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Monthly Newsletter of Vigyan Prasar

DREAM 2047

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VP News

National Science Day 2006 – Release of a Book and a CD

Vigyan Prasar has brought out a book entitled "Vigyan Rail – Science Exhibition on Wheels" documenting the epic saga of Vigyan Rail. The lavishly illustrated book was released by Shri Kiran Karnik, President, NASSCOM, New Delhi, during the National Science Day function at Technology Bhavan, New Delhi, on 27 February 2006. Present on the occasion were Dr. V. R. Gowariker, Chairman, Rajiv Gandhi Science & Technology Commission, Government of Maharashtra and a well known space scientist, and Professor V. S. Ramamurthy, Secretary, Department of Science and Technology.

Shri Kiran Karnik (centre) releasing the book "Vigyan Rail – Science Exhibition on Wheels". Dr. V. R. Gowariker (right) and Professor V. S. Ramamurthy (left) are also seen.

The book "Vigyan Rail – Science Exhibition on Wheels", has attempted to document the entire journey of Vigyan Rail ever since it was a mere dream to its realization. Vigyan Rail was a unique concept in bringing India's scientific heritage and recent achievements to the doorsteps of the people. The Science Exhibition on Wheels, which travelled across the country for about eight months, halting at 60 stations, was conceived, formulated and implemented by Vigyan Prasar jointly with the Ministry of Railways, and with the active support of the Department of Science and Technology. This profusely illustrated book attempts to present a glimpse of the unique Science Exhibition on Wheels and recounts its momentous journey across the length and breadth of the country. The journey has been lucidly narrated by the well known science journalist Shri B. S. Padmanabhan.

On this occasion, an interactive CD on Innovative Experiments in Physics in Hindi (*Nawachari Bhoutiki Prayog)* was also released. Dr. V. R. Gowariker released the CD. This interactive CD on Innovative Physics Experiments illustrate and demonstrate a series of novel activities that may help enhance interest in Physics amongst students and teachers. Activities aim at conceptual understanding of Physical phenomena rather that verification of experiments described in a text book. The CD contains experiments and activities in different branches of Physics. Video clippings of the actual activities help understand the principles and concepts in lucid manner. It is expected that students of class VIII to XII would be able to perform most of the experiments using commonly available objects/ equipment. Professor H.C. Verma and Dr. Mukesh Roy, Department of Physics, IIT, Kanpur have developed the activities presented in the CD. Dr. Mukesh Roy was present during the function.

CD "Nawachari Bhoutiki Prayog" being released by Dr. V. R. Gowariker. Also seen (from Left) Professor V. S. Ramamurthy and Shri Kiran Karnik

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

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The Virus Has Finally Landed

It was only a couple of months back that we had discussed in this column the looming threat of a possible invasion of bird flu in India - also called avian influenza - caused by the lethal H5N1 virus found in migratory birds and chicken (*Dream 2047* December 2005). Avian influenza was already making rounds in South-East Asia, Europe and the Middle-East. We were relatively complacent and believed that bird flu would not hit us, just the way SARS did not. Well, the H5N1 virus has finally landed.

Bird flu first appeared in Hong Kong in 1997 and ever since, the disease has become endemic in the poultry flocks of much of Asia - Indonesia, Vietnam, Cambodia, China, and Thailand. But since January this year, it has appeared in a seemingly alarming number of new countries. Although the arrival of bird flu in Europe and its neighborhood has caused panic, yet the cases are only in wild birds. The virus was infecting chicken and humans in northern Iraq early this year. It has now been discovered in Africa - in Nigeria and Egypt; and most recently in India, and is widely distributed across poultry flocks. The immediate issue is – how did the bird flu come to these countries, and India in particular?

Migratory birds are often blamed for spreading virus. The reason for this perception to grow is that H5N1 viral strains responsible for recent outbreaks including Nigeria have been found to be very similar to the one found in Qinghai Lake in western China - where large numbers of wild water birds perished between April and June 2005 after being infected by the virus. Apparently, some species of migratory water birds may be carrying the H5N1 in its most pathogenic form and introducing it to new areas along their route. But, bird migrations in India were over around November 2005. If migratory birds had brought the virus, the H5N1 outbreaks should have taken place much before than what was observed. Further, such outbreaks should have occurred at places further north where the birds would have reached much earlier. The wild birds would by now be preparing for their return journey. It is further significant that no suspicious illness was observed by the monitoring teams of the Bombay Natural History Society among those wild birds.

Another possibility is that the humans themselves are responsible for the spread of infection in poultry. It is suggested that there are three likely transmission routes for H5N1 – commercial trade and movement of poultry, trade in wild birds, and the use of infected poultry manure as agricultural fertilizer. Most outbreaks in South-East Asia could be linked to movements of poultry and poultry products, or infected material from poultry farms, such as mud on vehicles or even people's shoes. Live animal markets also could play an important role in the spread of H5N1 virus. Indeed, such markets were the source of the first known outbreak in Hong Kong in 1997.

Ever since the test reports of the affected poultry were confirmed as positive for H5N1 strain of avian influenza, around 2.3 lakh fowls were culled in and around Navapur, Nandurbar District of Maharashtra and about a lakh in Uchchhal town of Surat District, Gujarat. Egg and chicken dishes have but disappeared from airlines, hotels, and household menus. The stakes cannot be higher. With an estimated number of 50 crore poultry, the size of the poultry industry in India is estimated at Rs. 35,000 crores. The loss incurred by poultry farms in Navapur alone is calculated at Rs. 30 crore with over 5,000 losing their livelihood.

How is it that bird flu had already assumed the proportions of an epidemic when it was reported in India? From one poultry farm nearly three decades ago, the number of poultry farms, at the last count, had grown to 58 within a radius of 3 kilometers of Navapur Nagarpalika, with proximity to markets in Gujarat and Mumbai. Today, practically every second household in Navapur is linked to poultry business. It all started with hundreds of birds dying in coops (that is, cage or pen for confining poultry) on a single day. By mid-January 2006, a leading poultry farm had been nearly wiped out, with over 50,000 birds dying in a matter of days! Poultry farm owners were convinced that the birds died most likely of a more virulent form of Ranikhet disease, which usually occurs at the onset of summer. It is estimated that nearly two lakh birds died from 15 January to 10 February! The farmers hid the information fearing loss and sent birds from affected farms to markets. The first reports of large-scale deaths appeared on 8 February and soon after the samples were sent to the High Security Animal Disease Laboratory at Bhopal, the national facility entrusted with the detection of avian influenza in birds. The H5N1 virus invasion of India was officially announced on 18 February 2006.

Humans can contract bird flu if they come in close contact with faeces or saliva of the infected chickens. It can spread by movement of live birds from farm to farm, through people wearing contaminated clothes, contaminated vehicles, equipment, feed and cages. Infected humans will have high fever, cold, running nose and difficulty

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Evariste Galois

Pioneer of Modern Group Theory

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"The melodrama and tragedy of the short life of Galois seem largely self-imposed. The circumstances of his death seem to defy rational explanation. One of the letters written on the eve of his death ends: 'Preserve my memory, since fate has not given me life enough for the country to know my name.' Although it took some time before it was properly understood, Galois' theory forms one of the most beautiful parts of modern algebra."

Ioan James in* Remarkable Mathematicians: From Euler to von Newman, *Cambridge University Press, 2002

"In all the history of science there is no completer example of the triumph of crass stupidity over untamable genius than is afforded by the all too brief life of Evariste Galois."

E.T. Bell, the author of "Men of Mathematics"

"Some of his (Galois') results have been independently obtained by Niels Henrik Abel but Galois put them in a theoretical setting for them which proved to be very useful to later mathematicians. But brevity and obscurity of his writing delayed the understanding of his work, but it gradually came to be seen as a corner stone of modern algebra, in which the concept of a group first became of central importance."

Chambers Biographical Dictionary *(Centenary Edition), 1997.*

The story of Evariste Galois is one of the most tragic stories in the history of science. He died in a duel, five months before his 21st birthday. However, his work has become a cornerstone of modern algebra, in which the concept of group acquired central importance. In his theory of the roots or solutions of algebraic equations, Galois considered the properties of permutations of the roots. Galois groups or the groups of admissible permutations in which the roots (or the solutions) obey the same relations after permutations, have properties that throw light on solvability of the algebraic equations.

There are many legends around the life and work of Galois. Paul Dupuy's biography of Galois is considered as the primary source of information about the life of Galois. Dupuy was a historian and the Surveillant General of the Ecole Normale. Dupuy's biography, which appeared in 1896, contained eyewitness accounts and many relevant documents.

Evariste Galois

Evariste Galois was born on October 25, 1811 at a small place called Bourg-la-Reine, now a suburb of the French capital Paris. At the time Galois' birth the France was ruled by Napoleon. Both of his parents were well educated in philosophy, classical literature and religion. His father Nicholas-Gabriel Galois was the director of a boarding school, who later became the Mayor of Bourg-la-Reine. His mother Adelaide-Maire (*nee* Demante) came of a family of lawyers. The Galois family accommodated a school in their house located in the Grand Rue, now called Avenue du Générale Leclerc. The school played an important role in the prosperity and reputation of the family. Commenting on Galois' childhood, Ioan James writes: "Evariste had a happy, if unconventional, childhood. Like Gauss he seems to have had a phenomenal memory. Up to the age of twelve he was educated entirely by his mother, who instilled in him knowledge of the classics, and a skeptical attitude towards religion. She was an intelligent, lively, and generous woman, of strong character, but later seems to have been quite unable to restrain her brilliant, sensitive but headstrong son."

In 1823, Galois entered the elite school, *Lycee of Louis-le-Grand*, which was then called the College de Louis-le-Grand. It may be noted that both French revolutionary politician Maximilien Marie Isidore de Robespierre (1758-1794) and the celebrated French poet and writer Victor Marie Hugo (1802-1885) had studied in this school. This was the beginning of Galois' formal education. In the first years of his school Galois did well in

his examinations except that he was weak in rhetoric (the study of methods employed to write or speak effectively and persuasively). In 1826, Galois was asked to repeat the year because his work in rhetoric was not up to the required standard. At the beginning he did not display any special interest in mathematics. In fact he did not study mathematics until his fourth year in school. In February 1827, Galois enrolled in his first mathematics class, a course given by M. Vernier. But the moment he started studying mathematics he was attracted to it. Galois made phenomenal progress in his study of mathematics but at the cost of other subjects. His director of studies in his report wrote: "It is the passion for mathematics which dominates him. I think it would be best for him if his parents would allow him to study nothing but this, he is wasting his time here and does nothing but torment his teachers and overwhelm himself with punishments".

Augustin Louis Cauchy

In 1828, Galois took the examination of the École Polytechnique but failed. He wanted to enter this school both for academic and political reasons. It was a leading university in France and at the same time strong political movements existed among its students. Galois' father committed suicide on July 2, 1829. The reason for his suicide was that his name was drawn to a scandal for which he was not responsible. Being a good-natured man Galois' father could not stand it and took the extreme step. However, his tragic end greatly influenced his son's life. A few weeks after his father's tragic death, Galois sat for the second time at the entrance examination of the École Polytechnique. He again failed. It has been reported that during the oral part of the examination, Galois lost patience and threw the eraser at one of the examiners. Galois was successful in hitting the teacher but he forfeited the right to applying there again.

Jean Baptiste Joseph Fourier

After failing to get admitted into the École Polytechnique, Galois joined the École Normale Preparatoire (which was later renamed as École Normale Superieure) in February 1830. It was also considered a respectable institution but certainly less prestigious than École Polytechnique. He developed a friendship with Auguste Chevalier, a student from the second year. Auguste and his brother Michel, studying at the École Polytechnique, had a great influence on Galois. The two brothers were ardent followers of French social reformer and founder of French socialism Comte de Saint-Simon (1760-1825).

At École Normale, Galois was taught mathematics by a distinguished teacher named Louis Paul Emile Richard, who later also taught another great mathematician of France Charles Hermite (1822-1901). Richard did not fail to recognize Galois' exceptional talent in mathematics. Inspired by Richard, Galois soon started reading the works of great mathematicians like Adrien-Marie Legendre's (1752-1833) *Elements of Geometry (Elements de geometrie)*, a textbook of geometry ,and Joseph-Lois Lagrange's (1736-1813) original memoirs: *Resolution of Numerical Equations, Theory of Analytic Functions* and *Lessons on the Calculus of Functions*. Richard reported to the school authorities: "This student works only in the highest realms of mathematics." Encouraged by Richard, Galois published his first paper in mathematics.

Galois received his degree from École Normale on December 29, 1829. His examiner in mathematics reported: "This pupil is sometimes obscure in expressing his ideas, but he is intelligent and shows a remarkable spirit of research." His literature examiner reported: "This is the only student who has answered me poorly, he knows absolutely nothing. I was told that this student has an extraordinary capacity for mathematics. This astonishes me greatly, for, after his examination, I believed him to have but little intelligence."

At the age of 19, Galois sent three papers on theory of equations to the French mathematician Augustin Louis Cauchy (1789-1857) at the French Academy of Science, who valued Galois' papers highly and recommended Galois revise them into one paper in order to be considered for the Grand Prize in Mathematics at the Academy. This genius was at the verge of being recognized. But it seemed that he was destined to be the contrary. In February 1830, he submitted his paper *On the Condition that an Equation be Soluble by Radicals* to Joseph Fourier (1768-1830), the secretary at the Academy. Unfortunately, Fourier had died in April 1830 before he could enter Galois' paper officially. His paper was never found again. He published two other papers in December 1830. In January 1831, Galois submitted a third revision of his paper to Simeon Denis Poisson (1781-1840) at the Academy. And a letter in *Gazette des Ecoles* (January 2, 1831) was his last publication.

Galois was also very active in the French Revolution. Towards the end of 1830, the growing opposition to the reign of King Charles X, who was considered as ultra-conservative, led to an insurrection. The King failed to suppress the rebellion and he fled the country. Duke of Orleons accepted the crown as King Louis-Phillippe. The Republicans, who like the Bonapartists were opposed to King

Charles X, were not at all happy with the outcome. In April 1831Galois was imprisoned for threatening King Louis-Phillipe in a meeting. He was kept in Sainte Pelagie prison till June 15, 1831. In prison, he received a rejection letter from Poisson. In his report Poisson wrote: "We have made every effort to understand M. Galois' proofs. His arguments are neither sufficiently clear nor sufficiently developed to allow us judge their correctness, and we would not be in a position to give an outline of it in this report. The author states that the proposition, which is the main point of his paper, is part of a general theory open to many other applications. Frequently it happens that the different parts of a theory, by clarifying one another, are more easily understood together than individually. Thus it is hoped that the author would publish his work in its entirety so that we can form a definite opinion. But in the state in which it had been submitted to the Academy we cannot recommend that you give it your approval."

Siméon Denis Poisson

Marie-Sophie Germain

The comments of Poisson on Galois' work as quoted above cannot be considered unreasonable. Galois took upon the task of preparing a revised complete account of his work but at the same time he became too critical of the Academicians. Galois was passing through a difficult period. He had been expelled from the École Normale Superieure for supposedly writing an article in which it was argued that the students be armed. Because of his expulsion, the grant that he was receiving was also stopped. He unsuccessfully tried to earn a living by giving tuition in mathematics. Joseph Fourier, who was sympathetic to Galois, had died.

Charles Hermite

We may get a better indication of his character and behaviour during this period from a letter written on April 18, 1831 by the mathematician Sophie Germain (1776-1831) to her colleague Libri: "...the death of M. Fourier, have been the final blow for his student Galois who, in spite of his impertinence showed signs of a clever disposition. All this has done so much that he has been expelled from École Normale. He is without money and his mother has very little also. Having returned home, he continued his habit of insult, a sample of which he gave you after your best lecture at the Academy. The poor woman fled her house, leaving just enough for her son to live on, and has been forced to place herself as a companion in order to make ends meet. They say he will go completely mad and I fear this is true."

Galois' was again arrested on July 14, 1831 for wearing an illegal uniform and carrying a rifle. In France, July 14 is celebrated as Bastille Day, commemorating the storming of the Bastille in 1799 at the beginning of the French Revolution. Galois' second term of jail ended unexpectedly. He was released from prison in April 1832. This was because the worst raging cholera epidemics had arrived in France. Thousands of people, particularly the poor, fell prey to the disease. The authorities of Sainte-Pelagie jail after realizing the vulnerability of its inmates to the disease decided to transfer the youngest and the weakest to a health clinic, called Faultrier. Galois was one of those who, was transferred to the health clinic. But his trouble was not over. In the clinic he met Stephanie Dumotel, the daughter of one of the doctors and fell in love with her, but she rejected him. Galois took it very seriously. A few days after this episode, Galois was compelled to fight a duel with Pescheux d'Herbinville, a prominent Republican activist. The reason for the duel was not clear but it is almost certain that it had something to do with Stephanie.

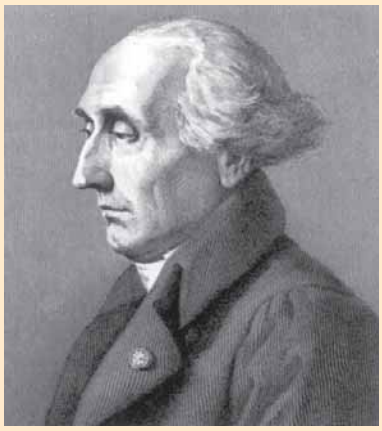
The famous duel took place on the morning of May 30, 1832. It seems Galois knew that he had no chance of surviving the duel. The previous evening, Galois wrote several letters (which were later well-publicised) to his Republican friends. In one of the letters he wrote: "I beg patriots, my friends, not to reproach me for dying otherwise than for my country. I die the victim of an infamous coquette and her two dupes. It is in a miserable piece of slander that I end my life. Oh! Why die for something so little, so contemptible? I call on heaven to witness that only under compulsion and force have I yielded to a provocation, which I have tried to avert by every means. I repent in having told the hateful truth to those who could not listen to it with dispassion. But to the end I told the truth. I go to the grave with a conscience free from patriots' blood. I would like to have given my life for the public good. Forgive those who kill me for they are of good faith."

In another, similar letter to his Republican friends, Galois wrote: "My good friends, I have been provoked by two patriots...It is impossible for me to refuse. I beg your forgiveness for not having told you. But my adversaries have put me on my work of honour not to inform any pa-

Comte de Saint-Simon

triot. Your task is simple: prove that I am fighting against my will, having exhausted all possible means of reconciliation; say whether I am capable of lying in even the most trivial matters. Please remember me since fate did not give me enough of my life to be remembered by my country. I die your friend."

He did not want his mathematics to die with him. He spent the whole night writing it. And while writing it he often wrote, "I have not time. I have not time" in the margins. He sent these results as well as the ones the Academy had lost to his friend Auguste Chevalier. Galois began his letter in this way: "My Dear Friend, I have made some new discoveries in analysis. The first concerns the theory of equations, the others integral functions. In the theory of equations I have researched the conditions for the solvability of equations by radicals; this has given me the occasion to deepen this theory and describe all the transformations possible on an equation even though it is not solvable by radicals. All this will be found here in three memoirs."

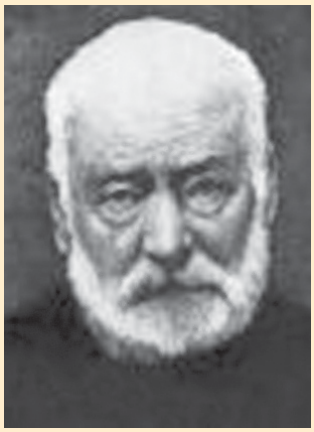


Joseph-Louis Lagrange

Galois then went on to describe and elucidate the contents of the memoir, which was rejected, by Poisson, as well as the subsequent work. During the course of the night he annotated and made corrections to some of his papers.

Galois ended his letter to Chevalier with the following request: "In my life I have often dared to advance propositions about which I was not sure. But all I have written down here has been clear in my head for over a year, and it would not be in my interest to leave myself open to the suspicion that I announce theorems of which I do not have complete proof. Make a public request of Jacobi or Gauss to give their opinions not as to the truth but as to the importance of these theorems. After that, I hope some men will find it profitable to sort out this mess. I embrace you with effusion. E. Galois."

Commenting on how Galois spent his last night, E. T. Bell has written: "All night long he had spent the fleeting hours feverishly dashing off his scientific last will and testament, writing against time to glean a few of the great things in his teeming mind before the death he saw could overtake him. Time after time he broke off to scribble in the margin "I have not time; I have not time," and passed on to the next frantically scrawled outline. What he wrote in those last desperate hours before the dawn will keep generations of mathematicians busy for hundreds of years. He had found, once and for all, the true solution of a riddle which had tormented mathematicians for centuries: under what conditions can an equation be solved?"



Victor Marie Hugo

In the duel, Galois was shot through the stomach. He was abandoned not only by his opponent but also by his own seconds. He was found by a passing peasant and was taken to the Hospital Cochin where he died the following day (May 31, 1832) in the arms of his brother Alfred. He had refused the services of a priest. Before his death, he is reported to have comforted his brother by saying: "Don't cry, I need all my courage to die at twenty." Galois was buried in an unmarked, common grave.

Galois' brother and his friend Chevalier copied his mathematical papers and as per Galois' wish they sent them to Gauss, and Jacobi and also to some other mathematicians. Galois wished that Jacobi and Gauss should give their opinions on his work. Apparently Gauss and Jacobi did not comment on Galois' work.

Twenty-four years after Galois' death, Joseph Liouville edited some of Galois' manuscripts and published them with a glowing commentary. "I experienced an intense pleasure at the moment when, having filled in some slight gaps, I saw the complete correctness of the method by which Galois proves, in particular, this beautiful theorem: In order that an irreducible equation of prime degree be solvable by radicals it is necessary and sufficient that all its roots be rational functions of any two of them."

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Getting a Pinch of Stardust

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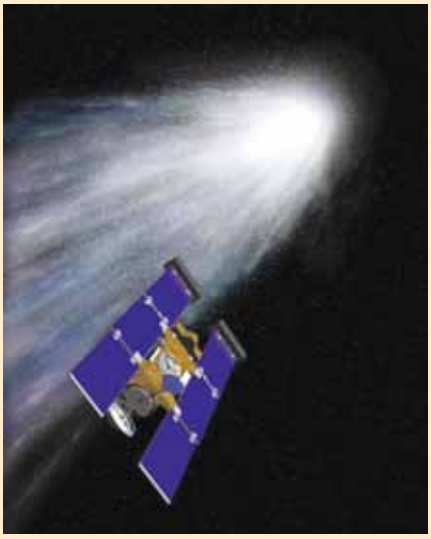
In one of the most remarkable feats of space exploration the American space agency NASA brought back to Earth a pinch of comet material and interstellar dust that may throw new light on the early history of the solar system. A piano-sized space probe named Stardust has returned to Earth with samples of particles from Comet Wild-2 and



Stardust approaching Comet Wild-2

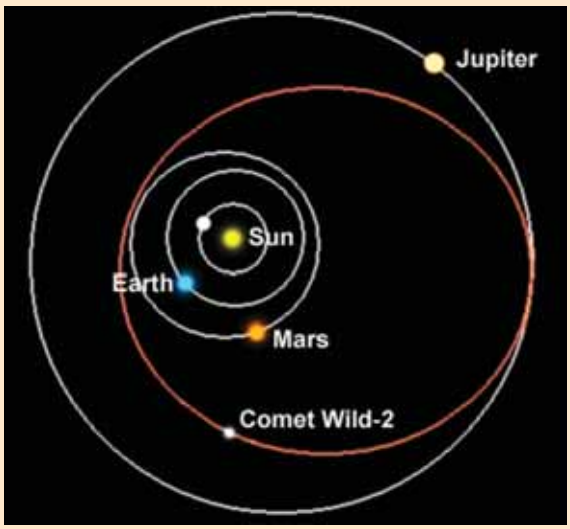
interstellar space. The capsule carrying the precious cosmic cargo – a milligram of dust left over from the solar system's birth 4.6 billion years ago – landed in the Utah salt flats in USA on 15 January 2006. Stardust is the first space mission dedicated solely to the exploration of a comet, and the first robotic mission designed to return extraterrestrial material from beyond the orbit of the Moon. This is the first time samples of pristine cometary matter have been brought back to Earth. The scientific importance of these first solid samples from our Galaxy cannot be overstated. Interstellar dust and gas were the building blocks of our solar system, the Earth, and all living things, including people.

Unlike the other small bodies in the solar system, comets have been known since antiquity. There are Chinese records of Comet Halley going back to at least 240 BC, but in the past they only aroused fear in the minds of people. The appearance of comets was considered bad omens. After the English physicist Isaac Newton demonstrated that, like the planets, comets were also members of the solar system and went round the Sun in highly elliptical orbits, the mystery of their sudden appearance was cleared. But uncertainty about their constitution and structure remained.

Individual comets are known to come from a swarm of comets orbiting the Sun at a distance of one to two light-years. Once in while, a comet, perturbed by gravitational force, strays into the solar system and races towards the Sun. As it approaches closer, the Sun's heat boils off gas and dust from the comet, forming the long tail characteristic of comets. That is why comets are invisible except when they are near the Sun. Particles left over from tail of comets in their orbit cause the meteor showers that occur periodically when the Earth passes through the orbit of a comet. Some occur with great regularity: the Perseid meteor shower occurs every year between 9 and 13 August when the Earth passes through the orbit of Comet Swift-Tuttle. Comet Halley is the source of the Orionid shower in October.

Scientists don't know exactly what comets are made of. But it is believed that comets represent the composition of the outer solar system in its primordial state. This makes them very interesting as samples of the early history of the solar system. Sometimes called "dirty snowballs" or "icy mud balls", comets are believed to be loaded with frozen water and other ices, plus organic materials and silicates, or rock. Many theorists believe comets delivered the water and other pre-biotic ingredients that led to life on Earth.

Most comets have highly eccentric orbits, which take them far beyond the orbit of Pluto; these are seen once and then disappear for millennia. Only the short- and intermediate-period comets (like Comet Halley, which returns every 76 years), stay within the orbit of Pluto for a



Wild-2 orbit

significant fraction of their orbits and are seen again and again after gaps of certain years. These are called periodic comets. Comet Wild-2 (pronounced "Vilt-2") is a short-period comet that orbits the Sun once every 6.39 years.

Comet Wild-2 is a relatively dim, new arrival to the inner solar system. Until recently it circled the Sun in an

Comet Wild-2

orbit between Jupiter and Uranus, but everything changed in September 1974 when Wild-2 passed within 900,000 kilometres of Jupiter. That encounter with the giant planet altered the comet's orbit so that at present it comes about as close to the Sun as the planet Mars, and loops about as far away as the planet Jupiter. A Swiss astronomer named Paul Wild discovered the comet during its first passage relatively near to Earth in January 1978.

The unique thing about Comet Wild-2 that interested planetary scientists was its "freshness". Before coming near Jupiter in 1974 comet Wild-2 was well preserved in the frigid outer solar system. With its new orbit, Wild-2 now comes much closer to the Sun. Since Wild-2 has passed the Sun only a few times, it still retains most of its original dust and gases – it is "pristine." When Stardust reached it in January 2004, Comet Wild-2 would have passed close to the Sun only five times. So very little of the comet's frozen surface would have had a chance to boil off. That means the particles boiling off Wild-2 that were collected by Stardust would have been unaltered by repeated passages by the Sun, as is the case with many other comets.

Another factor that prompted NASA to decide to send a probe to Comet Wild-2 was the fact that it was in the right place at the right time. To reach the comet in its present orbit, the scientists found a flight path that allowed the spacecraft to fly by the comet at a relatively low speed of only about 22,000 kph. Because of this "low velocity" flyby, comet dust could be captured by collectors on the spacecraft, rather than blowing right through the collectors and out the backside! NASA scientists decided to bring this comet dust back to the Earth for study.

Comet Wild-2 is fairly small as comets go. Its nucleus is only about 5.4 kilometres across. Compared to Comet Halley – which is about 8 kilometres wide and 16 kilometres long – that's really small. Targeting such a small object for sample collection from a distance of several million kilometres and then getting it back to Earth speaks volumes about the perfection achieved in space technology today.

The Stardust spacecraft was launched on 7 February 1999, from Cape Canaveral Air Station, Florida, USA. The primary goal of Stardust was to collect dust and carbon-based samples during its closest encounter with Comet Wild 2 in January 2004. The probe was also to bring back samples of interstellar dust, including recently discovered dust streaming into our solar system from the direction of Sagittarius. These materials are believed to consist of ancient pre-solar interstellar grains and nebular matter that include remnants from the formation of the solar system.

After launch, Stardust did not head directly for Comet Wild-2. In order to meet up with the comet the spacecraft made three loops around the Sun. It encountered the comet on the second loop, when its trajectory intersected the orbit of the comet. During the encounter, Stardust performed a variety of tasks including reporting counts of comet particles encountered by the spacecraft and real-time analyses of the compositions of these particles and volatiles. Inside the capsule carried by Stardust, a tennis racket-like sample tray held the particles captured in a solid gel as the spacecraft flew within 237 kilometres of Comet Wild-2 in January 2004. An opposite side of the tray held interstellar dust particles caught streaming through the solar system by Stardust during its seven-year journey. The particles were stored using a substance called

Aerogel

Aerogel for safe keep on the probe's long journey back to Earth. Aerogel is a unique material that is made from the same material as glass, but 1,000 times less dense (it is 99.8% air). Indeed it is the world's lightest solid.

The capsule retrieved from the Stardust is believed to contain about a million particles of comet and interstellar dust left over from the birth of the Solar System 4.6 billion years ago. Chemical and physical information locked within the particles could be the record of the formation of the planets and the materials from which they were made. Analysis of such fascinating celestial specks is expected to yield important insights into the evolution of the Sun its planets and possibly even the origin of life itself. After releasing the capsule – its main mission – the Stardust mother ship has been sent into orbit around the Sun.

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Romance of the Indian Calendar

❑ Prof. K.D. Abhyankar

We experience a continuous flow of time from the past via present to the future. For marking time we use various units were used in the past, ranging from *nimishas* to a *kalpa*. Three of them arise from natural phenomena; they are: The day related to the rotation of the Earth, the month related to the phases of the Moon and the year related to the revolution of the Earth around the Sun. Of these the *ritusamvatsara* or the tropical year of the seasons is most important for agricultural activities and related occupations and festivals. The Indian calendar or *Panchanga* has been evolving toward the determination of the tropical calendar over the past several thousand years. The present day *Panchanga* contains five entities, viz., *tithi, wara, nakshatra, yoga* and *karan*. *Wara* or weekday is common to all calendars of the world and had a common origin, but the *tithis* and *nakshatras* are the basic and unique features of the Indian *Panchanga*. Yoga and *karan* are astrological entities only.

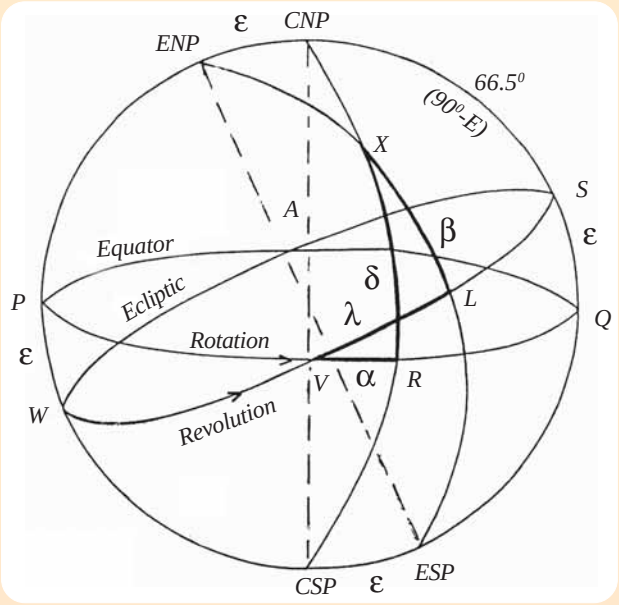

Figure1 : Celestial Coordinates

The history of the Indian Calendar can be divided into two epochs: Vedic and Siddhantic, the dividing line between them being the beginning of *Shaka-Samvatsara* and Christian eras. The Vedic period reached its acme of growth with the compilation of *Vedanga Jyotish*a by Lagadha Muni around 1400 BC. The beginning of Siddhantic period is marked by the composition of *Aryabhatiya* by Aryabhata in AD 499.

The earliest Indian calendar was based on actual observations of celestial bodies, particularly the Sun and the Moon. It was slowly systemized in the form of various sacrifices like *darsha-pooranamas yashtis* (New moon and full moon sacrifices), *rituyagnas* (seasonal sacrifices) and the yearlong *gavamayanam* and *utsarjinamayanam* sacrifices. Two things were observed during these exercises. One was the northward (22 December to 21 June) and southward (22 June to 21 December) motion of the Sun, which divides the year into two parts known as *uttarayana* and *dakshinayana*, respectively. The other was the identification of star groups, which were seen before sunrise and after sunset at the start of these divisions.

This northward and southward motion of the Sun is caused by the fact that the Earth's axis of ration is inclined to the plane of its orbit around the Sun by 66 ½ degrees instead of 90 degrees. So during half of its revolution the North Pole is pointed toward the Sun and in the other half the South Pole is pointed toward the Sun. The beginning of *uttarayana* and *dakshinayana* are called winter and summer solstice, respectively. The day is shortest and night is longest on winter solstice day, which occurs on 22nd December in the Gregorian calendar. The day is longest and the night is shortest on the summer solstice day, which occurs on 22nd June. In between we have two equinoxes when the day and night are equal in length; they are the *Vasant sampat* (vernal equinox) on 21st March and *Sharad sampat* (autumnal equinox) on 23rd September.

Determination of these four cardinal days was an important activity of many ancient peoples. For example, the Stonehenge in England was built specifically to locate the points of sunrise and sunset on the horizon on the two solstice days. It may be mentioned that even birds make use of the northward and southward motion of the Sun during their annual migrations over long distances.

The *Nakshatras*

The cardinal points have been used by Indians for framing their calendar. However, the Vedic and Siddhantic systems differ in their choice of the basic cardinal point. The Vedic year always started from winter solstice, which is taken as beginning of *Shishir ritu*; so it was a *ritusamvatsar*, the year of seasons. There are six Indian *ritus*, viz,. *Shishir* (22 December – 9 February), *Vasanta* (20 February – 21 April), *Grishma* (22 April – 21 June), *Varsha* (22 June – 21 August), *Sharad* (22 August – 21 October), and *Hemanta* (21 October – 21 December). On the other hand, in the Siddhantic system the year starts from the fixed vernal equinox of AD 285; so the year is sidereal (*nakshtra varsha*) as we shall see later. Further the Vedic calendar was based on the mean motions of the Sun and the Moon, but Siddhantic calendar took into account the non-uniform motion of these bodies due to their elliptical orbits through the system of *kakshavritta*

(deferent) and *neechocchavritta* (epicycle). The Siddhantic calendar also contains the ephemeris of the five *taragrahas* (planets) in addition to those of the Sun and the Moon. But there is a common thread between the two systems, viz., the devise of lunisolar adjustment through the addition of *adhikamasas* at appropriate times and the use of *tithis* and *nakshatras*.

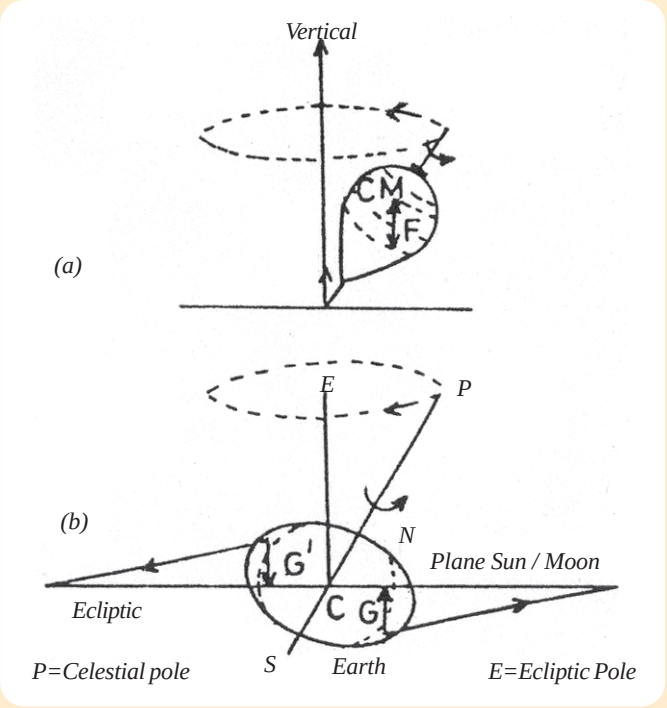

Figure 2 : (a) Precession of a Top (direct) (b) Precession ot the Earth (retrogade)

It was noticed that the stars which are seen in the east before sunrise and in the west after sunset change during the course of the year. Hence, they can be used for determining the cardinal days. For identifying the stars, the path of the Sun and the Moon, which is called *Varuna's* path (ecliptic) was marked with 28 groups of stars called *nakshatras*. As it was found that the Moon completes one round of the *nakshatras* in $27^1/_3$ days, the number of *nakshatras* was later reduced to 27 by dropping *Abhijit nakshatra*, so that there would be roughly one *nakshatra* for the Moon to 'occupy' every day.

The complete list of 28 *nakshatras* is found in the *Yajurveda*. As it starts from *Krittika nakshatra*, where the Sun was found on the vernal equinox day in that epoch, it can be calculated that the *Yajurveda* is about 4,500 years old, i.e., it was written around 2600 BC. A mathematical definition of *nakshatra* as 27^{th} part of 360 degrees (= 3348 *bhanshas* of *Vedanga Jyotisha*) occupying $13^1/_3$ degrees (=124 *bhanshas*) was given in *Vedanga Jyotisha* by Lagadha in about 1400 BC. The presently adopted boundaries of *nirayana* (i.e., fixed) *nakshatras* were determined during the Siddhantic period in about AD 285. At that time the vernal equinox had shifted to the beginning of *Ashwini nakshatra* due to the phenomenon of precession of Earth on its axis. It was, therefore, made the first *nakshatra*.

Nakshatras are used for naming the day on the basis of the *nakshatra* in which the Moon is found at the time of sunrise. *Nakshatras* are also used for naming the lunar month on the basis of the *nakshatra* in which the Moon is seen on the Full Moon day. This practice is a unique feature of Indian astronomy from the most ancient times. So it is clear that the *nakshatra* system originated in India and it was later taken over by the Arabs as 'Manzils' and the Chinese as 'Hsius'.

Although the Moon completes one revolution around the earth in $27^1/_3$ days, which is called the sidereal month or *nakshatra masa,* the more useful unit of time is the interval between two New Moons or two Full Moons, which is called the synodic month or *tithi masa*. As the Earth revolves round the Sun, the Moon has to move through more than 360 degrees to be in the same position with respect to the Sun. Consequently the phases repeat after about 29½ days, which is the length of the synodic month or *tithi masa*. Thus if the Moon is near the *Chitra nakshatra* on a particular Full Moon day, it is called *Chaitri purnima*. When the Full Moon is seen near the *Vishakha nakshatra*, it is *Vaishakhi purnima*. Although the Full Moon can be seen near of the 27 nakshatras, only 12 are chosen for naming the months.

Tithis

Now, since 29½ is closer to 30, Vedic astronomers divided the synodic lunar month into 30 equal parts which are called *tithi*s. As the Sun appears to move at the rate of about 1 degree per day while the Moon moves at the rate of 13.2 degrees per day, the Moon is constantly going ahead of the Sun. For astronomical purposes the synodic month begins when the angular distance between them is zero on the ecliptic, which represents New Moon. As the separation increases from 0–12 degrees, we cover the first *tithi*, which is called *shukla pratipada*, represented by S1. When the separation lies between 12 and 24 degrees we have *shukla dvitiya*, i.e., S2, and so on up to *purnima* (S15), which represents the duration when the separation between the Sun and the Moon lies between 168 and 180 degrees. Thereafter we have *krishna pratipada* (K1) when the Moon is ahead of the Sun by 180 to 192 degrees and so on until *amavasya* (K30). Actually it is K15 but it is denoted as K30 to indicate that it is the end of the month, when the Moon is ahead of the Sun by 348 to 360 degrees, or, behind by 0 to 12 degrees. From the geometry of the eclipses we see that the midpoint of a lunar eclipse occurs at the end of *purnima* and that of a solar eclipse at the end of *amavasya*. In Gujarat, Maharashtra, and four southern states the lunar month starts on Sl and ends on K30, so it is *amanta*; i.e., it ends on an *amavasya*. In the northern states it starts on K1 and ends on *purnima* (S15), so it is called *purnimanta*; i.e., it ends on a *purnima*.

Like the lunar month the day is also divided into 30 parts known as *muhurtas.* The Sun and the Moon rise

together on the New Moon day. Thereafter the Moon rises one *muhurta* after the Sun on S1, two *muhurtas* on S2 and so on till Full Moon day when the Moon rises 15 *muhurtas* after sunrise. Thereafter the Moon rises one *muhurta* after sunset on K1, two *muhurtas* after sunset on K2 and so on till K14, when it rises 14 *muhurtas* after sunset; i.e., one *muhurta* before sunrise. This is the last appearance of the Moon in the east during an *amanta* lunar month. It reappears after *amavasya* at the end of S1 in the west.

The Moon is not visible on *amavasya*, but if we observe the *nakshatra* near the Moon one day before and one day after the *amavasya*, the *nakshatra* between them will be its *nakshatra* on *amavasya*. Since, the Sun and the Moon are together on *amavasya* this is also the *nakshatra* of the Sun on that day. As *nakshatras* are not visible in the daytime this is the only method of knowing the solar *nakshatra*.

During the Vedic period all *tithis* were considered to be of equal duration – equal to $^{1}22/_{124}$th part of the day. But in Siddhantic period one made use of the actual separation of the Moon from the Sun for defining the *tithi*. As the Sun and the Moon move in elliptical orbits with nonuniform motion the duration of a *tithi* can vary between 20h 00m to 26h 48m. Similarly, the duration of a *nakshatra* can vary between 20h 18m to 27h 36m. So a *nakshatra* or *tithi* can continue for two days in succession, or can be less-than-a-day long. So a tithi is dropped on certain days as a *kshaya tithi*. The *tithi* and *nakshatra* shown in the Indian ephemeris or *panchanga* is the *tithi* and *nakshatra* that prevails at the time of sunrise. It is obvious that a *tithi* or *nakshatra* can start and end at any time of the day.

The Solar Month

The Earth completes one revolution around the Sun in 365 days 6 hours and 9.2 minutes, which is known as 'sidereal year'. The Sun makes one 'round' of the nakshatras; that is passes in the background of all of them, in this period; so it is called *nakshatra varsha*. In earlier days it was believed that the length of the tropical year of seasons was the same as sidereal year. Now a year of 12 lunar months amounts to 354 d 8 h 48.6 m, which is shorter than the sidereal year by about 10.9 days. Therefore, in order to bring the lunar year in agreement with the solar year, an extra lunar month, i.e., an *adhikamasa*, was added after every 32 or 33 months.

This practice existed in India from the most ancient times. In the beginning there were no fixed rules for inserting *adhikamasa*, which was added whenever observations indicated that an adjustment was needed for obtaining correct seasons. This is evident from the story in the Mahabharata that there was a controversy whether Pandavas had completed their year of *adnyatavasa* and Bhisma's ruling regarding *adhikamasa* was accepted by all. An attempt to fix the rule of inserting *adhikamasa* was made in the *Vedanga Jyotisha*, but the final solution was given by astronomer Sripati in the eleventh century AD as explained below.

As the sidereal year is close to $12^{1}/_{3}$ lunar months it was decided to divide it into 12 solar months. A solar month was defined as the interval required by the Sun to cover 30 degrees of the ecliptic. For this purpose $2^{1}/_{4}$ *nakshatras* were combined into a bigger division known as *rashi*. Thus we have 12 *rashis* from *Mesha* to *Meena*, the beginning of *Mesha* (*Meshadi*) being coincident with the beginning of *Ashwini nakshatra* (*Ashwinyadi*). The solar months are best named after the *rashis* against which the Sun is seen during the corresponding month like *Mesha masa*, *Vrishabha masa*, etc., as is the practice in Kerala. But, calling them by the corresponding lunar month causes confusion. For example, *Mesha masa*, which starts on April l4 at the present time, is called Chaitra in south India and Vaishakha in north India.

The mean length of the solar month is about $30^{1}/_{2}$ days, but due to the elliptical shape of the Earth's orbit it varies between 29.4 to 31.4 days. Thus in each lunar month the Sun crosses the boundary of one *rashi* on an average. Now if the Moon is in the middle of *Chitra nakshatra* on a Full Moon day, the Sun would be crossing the boundary between *Meena* and *Mesha rashis* at that moment, which is known as *Mesha sankranti* or *Mesha sankramana*. Hence Sripati gave the rule that the *amanta* lunar month, which included *Mesha sankrant*, should be called Chaitra. The corresponding *Purnimanta Chaitra* ends 15 days earlier. Similarly *Vrishabha sankranti* would give Vaishakha and so on.

Now due to the non-uniform motions of the Moon and the Sun there may not occur any *rashi sankranti* in a particular lunar month. Sripati said that such a month should be treated as *adhikamasa* and it be given the name of the following ordinary month. This mathematical rule is so perfect that it has made our calendar perpetual and foolproof as far as adjustment of lunar and sidereal solar year is concerned. But unfortunately it has not produced a calendar attuned to seasons because of the phenomenon of precession or *ayanachalana*, which is discussed below.

It should be mentioned that the Indian *rashis* are not the same as the signs of the zodiac used by the westerners. For example the Sun enters *Mesha rashi* on 14th April at present, but it enters the sign of Aries on 21st March. This difference also arises due to the phenomenon of precession. The *rashis* start from the fixed vernal equinox of AD 285 while the western zodiacal signs start from the current vernal equinox, which moves backward on the ecliptic due to Earth's precession. Consequently the two systems are moving further apart and the zodiacal signs are losing correspondence with the constellations, i.e., the *rashis*. The difference is about 24° at present. Thus when one says that he is an Aquarian it may have little to do with the constellation Aquarius, i.e., *Kumhha*. Western astrologers base their predictions on the zodiacal signs and Indian astrologers use *rashis* for their prediction. Further, Indians use two diverse systems that differ by 4 degrees, i.e., 4 days. This shows that no astrological system has a scientific basis, which indicates that astrology is not a science.

Precession or *Ayanachalan*

The English physicist Isaac Newton explained the phenomenon of precession on the following lines. Consider a rotating top as shown in Fig. 2(a). If the axis of rotation of the top is inclined with respect to the vertical, the Earth's gravitational force will try to pull the center of mass (CM) of the top down by force F. There will be an equal and opposite force F' at the lower tip of the axis of top due to the resistance of the ground. The two forces from couple which tries to make the axis of rotation horizontal. If the top were not rotating it would topple over immediately. But since it is rotating the couple produces a precession of the axis of rotation around a vertical axis in the direction of rotation.

Now, the Earth is flattened at the poles and bulged at the equator due to rotation as shown in Fig. 2(b). As the Earth's axis of rotation is inclined to the plane of the Earth's orbit, i.e., the ecliptic plane, by 66.5 degrees, the tidal force of the Sun and the Moon on the two opposite sides of the bulge have components G and G' perpendicular to the ecliptic plane, as shown in Fig 2(b). The couple formed by G and G' tries to make the axis of Earth's rotation perpendicular to the ecliptic plane. This is opposite to what happened in the case of the top. Hence the Earth's axis of rotation precesses around the ecliptic poles in the direction opposite to the direction of rotation, i.e., from east to west instead from west to east. The speed of precession is quite slow, about 50.2" per year; so it takes nearly 25,800 years to complete one round. Consequently, we have a different Pole Star at different epochs. For example, Alpha Draconis was the Pole Star in 3000 BC while Vega had that distinction around 12,000 BC. The equinoctial points V and A as well as solstice points W and S also shift backward on the ecliptic at the rate of precession. As a result, the star groups (*nakshatras*), which rise before sunrise in different seasons, also change with time at the rate of one *nakshatra* in 950 years, completing one round in 25,800 years. This phenomenon is known as precession of equinoxes in astronomy. But in India it is called *ayanachalan*, i.e., movement of solstices, because the Indians noted the change in the *nakshatras* at the time of the beginning of *Uttarayana*, i.e., winter solstice, as the year started at that point in ancient times.

It is the time taken by the Sun to go from one vernal equinox to the next that determines the length of the Tropical year of seasons. The Tropical year, i.e., the *Ritusamvatsara* has a length of 365d 5h 48m, which is shorter than the sidereal year by about 20.4 minutes. That is why Makarsankranti, which fell on 22nd December in AD 285 and represented the beginning of *uttarayana*, i.e., the winter solstice; now occurs on 14th of January and no longer represents the beginning of *uttarayana*. In the same way, all our festivals are progressively shifting with respect to seasons by about one day in $70^1/_2$ years. We do not notice this difference in our lifetime, which makes us believe that our calendar is attuned to the seasons. But it is not so and the spring season or *vasant ritu* now covers *purnimanta phalgun* and Chaitra, and not Chaitra and Vaishakha as taught to us. It is obvious that our *panchangas* do not represent a luni-solar sidereal calendar. althtugh they did not know its cause. Thus;

Calendar Reform

Vedic astronomers were clever in this respect, Because they changed the beginning of the year and with it the *Dharamshastras* they did not know its cause. Thus the year beginning, which occurred in Vaishakha in the most ancient epoch was changed to Chaitra, then to Phalgun and finally to Magha during *Vedanga Jyotis* period. However, it is not possible for us to walk in their footsteps now, because the Indian sidereal *panchanga* is now prevalent all over India and binds it into a cultural whole. Further, it has reached all levels of Indian society. Moreover, most panchamga makers now use modern ephemeris for calendar making. That is why the *Rashtriya Panchanga* recommended by the Calendar Reform Committee is ignored by people, particularly because it is almost a replica of the Gregorian calendar. So one has to continue the use of traditional but scientifically correct *panchanga* for our social and religious activities, remembering that they are being slowly divorced from the seasons with which they were originally associated. As already pointed out *Makara Sankranti* no longer represents the beginning of *uttarayana*, it now occurs 24 days after *uttarayana*, and the difference will go on increasing by one day every $70^1/_2$ years. In my childhood *uttarayana* used to occur on 13th or 14th of January, now it occurs on 14th or 15th of January.

It may be noted that our religious festivals, which are based on lunar months and *tithis*, oscillate back and forth by 15 days within the season on account of the practice of introducing *adhikamasaa*. For example, at present *Chaitri purnima* (S15) occurs on April 14 ± 15 days; consequently Sri Ramanavami (S9) occurs on April 8 ± 15 days. If we assume an epoch of 5000 BC for the *Ramayana*, Sri Ramanavami would be occurring about 99 days earlier, i.e., on December 30 ± 15 days. So Chaitra S1 would be occurring on December 22 ± 15 days, i.e., on winter solstice day on an average, which used to be the beginning of the year at that time.

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Beware of the Killer on Wings

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It can live without a head. Actually one robust fellow lived headless for a full 18 hours! Yes, I am talking about chickens. A chicken can stagger around without its head because the brain stem is often left partially intact after a beheading. It then controls most of its reflexes. However, even such robust fellows succumb to the onslaught of a minute organism called virus, which so small that about 100,000 can easily sit over a pinhead. The structure of a virus is also quite simple. You can visualize it as a minute bag containing DNA (Deoxyribose Nucleic Acid) or RNA (Ribose Nucleic Acid). All viruses, which cause influenza or 'flu', are grouped as RNA viruses. The outer wall of the bag is made-up of different proteins, which can change very rapidly. Therefore these can mutate and change their type, often becoming more virulent. This mutability makes it very difficult to develop any effective vaccine against these viruses because by the time the vaccine is ready the virus would have already mutated.

The viruses causing influenza in humans and animals are grouped into three categories – 'A', 'B' and 'C'. Influenza 'A' and 'B' viruses are of concern for human health. Only influenza 'A' viruses can cause pandemics. First known pandemic was spread in 1918 by 'H1N1' strain of the influenza A virus, killing at least 40 million people around the world. After 40 years of mutations the same strain changed to H2N2 and killed thousands of people in USA alone in 1958. The mortality rate during that pandemic was around 2.5% in the USA. After 10 years it again mutated to become H3N2 and created a flu-pandemic in 1968.

The flu, which infects only birds and less commonly, pigs, belongs to the strain H5N1. It belongs to the viral family of *orthomyxoviridae* and was found to infect all kinds of pet and wild birds. Popularly known as 'bird flu', it was first detected in recent history in 1961 in a poultry-farm in South Africa. A 3-year-old boy died in May 1997 after getting infected by the virus. This was the first recorded human infection with H5N1. Same year it infected 18 people and killed 6 of them in Hong Kong. In early 2003, two members of the same family in Hong Kong got infected by the virus and one of them died. Then it travelled to southern China where the bird flu played havoc but was not reported until the intervention of a WHO team. From China it spread to Republic of Korea, Vietnam, Japan, Thailand, Cambodia, Lao People's Democratic Republic, Indonesia and Pakistan. It did not enter India at that time, still media made so much issue of it that domestic consumption and export of poultry products was reduced, causing a loss of hundred of crores of rupees to the poultry industry.

Every day Indians consume about 11 crore eggs and 1 crore kilograms of chicken. Hydrabad is largest producer of eggs. India's poultry Industry has a turnover of Rs 35,000 crores per annum and provides livelihood to more than three million people, mostly in rural areas. India exports eggs and egg powder worth Rs 500 crores annually to Japan, EU and Middle East and is poised to become second only to USA, which is biggest player in the poultry industry. India is the fourth largest producer of eggs and fifth largest producer of broilers in the world. Poultry industry has been growing consistently at about 17% per annum, which is the highest growth rate in the agriculture sector in India.

During the recent outbreak in India, the incidence of bird flu was limited to only 16 odd large commercial farms at Nawapur in Maharashtra, and all the precautions were taken immediately to contain it; all birds within the 10-kilometre radius of infected farms were destroyed. But so much scare was created by media that the country suffered a loss in tune of about 1,000 crores, because of reduced domestic demand and due to ban imposed by the importing countries such as Japan, European Union, Middle East, Nepal, etc.

Quick response

To stop the spread of bird flu among poultry a 3-km radius (later increased to 10-km radius) area around the infected farms at Navapur Village in Numderbar district of Maharashtra was cordoned off and all transport and trading of poultry was banned in the area. More than 300,000 birds were killed and buried. The population of 19 villages in the area was kept under strict surveillance of medical experts and not a single case of bird flu or avian influenza infecting humans was reported.

Although the bird flu infected the poultry on 27 January, it came to the light only on 8 February, when a local newspaper reported that a truck driver was found throwing away chickens from a moving truck. This alerted the Maharashtra Animal Husbandry Commissioner Vijay Kumar and samples collected on 9 February, were sent to the High Security Animal Disease Laboratory in Bhopal.

By 18 February, the Bhopal laboratory had confirmed the presence of bird flu virus in the samples. After these confirmatory test of H5N1 the Central Government made an official announcement. The report was also submitted to the

World Organisation for Animal Health (WOAH) on 18 February. The WOAH placed the onset date of bird flu in India as 17 January, which shows a gap of nearly three weeks before the authorities came to know about the outbreak. How it reached India – through migratory birds or through infected poultry products is not yet known. (15 March 2006, Bird Flu is also reported from Jalgaon, Maharashtra, atleast 7,500 Birds are destroyed)

World wide Attack

Up to 6 March 2006 incidence of bird flu had been reported from the following countries: Austria, Azerbaian, Bosnia and Hezegovinia, Bulgaria, China, Croatia, Egypt, France, Germany, Greece, Hong Kong, Hungary, India, Indonesia, Iraq, Iran, Italy, Malaysia, Niger, Pakistan, Romania, Russia, Serbia and Montenegro, Slovakia, Slovenia, Switzerland, Thailand, Turkey, Ukraine, and Vietnam. The H5 strain was found only in Bosnia and Herzegovina, Pakistan, Serbia, Montenegro and Switzerland, while all the other countries mentioned were attacked by H5N1 strain. Only 175 cases of human infection of H5N1 strain have been reported around the World. Out of these 95 persons have died (Table 1).

Most strains of avian influenza virus are found only in the respiratory and gastrointestinal tract of infective birds and not in their meat. According to WHO sources the available studies indicate that highly pathogenic viruses including the H5N1virus spread virtually to all parts of an infected bird including its meat. Therefore, proper handling of poultry and poultry products during food preparation and proper cooking are extremely important in areas experiencing outbreaks of H5N1 avian influenza in poultry. Normal cooking temperatures of 70ºC will kill the virus, but one has to ensure that all parts of the cooked meat reach this temperature. To date evidence indicated that no one has become infected with the virus following consumption of properly cooked poultry or poultry products, even in cases where the food item contained the virus prior to cooking.

In countries with an outbreak of bird flu, eggs may contain the virus both on the outside (shell) and inside (white and yolk). It should not be consumed raw or partially cooked. It should be boiled or heated to at least 70^{0}C, a temperature high enough to kill the virus. The H5N1 virus can survive for at least a month at low temperatures. For this reason, common food preservation methods, such as freezing and refrigeration do not kill the virus in contaminated meat. In countries with an outbreak of the disease frozen meat and meat products should be handled the same precautions as fresh products. People handling raw poultry should wash their hands and disinfect surfaces. Soap and hot water are sufficient for this purpose.

Table 1

Country	Number of cases	Number of deaths
Cambodia	4	4
China	15	9
Indonesia	27	20
Iraq	2	2
Thailand	22	14
Turkey	12	4
Vietnam	93	42

Source: WHO (only laboratory confirmed cases). (According to new report, more then 100 people are dead now)

Not a single case of H5N1 in humans has been reported so far in India.

Symptoms and treatment

The symptoms of bird flu are similar as that of common flu but more severe. Normal seasonal infuenza causes only mild respiratory symptoms while H5N1 may lead to primary viral pneumonia. The multi-organ failure is common. Direct contact with infected poultry, or surfaces and objects contaminated by infected bird faeces or mucus secretions are presently considered the main route of human infection. Till date most of the human cases have been reported from rural or suburban areas, where many households keep small flocks of poultry as their secondary source of income. These birds often roam freely, sometimes entering homes or areas where children play. Infected birds shed large quantity of virus in their faeces and other body secretions (mucus discharge from nose, eyes, etc.) and the area where these birds live becomes major source of exposure to this virus. Moreover, whenever a bird shows any sign or symptom of disease the owner usually slaughters the bird for his own consumption or sells it at cheaper rate. This practice is a major hurdle in controlling various zoonotic diseases (disease of animals that can be transmitted to humans), as exposure is considered most likely to occur during slaughter, de-feathering, butchering and preparation of infected chicken meat for cooking.

For treatment of H5N1 infection only two drugs are available, viz., Oseltamivir (commercially known as Tamiflu) and Zanamvir (Relenza). They can reduce severity and duration of infection caused by seasonal influenza. The efficacy of these drugs depends on their early administration, viz., within 48 h after onset of symptoms. An older class of antiviral drugs,

amantadine and rimantadine, could potentially be used against pandemic influenza, but resistance to these drugs can develop rapidly and this could significantly limit their effectiveness against pandemic influenza. Some currently circulating H5N1 strains are fully resistant to these two drugs.

As understood at present, H5 and H7 viruses are introduced to poultry flocks in their low pathogenic form. When allowed to circulate in poultry populations, the viruses can mutate, usually within a few months, into the highly pathogenic form. This is why the presence of an H5 or H7 virus in poultry is always a cause for concern, even when the initial signs of infection are mild.

7,000 Strains of Bird Flu

Dr. Robert Webster has gathered samples of about11,000 influenza viruses from around the world since 1976. This unique viral library is located at St. Jude Children's Research Hospital in Memphis. These viruses included not only those that have infected people over the years, but ones from pigs and other animals including about 7,000 bird flu viruses gathered from poultry, ducks, gulls and other flocks.

The researchers have reported in a recent issue of the journal *Science* that they have completed the first large genetic analysis of more than 300 of these bird flu viruses. They have identified 2,196 bird flu genes and 160 complete genomes. This has doubled the information available for scientists to study how these viruses evolve and spread overtime.

Until now scientists trying to decode flu genetics have mostly focussed on specific genes involved in making flu vaccines, such as haemagglutinin – the H in 'H5N1'– on the virus surface that triggers the immune system to mount an attack. Now they will encounter a brand new haemagglutinin variation, like when H5 strain first infected people in 1997 and the body does not know how to defend itself.

Decoding all the influenza genes instead of select ones will help scientists learn how these constantly evolving viruses change and spread and why some are so much more virulent than others.

Enter the new flu, a protein called 'NS-1' produced inside flu-infected cells. In bird flu the'NS1' protein harbours a molecular feature that seems to help the virus latch onto and disrupt certain important cellular processes – a feature that influenza strains common in humans don't seem to have, the researchers concluded.

It might provide a marker of virulence. That would be very useful for scientists who collect samples of emerging flu viruses and today struggle to predict which might prove unusually dangerous, explained Dr. Karen La courciere. She is a flu specialist with NIH's National Institute of Allergy and Infectious Disease.

Vaccines effective against a pandemic virus are not yet available. Vaccines are produced each year for seasonal influenza but will not protect against pandemic influenza. Although a vaccine against the H5N1 virus is under development in several countries, no vaccine is ready for commercial production and no vaccines are expected to be widely available until several months after the start of a pandemic. The vaccine needs to closely match the pandemic virus, large-scale commercial production will not start until the new virus has emerged and a pandemic has been declared.

It is still being investigated that how the bird flu reached the remote rural area of Maharashtra. Migratory birds are a possible source of transmission. India has about 12,225 indigenous and migratory species of bird out of which 59 may carry the bird flu. But so far not a single migratory or indigenous wild bird has been found with bird flu in India. But China had an incident of upward 6,000 migratory birds at a nature reserve in Central China, caused by highly pathogenic H5N1. Thirty-one counties in China have reported outbreaks of the H5N1 in poultry this year and may have used bad vaccines, according to Dr. Robert Webster of USA. Chinese eat about 14,000 crore chickens a year. It has planned to vaccinate 5,200 crore chickens, geese and ducks. In the past only two large die-offs in migratory birds caused by highly pathogenic viruses are known to have occurred: In South Africa in 1961 (H5N3) and in Hong Kong in the winter of 2002-2003 (H5N1). The largest exporters of the poultry product in the world are USA, UK, Canada and Australia and they have been mysteriously left untouched by bird flu. They are also the largest producers of drugs and vaccines against the flu. Who knows, if present panic of bird flu was spread by wild birds or a civilized World?

Search for more Potent Medicines

"Bird flu" is being treated presently by using 'Tamiflu' tablets. It is prepared by extracting oil from seeds and branches of an aromatic cooking herb star anise (*Illicium verum*). Its fruit is brownish in colour and is star shaped. This herb can grow up to a height of 10 metres. Besides China, it is also found in Japan, Vietnam, the Philippines, and Indonesia. Shikmic acid, a key ingredient of Tamiflu, is extracted from the oil of star anise seeds.

Star anise

In the recent incidents of bird flu Tamiflu has proved ineffective in many cases. The drug is also in short supply. Therefore the pharmaceutical industry has been looking for alternatives. Most of the groups are making efforts to replace the herb oil by a synthetic chemical. One such group is working at University of Tokyo's Graduate School of Pharmaceutical Sciences under the leadership of Professor Masakatsu Shibasaki. His team has found a way to make Tamiflu without using shikmic acid extracted from star anise. By using a chemical ingredient instead, the new method eliminates weather as a risk factor in Tamiflu production

The method developed by Shibasaki's team uses a chemical ingredient called 1,4 cyclohexadiene. It employs a technique called asymmetric catalysis. It is more efficient and offers a more viable alternative. It is still at the stage of basic research and further research would be needed for it to be ready for practical use. Tokyo University has applied for a patent in Japan and is now in discussion with Roche, which is producing Tamiflu.

Dr. Jan-Inge Henter of the Karolinska Hospital In Stockholm believes that chemotherapy treatment could work because of the similarities between human infection with 'H5N1' bird flu and an illness known as haemophagocytic lymphohistiocytosis (HLH). Researchers from the Global Emerging Infections Surveillance and Response System (DODGEIS) of the US Department of Defence in Maryland is working towards improved preparedness against bird flu and other emerging infections in the developing countries.

Dr. R.D. Sharma (Ex-Director, DIPA) has retired from Indian Council of Agricultural Research, New Delhi, and is a well known popular science writer. He lives in New Delhi

Constipation

Natural Remedies Work Best

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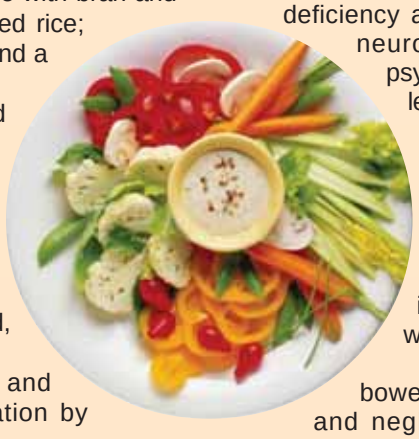
We are a nation of bowel-conscious people, obsessed with the regularity of its functioning. Both at the outpatients' clinic and in the wards, people complain about constipation. But on a closer look, the problem often lies more in the mind than anywhere else.

Tracing the roots of this mindset is not difficult. In most Indian homes, a child is brought up on the dictum that a regular bowel movement is a must for good health, and without it all body systems come to harm. So deep-rooted is this notion that it's difficult to accept the truth.

The physiological fact of the situation is that depending on the quantity and frequency of food it is perfectly normal to move the bowel just once every two-three days, even as it is normal three times a day. Defining constipation, therefore, is no easy task. At best, it can be defined as difficulty or unusual straining to achieve defecation, often with an unduly hard or an incomplete evacuation of the stool.

Many factors can cause the problem, most of which are easily remedied. Of these, the commonest are: Insufficient roughage in the diet because of partaking of too much refined food; lack of exercise and sedentary living habits; tight time schedules; confinement to bed during a long illness; not heeding to nature's call and suppression of defecatory urges just because it is inconvenient; inadequate allotment of time for full clearance of bowels; and sometimes prolonged travel. At times, a medication, long though you may have been taking it, can be the cause. The remedy in such situations is generally easy. Read on.

EAT A LOT OF FIBRE : Fibrous foods can be a big help. Eat lots of green vegetables, salad and fruits; substitute white bread, refined flour and rice with bran and whole grain breads, cereals and unpolished rice; and instead of juice, have a fresh orange and a sliced apple.



If this does not suffice, you could add psyllium extract (isabgol) or powdered unprocessed bran to your daily diet.

TAKE PLENTY OF FLUIDS : A minimum of six to eight glasses of fluid in winter months, and eight to twelve glasses during the summer months should be part of every adult's diet. While any fluid is good, the best is water.

EXERCISE REGULARLY : Walking and regular exercise tends to fight constipation by moving food through the bowel faster.

EASE STRESS : Slow down. Take it easy. When you're tense, your mouth dries up, your heart beats faster, and your bowel stops up as well.

HAVE A HEARTY LAUGH : A good belly laugh is an excellent remedy for constipation. A great reliever of stress, it also aids bowel movement.

RECONSIDER THE LAXATIVE TABLET : Often, indiscreet use of laxatives is the principal cause of constipation. Used under the false belief that the bowels must be cleaned daily, they become a habit and set a vicious circle in motion. The bowels do not act because they have nothing to act upon, and the person, thinking he is constipated, takes more laxatives, making matters worse.

CHECK YOUR MEDICINE CABINET : There are a number of medications that can bring on or exacerbate constipation. Antacids that contain aluminium and calcium, calcium supplements, antihistamines such as phenothiazines, sedatives, antidepressants, anti-Parkinson's drugs and diuretics are the commonest culprits.

NEVER STRAIN : It is never wise to huff and puff your way out of constipation. You risk giving yourself haemorrhoids and anal fissures, and set up a vicious cycle. These painful anal conditions make constipation even worse.

WHEN TO SEEK MEDICAL ADVICE : There may be a disease which needs treatment. Constipation can be due to a genuine organic cause: a decreased movement of the large bowel due to certain medications, a spinal cord injury or a general mobility disorder. The problem may also be due to a variety of metabolic abnormalities that disturb the fluid and electrolyte balance within the body, such as the improper functioning of the thyroid gland, a potassium and calcium deficiency and simple dehydration. Some mental and neurological disorders such as depression, psychosis, cerebral palsy and senility can also lead to constipation.

The most dangerous situation, however, is when constipation occurs due to a narrowing or a near total obstruction in the bowel due to an internal growth, tumour or severe narrowing from an inflammatory disease like tuberculosis. A use of purgatives in this condition can cause a tear in the bowel wall and seriously jeopardise the patient's life.

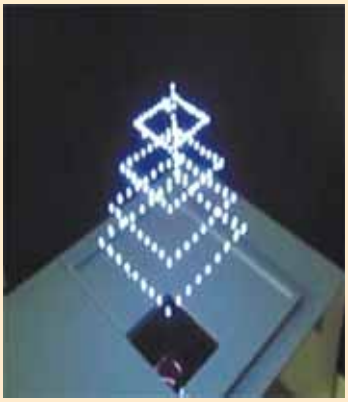
If, therefore, there is a recent change in bowel habit, it is best to consult a doctor. Delay and neglect can be risky. It can complicate the situation and turn a treatable condition into on incurable one.

* * *

Recent Developments in Science and Technology

3D plasma shapes created in thin air

The night sky could soon be lit up with gigantic three-dimensional adverts which has been possible due to development of Japanese laser display that creates glowing images in thin air.



The National Institute of Advanced Industrial Science and Technology (AIST) in Tokyo are developing the system, in collaboration with Burton Inc and Keio University.

The display utilises an ionisation effect, which occurs when a beam of laser light is focussed to a point in air. The laser beam itself is invisible to the human eye but, if the intensity of the laser pulse exceeds a threshold, the air breaks down into glowing plasma that emits visible light.

Very short, powerful laser pulses – each plasma dot – can only achieve the required intensity and last for only about a nanosecond (10^{-9} s). But the resulting image appears to last longer due to persistence of vision. As with movies and television, the impression of a continuous image is maintained by refreshing the flashpoints.

The demonstration system uses an infrared laser that creates a hundred flashpoints per second. Currently, these can be projected between two and three metres from the apparatus, in a space of about a cubic metre. Each flashpoint generates a popping sound, resulting in a constant crackling when the display is in operation.

Previous systems used galvanometric mirrors to control the focal point of the beam in two dimensions, to create only 2D images. But the new system adds a high-speed linear motor moving a lens to control the focal point of the laser in a third dimension, allowing solid shapes to be sketched out.

This technology may eventually be used in applications ranging from pyrotechnics to outdoor advertising.

Source: www.newscientist.com

Invention: Guitar phone

Musicians could soon have a new instrument to play – their phone. Motorola is patenting a cell phone that displays the layout of a guitar neck on its screen, and allows its keypad to be "plucked" or "strummed" by a user. The resulting guitar sounds can be played through the phone's speaker or can be inflicted on a friend at the other end of the line.

The phone has the usual four rows of keys, but switching to music mode turns the keys into a set of virtual strings that respond to pressing. Turning a control knob shifts the scale of the selected chord up or down – like a guitar capo – or switches between different types of chord, like major and minor.

The guitar phone can be played live, to adoring fans, or a melody can be composed in private and stored in memory for use as a ring tone or meeting reminder. Motorola says the phone could even be converted into a banjo or violin at the flick of a switch, with strings automatically retuning.

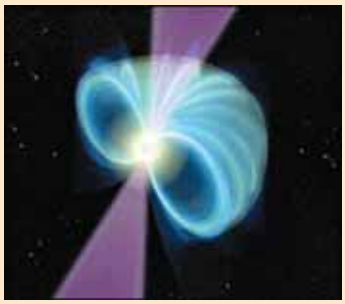
Source: www.newscientist.com

New Kind of Star Found

An international team of astronomers has discovered a new class of stars – massively compressed old neutron stars that seem inactive but for intermittent bursts of radio waves. Dubbing them rotating radio transients (RRATs), the researchers note that their isolated outbursts last for as short as two milliseconds and are separated by gaps as long as three hours.

These things were very difficult to pin down because for each object the researchers have been detecting radio emissions for less than one second a day and these are single bursts. So the researchers had to take great care to distinguish them from terrestrial radio interference.

The researchers first found 11 such objects in a search for isolated radio signals in data recorded during a four-year survey of a slice of the night sky by the CSIRO Parkes radio telescope in Australia. The survey set out to document pulsars – neutron stars that spin and emit powerful radio beams – and found a host of them, along with these strange objects. Since August 2003, each RRAT has been observed at least nine more times to detect multiple bursts. Despite their intermittent nature, the bursts make these new stars among the strongest radio sources in the universe.



The astronomers' analysis suggests that these neutron stars rotate like more regular pulsars, but only pulse occasionally. If these stars belonged to binary systems, as some other pulsars do, their reappearance from behind their partners might explain the periodic bursts.

Source: www.sciam.com

Compiled by : Kapil Tripathi

(Contd. from page 35)

The Virus Has Finally Landed

in breathing. Though there are no commercially available vaccines to protect humans against H5N1; they are still in developmental stages. The next alternative is antivirals like Tamiflu. But for Tamiflu to be effective, it should be taken no more than two days after the onset of symptoms. But, Tamiflu resistant H5N1 also has been seen in Asia! Fortunately no case of avian influenza was detected in human beings at Nandurbar. Although H5N1 cannot be transferred from one individual to another, but a time may come when a person suffering from human flu can simultaneously contract bird flu, allowing the viruses to swap genetic material. The hybrid then could become communicable to others, resulting into a pandemic.

What precautions could one take? Cooking at 70 degrees Celsius or above kills the virus, but refrigeration does not. Raw or partially cooked eggs should be avoided. Virus is sensitive to detergents, bleach and alcohol. Dead or culled birds should be packed in plastic bags and buried and area should be disinfected with lime and phenyl.

It is necessary to urgently address the issue of rehabilitating the poultry units affected by the cull and formulating a welfare package for poultry workers left jobless. This would improve the chances of future outbreaks being reported promptly. There is also a need to establish a National Centre for Biosecurity which could act as a nodal agency for early warning and timely action to counter biological threats to agriculture, animal husbandry and fisheries along the lines suggested by the National Commission on Farmers headed by Professor M. S. Swaminathan. Animal husbandry authorities, jointly with Krishi Vigyan Kendras, and NGOs need to initiate special campaigns to educate the poultry farmers on maintaining healthy and hygienic conditions at the farms and possible outbreak and control of various poultry diseases. This would help us root H5N1 out of India. Here is yet another challenge to science communicators and activists.

❒ **V. B. Kamble**