the pulp dehydrates naturally to a sticky paste enclosed by a few coarse strands of fiber extending lengthwise from the stalk. The 1 to 12 fully formed seeds are hard, glossy-brown, squarish in form, 1.1-1.25 cm in diameter, and each is enclosed in a parchment like membrane.

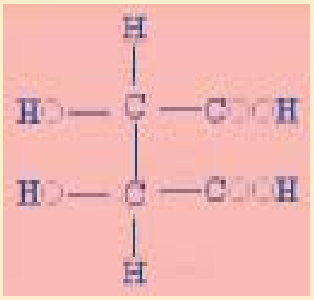
## Main constituents

The most valuable and commonly used part of the tamarind tree is the fruit. The pulp constitutes 30-50 % of the ripe fruit, the shell and fibre account for 11-30 % and the seed about 25-40 % The large range shown here may be associated with genetic variation in the crops grown in different countries. Tamarind has low water content and a high level of protein, carbohydrates (60-72 %) and minerals. The fruit contains a variety of pigments. The colour of the red type is due to water-soluble red-rose anthocyanin pigment, while in the common type leuco-cyanidin is present.

In general, the dried tamarind pulp of commerce contains 8-18 % tartaric acid (as potassium bitartarate) and 25-45 % reducing sugars of which 70 % is glucose and 30 % fructose; Fruit acids (20%) and sugar (up to 35%); furthermore, small amounts of terpenes (limonene, geraniol), phenylpropanoids (safrole, cinnamic acid, ethyl cinnamate), methyl salicylate, pectin, pyrazine and alkylthiazoles are reported to be the main constituents of the Tamarind pulp. Seed contain a fixed oil and insoluble matter as well as

albuminoids, fat, carbohydrates, fibre and ash containing phosphorus and nitrogen. The leaves and roots contain the glycosides such as vitexin, isovitexin, orientin and isoorientin. The bark yields the alkaloid, hordenine.

The most outstanding characteristic of tamarind is that its acidity, is due mostly to tartaric acid (2,3-dihydroxybutanedioic acid ($HO_2CCH(OH)CH(OH)CO_2H$) $C_4H_6O_6$, a dihydroxydicarboxylic acid), which is uncommon in other plant tissues. The tartaric acid is synthesised in tamarind leaves in the light and translocated to the flowers and fruits. It is high in young leaves and decreases with age and has been reported to show seasonal variations. Nonetheless, the content of tartaric acid, does not decrease during fruit ripening, indicating that it is not utilised in fruit development. Tartaric acid is an unusual plant acid, which is formed from the primary carbohydrate products of photosynthesis and once formed, cannot be further used in the plant due to the absence of the necessary enzymes.



*Tartaric Acid*

Nevertheless during ripening of the fruit, reducing sugars increase to 30-40% giving the sour fruit a sweeter taste. As the acidity does not disappear with ripening, but is more or less matched with increasing sugar levels, tamarind is known to be simultaneously the most acidic and sweetest fruit. Although tartaric acid occurs in other sour fruits, such as grapes, grapefruit and raspberries, it is not present in such high proportions as in tamarind.

*Tamarind fruit*

## The Multipurpose Tree

The Tamarind is a multi-purpose tree. Often used plant part are unripe fruits and the pulp of ripe pods The *fruit pulp* from its seed pods has long been used both in cooking and traditional medicine. It is a source of calcium, iron, vitamin B, vitamin C and phosphorous. The pulp is used in the production of medicines for cardiac ailments and blood sugar stabilization. In West Africa, an infusion of the whole pods is added to the dye when coloring goat hides. The fruit pulp may be used as a fixative with turmeric or annatto in dyeing and has served to coagulate rubber latex. The pulp, mixed with sea water, cleans silver, copper and brass. Unrip fruit is highly acidic. Pulp of ripe fruit which is sweet or acrid is coolout. Leaves are refrigerant. Red outer covering seed is a mild astringent and antibilious.

The paste made of the crushed *seeds* is said to be helpful diarrhea cure. The powder made from tamarind kernels has been adopted by the Indian textile industry as 300% more efficient and more economical than cornstarch for sizing and finishing cotton, jute and spun viscose, as well as having other technical advantages. It is commonly used for dressing homemade blankets. Other industrial uses include employment in color printing of textiles, paper sizing, leather treating, the manufacture of a structural plastic, a glue for wood, a stabilizer in bricks, a binder in sawdust briquettes, and a thickener in some explosives. It is exported to Japan, the United States, Canada and the United Kingdom. Tamarind seeds yield an amber oil useful as an illuminant and as a varnish especially preferred for painting dolls and idols. The oil is said to be palatable and of culinary quality. The tannin-rich seedcoat (testa) is under investigation as having some utility as an adhesive for plywoods and in dyeing and tanning, though it is of inferior quality and gives a red hue to leather.

The sapwood of the tamarind tree is pale-yellow. The heartwood is rather small, dark purplish-brown, very hard, heavy, strong, durable and insect-resistant. As the Tamarind *wood* is strong it is suitable for building, furniture and cabinetry. It bends well and takes a good polish and, while hard to work, it is highly prized for furniture, panelling, wheels, axles, gears for mills, ploughs, planking for sides of boats, wells, mallets, knife and tool handles, rice pounders, mortars and pestles. However, wide boards are rare, despite the trunk dimensions of old trees, since they tend to become hollow-centered. The wood is valued for fuel, especially for brick kilns, for it gives off an intense heat, and it also yields a charcoal for the manufacture of gun-powder. Even though the trees are seldom felled, they are frequently topped to obtain firewood. The wood ashes are employed in tanning and in de-hairing goatskins.

Tamarind *twigs* are sometimes used as “chewsticks” and the bark of the tree as a masticatory, alone or in place of lime with betelnut. Young stems and also slender roots of the tamarind tree are fashioned into walking-sticks. The *bark* contains up to 7% tannin and is often employed in tanning hides and in dyeing, and is burned to make an ink. Bark from young trees yields a low-quality fiber used for twine and string. Galls on the young branches are used in tanning. The bark is useful as an astringent to treat skin problems and sores. The flowers are rated as a good source of nectar for honeybees in South India. The honey is golden-yellow and slightly acid in flavor. Tamarind leaves and flowers are useful as mordants in dyeing. A

yellow dye derived from the *leaves* colors wool red and turns indigo-dyed silk to green. The leaves and flowers are good for sprains and bruises and sore joints. The leaf paste is applied as a poultice, to reduce pain and swelling in the joints of cattle.

The tamarind tree is a host for the *lac* insect, *Kerria lacca,* that deposits a resin on the twigs. The lac may be harvested and sold as stick-lac for the production of lacquers and varnish. If it is not seen as a useful byproduct, tamarind growers trim off the resinous twigs and discard them.

## Tamarind - the sacred

Since ancient times, in India as was the case in many cultures, members of the flora and fauna were identified with spirit and worshipped. Tamarind is one such a highly sacred and worshipped tree even today for certain sections of society, particularly among the rural folk and aboriginal tribes living in the forest. In some localities of India, the tamarind tree is considered to be haunted by spirits and is worshipped on a day called “Amli Agiaras”. Hindus may also tie a tamarind tree to a mango tree before eating the fruits of the latter. The rural people consider that the neighbourhoods in which tamarind trees grow becomes unwholesome, and that it is unsafe to sleep; for Tamarind is said to be the abode of ‘Bhooth’ (Ghost). Tamarind is said to be an indicator used to forecast the weather conditions by the tribal societies in Rajasthan, India. When the fruit is longer than usual, splendid weather with abundant rain is forecast for high yields of grain and pulse crops claim the local wisdom.

Some African tribes also venerate the tamarind tree as sacred. To certain Burmese, the tree represents the dwelling-place of the rain god and some hold the belief that the tree raises the temperature in its immediate vicinity. In Malawi, tamarind bark soaked with corn is given to domestic fowl in the belief that, if they stray or are stolen, it will induce them to return home. In Malaya, a little tamarind and coconut milk is placed in the mouth of an infant at birth, and the bark and fruit are given to elephants to make them wise.

## Medicinal Use

Medicinal uses of the tamarind are uncountable. Ripe tamarind fruit has a widely recognized and proven medicinal value. The pulp has been official in the British and American and most other pharmacopoeias. It is a common ingredient in cardiac and blood sugar reducing medicines The fruit is said to reduce fever and cure intestinal ailments. Its effectiveness against scurvy is well documented. Tamarind preparations are universally recognized as refrigerants in fevers and as laxatives and carminatives. Alone, or in combination with limejuice, honey, milk, dates, spices or camphor, the pulp is considered effective as a digestive, even for elephants, and as a remedy for biliousness and bile disorders, and as an antiscorbutic. In native practice, the pulp is applied on inflammations, used as an astringent on skin infections, is used in a gargle for sore throat and, mixed with salt, as a liniment for rheumatism. It is, further, administered to alleviate sunstroke and alcoholic intoxication. In Colombia, an ointment made of tamarind pulp, butter, and other ingredients is used to rid domestic animals of vermin.

Tamarind leaves and flowers, dried or boiled, are used as poultices for swollen joints, sprains and boils. Lotions and extracts made from them are used in treating conjunctivitis, as antiseptics, as vermifuges, treatments for dysentery, jaundice, erysipelas and hemorrhoids and various other ailments. The fruit shells are burned and reduced to an alkaline ash which enters into medicinal formulas. The bark of the tree is regarded as an effective astringent, tonic and febrifuge. The powdered seeds are made into a paste for drawing boils and, with or without cumin seeds and palm sugar, are prescribed for chronic diarrhea and dysentery. The seedcoat, too, is astringent, and it, also, is specified for the latter disorders. An infusion of the roots is believed to have curative value in chest complaints and is an ingredient in prescriptions for leprosy.

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## VP News (Venus Transit ...)

*contd from page... 36*

Haryana, UP and Bihar, Uttaranchal, UT of Chandigarh attended the programme. Shri Sanjeev Gupta, Secretary (S&T), Himachal Pradesh inaugurated the programme. Shri Bharat Khera, Member Secretary, and Dr. S. S. Chandel, HSCST were also present.

The training in both the programmes centred around basic information on Sun and solar system, various aspects of the Venus Transit, and safe observation of the transit. Night Sky-viewing was also arranged in both the programmes. In particular, the participants at Shimla were fortunate to observe the total lunar eclipse on the night of May 04-05, 2004 as well.The participants were given five resource articles, Venus Transit activity kit, and a CD containing six slide shows on different aspects of Venus Transit as resource material.

Dr. A. Bandyopadhyaya, Birla Institute of Fundamental Sciences, Kolkata, Dr. A. Ambastha, Udaipur Solar Observatory, Dr. N. M. Ashok, Physical Research Laboratory, Ahmedabad, Ms. Ujjwala Tirkey, NCSTC and Dr. V. B. Kamble, Vigyan Prasar delivered talks and conducted activities.

# Journey of Rice

## Brown Rice to Golden Rice

❑ M.K. Bajpai
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### Introduction

Rice, one of the oldest and most important food crops. It is the staple food of over half of the world's population. The earliest recorded of rice production in China dates back to about 2800 BC and in India to 1000 BC, about 90% of world's rice crop is produced in Asia Continent. Present world's production of rice is about 350 million tons per year and alone India produced about 88-89 million tons of rice annually.

Rice (oryza sativa) belongs to Gramineae or grass family and contains 24 chromosomes. Today about 8000 botanically different varieties of rice are in existence in the world out of which more than 4000 varieties are identified in India. At present about 18,000 varieties of rice are maintained in the World Rice Collection Centre of the International Rice Institute. Many more varieties are developed and are developing day by day through technology of Hybridization & Genetic Engineering, for the futher improvement in nutrirional & high yielding property of rice.

### Nutritional Value

Rice is very good source of nearly all the vital nutrients; its nutritional composition contains Carbohydrates (87.2%), Protein (8.3%), Fat (2.0%), Ash (1.7%) and Fibre (curde fibre – 1.1%) mainly. The Carbohydrate present in rice is in the form of starch, which makes the principal difference between Waxy Rice (glutinous) and Normal rice. Waxy rice contains 100% amylopectin and stains iodine solution red whereas normal rice contains substantial amount of amylase and stain iodine solution blue. The nutitional quality of rice protein is high relative to other cereal proteins due to high content of lysine amino acid, together other essential amino acids. There is very little amount of lipids found in rice. However, rice bran contains much high percentage of Lipids (about 21%).

Rice is a good source of vitamins like Thiamin and Niacin, but poor source of vitamin-A. Some of major vitamins in rice are:

| | |
|---|---|
| Retinol (Vitamin A) | 0.06 mg/kg |
| Thiamin (Vitamin B1) | 4.5 mg/kg |
| Niacin (Nicotine Acid) | 44.0 mg/kg |
| Pantothenic Acid (Vitamin B3) | 12.0 mg/kg |
| Inositol | 1000 mg/kg |
| A-tocopherol (Vitamin E) | 17 mg/kg |
| Choline | 950 mg/kg |
| Pyridoxine (Vitamin B6) | 7.0 mg/kg |

Rice is also a good source of minerals like potassium (0.20%) and phosphorous (0.31%), calcium, iron, sodium, silicon, magnesium, sulphur and zinc are other minerals in rice in trace/minor amounts.

### Processing

With the new development of technologies in food processing, milling of rice was introduced to enhance the physical quality of rice & minimize the undesirable effects, as milled rice is high in starch but low in vitamins. Brown rice is milled to removed bran (outer covering layer) germ (small embryonic parts) and aleurone layer to obtain white rice with minimum feasible quantity of broken kernels free from unwanted weed seeds, damaged kernels together with other objectionable materials. On milling of rough brown rice, approximately 20% hulls, 8% bran, 2% polish & 70% milled rice is obtained. Now these days rice is milled by various technology methods for better results, but even after application of advanced technology of milling, the process reduces nutritional value of rice especially in terms of vitamins. However, Parboiling technique in rice milling had reduced the loss of vitamins & minerals during processing up to considerable extent, further more advance innovative technology required to retain the original natural nutritional content of rice during processing (milling), as about 80% of thiamin, 56% riboflavin, 65% niacin, 60% pantothenic acid and 55% of pyridoxine vitamins are removed/lost from brown rice when it is milled into white rice.

Some if the methods of which have been used for adding dietary supplements to rice in order to compensate the loss of nutrients during processing and enrich the rice with vital vitamins and minerals are as follows:

1. Mixing rice kernels with powder containing vitamins and minerals, but most of this enriched powder get washed away, when consumer wash rice before cooking.
2. Supplying of wafes containing enrichments which must be added while cooking the rice, this method again require cooperation of consumer.
3. Adding a small percentage of grains, which have been coated impregnated with, enrich ingredients, such enriched grains were called 'PREMIX'.

Various other methods are also applied, but most of them were disliked/ unaccepted by consumers. Cereals/

food technologies to yield better product together with natural goodness of enriched rice commercially.

| Components | Brown Rice | Milled White Rice |
|---|---|---|
| Carbohydrate | 87.2% | 91.5% |
| Protein | 8.3% | 7.6% |
| Ash | 1.7% | 0.5% |
| Fat | 2% | 0.3% |
| Fibre | 1.1% | 0.4% |

## Advanced Technology
### *(Bio-technology & Genetic Engineering)*

With the development of advance Biotechnology and Hybridization Technology, new hybrid rice varieties introduced in market called High yielding Varieties (HYV). Taichung Native – I & IR –8 were introduced as HYV of rice in this race in 1965-66 respectively.

These HYV of rice had increased world production of rice by about 50% during 1970-75. India had also develop HYV of rice namely Pasa Basmati-I, Kastari, Nalini, IR-20, Pankaj and Suvarna.

Recently Indian Council of Agricultural Research, New Delhi introduced two new hybrid varieties of rice KRH-2 (resistant for blast and brown spot disease) and *Anjali* (short duration 90-95 days variety).

Now these days genetic engineering also playing very important role in the development of more effective and improved advanced varieties of rice by imparting vital nutrients in it. In this technology new genes of desired traits are introduced in DNA of rice. Golden Rice is the recent miracle of this advanced technology, which is potentionized with vitamin A against natural rice, which is deficient in vitamin A.

## Genetically Modified Golden Rice
### *Needs and Discovery*

According to UNICF about 124 million children suffer Vitamin A deficiency each year worldwide out of which about a million die and 3,50,000 suffer blindness. On an average out of the 3 billion-rice eaters worldwide 10% suffer Vitamin A deficiency. Actually rice is a staple diet in developing countries and India's most popular cereal, but it does not provide adequate variety of Vitamin A.

Golden Rice is the vitamin A rich transgenic new rice, which can save millions from blindness, and other diseases related to malnutrition. Golden Rice has been created by G.M Technology and contains many genes to produce Beta-carotene – the building block of vitamin A. Thus introduction of Golden Rice is the modest start to new Green Revolution of 21$^{st}$ century.

### *Who Did It*

In 1985, Professor of Plant Science in Swiss Federal Institute of Technology of Switzerland named Dr Ingo – Potrykus, thought about genetic engineering of Rice Ingo – Potrykus together with his partner, Peter Beyer of Freiburg University and worked for about a decade with investment of about 100 million dollars and succeeded in early spring of 1999 to develop rice with β–carotene. Dr Protrykus worked at Max Plank Institute (Germany) and went to Switzerland in 1976. Dr Potrykus has been retired on March 1999(Dr Potrykus is a German scientist).

### *How it is Done*

Golden Rice contains many genes derived from other useful varieties of rice, Daffodil (flower) and certain class of bacteria. Basically inventors used combination of 3 genes in rice to produced enzymes called PHYTOENE Synthase, PHYTOENE Desaturase & LYCOPENE Cyclase which activates biological synthesis of β–carotene is derived from daffodil flower and introduced into the endosperm giving it a golden hue (appearance) that's why it is called Golden Rice.

### *About Golden Rice & India*

Today the golden rice can produce about 1.6 micrograms of β–carotene per gram of rice vitamin A deficiency can impair immune system and cause influenza, diarrhea, measles etc. beside blindness. The first feature story of Golden Rice published in Science (journal) & later in Time magazine. Researchers decided to provide Golden Rice technology to the poor developing countries at free of cost.

Department of Bio Technology (India) and Indian Council for Agricultural Research together agreed to take part in joint research with Swiss Scientists for research on Golden Rice in India. They decided to introduce the novel gene by direct transformation of desired gene in the India's most popular 'Sela' rice (varieties IR-64 and PUSA II) and then it's crossbreeding with other varieties of Indian rice.

Golden Rice will be provided to farmers at low cost (subsidy) within 7 years. However, plant bio-technologists working continually to enhance the level of β–carotene in Golden Rice. Akhilesh Tyagi of Delhi University is one of them, who believes, that β–carotene level can be increased by using some gene promoters.

## Criticisms

Many scientists say that Golden Rice will not be proved as panacea for vitamin A deficiency because:

1. Studies show that absorption of vitamin A by human body depends on overall nutritional status.
2. Even 2 fold increase in β–carotene level in Golden Rice provide only 3.3 micrograms of it in per gram of rice but leaves of coriander and drumstic can provide 4 times more level of β–carotene.
3. Fortified foods with vitamin A like biscuits, flours etc. will be cheaper sources.

# Chronic Fatigue

## 18 successful tips to rev up your body and mind

❑ Dr. Yatish Agarwal
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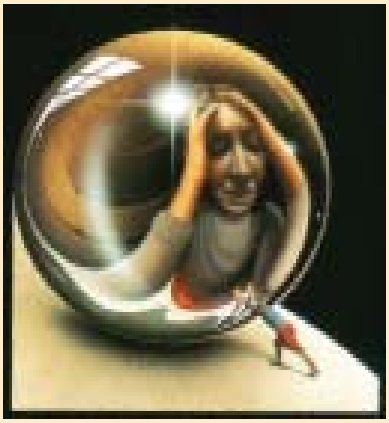
Did you say that you haven't been feeling too well lately? Despite a night's sleep and rest, you wake up a tired man. Energy and enthusiasm seem to desert you and nothing can quite rev up your body engine. You have never been like this before, and do not know what to do.



You decide to see a doctor. He takes you thorough a complete go over, orders any number of laboratory tests and when you get back to him with the test reports, he hands you a clean chit. He tells you, "your haemoglobin is good, you do not have diabetes, nor a heart disease, there is no tuberculosis, and your liver and kidneys are fine!" That's reassuring, but you continue to be in the same drab state. Your doctor is obliging! He hands you a prescription for multivitamin pills and says, 'you'll be fine.' Yet nothing changes.

If that is how you feel, this is just the piece of advice you need. You are feeling the woes of chronic fatigue. If you are willing to try some simple remedies, here are some:

**Rev up your body and mind:** Start the day with a 30-45 minute brisk walk. It will charge your batteries and set your engine to full throttle. It is a wonderful source of energy, both for your body and mind. Formulate a daily exercise programme and maintain regularity. Provided you do not default, you will take in its benefits soon.

If in the course of the day, you feel that your body engine has again begun to slow down, take a brisk five-minute walk. Else, do stretch-ups.

**Start your day well on time:** Never begin the day being under pressure for time. Reserve a few minutes for traffic hold-up, and time delays on other people's part. If you still fall behind the clock, reschedule the day's plan. Too much of rush-rush saps energy, and often, quite unnecessarily.

**Set clear targets for each day:** Take out two-minutes each morning and set specific targets for the day. Decide what you want to do, and never let things to drift on. You may have to revise the targets at mid-day, but that's okay. If the targets go awry, you know the reasons. Do not, however, let others dictate your course of action. You can never please everybody. The bottom line, however, is: 'Your employer is the boss, he pays for your time.'

**Honesty is the best policy:** Just don't say, 'aye, aye' to every job that comes your way. It never does any good to bite more than what you can chew. You must know when to say, 'no.' If you are polite and genuine, you will find most people would understand and respect you for your uprightness.

Taking too many commitments all at one time is one sure way to write your epitaph. The pressure squeezes you all the time.

**Set a clear priority:** Tackle one thing at a time. Many times we feel fatigued just because we think, 'I have so much to do, where should I start and how will I ever complete it.' The solution is simple. Make a list, set your priorities and chart your progress, giving your best to the job in hand. This way your mind will stay focused, you will have the satisfaction of doing a job well and you can still complete all the tasks one by one.

**Take deep breaths:** The yogis and the sages have done this for thousands of years. To break out of fatigue: take three deep breaths. It is simple. First, exhale through the mouth and nostrils. Next, inhale slowly through the nostrils only, counting one to twelve. Now, hold your breath, counting from one to six. Finally, exhale, counting to six. Repeat this three times. You can do this four times a day. This simple exercise will refresh and re-energise you.

**Stay trim and fit:** Keep your weight under control. The extra pounds always court fatigue and wear you down. Shed the extra pounds to realise the difference.

**Do not fast:** Do not neglect meals. Eat on time, even if you are under pressure for time. If you go fasting for long hours, it lowers the blood sugar, and this leads to a low energy level.

**Eat well:** The second dictum to remember about food is to eat light, if you have work to do. The diet should be nutritious and well balanced. Eat plenty of fresh fruits, salad

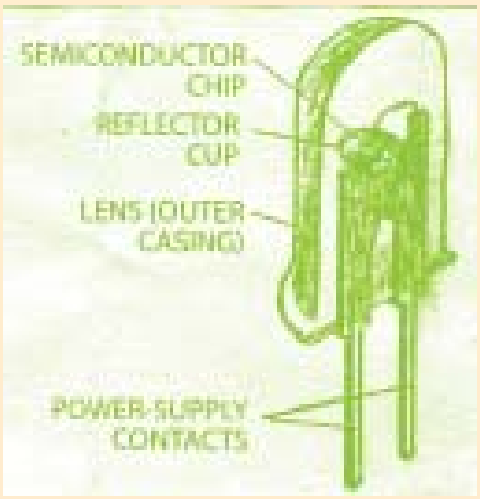
contd on page... 22

# LEDs will usher in a new Illumination Era

❑ P.K Mukherjee

A new generation of solid state (semiconductor) devices, known as light-emitting diodes (LEDs), will ultimately be used in place of the traditional incandescent bulbs. They are now being tested in traffic lights and to light gangways in designer homes and luxury yachts. The new LEDs burn for 100000 hours, hundred times longer than an ordinary bulb. They can, therefore, be expected to last about a lifetime (around 70 years) without burning out.

Invented in the 1960s by the computer company, Hewlett-Packard, LEDs have since been used in character and graphic displays and In calculators, digital clocks, and electronic equipment.




*LED The inside view*

An LED is, basically, a p-n junction diod which when forward-biased emits light in the form of electromagnetic radiation. The wavelength of the emitted radiation may fall in the visible, infrared, or ultraviolet range of the spectrum. Accordingly, one may have ordinary LEDs (that emit visible light), infrared, or ultraviolet LEDs.

The wavelength of the emitted radiation depends on the semi conducting material used for making the layers of the LEDs. An LED made of gallium arsenide, for instance, would emit red light. With gallium phosphide as the semi conducting materials, one can construct an LED that emits green light. Using other semi conducting materials, LEDs emitting yellow, orange and white colours have also been developed. In 1997, an LED producing blue light was developed by Shuji Nakamara of Nichia Corporation of Japan. We used gallium nitride to make the layers of this LED.

As is well known, recombination of electrons and holes taking place near the junction of an LED leads to the production of photons. The number of photons emitted for every electron merging with a hole determines the efficiency of an LED. In the early LEDs (which were made in the 1960s), the electrons merged with holes relatively inefficiently; for every 1000 electrons, only one red photon was produced.

With time, however, drastic improvements in the efficiency of LEDs were achieved. In 1999, Michael kranes and his co-workers at Hewlett-Packard were able to build LEDs that could transform more than 55 percent of the incoming electrons into photons at the red wavelength.

The continued rise in material quality and the development of substances that allow efficient transformation of electrons and hole into photons have been mainly responsible for bringing about the improvements in the efficiency of LEDs. Better manufacturing techniques have also contributed to these improvements. In the mid-1990s, a team at Hewlett-Packard found a method for enhancing the brightness of the light escaping from the chip by making LEDs in the shape of inverted pyramids. The inverted pyramid structure reduces the number of internal reflection, thus boosting the amount of light escaping from the chip.

The white LEDs (that emit white light), when are being made available commercially at present, have an efficiency that is only marginally better than the incandescent bulbs. These are already being used for cell-phone backlights and pedestrian walk signals in some countries including the United States. However, high-power LEDs suitable for general-purpose illumination are still far too expensive to be mass-marketed.

To generate white light from the LEDs two main methods are now in use. The first method involves combining the outputs of the red, green and blue LEDs to make white light, based on the additive principle of colour mixing. However, the problem with this technique is that it is difficult to mix the colour of the LEDs efficiently with good uniformity and control.

The second method utilizes a process similar to that used in fluorescent tubes. An ultraviolet LED is used to excite a mixture of red, green and blue phosphors to give white light. This process though simpler than mixing three colours is, however, less efficient as some energy is lost In converting ultraviolet or blue light into lower-energy light (i.e., light toward the red end of the spectrum). Also, some light is lost due to the scattering and absorption in the phosphor packaging.

At present both the methods are cost prohibitive for illumination applications. However, major lighting companies the world over are spending huge sums of money on LED research and development. The key issues with these companies are to reduce production costs substantially and to improve performance.

"What is dimming immediate hopes of introducing the LEDs to homes is the cost of individual units and the difficulty in creating the right white light for the home", says

George Mueller, Chairman of Colour Kinetics, an experimental lighting firm in Boston, Massachusetts. The firm has patented a system that can create some 16.7 million different shades of lighting. These different shades may be used to advantage for different purposes including lighting of rooms.

*Inverted Pyramid* LED

Differently coloured LEDs may be put together in an array to adjust their combined light. For example, white light obtained by combining the outputs of the red, green and blue LEDs can be made to feel "cooler" by turning off most of the red LEDs and turning on most of the blue ones. Thus, LEDs can offer novel ways of using light. For instance, one can manipulate the colour of a room without putting up new wallpaper or applying fresh paint, just by adjusting the ratio of the wavelengths in the emitted light.

Indeed, LEDs seem to offer intriguing possibilities in the field of lighting. No wonder they are in the race to replace the fragile incandescent bulbs that not only burn out relatively quickly but also waste most of their energy in the form of heat. Thus, besides increasing energy bills, the bulbs add to the environmental problems as well. In this scenario, the consumers would certainly get long-lasting, solid state interior lights in the form of LEDs that would not reduce the energy needs but also cut the emission of carbon dioxide pumped into the atmosphere.

*An ordindry LED*

Economists have calculated that if half the bulbs now used in the United States were replaced with LEDs, twenty-four power stations would be shut, saving billions of dollars and slashing carbon dioxide emission. The US also plans to replace all traffic lights with LEDs by 2006. With the energy prices rising and the consequences of global warming becoming more and more apparent, other countries including India must also follow the US example by switching over to LEDs in a phased manner. With determined and concerted efforts, this switching over may be possible over a span of, say, a decade. There is no gainsaying that the LEDs will certainly usher in a new illumination era.

*contd from page... 24*

and vegetables. Junk and fast food items, like pizza, *alloo ki tikki*, *samosas*, French fries and hamburgers can divert much blood flow to the intestines, and starve your brain of blood.

**Sleep is a tonic:** Take a regular six to eight hours' sleep during the night. Late nights and lack of sleep is sure recipe to wear oneself down. Do not take an overdose either. If you oversleep, you may wake up with heaviness in the head and feel groggy all day. A quick, 15-minute post lunch nap can also work wonders in keeping you afresh.

**Think positive:** Many people have written wonderful books on the virtues of positive thinking. Read them. It will open your mind to a vast ocean of energy. You will feel motivated to outdo the impossible, and things will start to happen your way.

**Let music light your fire:** Good music—music that you enjoy—is a wonderful remedy to overwhelm stress and fatigue. Tune in and pep yourself up.

**Soak in aqua pure:** Water is an energiser. Drink plenty of it each day. Splash in it whenever you can. A soak in the bathtub can wipe you clean of fatigue. You can also swim, if you like, and it makes an excellent exercise. And enjoy it in its newer forms, such as Jacuzzi and sauna bath.

**Spice life with humour:** Laughter is the best medicine. Go on, enjoy! A good laugh can set you free, both physically and emotionally.

**Change and explore:** If life falls into a drab routine and there is nothing new or exciting, a feeling of fatigue can overpower. Don't let this happen. Take new challenges. Try to do new things. Be sporty. And you will find life would soon brighten up. Remember, it is man's nature to explore. It offers thrill and excavates new depths of energy in you.

**Do things that you enjoy:** Take time out and read, go to a theatre, enjoy a picnic, visit a friend, may be just go for a drive—but do things that you enjoy. Freak out. Life is not just for being a workaholic. Relaxation is one good recipe to re-energise.

**Take a vacation:** All work and no play, makes Yatin a dull boy. Is this you? If yes, then it's time to pack your bags, say bye-bye and set out for a holiday. I always find the Himalayas and the sea a perfect haven. They are an excellent energy booster.

**Check with your doctor:** If you are taking any medication on a regular basis, check with your doctor if it could be the culprit, giving you that knocked-out feeling. Many medications, like antihistamines, anti psychotics, sedatives, tranquillisers, and analgesics can give you that low drain out feeling. If this happens, and you need long-term medication, ask your doctor if he can make suitable changes.

# Recent Developments in Science and Technology

## Scientists 'See' Effects of Aging in Brain

As the people becoming older their power of thinking goes down. Till now there were no such findings, which could explain, that how the human brain reacts to aging, independent of specific diseases such as Alzheimer's. Now a report published by the *Proceedings of the National Academy of Sciences* identifies a specific section of the brain that is most vulnerable during the twilight years.

Using human subjects to study age-related changes in the brain is problematic because it is hard to exclude patients who may be suffering from early-stage Alzheimer's but have not yet been diagnosed. Scott A. Small of Columbia University and his colleagues thus turned to rhesus monkeys and rats—animals that experience brain changes as they age but are free of Alzheimer's-type diseases—instead. Using magnetic resonance imaging (MRI), the team measured blood flow to the brain and found that older monkeys displayed a significant decline in blood volume in a section of the hippocampus known as the dentate gyrus. The researchers employed a different approach to analyze brain activity in rats. They monitored activity of a gene associated with learning, *ARC,* in the hippocampus and found that older animals had lower levels of expression in the dentate gyrus compared to their younger counterparts. Together, the results suggest that the dentate gyrus is the brain region most sensitive to aging in a number of species. Alzheimer's also affects the hippocampus. Researchers feel that these findings will helpful in differentiating between brain changes attributable to normal aging processes and those arising from disease.

*Source: Scientific American, April 2004*

## Magnetism at Terahertz Frequencies

A 'Metamaterial' that display strong, tuneable magnetic activity at terahertz frequencies has been created. Creating a magnetic activity at the edge of Optical frequencies is a milestone towards optical magnetism which is not found in natural material due to lack of magnetic monopole. It will allow researcher to develop materials that operate in between optical frequencies and microwave frequencies. It opens the door to new applications in medicine, bio-sensing and security imaging.

*Source: science news.com*

## New Drug Delivery Technique Avoids Needles

Scientists has been developed a new drug delivery technique, which may soon have an alternative, painless way to receive medication. A new technique described in the journal *BMC Medicine* uses a stream of gas to help deliver drugs through the skin.

James Weaver of the Massachusetts Institute of Technology and his colleagues developed the novel procedure, which is known as microscission. It uses minuscule inert crystals of aluminum oxide to remove the rough outer layer of skin and create tiny holes, known as microconduits and measuring less than a quarter of a millimeter in diameter, through which medication can move. A jet of flowing gas then takes the crystals and the loosened skin away. After creating four microconduits on the inner arm of volunteers, the team applied a pad soaked in the anesthetic lidocaine. Within two minutes, the drug had worked and the subjects reported no feeling in the region

This new technique definitely will helpful to those often have to jab a finger to test their blood sugar; microscission could represent a less painful alternative, the team suggests

*Source :Scientific American April 2004*

## Faster circuits go for gold

Creating tiny golden images in blocks of glass might seem like the latest in up-market jewellery design. But the technique could lead to a new generation of electronics.

One route to faster computing is to increase the number of connections between components in a circuit. "The microelectronics industry is two-dimensional at the moment," says Mark Miodownik, materials scientist from King's College London. "Going up to three dimensions opens up the potential for faster chips and bigger memory."

Making a three-dimensional circuit is no easy task, however. At the moment, chip designers build them layer by layer, but this is a laborious process and it limits the designs that can be used. Now Jianrong Qiu, a physicist at the Shanghai Institute of Optics and Fine Mechanics, and colleagues from China and Japan have worked out a way to draw the desired circuit directly into a block of glass.

The secret was to add gold oxide to the glass, at a concentration of one part in 10,000. Then they focused short laser pulses on to specific points inside the block, to dislodge individual atoms of gold. When the block was heated to 550 ºC, the gold atoms coalesced into tiny globules. The blobs make up a dotty structure in the same way that newspaper photographs are made from many tiny points of ink. So far the researchers have used the technique to create three-dimensional images in the glass. The 5-millimetre-wide image is made from millions of tiny balls of gold, each about seven nanometres across, which is roughly 10,000 times thinner than a human hair. The researchers report their results in the latest edition of the chemistry journal *Angewandte Chemie*.

*Source : Nature, April 2004*

**compiled by: Kapil Tripathi**

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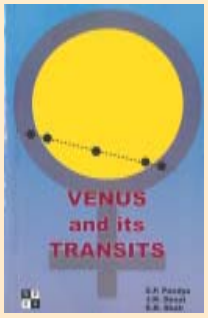
# VP Publication on Venus Transit




Vigyan Prasar has undertaken a countrywide campaign to popularise astronomy in particular and Science & Technology in general with activities built around the very rare celestial event of Venus Transit on 08 June 2004. The present book, "*Venus and its Transits*" by S.P. Pandya, J.N. Desai and S.R. Shah, is a part of this effort. The book describes various aspects of Venus and its transits including the quest of the Astronomical Unit. The book has the following chapters : "Introduction", "Venus : Comparison with Earth, and its phases", "A 'Day and a 'Night' on Venus", "Atmosphere of Venus", "The Surface and the Interior of the Venus", "Transits". The book written in a popular style will enable the readers to understand this rare celestial phenomenon and inspire them to view it with due precautions.

***Venus and its Transits by : S.P. Pandya, J.N. Desai, S.R. Shah; ISBN : 81-7480-105-7; Rs. 45/- PP : x+68***

# Workshop on Transit of Venus

One day workshop on Transit of Venus was organized by VP on 26 April 2004. About 50 participants, mostly teachers from different schools in Delhi associated with VIPNET clubs attended the workshop. Besides lectures on various aspects of Venus Transit, participants had a hands-on experience of using telescope for viewing the Sun and doing experiments using the activity kit "Venus Transit", brought out by VP.

# Obituary

**Shri Dilip M. Salwi** is no more in our midst. He died on April 02, 2004. He was just 52 and was at the height of popular science writing career. It will not be an exaggeration to say that he was one of the most well-known popular science writers in the country. He had written scientific biographies, science fiction, science dramas, science quiz books on topics in other areas. He had written about 50 books. His popular titles include "Scientists of India", "Story of Zero", "Chemline Book of Quotable Science", "Science in 21st Century", "Robots are coming", "Folktales of Science", and "What is Science". He wrote some beautiful biographies of eminent Indian Scientists under the Charitravali Series of Rupa & Co. He wrote regular columns in a number of national dailies. Shri Salwi won several awards and Fellowships for his significant contribution in the field of Science Popularisation.

A simple and affable man, Shri Salwi had a large number of friends and admires. He loved children and he wrote for them with a missionary zeal. Shri Slawi contributed to "Dream-2047" a number of write-ups on various scientific institutions in the country. Vigyan Prasar has also published a book titled "Science in Indian Media" by Shri Salwi.

Shri Salwi's untimely death is a great loss to the community of science writers as well as readers. Vigyan Prasar deeply mourns his sad demise. It will be a real tribute to this dedicated science writer if more young people take a solemn pledge to dedicate them selves to science popularisation.

Shri Salwi is survived by his wife, a son and a daughter.

## VP News (Vigyan Rail...) contd from page... 36

on Vigyan Rail. On April 22, 2004, valedictory function was organized by Vigyan Prasar, where students and other visitors shared their experience and made a few constructive suggestions. Some 40,000 people visited the exhibition at chennai.

Vigyan Rail next moved to Kannyakumari on April 24, 2004. Dr. Vedachalam, Director, Liquid Propulsion System Centre, ISRO, inaugurated the exhibition. About 5000 people visited the exhibition during the one day halt of Vigyan Rail at Kannyakumari. As per itinerary of the Vigyan Rail, the train was scheduled to halt at Kannyakumari from 24-25 April 2004. But due to non availability of rail track at Kannyakumari, railway authorities decided to take the train to Nagarcoil on April 25, 2004. About 3000 people visited the exhibition at Nagarcoil.

The next halt of Vigyan Rail was at Thiruvananthapuram, where it was stationed during 26-30 April 2004. The Vigyan Rail was inaugurated by Dr. B. Ekbal, Vice Chancellor, Kerala University. DRM, Thiruvananthapuram; ADRM; Chief Commercial Manager, Southern Railways, Thirivananthapuram, were present in the inaugural function.