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DREAM 2047

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VP News

EDUSAT – A satellite dedicated to Education, Science & Technology

EDUSAT, a satellite dedicated to education, science & technology is scheduled to be launched this year and expected to be available for launching a dedicated science channel in early 2005. A large number of educationists, educational institutions and experts are already associated in various facets of the channel. DECU, Ahmedabad and Vigyan Prasar have joined hands in this venture. Several regional meetings and workshops were held in different parts of the country for the need of initiating a science channel and finally a vision statement for science channel was prepared. A meeting was held on February 25, 2004 at DST to discuss the action plan for managing the science channel in cooperation with other departments/agencies. Production of software was also discussed in the meeting. Among those were present included Prof. V.S. Ramamurthy, Shri. G. Madhavan Nair,Chairman of ISRO, Prof. Yash Pal, Prof. E.V. Chitnis, Shri Kiran Karnik, Shri Siddharth Kak, Shri B.S. Bhatia, Dr. V.B. Kamble, Shri Kartikeya V. Sarabhai, and Ms. Chandita Mukherjee.

(From L to R) Shri B.S. Bhatia, Prof. V.S. Ramamurthy, Shri. G. Madhavan Nair, Prof. E.V. Chitnis and Prof. Yash Pal

Inside

NCSTC Award at National Science Day 2004

Dr. Subodh Mahanti, Scientist 'F', Vigyan Prasar receiving the National award for best efforts in Science & Technology coverage through Mass Media. The award was conferred on him by Dr. R. Chidambram, Principal Scientific Advisor, Govt. of India on 27th February 2004 at National Science Day celebration. The award consists of Rs.50,000 (Rupees Fifty Thousand only) in cash, a memento and a citation.

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

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Editor : Dr. V.B. Kamble

Internet — How it all began

Personal computers came to India only about twenty years ago, and Internet in India as we know today is only about ten years old. Yet it is difficult to think of life without access to Internet! Be it e-mail, chat, news, job hunting, product info, shopping on the net, entertainment, contests, rail or air tickets, downloading software or games, matrimonial alliance and so on - the list is growing!

How did it all begin? Some 40 years ago, the RAND Corporation, America's foremost Cold War think tank came up with a proposal for a communication network that would have "no central authority" and which would be "designed from the beginning to operate while in tatters." The principles were simple. The network itself would be assumed to be "unreliable" at all times, and would be designed from get-go to transcend its own unreliability. All the nodes in the network would be equal in status to all other nodes - each node with its own authority to originate, pass and receive messages. The messages themselves would be divided into packets with each packet separately addressed. Each packet would begin at some specified source node, and end at some other specified destination node. Further, each packet would wind its way through the network on an individual basis. The particular route that the packet took was unimportant. Only final results would count. The packet would be tossed from node to node, more or less in the direction of the destination, until it ended up in the proper place. This rather haphazard delivery system might be "inefficient" in the usual sense, but it is extremely rugged.

During the 60s this intriguing concept of a decentralized, blastproof, packet-switching network was kicked around by RAND, Massachusetts Institute of Technology and University of California, Los Angeles. Pentagon's Advanced Research Project Agency (ARPA) embarked upon a more ambitious project in the USA. The nodes of the network were to be high speed computers. At that time, these were rare and valuable machines which were in real need of good solid networking, for the sake of national research and development projects. In 1969 the first such node was installed in UCLA. By December 1969, an infant network came into being with four nodes, called ARPANET, after its Pentagon sponsor. The four computers could transfer data on dedicated high speed transmission lines. They could even be programmed remotely from other nodes. Scientists and Researchers could share one another's computer facilities by long distance. In 1971, there were 15 nodes in ARPANET and in 1972 there were 37. Throughout the 70s ARPA's Network grew. Its decentralized structure made expansion easy. ARPA's original standard for communication was known as Network Control Protocol or NCP. As time passed and the technique advanced NCP was superseded by a higher level more sophisticated standard known as TCP/IP. TCP or Transmission Control Protocol converts messages into streams of packets at the source, then reassembles them back into messages at the destination. IP or Internet Protocol handles the addressing, seeing to it that packets are routed across multiple nodes and even across multiple networks with multiple standards. In 1983 the military segment of ARPANET broke off and became MILNET. ARPANET itself expired in 1989.

As the 70s and 80s advanced, different social groups found themselves in possession of powerful computers. It was fairly easy to link these computers to the growing network of networks. Since the software called TCP/IP was public domain, and the basic technology was decentralized, it was difficult to stop people from barging in linking up somewhere or the other. This is what came to be known as the "Internet". The nodes in the growing network of networks were divided up into basic varieties, say, gov, mil, edu, com, org and net. Such abbreviations are a standard feature of the TCP/IP protocols. The use of TCP/IP standards is now global. Today there are thousands of nodes in the Internet scattered over the hundreds of countries with more coming online everyday.

The Internet has grown into a network of networks, linking computers to computers sharing protocols called TCP/IP. Each runs software to provide or "serve" information and / or to access and view information. Surely, the Internet is the transport vehicle for the information stored in files or documents or another computer. It is an international communications utility servicing computers. It is a misstatement when one says that "I found the information on the Internet!" In fact, what one means is that the document was found through or using the Internet – on one of the computers linked to the Internet - the Internet itself does not contain information. The World Wide Web (WWW or the Web) incorporates all of the Internet services mentioned above and much more. We can retrieve documents, view images, animation and video, listen to sound files, speak and hear voice, and view programmes that run on practically any software in the world provided our computer has the hardware and software to do these things.

Internet made its entry in India in 1988 when several Indian Universities joined the net. Internet was very different then than what it is today. Few outside a small group of researchers and technicians knew of the internet, and they used it primarily for sharing technical information and facilitating the development of standards and networking technology. It was only in early 90s that Internet became a familiar term in our country. Internet has continued to expand ever since in a steep manner. India's active Internet subscribers were estimated at 1.5 million by March 2002. NASSCOM (National Association for Software and Services Companies) forecasts that the number of Internet subscribers will rise to 7.7 million by the year 2004/05 with the user base rising to 50 million. However, it is interesting to note that nearly 70 per cent of users are between the age group 15-30. Nearly 75 per cent of users are male and 25 per cent female, but the scenario is fast changing.

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Transits of Venus: The Expeditions

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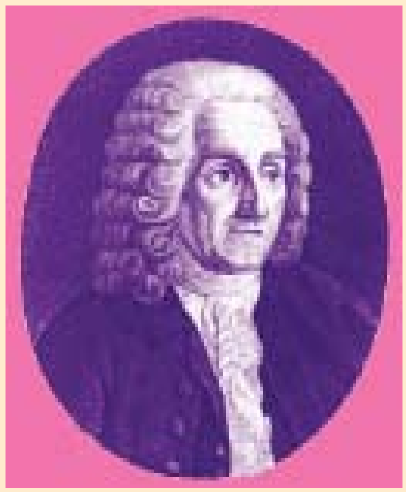
Halley's call

Edmond Halley (1656-1742) realized in 1691 that transits could be used to measure distance of the Sun from the Earth, while watching the transit of the planet Merucry. In particular, he emphasized that the transits of the planet Venus would be ideally suited for the purpose. He hence exhorted the astronomical community to apply themselves to this observation . Following his call and challenge in his monumental paper of 1716, the astronomers from Europe planned ambitious international expeditions (see Venus Transits and the Astronomical Unit, *Dream 2047*, February 2004). Surely, this was not at all a trivial undertaking, since the transits could be observed only from some of the most inaccessible places on the Earth. This, especially, holds true for the Venus Transits of 1761 and 1769 when the transits could be observed from South Africa, Siberia, North America, the Indian Ocean, the South Pacific and Central America. The only way to get to these places involved a long and difficult journey by wooden sailing ships. Needless to say, such journeys exposed the travellers to considerable hardships and mortalities from scurvy, disease and even ship-wrecks long before they could reach their destinations. Further, in order for the data to be of any use, it was necessary for the observers to measure the latitude and longitude of their observing stations with great accuracy. This required extremely careful observations, and the astronomers sent out had to be the best in their profession and very well equipped to make the necessary observations. As a result, observers were required to get to the observing station well in advance of the transit, prepare the observing site, set up their equipment and work hard to measure their precise position both before and after the several hours of the Venus Transit. Travel times were measured in months and years in that age unlike in hours today by fast aeroplane. This meant the observing runs could last years in many cases! In addition to the problems of long distance travel, packing instruments, clocks, telescopes, etc. needed to make the measurements, it was the politics in different countries that made the travels (or travails !) more exciting.

It so happened that most of the astronomers preparing to observe Venus transit were English and French when the transit of 1761 was occurring. These were the troubled times in Europe and the transit was occurring during the height of the famous 7 years war between England and France (Box 1). It may be interesting to note that this war could be termed as the true World War and was fought nearly in both the hemispheres. Despite bitter hostility between France and England, astronomers from both the countries were given letters of transit and co-operation to pass the enemy lines and shipping lanes without being subjected to any difficulty.

In this article, we shall briefly describe the major attempts to measure the solar parallax during the 18th and 19th centuries. We shall, however, describe the attempts of the 18th century in more details and only make a few references to the attempts during the 19th century, since the observations in the 19th century were really to further refinements in the measurements made in the previous century. Further, we shall discuss only a few important expeditions.



Joseph Nicolas Delisle

Joseph Nicolas Delisle

As remarked earlier, the first transit of the 18th century was to take place when the 7-year war between England and France was at its peak. Outstanding in the task of giving France her position of importance in Venus Transit is the name of Joseph-Nicolas Delisle (1688-1768). He deserves special emphasis for his significant historical communication with Edmond Halley and for his early enthusiasm in the transit enterprise. He made substantial contribution to the original operational technique which Halley had proposed. His penchant for astronomy was revealed by his interest in the total eclipse of the Sun in 1706 when he was 18 years old. At the request of Giovanni Dominico Cassini (1625-1712) he was also involved in the production of various astronomical tables. Halley was evidently much impressed with Delisle, and welcomed by Newton. It was Delisle who published the corrections to Halley's predictions for the transits of Venus in 1761 and 1769.

With his interest in transits reinforced by the meeting with Halley in 1724, Delisle undertook a thorough study of the problem of solar parallax. His analysis took two distinct directions. First, he approached the problem historically by examining various past attempts to determine the solar distance. Second, Delisle approached the problem by analysing the data compiled, and the methods suggested by his scientific contemporaries. The technique of measuring solar parallax which Delisle proposed was really a simplification of Halley's method. With Halley, Delisle assumed that exact moment of contact could be determined, but he recognised that observation of the entire transit, or at least of the ingress and egress, were not necessary. This required excellent weather conditions for the whole duration of the transit – a factor which could not entirely be relied upon. It occurred to him that the observer who sees the planet take the longer path across the Sun witnesses the beginning of the transit much earlier than the observer who records the shorter path. This is rather obvious since both are apparent paths, the longer route must have an earlier beginning and later ending than the shorter one. It was, therefore, necessary only to record the local time for the exact moment of contact either at ingress or egress. Then from an exact knowledge of the longitude and the place of observation, the local time could be adjusted to Greenwich Mean Time (GMT). The difference in time between two points of observation would then be proportional to the time by which contact for the longer path precedes the contact for the shorter path, and hence proportional to the distance between them. Once this is known, from the basic method described in the earlier article (*Dream 2047, February 2004*), the size and distance of the Sun can be calculated. From the point of view of the operational problem, Delisle's method was obviously superior to Halley's. It required only one observation from a given point and thereby reduced the likelihood of failure due to adverse weather conditions; or if observations of the planet's ingress and egress were both made at the same station, the probability of success was doubled. The range of useful stations was also extended by this method to include those parts of the world where only the beginning or the end of a transit would be visible. However, his scheme required an extremely precise determination of longitude at the place of observation. Further, the power and quality of the lenses employed in various telescopic combination also affected the apparent time spent by the planet on the face of the Sun. It turned out that the apparent duration varied directly with the length of the telescope and it became necessary to understand the same before the difference in time due to the geographical locations of the observers station could be properly utilised.

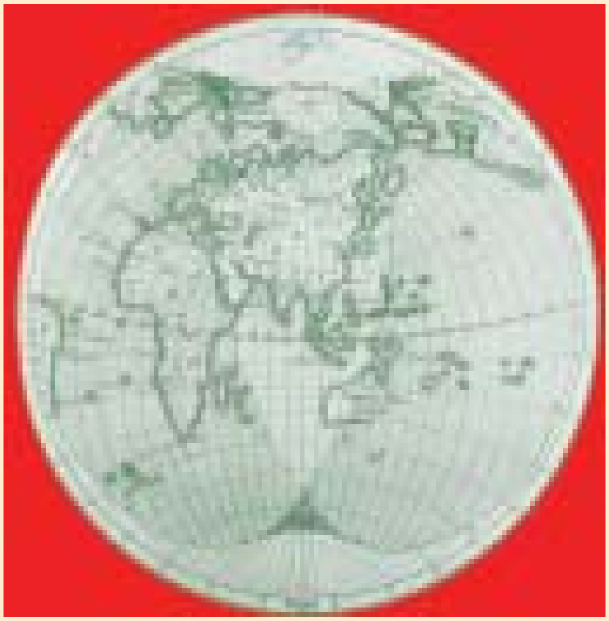


Figure 1 : Mappemonde

Preparations – 1761

Delisle had prepared the geographical projections in his *Mappemonde* for the Mercury transit of 1753. This made it possible to determine advantages and disadvantages of each station. He prepared a similar *Mappemonde* (The World Map) for the 1761 transit of Venus **(Figure 1)**. This made a co-ordinated effort possible in which several astronomers took part in the transit of Venus expedition to all parts of the world. Guillaume Le Gentil, for example, was to go to India, Chappe d'Auteroche to Siberia in 1761 and California in 1769, and Alexandre-Gui Pingré to the Isle Rodrigue of Madagascar. By the winter of 1760-61, French preparations for transit observations beyond the borders of France were thus well advanced. However, France was not alone in her intense interest; in the midst of a world war, 4 years old in 1761, there was room for scientific co-operation with her principal enemy, the British Crown.

Strangely, British preparations to observe the Venus transit in 1761 did not find much enthusiasm despite the idea laid out by Edmond Halley that the transits of Venus could serve as a means to determine the actual scale of the Universe. In fact, till 1760, the preparations to observe the transit of 06 June, 1761 were minimal. It was only the presentation of Delisle's *Mappemonde* and memoir to the Royal Society in June 1760 that precipitated British preparatory action. It was that time that the Council of he Royal Society considered sending "proper persons to proper places to observe the approaching transit of Venus". Based on Halley's predictions in 1716 and subsequent changes which Delisle had argued for in the memoir alongwith the *Mappemonde*, the first choice went to the Island of St. Helena in the South Atlantic Ocean and second to Bencoolen on the East Indian Island of Sumatra with Batavia listed as an alternative location. The next question was the personnel to be selected and the transportation to their destination. Further, the Seven Years' War with France was only about half over. The Royal Society approached the Court Directors of the East India Company for assistance in placing observers in St. Helena and in the East Indies. In any case, the observation of Venus transit had acquired the competitive and nationalistic attributes perhaps due to the war in progress. The fact that the French and few other European countries were sending astronomical expeditions to various parts of the world was felt to be of immediate concern to the British Empire and was viewed with some apprehensions about national prestige. For here was an enterprise wholly initiated by an Englishman – Edmond Halley – in the previous century, and even more "never observed but once before since the world began, and then only by another Englishman, Jeremiah Horrox!" Although many volunteers had written to the Royal Society Council offering to make the voyage to Bencoolen, eventually the team of Charles Mason (1730-1786) and Jeremiah Dixon (1733-1779) was selected. Rev. Nevil Maskelyne (1732-1811) was drafted for St. Helena expedition. The expeditions which sailed from Britain bound for Bencoolen and St. Helena were not the only ones set out to observe

Box 1
Seven Year War (1756-63)

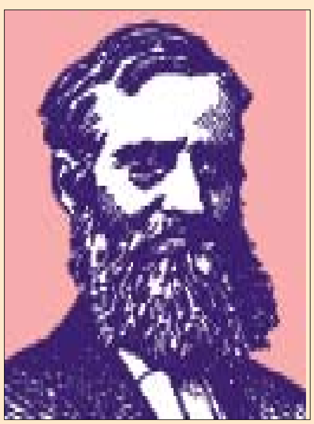
The Seven Year War was both a battle for maritime and colonial supremacy between Britain and France and a wider European power struggle centred on competition between Austria and Prussia for Silesia. In Europe, Prussia retained Silesia and became a power of equal weight to Habsburg Austria, while the British victory at Quiberon Bay destroyed French naval ambitions. Overseas, the ascendancy of Britain as a commercial and colonial power and the relative decline of France were confirmed. In India, the British victory at Wandewash (1760) laid the foundations for its future domination of the subcontinent; in North America, British naval superiority paved the way for military victory against the over-extended French. Britain gained Canada and the French possessions east of the Mississippi, together with Florida, formerly Spanish.

Venus Transit in 1761. In North America, under the stimulus of John Winthrop (1714-1779) at Harvard, the province of Massachusetts sponsored expedition to St. Johns in New Foundland. Massachusetts was then a British Colony. The total effort of the British to observe the transit of Venus of 1761 was thus unexpectedly enlarged by the independent colonial expedition to a new station. As a result, for all their lateness on the scene, they were able to match the French in the number of expedition despatched overseas to take advantage of the first of the two transit opportunities of the century. The strength of conviction which lay behind the drive to take part in these observations is perhaps best summarised by one of the leading English instrument makers and scientific popularisers of the day, Benjamin Martin. "If we make the best use of each (of the transits of Venus of 1761 and 1769), there is no doubt but Astronomy will, in ten years time attain to its ultimate perfection."


Alexandre-Gui Pingré

French Expeditions: 1761

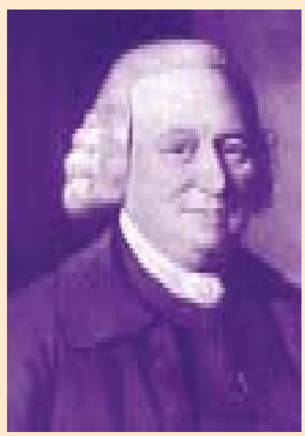
A major French expedition was sent to the French Island of Rodrigue, off the coast of Madagascar in the Indian Ocean under the leadership of Alexander-Gui Pingré. It rained during the morning of June 6, 1761, and afterwards the Sun was covered with thick clouds. Pingré and his team were unable to determine the moments of first and second contact between Venus and the Sun and even at the conclusion of the transit. But they were able to make some useful observations. In the days that followed, Pingré determined the latitude and longitude of their station. A few days later, a British Man-of-War (that is, an armed ship) bombarded their settlement. The island was captured, Pingré was imprisoned and his isolation lasted about 100 days. Finally, he managed to catch a ship back to France and almost made it before the ship was attacked by a British warship! Pingré's ship, after a fierce battle, was captured and Pingré was transported to Lisbon as a prisoner of war for exchange. When he was freed, he travelled home overland, having had enough of ship!


Charles Mason

The other French expedition was sent to Tobolsk in Siberia under the leadership of Jean-Baptiste Chappe d'Auteroche. It first travelled by horse driven sled. He barely made it across the frozen Volga river. Luck favoured him. Soon after he crossed the Volga, the ice pack broke up! Chappe arrived in Tobolsk with only six days to spare before the transit day. The river near Tobolsk was in floods and the local people were convinced that the unusually severe spring floods were being caused by this strange foreigner using his bizarre instruments and messing up with the Sun! As a result he had to be physically protected by a cordon of armed guards. He, still managed to obtain very good timings of the transit. His observations were of great use to his contemporaries and continued to be used to the end of the 19th century.

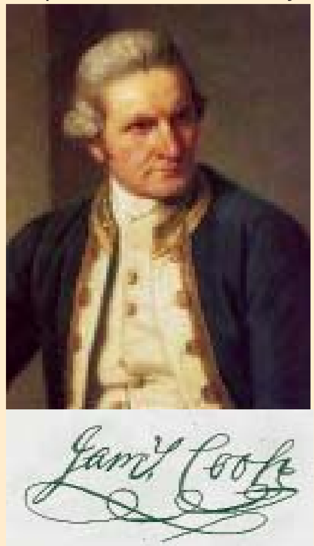

Jean Chappe d'Auteroche

The least successful of the three major French expeditions with respect to the original goal, the transit of Venus, was the one which was the first to leave and the last to return. The leader of the expedition was Guillaume Joseph Hyacynthe Jean-Baptiste Le Gentil de la Galaisiere, or "Le Gentil" for short. He was an educated French nobleman despatched on March 26, 1760 to Pondicherry, a French settlement not far from Chennai. After three months at sea, he arrived at Mauritius, a French Colony in the Indian Ocean. To his horror, he learnt on his arrival that the Indian Ocean was swarming with British warships, and that Pondicherry was under siege by the British forces. Despite the fact that he had valid papers giving him free passage, it surely was dangerous presenting them at sea when a major naval war was going on! However, he was not to be deterred. He managed his way on to a troop ship bound for Pondicherry, but to his misfortune he learnt mid-way that Pondicherry had already fallen four months before to the British!. The Captain turned around and sailed back to Mauritius. *The transit occurred while Le Gentil was at sea*. From the pitching deck of a French troop ship, it was impossible to make any useful observations. How tragic ! Le Gentil decided to stay in Mauritius and wait until the next transit eight years later. He set about computing what the best location would be and made a series of scientific studies of Mauritius and nearby Madagascar on botany, zoology, geology and anthropology. He finally determined the best site in 1769 transit would be Manila in Philippines and began planning his next expedition there.


Neville Maskelyne

The British Expeditions: 1761

In a major expedition, Charles Mason and Jeremiah Dixon were despatched to Bencoolen in Sumatra. Soon after they began their voyage, their ship was attacked by a French frigate. A violent battle made their ship return to Plymouth harbour with 11 dead and 37 wounded, and some damage to the astronomical equipment. The ship needed extensive repairs. The delay thus caused made it impossible for them to get to Bencoolen on time. The voyage was re-routed and they prepared to observe the transit of Venus from Cape of Good Hope. They set up their observation station on time and were fortunate in obtaining excellent data. In fact, they worked so well together that the British Government despatched both of them to the American colonies to survey the disputed border between the colonies of Pennsilvania and Maryland in 1763. The border they surveyed still happens to be the border between these two States and is better known as Mason-Dixon line.



Captain James Cook

The other expedition led by Neville Maskelyne was sent to St. Helena in the mid-Atlantic. This expedition did not meet with any significant success. The food was bad and the weather stank. Unfortunately, the Sun got clouded and Maskelyne missed the end of the transit making his data not of much use.

We shall mention two more expeditions in passing. John Winthrop was at Harvard College in Massachusetts Bay Colony, and was sent to St. Johns, New Foundland to observe the transit. He got useful timings with a relatively incident free travel. The other expedition was an Austrian expedition in which father Maximillian Hell went to Vardo, Norway, above Arctic circle. He got good data on transit. Incidentally, "Hell" in German means "Light or Bright"!

Conclusions drawn from the 1761 Transit

What were then the conclusions to be drawn from the 1761 transit? To calculate the parallax, involved techniques and comparisons were used with data from several key stations and a value of 8.565 arc seconds was obtained for the solar parallax. A second method gave a value of 8.56 arc seconds while a third method gave a mean parallax of 8.57 arc seconds. However, no scientific consensus was arrived at. Indeed, there was a debate on the value of the solar parallax to be determined from the 1761 transit by the French and the British astronomers. *Eventually, the astronomers agreed upon the fact that in view of the uncertainty involved in the determination of the solar parallax based on the observations of the 1761 Venus transit, there was no choice but to wait until the next transit of 1769!* Consequently, in spite of the care which had gone into the preparations for the observation of the transit of Venus and the tremendous worldwide efforts to render success in the dream of a definitive determination of the solar parallax seemed remote. One difficulty upon which these transit observations floundered centered upon determination of their precise moment of the contact between the Venus and the Sun, mainly due to the black drop effect (*Dream 2047,* February, 2004). The second major factor was the determination of exact longitude of the observing stations. Surely, this was a big problem in the 18th century.

Figure 2 : Captain Cook Voyage

The transit of 1769

By the time the second transit of Venus in the 18th century took place, the Seven Year War between England and France had ended. As a result the travel had become much safer. With data in hand from the first transit, astronomers once more set out to observe the second transit. Once again the major expeditions were sent by France and Britain and a few by some other countries. We shall briefly review the major expeditions of the transit of 3-4 June, 1769.

French Expeditions: 1769

This time Chappe was sent to Mission San Jose del Cabo on the tip of Baja, California. Unlike his earlier expedition to Siberia at Tobolsk, his trip this time was uneventful. He could obtain excellent data and timings on the transit day. He was able to determine the longitude of his position by means of the lunar eclipse of 18th June, 1769, as well as by the more common technique of observing immersions of the first and second satellites of Jupiter. However, shortly after the transit took place, an epidemic struck the village where he was stationed and Mission of San Jose that wiped out about three-fourths of the population, including all of Chappe's assistants except his engineer Pauly. Chappe continued to observe long after he got the disease. Indeed, epidemic was at its peak when he made an important observation of the lunar eclipse. However, on 01 August, 1769 at the age of 41 he too succumbed! Only his engineer Pauly survived to bring back Chappe's paper, the instrument and narration of their misfortune. Pauly's travels took him across the wilds what was then the Mexican State of Texas. His comment about Texas was that the food there was not even fit for pigs!

Let us recall that Le Gentil was having a busy time studying various scientific aspects of Mauritius. He studied a number of islands, planning at the same time his observations of the second transit. Now that the hostility had ended, he was free to travel wherever he wanted. He obtained the letters of introduction from the Governor of Mauritius and the French Academé. He then travelled aboard a Spanish ship bound for Manila in the month of May, 1766. He arrived at Manila after a weary voyage of 3 months. It turned out that the Spanish Governor in

Philippines was not fond of foreigners. Poor Le Gentil! He was suspected to be a spy and was harassed! Pondicherry was by then returned to France by the Treaty of Paris. Le Gentil, therefore, packed up and sailed to Macao where he tried to find passage to Pondicherry. In the February of 1768, he sailed on an Indian ship bound for Pondicherry. By means of Portuguese vessels bound for Madras (Chennai), Le Gentil was able to get to Pondicherry on 27 March, 1768, 14 months before the transit. There, with the aid of Governor Law, he constructed an excellent observatory on the ruins of the city's fort. With more than enough time to prepare for the transit, Le Gentil carefully began to collect the data required for a successful transit observation. These included determining the latitude and longitude of a station, a study of atmospheric refraction at the horizon, an observation of total lunar eclipse with Governor Law and inevitable observation of the satellites of Jupiter. On the eve of transit, the weather was perfect. However, at about 2.00 A.M. on the transit eve, Le Gentil was awakened by the sound of the wind changing. He arose from his bed to see clouds coming in as a front approaching in Pondicherry. On transit day, the Sun rose behind the clouds and stayed there for all day during the transit of Venus! After nine years abroad and travelling nearly a lakh of kilometres he wrote "I was more than two weeks in a singular dejection and almost did not have the courage to take up my pen to continue my journal; and several times it fell from my hands, when the moment came to report to France the fate of my operations". Well it turned out that it was sunny in Manila that day, where he had decided to go for the transit observations earlier!

Maximilian Hell

Le Gentil now only had to wait in Pondicherry for a ship back home. He suffered from severe dysentery and a fever that nearly killed him. At last he secured a passage on a ship bound for Mauritius in 1770. At Mauritius, he again had to wait for a ship bound for France. Le Gentil finally got space on a French ship. Off Cape of Good Hope they encountered a hurricane that battered the ship and it just managed to limp back to Mauritius. Le Gentil, however, managed to board a Spanish warship bound for Cadiz., a city and port on the coast of south-west of Spain. This ship also ran into storms and took two weeks round the Cape of Good Hope. Eventually, in August, 1777, he reached Cadiz. Tired of sea voyage, he travelled by road and finally reached his beloved France after 11 years 6 months and 13 days as recorded by him in his journal. Misfortune did not leave him in France either. On arriving in Paris, he learned that his relatives, on hearing a rumour that he had died, had proceeded to plunder his estate. Even the French academé had given his Chair to somebody else! Le Gentil hired lawyers and began suing the people. Sure, he got back a part of his estate, but this nearly made him bankrupt. At long last luck finally smiled on him. The Academé created a special chair for him. He married a wealthy heiress named Mme. Potier. They lived together in great happiness and had a daughter. Le Gentil died on October 22, 1792.

Tahiti (Areial)

British Expeditions: 1769

For the 1769 Venus transit, a British expedition led by William Wales and J. Dymond was sent to the Hudson Bay station, known as the Polar Bear capital of the world. As it turned out, harsh winter took its toll and the brief summer saw black flies, mosquitoes, horse flies and other insects trying to eat them alive while setting up their equipment. Despite all this, Wales managed to get good transit timings.

A famous expedition that was undertaken was that of Captain James Cook (1728-1779) . Capt. Cook and Joseph Banks (1743-1820) sailed from Plymouth on August 26, 1768 on the HMS. Endeavour, on a voyage **(Figure 2)** which lasted until 1771 and reduced their original contingent of men from 94 to 56, but which was successful in the extreme and brought them worldwide fame. Indeed, their mission was to circumnavigate the globe and explore the Southern Pacific. On the way, they were to be anchored at the South Pacific island of Tahiti to observe the transit of Venus. After nearly seven months of sailing, they reached Tahiti. They received a warm welcome by the locals. On a high point of ground, they set up an observatory above the bay. This point is known to this day as "Point Venus". Meanwhile Capt. Cook had a tough time keeping his sailors in good humour. They felt terribly bored and s a result started creating troubles for him! Despite a few instances of theft of some of the instruments, Capt. Cook and his companion got excellent transit timings. Indeed, it was on this trip that the famous (or infamous) black drop effect received special attention! Black drop limited the precision of the transit timings to about 10 seconds instead of the hoped for 2 seconds by introducing an irreducible and difficult to measure amount of systematic effort in the timings. Capt. Cook's team hoped that better instrument would reduce the black drop effect, but the primary cause was the Earth's atmosphere. Charles Green, the astronomer in Capt. Cook's team did not live to enjoy the fruits of his labour. He died on the return voyage. Cook and his crew completed their circumnavigation of the Earth and reached England safely and in high spirits. The expedition was a total success and

Capt. Cook's fame as Mariner and explorer reached far and wide. The drawings of the specimens collected by Captain Cook are reproduced in Figure 3 from his own records. He charted the coast of New Zealand and explored the east coast of Australia claiming it for Britain. He returned to the Pacific in 1772-1775 to search for the fabled Antarctic continent.Cook's final voyage in 1776-1779 to discover a passage round North America from the Pacific side ended in a disaster when he was killed in a skirmish with native peoples in Hawaii.

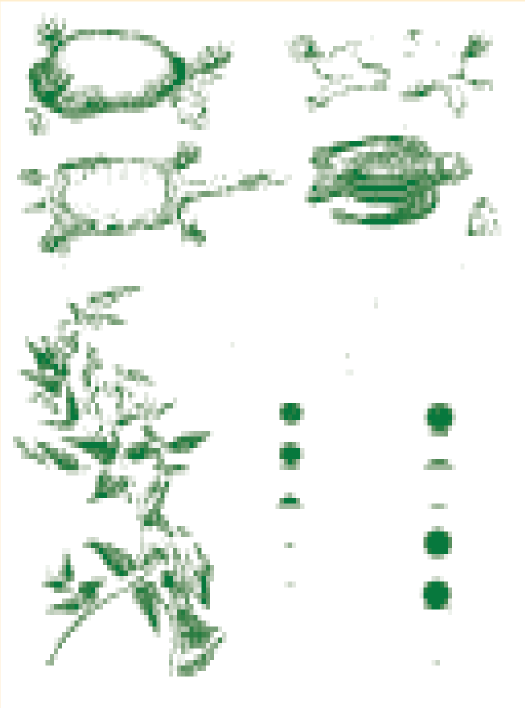


Figure 3 : Captain Cook's observations : The figure shows in the bottom right hand corner the appearance of Venus as it approached the Sun's limb alongwith some of the botanical and zoological specimens that were collected by the expedition, many of them previously unknown to science.

There were a few other expeditions as well. Special mention may be made of Father Maximillion Hell of Austria. He once again returned to Vardo, Norway, and was rewarded with good timing data. Further, there were 19 observations made in the British Colonies in North America supported by American Physical Society at Philadelphia. Jeremiah Dixon once again observed the transit at Hammerfest, an island off the Norwegian coast about 10 kilometres south-west of North Cape, while William Bayley observed the transit at South Cape. Charles Mason agreed to go to County Donegal in North-West island to observe the transit.

There were 138 observers stationed at 63 locations in 1769 as compared to 120 observers from 62 separate stations in 1761. However, even this worldwide massive effort could not fulfil the dream of producing a definitive value for solar parallax. It took seven years to analyse the data with the value of solar parallax ranging between 8.43 seconds of arc to 8.80 seconds of arc. Certainly, this was a considerable improvement over the situation following the first transit, which had produced limits of 8.28 and 10.60 seconds. J.F. Encke in 1824 obtained a figure of 8.5776 seconds of arc for the solar parallax. This

Box 2
Father Lafont observes Venus Transit of 09 December, 1874

On December 9, 1874, the transit of the Venus across the Sun's disc aroused the enthusiasm of astronomers throughout the world. The Italian Government sent a party of savants; headed by Professor Tacchini, to India, while an English expedition, with Father Perry and Father Sidgreaves of the Stoneyhurst Observatory on its staff, was sent to Kerguelen in the Antarctic Ocean.

Muddapore (Madhupur), on the chord line of the East Indian Railway, was the spot selected for observation by Professor Tacchini, and he courteously invited Father Lafont to take part in the expedition. Later Father Lafont wrote the following account of the expedition and got it published:

"After all the careful preliminary arrangements, we were all anxiously awaiting the rising of the sun; anxiously, for though the weather had been excellent almost every day since the arrival of Professor Tacchini, the clouds two or three days before had caused the astronomers great fear and anxiety. From 4 O'clock all were up, gazing at the sky, and the sight was not quite reassuring; light but numerous clouds overspread the horizon, and assumed rosy tinges as the sun began to rise. Nothing daunted however the four observers who, each with his chronometer in hand, entered their respective observatories to prepare for work.

"Upon *pukka* platforms erected for the purpose, next to Dr. Palmer's bungalow, Prof. Tacchini had installed four miniature observatories with revolving cupolas; in the first he himself was to observe all the particulars of the phenomenon by means of a magnificent spectro-telescope of great power, mounted equatorially; in the second and third. Prof. Dorna and myself had to note the exact times of the four contacts of Venus with the sun, in the usual manner, with large equatorial refractors and carefully rated chronometers; the fourth observatory was tenanted by Prof. Abetti, who used a spectro-telescope similar to that of Prof. Tacchini.

"As the time approached when the first contact was expected, the clouds gathered more numerous around the sun, as if determined to hide it, and we had great difficulty in securing a view of its bright edge through the openings left between these obnoxious screens. However, Prof. Dorna and myself succeeded in taking down with tolerable accuracy the two first contacts.

"Those who understand the spectroscopic method must have guessed already that our talented chief and his companion could not have seen these two first phases of the transit, since absolute purity of the atmosphere is a necessary condition of success in these delicate researches.

"Fortunately, soon after, the sky gradually became clearer, and during the transit Prof. Tacchini discovered in the atmosphere of Venus unmistakable signs of the vapour of water. This result, corroborated by Prof. Abetti, is in itself a very valuable addition to our knowledge of the planet.

"Encouraged by this unforeseen discovery and the better state of the atmosphere, we all resumed our places at the eye-piece of our instruments, and had the great satisfaction of catching, all of us this time, the two last contacts. Here again, the ordinary method of observation gave us times agreeing very closely, whilst our companions of the spectroscope had the good fortune of establishing upon experimental proofs the great superiority of the spectroscopic method over all others, in determining the real time of contact, to a small fraction of a second, with ease and certainty. The main object of this mission is therefore accomplished. "I may mention, before concluding, that Prof. Dorna observed the black dross both at ingress and egress, whereas not a trace of it was seen with instrument I used, a German telescope by Starke, 52 lines aperture, and 6 feet focal distance. According to my results, the whole transit lasted 4 hours, 41 minutes, 1.5 seconds".

Incidentally, Dr. Mahendralal Sircar also observed this transit.

value was upheld in most astronomical papers for about 25 years.

For the 18th century transit as a whole, the problem of longitudinal precision and an inability to handle the black drop effect were two major factors in upsetting the transit method in the eyes of contemporary astronomy. Other factors included the amount of variation introduced by the personality and physiology of the individual observer, the flaws in the telescopes used, and the conditions of vision.

Expeditions in the 19th century

The difficulties outlined above in evaluating the solar parallax accurately prompted the astronomers all over the world in the 19th century once again to organise expeditions in different parts of the world to observe the transits of 09 December 1874 and 06 December 1882. The transit observation in the 19th century were to further refine the measurements in the previous century. By now it was possible to make spectroscopic observations during the transit. Italian expedition at Muddapur (Madhupur) in Eastern India is well-known in the history of

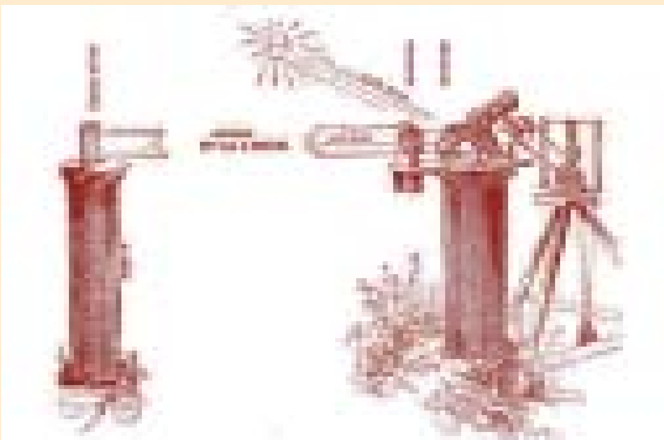


Figure 4 : An expedition to observe Venus Transit in 19th Century

astronomy for its spectroscopic observations of the 1874 transit of Venus. Petro Tacchini of the Astronomical Observatory of Palarmo was designated to organise the expedition. In this mission, the Italians obtained a very important result. They observed, for the first time, details of the spectrum of Venus which confirmed the existence of its atmosphere. At the same time they demonstrated the validity of the spectroscopic observation to determination of exact instant of the contacts during the ingress and the egress. One of the members of the transit party at Muddapur was Rev. Father E. Lafont, famous Belgian Jesuit (1837-1908) who was Professor of Physics at St. Xavier College, Calcutta (Kolkata). He was a good meteorologist and an amateur spectroscopic. Lafont was responsible for setting up an astronomical observatory at Calcutta (Kolkata) and was a prominent science populariser (*Dream 2047*, February, 2004). A description of the observations of Venus transit by Lafont is given in Box 2. There are also indications that the famous Indian astronomer of Orissa, Pathani Samanta also observed the Venus transit of 1874. Ankitam Venkata Narsinga Rao who owned a private observatory at Visakhapatnam observed this transit. There are indications that Chintamani Raghunathachari of Madras observatory also observed the transit. The setup used and the transit as observed in one of the expeditions is shown in Figure 4 and Figure 5.

Figure 5 : Venus Transit as obsrved in 1874 in one of the expeditions

Got it at last !

Simon Newcombe combined the 18th century data with those from 1874 and 1882 Venus transit and derived a refined solar parallax of 8.79 arc seconds corresponding to a distance of the Sun from the Earth (the Astronomical Unit or AU) of 149.59 ± 0.31 million kms. – i.e. precision of one part in 480. In the late 20th century during the radar measurement of the distances of the planet helped to refine the astronomical unit further to its modern value of 149,597,870.691 ± 0.030 kms, that is, correct to 30 metres !

We have briefly described the efforts to measure the solar parallax during the 18th and 19th centuries that eventually gave us the scale of the solar system and that of the Universe. It would be worthwhile repeating these observations from various locations during the transits of Venus in 2004 and 2012. Indeed, this is a great opportunity re-live the history !

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Internet...Contd. from page... 35

Internet users still belong to the higher income group, but with the costs of hardware and software coming down, more and more people shall have access to Internet. Creation of a separate Ministry of Information Technology and a sound proactive policy have helped the growth of IT sector and hence Internet in our country. The impact of Internet is already visible in our country. It has opened up a huge reservoir of information and knowledge alongwith immense possibilities in the fields of education, development and efficient governance. What started as a network of four nodes in 1969 has grown into a gigantic network of networks, and continues to grow.

❐ **V. B. Kamble**

Robert Boyle

Who Paved the Way for Modern Chemistry

❑ Subodh Mahanti
e-mail: mahantisubodh@hotmail.com

"Boyle's main contribution to chemistry was his insistence on experiment, precision and accurate observation. He devised many analytical tests including the use of vegetable dyes as acid-base indicators and of flame tests to detect metal. The chemist's concern for the purity of his material began with Boyle.

A Dictionary of Scientists. Oxford University Press, 1999.

"With the publication of *The Sceptical Chymist* (1661), Boyle prepared the way for a more modern view of chemistry, which put aside alchemical ideas and Aristotelian doctrine of four colours…it was Boyle who changed chemical attitudes and prepared the way for Priestley and Lavoisier to create the Chemical Revolution."

The Cambridge Dictionary of Scientists. Cambridge University Press, (Second Edition, 2002.

"He (Boyle) was, surprisingly, an alchemist, but his alchemy was a logical outcome of his atomism. If every substance is merely a rearrangement of the same basic elements, transmutations should be possible. Modern atomic physics has proved him right."

Chambers Biographical Dictionary, Centenary Edition. Chambers Harrap Publishers Ltd., 1997.

Robert Boyle established the study of chemistry as a separate science. In fact among many rightful contenders for the title "Father of Modern Chemistry" is Robert Boyle. He was the first prominent scientist to perform experiments under controlled conditions and publish his researches with elaborate details concerning procedure, apparatus and observations. His best known scientific publication was *The Sceptical Chymist.* In this work, which was published in 1661, Boyle discusses the idea of an element. While it is true that Boyle's idea of an element was somewhat vague but his idea was a clear break with the then erroneously held concept of an element. The first use of the term "chemical analysis" is attributed to Boyle. He used this term in the same sense as we understand it today. He did important work in mechanics, medicine, hydrodynamics and a wide variety of experiments with vacuum pump. Boyle's most interesting and influential contribution was his "corpuscular or mechanical hypothesis." This was the fullest and most detailed development of physical atomism up to his time. He was also interested both theoretically and practically in alchemy. His interest in alchemy was governed by his desire to acquire more knowledge of God and the world than by any desire for riches. Boyle was active in the "Invisible College", an informal body devoted to the "new philosophy", which in 1663 became the Royal Society. Unfortunately while Boyle's contribution was very significant in the development of modern chemical thought but today he is remembered solely for Boyle's Law. Boyle was one of the leading intellectual figures of the seventeenth century. Boyle was a prolific writer. He was a great experimentalist. His scientific interest covered a broad area.

Robert Boyle

Throughout his life Boyle sought to improve the lot of humanity by devising better methods and practices. For example he was interested in the improvement of agricultural methods, in the improvement of medicines and medicinal practice, in the possibility of preserving food by vacuum packing and in many other things. He was involved in a project to distill salt water into fresh at sea. Probably Boyle organized a commercial enterprise that produced chemicals.

He had an abiding faith in his religion, Christianity. He spent time and energy for making the Bible available widely. He got it translated into a variety of languages such as Irish, Turkish, and various native American languages. Boyle had no hesitation in believing, though in a more intellectual realm, that God does help some men acquiring scientific knowledge. In 1663 Boyle wrote: "And though I dare not affirm…that God discloses to Men the Great Mystery of Chymistry by God Angels, or by Nocturnal Visions…yet persuaded I am, that the favour of God does (much more than most Men are aware of) vouchsafe to promote some Mens Proficiency in the study of Nature." Boyle emphasized the need to have an examined faith. However, in reality he saw "usually, such as are born in such a place, espouse the opinions true or false, that obtain there." Thus he wrote: "the greatest number of those that pass for Christians, profess themselves such only because Christianity is the religion of their Parents, or their Country, or their Prince, or those that have been, or may be, their Benefactors; which is in effect to say, that they are Christians, but upon the same grounds that would have made them Mahometans, if they had been born and bred in Turkey." Boyle sincerely believed in miracles. In fact miracles were a crucial factor in his opting for Christianity. He saw clear stamp of God upon the Christian miracles.

Christian Huygens

Gottfried Wilhelm Leibniz

Robert Boyle was born at Lismore Castle, Munster, Ireland on January 25, 1627. He was the fourteenth child of his parents' fifteen children. And being the last child of his parents to survive to adulthood, he was the youngest in the family. His father, Richard Boyle (1566-1643) was the first Earl of Cork. Richard Boyle was immensely wealthy and he is also known as the "Great Earl". Richard Boyle had left England at the age of 22 and had gone to Ireland. Boyle's mother Catherine Fenton, was Richard Boyle's second wife, his first having died within a year of the birth of their first child. Boyle hardly got time to know his parents well. His mother died in childbirth a few weeks after his third birthday. Boyle last saw his father just before he left for a continental tour. At the time Boyle was twelve. In his autobiographical account he reflects on his noble birth that 'being born heir to a great family is but a glittering kind of slavery' and 'is ever an impediment to the knowledge of many retired truths, that cannot be attained without familiarity with meaner persons.' Commenting on his father, Boyle wrote: "He, by God's blessing on his prosperous industry, from very inconsiderable beginnings, built so plentiful and so eminent a fortune, that his prosperity has found many admirers, but very few parallels."

John Wilkins

Boyle had a privileged upbringing. Boyle's parents believed that best upbringing for young children up to the time they began their education could be provided away from their parents. So Boyle was sent away to be brought up in the country. Boyle had no university degree. Boyle was educated at home and then he studied at Eton for four years (1635-38). Boyle alongwith one of his brothers entered Eton in 1635. The two young Boyles lived in the house of the Headmaster John Harrison. When Boyle entered Eton, it was just becoming fashionable as a place where important people were sending their children for studying. Boyle writes that Harrison gave Boyle "a strong passion to acquire knowledge". Boyle was doing very well at Eton. However, after the retirement of Harrison, Boyle failed to fit in with the educational discipline, Harrison's successor brought to the school. And finally Boyle and his brother were taken out of Eton in November 1638. After leaving Eton, Boyle came under the tutorship of Isaac Marcombes, a native of Auvergue. Boyle was sent on a Grand Tour of France and Italy (1638-44), accompanied by his brother Francis and Marcombes. In Italy he studied the work of the recently deceased Galileo. During his stay abroad, Boyle's father got entagled in battle with Irish rebels and he died in September 1643. Boyle spent some time at Geneva and he lived there mainly on his tutor's earning. In the summer of 1644 he had to sell some of his jewellery to finance his trip to England. When Boyle returned to England, it was in a chaotic state. Since 1642, King Charles was at war with the Parliament and several battles in 1644 left both King and Parliament in disarray. Describing the situation Boyle wrote in a letter: " [I] got safe into England towards the middle of the year 1644, where we found things in such a confusion, that although the manor of Stalbridge were by my father's decease descended unto me, yet it was near four months before I could get thither."

It took quite some time before he could start living at Stalbridge. During this time he lived with his sister Katherine and he also undertook a trip to France to repay his debts to his tutor. Finally he settled down at Stalbridge. Though Boyle had no intention to live long at Stalbridge, he remained there for around six years. At the beginning Boyle engaged himself in devotional writing. He composed early versions of *Seraphic Love*, The martyrdom of *Theodora*, and other pious reveries. Subsequently Boyle came in contact with several members of the loosely organized group of technical and utopian writers inspired by Francis Bacon and clustering around Samuel Hartlib.

In a letter written to his old tutor in France in October 1646 Boyle wrote: "As for my studies, I have had the opportunity to prosecute them but by fits and snatches, as my leisure and my occasions would give me leave. Diverse little essays, both in verse and prose, I have taken pains to scribble upon several subjects....The other humane studies I apply myself to, are natural philosophy, the mechanics and husbandry, according to the principles of our new philosophical college...”

John Wallis

About 1649, Boyle became interested in scientific experimentation. Boyle’s first exposure to systematic experimentation occurred at the hands of George Starkey who wrote immensely popular Chrysopoetic treatises under the pseudonym Eirenaues Philalethes. From Starkey, Boyle acquired a full experimental knowledge of Helmontian chymistrty, a discipline that fused mundane chemical pursuits with the quest for such ‘great arcana’ as the universal dissolvent or alkhasa and the Philosopher’s Stone. For this he needed a furnace. However, he could not find one at Stalbridge, a place far enough away from tradespeople who could make such an item. So he ordered one but when it finally arrived, it was completely broken. Eventually a furnace did arrive and Boyle could start his experimenting.

Christopher Wren

Boyle moved to Oxford in 1654. Here he came into contact with a group of physicians and natural philosophers who encouraged his pursuit of natural philosophy. Among those with whom Boyle interacted were: John Wilkins, John Wallis, Seth Ward and Christopher Wren. At Oxford, Boyle first worked on pneumatics. He got an air pump built for him by Robert Hooke after the type invented by Otto von Guerick (1602-86) in 1654. Assisted by Robert Hooke, Boyle performed a number of pioneering experiments. He showed that air was essential for the transmission of sound, and for the respiration and combustion. He also realized that respiration and combustion exhausted only part of the air. He showed for the first time that Galileo was correct in his assertion that all objects fall at the same velocity in a vacuum. In his most famous experiment on pneumatics, he took a U-shaped tube with a shorter closed end, and a longer open end in which he poured mercury. With the help of this device he could isolate a given volume of gas in the shorter end. When the mercury was level in both ‘limbs’, the gas was under atmospheric pressure. Boyle could increase the pressure by adding more mercury to the longer limb of the U-shaped tube. And by doing so, Boyle found that the volume was halved if the pressure was doubled, reduced to a third if the pressure was tripled and so on. His work on

Seth Ward

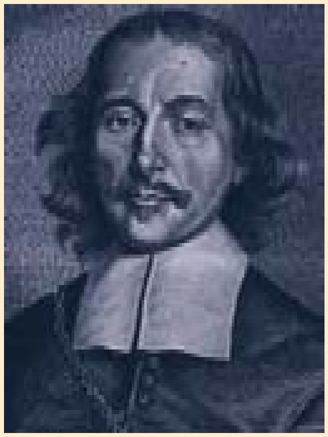
compressibility of air was published in 1660. It was his first major scientific work. It was titled *New Experiments Physico-Mechanicall, Touching the Spring of the Air and its Effects*. In the second edition of this work published in 1662, Boyle described the famous law stating that pressure and volume of a gas are inversely proportional that is if the pressure increases, volume would decrease and the vice versa. It became known as Boyle’s Law in Britain and USA but in France it was credited to Edme Mariotte (1620-84), who announced the discovery of the same law that Boyle had announced in 1662. As we know Boyle’s law holds for ideal gas and it can be summarized as $PV=k$, where k is a constant , and P and V are pressure and volume respectively.

Gottfried Wilhelm Leibniz (1646-1716) expressed his astonishment to Christian Huygens (1629-95) over the fact that Boyle did not construct any theory based on his excellent and extensive experimental observations. He wrote that Boyle “who has so many fine experiments, (had) not come to some theory of chemistry after meditating so long on them. Yet in his books, and for all the consequences

Some important works of Robert Boyle

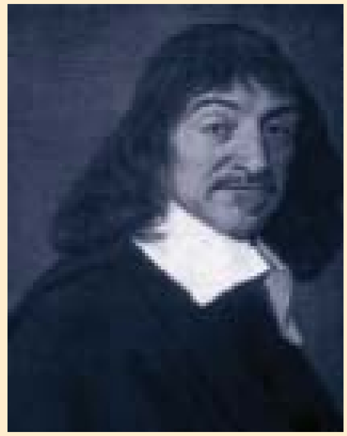
1. New Experiments Physico-Mechanical, Touching the Spring of Air and its Effects
2. Certain Physiological Essays
3. The Sceptical Chymist
4. Some Considerations Touching the Usefulness of Experimental Natural Phylosophy
5. The Origins of Forms and Qualities
6. The Excellency of Theology, Compar’d with Natural Philosophy
7. Considerations about The Excellency and Grounds of the Mechanical Hypothesis
8. The Free Enquiry into the Vulgarly Receiv’d Notion of Nature
9. The Discourse of Things above Reason
10. Disquisition about the Final Causes of Natural Things
11. The Christian Virtuoso
12. Experimental History of Mineral Waters (1685)
13. Of the Reconcileableness of Specific Medicines to the Corpuscular Philosophy (1685)
14. Medicinal Experiments: or a, Collection of Choice Remedies, 1692 (Posthumous)
15. Experiments and Consideration Touching Colours
16. Hydrostatic Paradoxes
17. About the Excellency and Grounds of the Mechanical Philosophy.

that he draws from his observations, he concludes only what we all know, that everything happens mechanically. He is perhaps too reserved. Excellent men should leave us even their conjectures; they are wrong if they wish to give only those truths that are certain."


Otto von Guerick

Boyle defined the term "element" in *Sceptical Chymist* (1661): "...certain primitive and simple, or perfectly unmingled bodies; which not being made of any other bodies, or of one another, are the ingredients of which all those called perfectly mixt bodies are immediately compounded, and into which they are ultimately resolved." Many ideas in the *Skeptical Chymist* were taken over from Rene Descartes (1596-1650). However, in one respect Boyle fundamentally disagreed with Descartes. For Descartes, the concept of vacuum did not exist. He believed in an all pervading either. However, Boyle rejected the idea of ether as he did not get any experimental evidence for it. Like Descartes, Boyle ones believed that the primary particles move freely in fluids and less freely in solids.

Boyle did not accept various honours offered to him by Charles II such as Provotship of Eton and a peerage. However, he was appointed to the Board of the East India Company and Member in the Royal Company of Mines. It has been reported that Boyle carried out explorations for the Royal Company of Mines for industrial and medical resources. He was granted a forfeited estate in Ireland in 1662. The income


Rene Descartes

form this estate was used by Boyle for the advancement of learning and the dissemination of Christianity. He was appointed Governor of the Society for the Propagation of the Gospel in New England in 1661.This position he held until 1689.

Robert Boyle died in London on December 30, 1691. He was buried in the Church of Saint-Martin-in-the-Fields next to his sister. However, the church was later demolished and no record was kept as to where his remains were moved.

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FIP Awards at World Book Fair

Vigyan Prasar's monthly bilingual (Hindi+English) newsletter "DREAM 2047" was awarded Second Prize for Excellence in Publishing (for the year 2002-2003) in the category of Journals and House Magazines (Hindi) by the Federation of Indian Publishers. Shri V.K. Joshi received the award on behalf of Vigyan Prasar from Hon'ble Chief Minister of Delhi Ms. Sheila Dixit during World Book Fair at Pragari Madan (16 Feb. 2004). "Dream 2047 was also awarded the second prize in 2002 (for English).

Vigyan Prasar Hindi Publication "Khiele Matritava Goonji kilkarian" awarded First Prize for Excellence in Publishing (for the year 2002-2003) in the category of Scientific/ Technical/Medical Books (Hindi) by the Federation of Indian Publishers. Dr. Subodh Mahanti received the award on behalf of Vigyan Prasar from Hon'ble Chief Minister of Delhi Ms. Sheila Dixit during World Book Fair at Pragari Madan (16 Feb. 2004)

Recent Developments in Science and Technology

Cancer radiation risk estimated

A British study has quantified the cancer risk from diagnostic X-rays. Radiation from medical and dental scans is thought to cause about several cases of cancer per year in each country.

The benefits of using X-rays still far outweigh the potential increase in cancer risk, says Amy Berrington de González from Oxford University, UK, who coordinated the study. But it's important to know what that risk is, she says, so doctors can weigh up the pros and cons of using the technique.

X-rays and their computerized cousin, CT scans, are routinely used to diagnose cancer and examine bone breaks. But the radiation can penetrate through cells and damage DNA. In some people, this can trigger cancer.

To minimize the risks, doctors use low doses. A chest X-ray, for example, delivers just three days' worth of low, background radiation. But X-rays are commonplace in hospitals and huge numbers of people receive them.

Attempts to quantify the risk of X-rays have been made before. The most recent previous estimate, made in 1981, found that X-rays probably accounted for 0.5% of cancer cases in the United States. New study confirm that 10% cases of cancer are due to x-ray.

Source : nature.com

Organic food contaminated with GM

A wide range of 'organic' food products on sale in the United Kingdom contain genetically modified (GM) ingredients, according to a study due to be published in April[1]. The revelation has prompted organisations that certify food as organic and GM-free, such as the Soil Association, to hurriedly review their procedures.

Transgenic soya was found in ten of 25 organic or health food products tested by Mark Partridge and Denis Murphy, biotechnology researchers at the University of Glamorgan in Pontypridd, Wales. Eight of the ten were labelled either as 'organic', which should indicate the absence of transgenic ingredients under Soil Association rules, or explicitly as 'GM-free'.

The study, which confirms previous tests by national food standards agencies in Ireland and the UK, implies that a wide range of foodstuffs probably contain traces of GM material.

Soya is a very popular ingredient, both in organic and non-organic foods. Over 60% of processed food in a typical supermarket contains soya extracts, including vegetarian sausages and soya mince. Soya flour and unprocessed soya beans are also popular in organic and health food shops. In addition, organic meat must come from animals fed on organic crops, and many farmers use organic soya meal as feed.

Source : nature.com

Plants May Point Way to Clean Hydrogen Fuel

Plants have a skill that scientists envy: the ability to split water into hydrogen and oxygen through photosynthesis. Performing

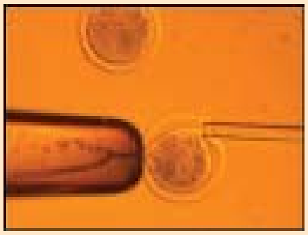
this task on an industrial scale could open up a novel avenue to producing clean hydrogen fuel. To that end, recent findings published in journal *Science* may prove useful. Researchers report that they have observed, in great detail, the key to the process

Nature figured out how to split water using sunlight in an energy-efficient way 2.5 billion years ago," says study co-author Jim Barber of Imperial College London. Barber and his colleagues used x-ray crystallography to take the highest-resolution image yet of the catalyst essential to the photosystem II complex in plants, which enables photosynthesis. The scientists analyzed a plant bacterium known as *Thermosynechococcus* and determined that the complex comprises four manganese atoms, four oxygen atoms and a calcium atom arranged as a cube, with the most reactive manganese atom attached to a corner oxygen. "Our structure also reveals the position of key amino acids, the building blocks of proteins, which provide details of how cofactors are recruited into the reaction center," says team member So Iwata of Imperial College and Japan Science and Technology Corporation.

Source: Scientific american, Feb. 2004

Cloned Human Embryos Yield Stem Cells

Scientists in South Korea have succeeded in obtaining stem cells from cloned human embryos. A report published in journal *Science* describes the work, in which 30 embryos of about 100 cells were created and used to harvest stem cells that later differentiated into a variety of tissue types. The findings offer hope for treating disease through so-called therapeutic cloning but are sure to revive ethical debates.



The list of successfully cloned animals includes sheep, mice, horses and cats, among others, but primates have proved difficult. In the new work, a team of researchers led by Woo Suk Hwang of Seoul National University collected 242 eggs from 16 unpaid volunteers who knew their eggs would be used for scientific experiments. The scientists transferred the nucleus of a somatic, or nonreproductive, cell into an egg from the same donor that had had its nucleus removed. The researchers used a slightly different technique to extract the contents of the egg—employing gentle extrusion instead of the more commonly used suction method—which, together with careful timing and the freshness of the donated eggs, may have aided their success.

Source: New Scientist, Feb. 2004

Compiled by: Kapil Tripathi

Curry Leaf

An Authentic Indian Spice

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Called in Tamil as *Karuveppilai* (or *Karuvepila*), Bengali as *Barsunga* and in Hindi *Meetha neem* (or as *Kari patta, Katneem*), curry leaf's botanical nomenclature is *Murraya koenigii* Spreng. In certain parts of the country it is also called as Kadhi Patha and is used to made the delicay made out of curd and channa dal powder–kadhi. Native to India, curry plant is found wild almost everywhere in the Indian subcontinent excluding the higher levels of the Himalayas. There are references to this plant in ancient Tamil classic Sangam literature (c 2 BCE); wherein the plant is referred as '*kanchaka narumuri*'. Found in the outer Himalayas, from the Ravi eastwards, ascending to 5,000 feet, in Assam, Chittagong, Upper and Lower Burma, is widespread in evergreen and deciduous forests of peninsular India, often as underwood.

Tamil *kari* actually is the 'gravey'; *vepilai* means neem leaf; impling that traditinally the plant was thought to be a type of neem; but useful for making '*kari'* (curry). British mistook 'curry' to mean spicy/ spice (for, gravey is usually spicy and is called masala) and named the plant curry leaf/plant; and the name stuck. Though the name suggests association with the Neem tree, actually curry leaf plant is a tropical tree of the citrus family (*Rutaceae*), such as lime.

The leaves are the useful part of the plant. The long slender leaflets are dark green on top and paler underside. Since they lose their delicate fragrance when dried, it is necessary to obtain them fresh; dried leaves hardly has any use. The leaves have a strong, warm curry aroma when bruised or rubbed. Its sensoric quality is fresh and pleasant, remotely reminiscent of tangerines. Under the traditional 'six types of tastes' curry leaves are classified as bitter. 'Just as the tender leaves of curry plant' is an idiom usually used in Tamil to emphasis the distinctiveness and rarity, befitting the delicacy of the tender leaves of curry leaf plant. On the other hand, as most people discard the leaves from their serving, though may use the leaves to season and flavour, the idiom 'just as the curry plant' implies just opposite- heedless and callous attitude.

Figure 1: The plant, flower and the tender leaf

Culinary use

Curry leaf is a popular leafy-spice used almost daily, either as fresh form when available or as preserved as dried or frozen for long-term storage, in Indian cuisine for its characterizing authentic flavor and distinct aroma. Curry leaves are to Indian cooking what Bay leaves are to the western world. Actually there is a reference to its use in making mango pickle in the *Sangam* literature *Perumpanatrupadai*- indicating its hoary past of at least 2000 years. Aromatic and flavorful, they can change the taste of a dish quite dramatically. Sizzled in oil, roasted in a pan or blended just raw, these versatile leaves pack quite a punch. In India, they are also used for medicinal purposes. Their effectiveness in preventing nausea and upset stomachs is almost legendary.

While curry leaf is used in very small quantities primarily for its distinct aroma due to the presence of volatile oils yet nutritional value and functional properties have attracted attention of researchers. Interest in greater use of curry leaf has been stimulated since its high antioxidant and anticarcinogenic potential were reported. Curry leaves are reported to a source of α-tochopherol, β-carotene, and lutein.

Traditionally curry leaves are used in two ways -adding the final seasoning to a dish as in *"Tarkas*" or as a basis for beginning a recipe. In Indian cuisines, curry leaves are used fresh; for some recipes, the leaves should be oven-dried or toasted immediately before usage or garnished once the cooking is almost over. Another common technique is short frying in butter or oil- '*tarka'* . Since South Indian cuisine is dominantly vegetarian, curry leaves seldom appear in non-vegetarian food; the main applications are *Rasam* (thin lentil) or *sambaar* (vegetable curries). Because of their soft texture, they are never removed before serving, but can be eaten without any hazard. However in Sri Lanka and Kerala, the delicious chicken and beef curries are flavoured with curry leaves.

Though extensive use of curry leaves are in Southern India and Sri Lanka (and are absolutely necessary for the authentic flavour), it is of importance in Northern India too. Together with South Indian immigrants, curry leaves reached Malaysia, South Africa and Réunion island. Outside the Indian sphere of influence, they are rarely found.

Main constituents

Fresh leaves are rich in an essential oil, but the exact amount depends besides on freshness and genetic strain also on the extraction technique. Typical figures run from 0.5 to 2.7%. The following aroma components have been reportedly identified in curry leaves of Sri Lanka (in parentheses, the content in mg/kg fresh leaves): α-caryophyllene (2.6 ppm), α-gurjunene (1.9), α-elemene (0.6), α-phellandrene (0.5), α-thujene (0.4), α-selinene (0.3), α-bisabolene (0.3), furthermore limonene, α-trans-ocimene and α-cadinene (0.2 ppm). Newer

Contd. on page...20

Memory Mantras

Handy Tips to Better Recall

❑ **Dr. Yatish Agarwal**
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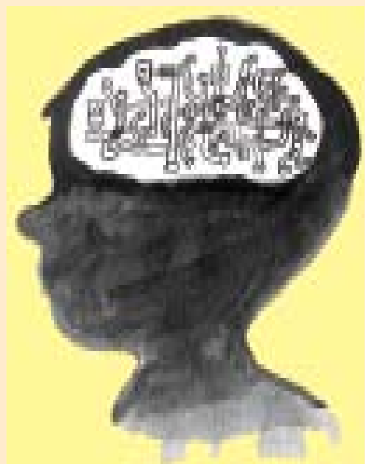
From *kagzi badam* to *Memory Plus*, there are tens of concoctions which promise you better memory. Alas! Only if things had been that easy! Each of us would have been a genius.

Memory slips, or moments of forgetfulness, are something we all suffer from. Often a name is on the tip of our tongue but we fail to come out with it. It is the same when we try to recall the most suitable word and fail. Situations such as this arise often enough and we wonder how we could improve our memory.



Before we go on to learn some simple ways, you must know why Mother Nature planned it such. In fact, if you think some more, you will soon realise that the evolution of imperfect human memory is a blessing in disguise. Honestly, memory must be defective to be effective! Had it not been so, we would have been driven crazy with the mine of information that we all receive. The mind would have simply got cluttered with trifles. The merit, therefore, lies in being able to remember things that matter to you.

And here are some handy tips to that:

Remember, there is no substitute for hard work : If you must face a memory test, go well prepared. Do not just rely on recalling from your remote memory. Revise actively. Plan and work in such a way that you may do active revision. Read a text once, read it once again within the next 24-hours and again within a week to ten days, for it to stick firm and nice in your memory bank.

Take notes, read them aloud, recite information to your self, draw an outline — because all of it helps. Highlight important lines and paragraphs. Give yourself practice tests to figure out where you need to work more. You may also use revision aids to test yourself.

Be observant : Observing means paying fullest attention to detail and soaking it up. This is a skill few people are good at. For instance, you must have seen a 500-rupee currency note several times, but can you remember what is pictured on the back of it? Unless you know it is Gandhiji leading his fellow citizens on the Dandi March, you must improve your observation skills. The rule is: Learn to click a mental picture of the things that are significant to you.

Make mnemonics and think in rhymes : Make mnemonics or a rhyme for hard-to-recall facts and complicated and highly detailed information. It helps, and in a big way. Many things that I learnt at medical school nearly twenty-five years ago are still glued to my memory simply because a friend was clever enough to coin a few interesting mnemonics. You can try it too. It works like magic every time.

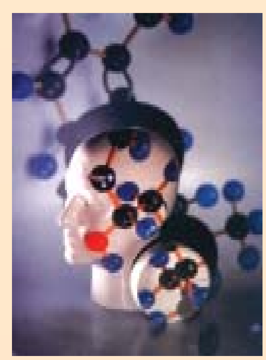
Think around. To oil your recall machinery and get it working, reinstate as much as possible of what you know surrounding the issue, and there is every possibility that the missing piece of information will come back to you quick in a flash. The more connections you make, the better your chance of striking at the correct answer.

To remember events, look for markers : Things that happened to you long ago did not happen to you in isolation from other events. Think of them, and you could easily have the year and other details of the event come back to you in a flash. For instance, I needed to recall the year we went to Manali, and tried, as I did, could not remember the year. But as I thought deeper it came quickly – it was the year the late Prime Minister Mrs. Indira Gandhi was assassinated. Pat came the answer: 1984. This was a fact easy to find, and even if my mind would have failed me, I could have easily looked it up in any GK reference book. Many times drawing such associations can set your mind on the correct track and help you recall a fact that occurred in the past.

Make a list : Jot down on a piece of paper the things that you need to remember. This will stack up that piece of information in your memory and, at the same time, free your mind for more important things. Your short-term memory, which has a limited bank, will no longer be under pressure.

Indulge in mind-sport : Doing crossword puzzles, delving in mind sports and playing board games like scrabble, chess and cards is an excellent recipe for sharpening your memory. The benefits will be gradual and subtle, and you must choose the games that you enjoy. But play them well, to win!

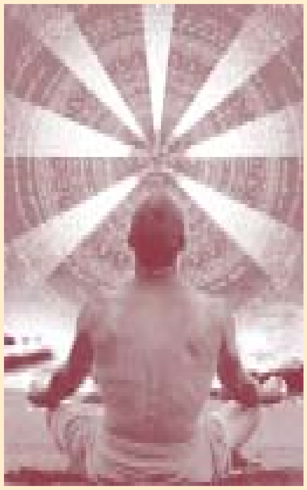
Read, read and read : If you find yourself groping for words, and this happens often, do as much reading as you can. Read stuff that is good and enjoyable and very soon you will find the words will flow in again. It is a solution I have tried with success. You could use it too!



Say 'no' to alcohol and drugs : If you consume too much alcohol or use drugs, you are doing a disservice to yourself. They make you forgetful. Even the so-called performance enhancing and keep-awake stimulant drugs work the wrong way. They just fill you with false perceptions about time and ability. Stay away from them.

Meditate : Meditation increases the mind's concentration and brings calmness. You free your mind of its encumbrances, allowing it a hard-earned rest as you enter a state of suspended consciousness. Go ahead. Try. It may take time and appear difficult, especially at the initial stage when you are in the process of getting the grasp of it. However, with the help of a yoga teacher it would not take long to succeed.

Maintain your calm : Stress, anxiety and nervousness can disrupt memory performance badly. Many excellent students perform poorly in exams just because of this. Always maintain your cool and you would do much better. If you are the worrying kind, try yoga, deep breathing exercises, brisk walks and relaxation.



A healthy body houses a healthy mind : If you exercise aerobically four to five times a week, there is a pretty good chance that you will beat a person who does not do any physical exercise in a memory test. If you aren't regular with your physical exercise, change your sedentary ways now! Exercise is a wonderful tonic for the mind. It improves the blood flow to the brain, which automatically translates into improved thinking and memory.

Take a balanced diet : Research shows that a balanced diet, rich in vitamins, serves to refurbish your memory, word fluency and recall. Vitamins of the B complex family, particularly niacin, and beta-carotene, a vitamin A precursor, are specially recommended.

Think positive and aim high : Never think you are not going to do well. Think positive and try one hundred per cent. You might end up achieving a neat 90 per cent score, and that isn't bad! But try some more, and you may fulfil your goal *in toto*.

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Curry Leaf... *contd. from page...22*

work has shown a large variability of the composition of the essential oil of curry leaves. In North Indian plants, monoterpenes prevail (α-phellandrene, α-pinene, α-pinene), whereas reports suggestes that South Indian samples yielded sesquiterpenes: α-caryophyllene, aromadendrene, β-selinen. An alkaloid, murrayacinine, is also found in this plant

Botany

The curry leaf comes from the small deciduous curry leaf tree, or Murraya, which is native to southern Asia. It possesses a pungent curry scent with overtones of anise and citrus. A small spreading shrub, about 2.5 metres high; the main stem, dark green to brownish, with numerous dots on it; its bark can be peeled off longitudinally, exposing the white wood underneath; the girth of the main stem is about 16 cm.

Figure 2: Curry leaf

Leaves are exstipulate, bipinnately compound, 30 cm long, each bearing 24 leaflets, having reticulate venation; leaflets, lanceolate, 4.9 cm long, 1.8 cm broad, having 0.5-cm-long petiole. Flowers are bisexual, white, funnel-shaped, sweetly scented, stalked, complete, ebracteate, regular, actinomorphic, pentamerous, hypogynous, the average diameter of a fully opened flower being 1.12 cm; inflorescence, a terminal cyme, each bearing 60 to 90 flowers; calyx, 5-lobed, persistent, inferior, green; corolla, white, polypetalous, inferior, with 5 petals, lanceolate; length, 5 mm; androecium, polyandrous, inferior, with 10 stamens, dorsifixed, arranged into circles of five each; smaller stamens, 4 mm. long whereas the longer ones, 5 to 6 mm; gynoecium, 5 to 6 mm long; stigma, bright, sticky; style, short; ovary, superior. Fruits are round to oblong, 1.4 to 1.6 cm long, 1 to 1.2 cm in diameter; fully ripe fruits, black with a very shining surface; pulp, Wistaria blue; the number of fruits per cluster varying from 32 to 80. There are only one seed in each fruit, 11 mm long, 8 mm in diameter, colour spinach green.

Medicinal uses

Curry leaf has been used in folk medicine in China and other Asian countries as an analgesic, astringent, antidysenteric, antioxidant, febrifuge, hypolipidemic, hypglycemic, for improvement of vision, to treat night-blindness, and for regulation of fertility. The reported nutritional value of curry leaves have prompted the Tamil nadu government to include two grams of either curry leaf powder (or drumstick leaf powder) for five days in a week along with the noon-meals served to children of economically weaker section, with an expectation that inclusion will help eradicate "Vitamin A" deficiency among children between 3-5 years.

The leaves, the bark and the roots of *Murraya koenigii* (L.) Spreng is used as a tonic and a stomachic. The bark and the roots are used as a stimulant by the traditional physicians. They are also used externally to cure eruptions and the bites of poisonous animals. The green leaves are stated to be eaten raw for curing dysentery, and the infusion of the washed leaves stops vomiting.

A strong odiferous oil occurs in the leaves and the seeds of curry leaf plant. The chemical examination of this oil reported that this essential oil exhibited a strong antibacterial and antifungal activity. Analysis of purified extracts of *Murraya koenigii* Spreng indicate a significant a-amylase inhibitory activity. Effect of curry leafs on carbohydrate metabolism has been studied using rats as experimental animals and significant hypoglycemic action as been observed. There was increase in the concentration of hepatic glycogen and glycogenesis.

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The Science Exhibition on Wheels –Vigyan Rail

Vigyan Rail made its journey in the month of February 2004 to the states of Bihar, West Bangal, Assam and Nagaland between 29 January 2004 and 26 February 2004 to four locations; Sonepur, Muzzafarpur, Samastipur and Barauni.

The halt at **Sonepur** was on 29 January 2004. The Vigyan Rail was formally inaugurated by the DRM, Shri Neeraj Kumar and a number of schools in and around the area visited the rail during its one-day halt. About 8000 people had visited the exhibition on that day.

Long queue of school children at Alipurdwar Junction, Assam

The next halt in North Bihar was in **Muzzafarpur** during 29th January to 1st February 2004. The District Magistrate, Shri Amrit Lal Meena, inaugurated the exhibition. Dr. Nihar Ranjan Singh, Vice Chancellor of Dr B R Ambedkar University, Muzzafarpur also visited the exhibition and highly appreciated the efforts. In total 54,000 visitors made use of the exhibition at Muzzafarpur.

The Vigyan Rail Exhibition at **Samastipur** was from 2 to 4 February 2004. The exhibition at Samastipur was inaugurated by the DRM Shri Aggarwal. The District Magistrate, Shri Lal made a visit to the Vigyan Rail. In total for three days, about 55,000 students and visitors benefited from the exhibition at Samastipur.

The Vigyan Rail halt at **Barauni** was from 5 to 7 Feb 2004. The exhibition was inaugurated by Shri T Sudhir, Asst. GM (HR), Barauni Refinery in the presence of Regional Manager of East Center Railway Shri Asgar Ali on 5th Feb 2004. On an average about 16,000 people visited the train totaling to about 50,000 people in three days.

The science exhibition on wheels entered North Bengal after completing its journey from Bihar on 7th February 2004. The Vigyan Rail at **Siliguri** junction was inaugurated by the Vice Chancellor of North Bengal University Prof. P.K. Saha and in the presence of Shri S.N. Singh, ADRM , Shri B. Lama, SDM and Shri Karan Singh, Area Traffic Manager-Railways. About 50,000 people visited the exhibition everyday at Siliguri junction during 7-10 February 2004.

The Vigyan Rail next moved to **Alipurduar** junction on 11th February 2004. Here the rail was inaugurated by Mrs. Pampa Babbar, DRM alongwith ADRM, DCM and ADM. Shri Satyabrata Das, the local MLA was also present in the function. Over 1,20,000 people visited the Vigyan Rail during its four days stay at Alipurduar.

The train entered North East as its next destination in **Guwahati** on 15th February 2004. Prof. G. Talukdar, Vice Chancellor of Guwahati University, Shri M.C. Chauhan, ADRM, Shri Afsar Hazarika, DC (Kamrup-Metro) were present in the inaugural ceremony. Dr. V. B. Kamble, Director, VP, welcomed the guest and gave a brief account of this prestigious project followed by short speech by each invitee. There was an average crowd of 4000 people who visited the exhibition everyday.

The next halt of Vigyan Rail was at **Dimapur,** Nagaland where it was stationed from 21st to 23rd February 2004. The exhibition was inaugurated by Shri Deo Nukhu, the Minister for Higher & Technical Education, Science & Technology and IT, Nagaland, Shri Jyoti Kalash, DC, Dimapur, Shri Janardan Kumar, SP, Dimapur and Dr. Zavei Hiese, SSO, DST, Nagaland. During its three days stay it received overwhelming response from the city as well as from far-flung areas. Nearly 30,000 people visited the exhibition.

The last destination in North East of Vigyan Rail was **Tinsukia,** Assam during the period 24th to 26th February 2004. The exhibition was inaugurated by Shri Ashok Kumar, ADRM (Railways), Shri Sanjeev Mandekar. Nearly 50,000 people visited the Vigyan Rail exhibition till 26th February 2004.

There were extensive press and electronic coverage of the exhibition in local newspapers, AIR, DDK and other private TV channels.

World Book Fair 2004

Vigyan Prasar participated in the 16th World Book Fair at New Delhi from 14-22 February 2004.

Release of "Transit of Venus" Kit and "India in Space" CD

Vigyan Prasar has brought out an interactive CD on "India in Space" and a kit on "Transit of Venus" which were released by Prof. V.R. Gowariker, former Scientific Adviser to PM, on the occasion of National Science Day on 27th February 2004. The kit contains 18 activities, a safe solar viewer and a mutlicolour chart. It is priced at Rs. 50/-. For more information please contact Director, Vigyan Prasar.