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VP News

Vigyan Rail Completes its Journey

After completing eight months of journey, Vigyan Rail finally reached its final destination Delhi Safdarjung station on August 16, 2004 and was stationed there up to August 20, 2004. Vigyan Rail had commenced its journey from this station on December 15, 2003. Shri Kapil Sibal, the Hon'ble Minister of State, Science and Technology and Ocean Development (Independent Charge) visited the Vigyan Rail on August 18, 2004 along with Prof. V. S. Ramamurthy, Secretary, Department of Science and Technology; Shri K. K. Jaswal, Secretary, Department of Information Technology; Shri M. V. Kamath, President, Vigyan Prasar Society; Dr. V. B. Kamble, Director, Vigyan Prasar and many other dignitaries. Earlier, delegates from Ministry of Science and Technology, Argentina and officials from US Embassy also visited Vigyan Rail and appreciated the concept and effort.

During its journey, Vigyan Rail travelled over 15000 Km covering the entire length and breadth of the country and stopped at 60 stations. At every destination, Vigyan Rail generated lots of enthusiasm and encouragement among all sections of the people, students in particular. The overwhelming response to Vigyan Rail was widely reported in print and electronic media throughout the journey.

Concluding function of Vigyan Rail at India International Centre (From L to R) Shri K.K. Jaswal, Secretary Dept. of Information Technology, Prof. V.S. Ramamurthy, Secretary , DST, Shri Kapil Sibal, Hon'ble Minister of State, Science and Technology and Ocean Development (Independent Charge), Shri M.V. Kamath, President, Vigyan Prasar.

Vigyan Prasar organized a get-together on August 18, 2004 to mark the end of Vigyan Rail's journey in the first phase. Hon'ble MOS Shri

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Shri Kapil Sibal, the Hon'ble Minister of State, Science and Technology and Ocean Development (Independent Charge) visiting the Vigyan Rail

Inside

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

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Editor : Dr. V.B. Kamble

The Journey has just Begun

The epic journey of Vigyan Rail that began over eight months ago ended in August 2004. After visiting 60 destinations throughout the country covering 15,000 kilometres, it finally chugged into Delhi Safdarjung railway station on August 16, 2004 from where it had steamed out on December 15, 2003. At every place it visited, from Rajkot to Tinsukia and Pathankot to Kanyakumari, it received a thunderous welcome. An estimated five million people visited the Science Exhibition on Wheels during this period. Indeed, this was a historic event for the country in the field of science communication – perhaps in the world.

Surely, Vigyan Rail was a unique experiment, and it has proved how people crave for information and knowledge about science and technology they use everyday or the environment they live in. This was more conspicuous amongst children. The children always outnumbered the grown ups. Vigyan Rail also established a general rule - smaller the place, larger the crowds. New Alipurduar New Jalpaiguri, and Rajkot saw over 50,000 visitors a day, while Delhi and Howrah did not have even a few thousand visitors a day! Ahmedabad, however, was an exception to this rule – nearly 50,000 people visited the exhibition every day. But, Bareilly took the cake! Within three days nearly 2.5 lakh people visited the exhibition!

How could one explain this strange behaviour? How is it that the people in metros - children in particular – were so apathetic to Vigyan Rail which attempted to take science to the people and make them aware of the progress India has made in different fields? Based on the interviews with the visitors, one factor that emerged was the availability and accessibility of information in urban and rural areas. Information is relatively easily available and accessible in metros. International trade fairs, book fairs, and exhibitions have become an integral part of the urban fabric, and the internet connectivity makes the information easily accessible. Difficulty in transportation in urban areas is yet another deterrent. On the other hand, Vigyan Rail, along with an element of novelty, offered a unique opportunity for access to information at smaller places. This is why there was an atmosphere of festivity and celebration whenever Vigyan Rail visited a small place.

Farmers in Rajasthan and Punjab took notes about the improved variety of seeds. At Allahabad, aspirants to civil services were seen jotting down latest details about the progress the country has made in the field of health and medicine. The reason? Detailed and latest information available at the Science Exhibition on Wheels can never be obtained from one single source - they said! But, it was school children who appeared most fascinated. It became almost a regular phenomenon to find them take down notes assiduously in each coach, either out of their own interest, or because it was an assignment from their science teacher! True, a majority of the visitors paid only a single visit, but came out with a sense of pride about the achievements of our country in various fields.

Indeed, in terms of direct contact with the people and exposing them to the scientific developments of the country, there cannot be a better mechanism than the widespread network of Indian railways. At every place, if there was one refrain, then it was the duration of halt was too short! At Chandigarh, a schoolgirl who was visiting the exhibition for the third time was asked what brought her to the exhibition again and again. Her prompt reply was, "I never knew science and technology was so interesting. Now I want to be a scientist!" Our children are rarely exposed to the thrill and excitement of science. No wonder they shy away from a challenging scientific career. Vigyan Rail has been successful in exposing our younger generation to the thrill and excitement of science and inducing them to take up science as a career.

Vigyan Rail was a result of close coordination and collaboration among Vigyan Prasar, Ministry of Railways and seventeen Departments / Ministries engaged in scientific activities. Defence Research and Development organization, Indian Space Research Organisation, Environment and Forests and Non-conventional Energy Sources turned out to be the star attractions with several working models and interesting exhibits. However, what lacked was the element of interactivity. There were a few interactive exhibits, but there should have been more of them – in every coach. It would have made visit to the exhibition even more rewarding. Further, every participating Department / Ministry must depute an officer at each destination to explain the exhibits to the visitors in the local language. This is because the local volunteers are not fully equipped to satisfy the curiosity of the inquisitive visitors. Next, it is desirable that the participating Departments / Ministries bring out on their own and distribute leaflets / brochures explaining their part of the exhibition. These feelings were expressed by a large number of visitors. DRDO did both! In our future endeavour, we shall need to emulate DRDO to make the entire exercise more meaningful.

In view of the year 2004 having been declared the Year of Scientific Awareness, efforts are on by National Council

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Subrahmanyan Chandrasekhar

❑ S. K. Trehan

Subrahmanyan Chandrasekhar was born in Lahore on October 19, 1910. His father C. Subramanyan Ayyar was Assistant Auditor General of Northern Railways posted at Lahore. Chandra was number three in a family of 10 children; 4 sons and 6 daughters. In 1916 the family moved to Lucknow and in 1918 to Madras where his father was posted as Deputy Accountant General. Chandra's education started at home in a very disciplined manner. His father used to teach him in the morning before he went to the office and his mother used to teach him Tamil. Chandra enjoyed learning English and Arithmatic caught his fancy. He was sent to a regular school only when he was eleven. Chandra, though young, showed considerable maturity and understanding. He liked mathematical physics more than pure mathematics and he was determined to persue pure Science.

Arnold Sommerfeld visited Madras in the fall of 1928 and lectured at the Presidency College, Madras. Chandra met him at his hotel and discussed some problems with him. With the deep mathematical preparation Chandra was able to complete a paper "The Compton Scattering and the New Statistics" and this paper was published in the Proceedings of the Royal Society in 1929.It is to be noted that he was only 18 at that time. The Principal of Presidency College, Madras recommended Chandra for a Govt. of India Scholarship to persue his research in England. The scholarship matured about February 1930 and he received official intimation on May 22, 1930 and left Madras for Bombay on July 22, 1930. He left for England on Lloyd Trisetino on July 31, 1930. On the personal recommendation of Fowler, Chandra was admitted to Trinity College, Cambridge on September 4, 1930. It is worth mentioning that on his voyage, he had extended Fowler's work which led eventually to his own discovery of the celebrated critical mass condition- the Chandrasekhar mass limit - on Stellar masses that could become white dwarfs. He submitted his Ph.D. thesis on "Distorted Polytropes" in May 1933 and was awarded the Ph. D. degree in October 1933.

With the formality of the degree out of the way, Chandra was left only with the question of the future. He talked to Fowler and asked him whether there was any chance for him to stay an additional year in Cambridge. Folwer was not hopeful at all. He told him "No, I do not think there is any chance. You can try for a fellowship at Trinity but the competition is quite severe. I doubt if you will get it". After some thinking, in spite of Fowler's discouraging remarks Chandra decided to apply for a fellowship, the outcome of which would be decided in early October. A fellow of Trinity was a wild dream. The only other Indian who had been elected to a Trinity fellowship was Srinivasa Ramanujan some sixteen years earlier. The competition was formidable. It was open to candidates from all fields. Each candidate submitted a fellowship thesis containing an account of his work during the previous years and took two written examinations, one in general aspects of Science and philosophy and the other in literature and the arts. Chandra submitted his thesis to Sir J.J. Thomson, the Master of the College on August 24 and prepared himself for the examination to be held on September 29, 1933.

Chandra as Fellow of Trinity College, Cambridge, 1934

On 9th October 1933, the fellowship was to be announced. He was shocked to find his name on the list. When he saw his name, he remembered telling himself quite loudly, "This is it, this changes my life".Milne, while congratulating Chandra in his letter dated October 9, 1933 wrote, "I believe that the election to a Trinity fellowship is one of the most important as well as the most gratifying events that can happen to one. I hope it will be source of inspiration to you as it was to me, to be a member of such a society, to be part of those ancient and restful buildings, and to have your name inscribed in the roll which counts in its past so many names we all revere".

Chandra joined the University of Chicago, Yerkes Observatory as Assistant Professor of Theoretical Astrophysics in December 1936. He was made an Associate Professor in 1941 and Professor in 1943. At Yerkes, Chandra continued his theoretical research on stellar interiors, but gradually tapered it off as he turned to radiative transfer and stellar atmospheres, which he had begun working on at Cambridge. He wrote his first research monograph. "An Introduction to the Theory of Stellar Structure, published by the University of Chicago Press in 1939.

All of Chandra's research depended on his great mathematical powers, the ability to see his way through complicated system of integrodifferential equations and solve them. It required immense concentration,self confidence, insight and hard work, all of which he had in abundance. Many of his papers required massive numerical computations in the days before high speed digital computers; in his early years he did all the computations himself, using electric powered mechanical computers. His graduate students did some of the calculations and then he had an assistant to do these.

In 1946, Chandra became a Distinguished Service Professor at the young age of 36. In 1944, he was elected to the Fellowship of the Royal Society of London. In 1947 he was awarded the Adams Prize of Cambridge University. In 1952 he was awarded the Bruce Medal of the Astronomical Society of the Pacific. While giving the medal the President of the society remarked that the society has honoured many astronomers in giving this medal but only twice has the society been honoured by giving the awards to such young astronomers (Arthur Stanley Eddington and Subramanyan Chandrasekhar). He has received numerous awards, medals and honours which are listed towards the end. We would first like to describe his scientific work.

Chandra and Lalitha after their marriage, Madras, 1936

The Theory of White Dwarfs

The white dwarf stars differ from the normal stars in two fundamental respects. First they are highly "underluminous"; that is judged with reference to an average star of the same mass, the white dwarf is much fainter. A typical white dwarf is the companion of Sirius which has a mass about equal to that of the sun but whose luminosity is only 0.003 times that of the sun (i.e. 0.3 percent). Second the white dwarfs are characterized by exceedingly high values of the mean density. The companion of sirius which has mass about equal to that of the sun has a radius of approximately 20,000 kilometers, astonishingly small for such a great mass. This implies a density of 61,000 gms per cubic centimeter or just about a ton per cubic inch. It is the second characteristic which is generally emphasized, though from a theoretical point of view the fact that the lumisosity is very small is of equal importance.

Conference on White Dwarfs and Supernovae, Paris, August 1939. The photograph shows all conference participants. Left to right: (front) Frederick J.M. Stratton, Cecilia Helena Payne-Gaposschkin, Henry Norris Russell, Amos J. Shaler, Arthur S. Eddington, Sergei Gaposschkin; (back) Carlyle S. Beals, Bengt Edlen, Pol F. Swings, Gerard P. Kuiper, Bengt G.D. Stromgren, S. Chandrasekhar, Walter Baade; Knut Lundmark is standing between Chandrasekhar and Eddington

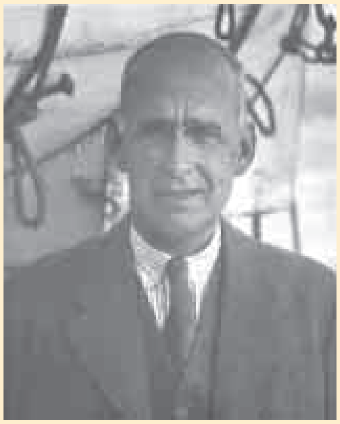
Since the radius of a white dwarf is very much smaller than that of a star on the main series, it follows that for a given effective temperature, the white dwarf will be much fainter than a star on the main series. Similarly for the same luminosity the white dwarf will be characterized by a very much higher effective temperature (i.e. much whiter) than the main series stars. This explains the origin of the term white dwarf.

In 1930, when Chandra was only 19, on the long voyage from India to England, he worked out the theory of white dwarf stars, basing his calculation on Einstein's Special Theory of Relativity and the new quantum mechanics. He obtained the result that if the mass of the star exceeded a certain critical mass, expressible in terms of the fundamental atomic constants, the star would not become a white drarf.

For sufficiently large M, special relativity comes in eventually and quantum mechanical pressure cannot compete with gravity nor with the classical thermal pressure; in this limit a star will keep on contracting as it radiates away energy and (unless it looses mass first) will eventually suffer a fate worse than death-invisibility. General relativity had preceeded quantum mechanics and it was already known that no radiation could escape from a star if it contracted to less than its Schwarzschild radius, such a state of invisilility is what we nowadays call a black hole.

The appreciation of the importance of this discovery by the astronomers was withheld because when Chandra presented his results at the January 1935 meeting of the Royal Astronomical Society in London, Sir Arthur Stanley Eddington began to ridicule the whole idea before the Scientific community. He made it look as though Chandra understood neither relativity nor quantum mechanics. More than twenty years passed before the Chandrasekhar Limit became an established fact and assumed its important role in Astrophysical Research. It is, perhaps, in order to mention here the great authority of Eddington, who was the greatest astronomer of his time and what dogmas held by people of his stature can do to science.

It took nearly three decades before the full significance of the discovery was recognized and the Chandrasekhar limit entered the standard lexicon of physics and astrophysics. Five decades passed before he was awarded the Nobel Prize. Chandra remarks: "It is quite an astonishing fact that someone like Eddington could have such an incredible authority which everyone belived in and there were no people who were bold enough and understanding enough to come out and say Eddington was wrong. I don't think in the entire astronomical literature you will find a single sentence to say Eddington was wrong. Not only that, I don't think it is an accident that no astronomical medal I have received mentioned my work on white dwarfs ……". He further remarks: "I personally believe that the whole development of astronomy, of theoretical astronomy particularly with regard to the evolution of stars, and the understanding of the observations relating to white dwarfs, were all delayed by at least two generations because of Eddington's authority".



Sir Arthur Stanley Eddington (1882-1944), 1932. Photograph courtesy of The Bettmann Archive, UPI/Bettmann

Stellar Dynamics

Due to this episode, Chandra gave up the studies in Stellar Structure and turned to studies in Stellar Dynamics during 1938-42. He established that a star must experience Dynamical Friction i.e. it must suffer from a systematic tendency to be decelerated in the direction of its motion. This dynamical friction which the stars experience is one of the direct consequences of the fluctuating force acting on a star due to the varying complexion of the near neighbours. From considerations of a very general nature, Chandra concluded that the coefficient of dynamical friction must be of the order of the reciprocal of the time of relaxation of the system. Among the comprehensive methods of attack on the problems of Stellar Dynamics, mention must be made of the Statistical Theory of Stellar encounters devloped by Chandrasekhar and Von Neumann. This Statistical theory made fresh start on a variety of problems along which the Theory of Stellar Dynamics evolved.

Stochastic Problems in Physics and Astronomy.

Chandrasekhar was successful in giving a mathematically rigorous account of the problem of Random Flights first posed by Karl Pearson in 1905. His formulation was as follows : A man starts from a point 0 and walks I meter in a straight line; he then turns through any angle whatever and walks another I meter in a second straight line. He repeats this process n times. Chandra obtained the solution based on probabilistic arguments. Chandra also gave a very comprehensive account of the theory of Brownian Motion.

These problems were comprehensively discussed in a long article in Reviews of Modern Physics,"Stochastic Problems in Physics and Astronomy" (volume 15, no. 1, 1943, 1-89). This is one of the most widely referred – to and influential articles in this general subject area.

In late 1941, Chandra spent one quarter at the Institute for Advanced Study at Princeton, doing joint research on complex statistical mechanical problems with John Von Neumann. They were both very powerful applied mathematicians, and as Von Neumann was one of the top theorists at Aberdeen (and in several other weapon programs as well) they continued their colloboration all during the war years. Chandra was amazingly productive and by 1946 was widely recognised as the outstanding young theoretical astrophysicist in the United States. He was teaching all the theoretical astrophysics courses at Yerkes Observatory and five graduate students had completed their Ph.D. thesis under his supervision by 1944.

Chandra with all his brothers and sisters on visit to madras, 1961. Left to right: (front) Vishwam, Rajam, Chandra, Bala, Balakrishnan; (back) Savitri, Vidya, Ramanathan. Sarada, Sundari.

Radiative Transfer. (1943-49)

In the forties Chandra examined the problems of specifying the radiation field in an atmosphere which scatters light in accordance with well defined physical laws. Though this problem originated in the investigations of Lord Rayleigh in 1871 on the illumination and polarization of the sunlit sky, the fundamental equations governing Rayleigh's particular problem had to wait for seventy five years for their formulation and solution. The subject of radiative transfer was given impetus by the work of Schüster in 1905 who formulated the radiative transfer problem in an attempt to explain the appearance of absorption and emission lines in stellar spectra, and Karl Schwarzschild introduced in 1906 the concept of radiative equilibrium in Stellar atmospheres.

Radiative Transfer provides the foundation for the analysis of stellar atmospheres, planetary illumination and sky radiation. The fundamental problems of the subject are formulated and analysed. It is shown how allowance can be made for the polarization of the radiation field by using a set of parameters first introduced by Stokes. Further studies deal with transfer problems in semi-infinite and related astrophysical and mathematical problems.

On the physical side, the novelty of the methods used consists in the employment of certain general principles of invariance which on the mathematical side leads to the systematic use of non-linear integral equations and the development of the theory of a special class of such equations, which can be solved in terms of what are now commonly known as "Chandrasekhar's X and Y functions".

Chandra enjoyed his preoccupation with radiation transfer and, as he often says, it was the happiest period of his scientific life (though he felt the same in later years about his work on the mathematical theory of Black Holes). "My research on radiative transfer gave me the most satisfaction", says

Chandra. “I worked on it for five years, and the subject, I felt, developed on its own initiative and momentum. Problems arose one by one, each more complex and difficult than the previous one, and they were solved. The whole subject attained an elegance and a beauty which I do not find to the same degree in any of my other work. And when I finally wrote the book Radiative Transfer, I left the area entirely. Although I could think of several problems, I did not want to spoil the coherence and beauty of the subject [by further additions]. Further more as the subject had developed, I also had developed. It gave me for the first time a degree of self assurance and confidence in my scientific work because here was a situation where I was not looking for problems. The subject, not easy by any standards, seemed to evolve on its own”.

Chandra with Igor D. Novikov and Ya.B.Zeldovich, General Relativity Conference Warsaw, 1962

The work on Radiative Transfer provided

(i) to the mathematician some novel problems in Integral Equations.
(ii) To the astronomer a comprehensive theory of stellar atmospheres.
(iii) To the physicist
(a) classical treatment of the polarization of light. This had been done the first time by George Stokes and forgotten. Chandra introduced these to the physicists again.
(b) An account of neutron transport and diffusion - because the mathematical problems are equivalent.

Stability and Turbulence. (1952-60)

This period was devoted to a study of hydrodynamic and hydromagnetic Stability and the theory of turbulence. These studies were also confirmed experimentally in various cases at a special Laboratory set up for the purpose at the University of Chicago. The stability problems were formulated very comprehensively using variational principles. These studies were compiled in the book “Hydrodynamic and Hydromagnetic Stability” by S. Chandrasekhar (Oxford at the Clarendon Press 1961).

Farewell from family and friends, Madras railway station, October 1936

This is a voluminious book (XIX + 654 pages) where Chandra starts with the discussion of the classical Benard Convection problem, then generalises it to include the effect of rotation of magnetic field and then their combined effect. The problems of thermal stability in fluid spheres and spherical shells is then discussed. This is followed by the stability of couette flow and more general flows between co-axial cylinders. The problems of Rayleigh-Taylor and Kelvin Helmholtz instability are then discussed in great depth. The last chapters are devoted to a detailed study of the stability of Jets and Cylinders and some problems of gravitational stability. It has been a great resource book for persons who undertook studies in Magnetohydrodynamic stability in the sixties and later.

The work on Hydrodynamic and Hydromagnetic stability provided :

(i) to the astronomers basis for theories of convection, magnetic fields etc.,
(ii) to the physicist the remarkable achievement that the theories (Some of them at least) had been verified experimentally (at the University of Chicago) to an accuracy of within one percent.
(iii) to the mathematician Characteristic value problems in High Order Differential equations.

Ellipsoidal Figures of Equilibrium (1960-69)

Chandra begins the book with a historical introduction of the problem which attracted the attention of the past masters. He points out the loose ends left in the investigations of Riemann, Dedekind, Jacobi and Maclaurin and then, in subsequent chapters, goes on to describe the entire subject from his own perspective. A remarkable aspect in the discussion of the Riemann ellipsoids is to point out first the accomplishments of his paper, in view of his unique position in science. These are discussed in detail in the Biographical notes which follow every chapter. Chandra writes: “Certainly, few papers, if any, that have been written in the subject have comparable content or scope. But where Riemann went wrong was in his general considerations relative to the stability of his ellipsoids. Lebovitz has analyzed these parts of Riemann’s’paper and located the origin of his errors”.”It is to be observed that it is not very common for researchers to go to the depth to find out the reasons for the error. It is only persons of the highest level in science who will be satisfied only after finding out the exact details which led to the error. Chandra was never satisfied till he got to the root of the problem. As Chandra himself remarks in the book, “the object is not to point out the mistake of Riemann as to put the things in order”.

The Mathematical Theory of Black Holes (1974-1980)

Black Holes are the remains of collapsed stars far larger than white dwarfs. Whereas white dwarfs shine dimly, black holes have a gravitational pull so strong that nothing, not even light, can escape from them.

It is indeed one of the strangest ironies in science that Eddington failed to see the far reaching consequences of a very simple and straightforward application of the special theory of relativity while he was amongst the very few to embrace Eintein's general theory in the English speaking world. If Eddington had been open minded about the ideas of relativistic degeneracy and therefore the mass limit, he could have persued the subject in the framework of the general theory and would have possibly found that stars become unstable before they reached the limit and that a black hole would ensue.

Copley Medal of the Royal Society recipients, London, 1984. left to right: (front) S. Chandrasekhar, Sir Clive Sinclair, J.R. Mallard, P. Mansfield, Sir Sam Edwards, H.H. Hopkins; (back) E. Mayr, A.L. Cullen, Mary F. Lyon, R.P. Kerr, A.R. Battersby, R. Bond, J.F. Davidson, J.M.S. Hutchison

Chandra says: "Eddington could have done it. When I say he could have done it. I am not just speculating. It was entirely within his ability, entirely within the philosophy which underlies his work on internal constitution of stars". It could be said that Chandra's work on black holes was one of his scientific objectives. Having predicted them from astrophysical considerations before anybody else, he had been learning relativity all these years. And gradually from the post-Newtonian approximations to the stability of rotating stars, it was natural for him to move on to the perturbations of black holes. In fact it was his interest (in the sixties) in the ellipsoidal figures of equilibrium and his determination that this theory of Riemann, Jacobi, MacLaurin and Dedekind should be completed and presented in a unified treatment, that postponed for several years his entry into the realm of relativistic black holes. The work was done from 1974 to 1980, culminating in the writing of his book in 1980-81.

Prime Minister Indira Gandhi and Chandra on the occasion of the Second Jawaharlal Nehru Memorial Lecture which Chandra delivered, New Delhi, November 1968

From the late 1960's on, Chandra was working seriously on general relativistic problems. By then it was clear that stars more massive than the Chandrasekhar limit that had exhausted their nuclear fuel could contract to much denser neutron stars, which have a similar but larger mass limit, and that still more massive stars could contract to black holes, if they did not explode completely as supernovae. Thus Eddington's question had been answered and Chandra, with his post doctoral research fellows and Ph.D. students,was working out many of the properties of black holes of all masses.

With such a wide background of achievements in Science, Chandra presents two contrasting images to those around him. To those who have had no close association with him, his almost ascetic, highly disciplined, organised and simplified life makes him seem completely unapproachable, someone to be respected from a safe distance. For instance a student once told him "Most people think you are an ogre". But those who have worked with him closely or made an effort to know him have a different experience altogether. "He is so intense in all his interests" says James Cronin (a Nobel Laureate)" that one gets the impression that he is averse to small talk. He is not. He is a man full of warmth and friendship with deep human concern".

"There is a kind of fineness about him "says Marvin Goldberger, both from a physical and from a philosophical point of view. He is one of the most elegant looking people I have ever met". Victor Weisskopf first met Chandra when he was a Cambridge graduate student spending a year in Niels Bohr Institute in Copenhagen in 1932. "The strange thing about Chandra is that he has changed very little. He has got white hair, but apart from that he looks to me exactly like he looked at that time. Right from the beginning, but even more later on, he became sort of the most pure example of the ideal scholar in Physics... nothing of vanity, nothing of pushiness, nothing of job seeking, publicity seeking, or even recognition seeking .... His deep education, his humanistic kind of approach to these problems, his knowledge of world literature and in particular English literature are outstanding. I mean you would hardly find another physicist or astronomer who is so deeply civilized"

Chandra &. Literature.

Chandra has a deep and abiding interest in literature and classical music. He cultivates them with the same degree of thoroughness and intensity as his science. "My interest in literature began in a serious way in Cambridge about 1932" says Chandra "I used to devote most of the two to three weeks between terms to the study of literature. The real discovery for me at that time was the Russian authors. I read systematically, in Constance Garnett's translation, all the novels of Turgenev, Dostoevski's Crime and Punishment, Brothers Karamazov and Possessed. Chekhov, I read of course all his stories and plays. Not all of the Tolstoys' but Anna Karenina certainly. Among English writers I started reading Virgina Woolf, T.S. Eliot, Thomas Hardy, John Galsworthy and Bernard Shaw. Henrik Ibsen was also one of my favourite

Books by S. Chandrasekhar

1. An Introduction to the Study of Stellar Structure. Chicago : University of Chicago Press 1939. Repr. New York : Dover 1958, 1967 Translations in Japanese & Russian.
2. Principles of Stellar Dynamics
   Chicago : University of Chicago Press 1942 Repr. New York : Dover 1960 Translated into Russian.
3. Radiative Transfer
   Oxford : Clarendon Press 1950. Repr. New York : Dover 1960. Translated into Russian.
4. Plasma Physics : Notes complied by S.K. Trehan from a course given S. Chandrasekhar at the University of Chicago, Chicago : University of Chicago Press 1960, Repr. 1962, 1975.
5. Hydrodynamic and Hydromagnetic Stability : Oxford : Clarendon Press 1961. Repr. New York : Dover 1970, 1981. Translated into Russian.
6. Ellipsoidal Figures of Equilibrium. New Haven : Yale University Press 1969 Repr. New York : Dover, 1987 translated to Russian.
7. The Mathematical Theory of Blook Holes, Oxford : Clarendon Press 1983.
8. Eddingaton : The most distinguished Astrophysicist of his time, Cambridge : Cambridge University Press 1983.
9. Truth & Beauty : Aesthetics and Motivatious in Science, Chicago, University of Chicago Press 1987.
10. Newton's Principia for the Common Reader, Oxford : Clarendon Press, 1995.
11. Selected Papers : The University of Chicago Press:

Volume 1 : Stellar Structure and Stellar Atmospheres. 1989, (516 pages).

Volume 2 : Radiative Transfer and Negative Ion of Hydrogen, 1989, (622 pages).

Volume 3 : Stochastic, Statistical and Hydromagnetic Problems in Physics and Astronomy, 1989, (642 pages).

Volume 4 : Plasma Physics, Hydrodynamic and Hydromagnetic Stability and Applications of the Tensor – Virial Theorm, 1989, (586 pages).

Volume 5 : Relativistic Astrophysics, 1990, (588 pages).

Volume 6 : The Mathematical Theory of Black Holes and of colliding Plane Waves, 1991, (740 pages).

Volume 7 : The Non-Radial Oscillations of Stars in General Relativity and other writings, 1997, (295 pages)

Henry Norris Russell and Chandra at a symposium to commemorate the fiftieth anniversary of the University of Chicago, September 1941

authors The only serious literary study I have accomplished since I came to the United States is that of Shakespere's plays. I have read all of his plays at least once, and some, especially the tragedies, I have read three or four times".

He gave the second Ryerson Lecture at the University of Chicago in 1975. The title "Shakespere, Newton & Beethoven or the patterns of creativity." In this lecture the main point was why it is that in the arts and literature, the quality of work improves with age and experience while in Science, generally it does not. Chandra felt that we do science in isolation, focus narrowly on our immediate goals and that we are not sufficiently broad in our interests and persuits. He feels that one would do better Science if one read Shakespere, particularly his penultimate play, The Tempest".

Chandra receiving the Nobel Prize in physics from King Carl XVI Gustav of Sweden, Stockholm, 1983. Photograph by Jan Collsioo.

On the shoulder of gaints

Newton's Principia was published in 1687; not only is it the crowning achievement of the 17th century scientific revolution but it is also generally regarded as the most important book in the history of physical sciences. No one can call it an easy read. The first edition ran to only 500 copies. In Newton's own life time only a handful of talented men, working without distraction at the frontiers of current research, had each in his own way achieved a working knowledge of the Pricipia's technical content. Even in 1730, Voltaire described the book as incomprehensible and obsure. Chnadra goes on to say that he regards the Principia as not only surpassed but only unsurpassable. To Chandrasekhar, Newton was not merely a chip off the old block, but the block itself.

In Newton's Pricipia for the Common reader, Chandra makes considerable effort to circumvent Newton's propensity for a *secrtive* style. Chandra transforms the Newtonian Mathematics into modern idioms and thus makes it much more accessible to what he quainlty refers to as the common reader. This is not to imply Universal

Honours, Medals and Prize awarded to S. Chandrasekhar

1934	:	Fellow, Indian Academy of Sciences, Bangalore.
1944	:	Fellow of the Royal Society of London.
1947	:	Adams Prize (Cambridge University)
1952	:	Bruce Medal (Astronomical Society of the Pacific)
1953	:	Gold Medal (Royal Astronomical Society)
1955		Member, National Academy of Sciences, U.S.A.
1957	:	Rumford Medal (American Academy of Arts & Sciences)
1962	:	Fellow, Indian National Science Academy.
1962	:	Royal Medal of the Royal Society of London.
1966	:	National Medal of Science (U.S.A.).
1968	:	Padma Vibhushan (INDIA).
1971	:	Henry Draper Medal (National Aacdemy of Sciences, (U.S.A.).
1973	:	Smoluchowski Medal (Polish Physical Society).
1974	:	Dannie Heinman Prize (American Physical Society).
1983	:	Nobel Prize for Physics (Royal Swedish Academy).
1984	:	Dr. Tomalla Prize (ETH, Zurich).
1984	:	Copley Medal of the Royal Society of London.
1984	:	R.D. Birla Memorial Award (Indian Physics Association)
1985	:	Vainu Bappu Memorial Award (INSA)

readership, people will need at least the equivalent of a mathematics degree to understand the proofs.

The great joy of Chandra's book is that it repays all the attention one gives it. As one proceeds every thing becomes so much easy to understand. The veil of Newtonian obscurity is lifted and one begins to grasp the extent of Newton's achievment.

Chandra has been active in Science from 1928-1995, a span of 68 years. His number of publications is about 377 during this period. About 46 students got the Ph. D. degree under his guidance. Very few scientists have accomplished this. He covers almost four generations. His work can cover volumes. A small fraction of it would have satisfied a lesser mortal. Let me conclude this with the" concluding remarks of his Nobel Lecture (1983).

" The simple is the seal of the true and Beauty is the splendour of truth".

While finalising this article for publication we learnt about the sudden demise of Professor Surindar Kumar Trehan on September 09, 2004. By his death, Indian scientific community has lost one of its accomplished members. We express our heartfelt condolence to the bereaved family. We are particularly saddened by the fact that Prof. Trehan is no more to see his article in print. It was quite rewarding to interact with him. A very brief write-up on Prof. Trehan by Prof. Bimla Buti, a highly acclaimed Plasma Physicist and a student of Prof. S. Chandrasekhar, is reproduced blow.

-Editor

Prof. S. K. Trehan (1931-2004)

Prof. S.K. Trehan, after doing his M.Sc. from Delhi University, preceded to University of Chicago where he had worked with Nobel Laureate Prof. S. Chandrasekhar for his Ph.D. in Plasma Physics. After spending a couple of years as a Post-Doctral Fellow at Princeton Plasma Physics Laboratory, he returned to work at Physics Department, Delhi University. He was an excellent teacher and guided a number of Ph.D. students both at University of Delhi as well as at Department of Mathematics , Panjab University, Chandigarh. He had worked at Goddard Space Flight Centre (GSFC), NASA, and had visited High Altitude Observatory as well as Simon Fraser University, Vancouver, Canada a number of times. He was a Bhatnagar awardee and a fellow of Indian National Science Academy, Indian Academy of Sciences and National Academy of Sciences. He had served on several National Committees. Shockingly he suddenly passed away on September 9, 2004.

(Vigyan Rail completes its journey) Contd. from page 36

Kapil Sibal, Prof V. S. Ramamurthy, Shri K. K. Jaswal, all the nodal officers of the participating Departments/ Ministries and members of the Governing Body of Vigyan Prasar were present in the function. On this occasion, Shri Kapil Sibal, thanked all the people involved in Vigyan Rail. He emphasized the need of effort like Vigyan Rail to reach every part of the country to empower people with the knowledge of Science and Technology. He suggested that Vigyan Rail, during its next phase of the journey, along with the present exhibits, should also showcase the unique contributions made by individuals at the local level. He presented mementos to the nodal officers. Prof. V. S. Ramamurthy thanked Shri M.V. Kamath for his idea of Vigyan Rail. He said that Vigyan Rail has completed its first phase of the journey and has generated lots of enthusiasm among the people. However, India is a vast country and there are still many places where Vigyan Rail could not reach. In its second phase of journey Vigyan Rail will visit many of those places. Shri K. K. Jaswal, Secretary, Department of Information Technology, said that the concept of Vigyan Rail was unique and it has already received overwhelming response all over the country. He also stressed the need of encouraging the inventions made by common people at the local level. Dr. V. B. Kamble made a presentation on the entire journey of Vigyan Rail, its impact and response in different part of the country.

Sivaramakrishna Chandrasekhar

A Pioneer Liquid Crystal Physicist

❑ Subodh Mahanti

> My attitude hasn't made me rich man, but it has made me a happy one. I've been able to fulfill the dream of discovery. No scientist could ask for more.
> Shivaramakrishna Chandrasekhar

Sivaramakrishna Chandrasekhar is best known for his discovery of a new class of liquid crystals known as discotic liquid crystals. His discovery opened an entirely new area of research and which led to a number of importanr applications ranging from legibility films for giant Liquid Crystal Devices (LCDs), clearly legible in large public spaces to hybrid nano-chips. His book, *Liquid Crystals,* is a universally acclaimed classic. He was a great advocate of liquid crystal sciences and technologies in India. He was a great educator. Chandrasekhar had a deep interest in classical Indian as well as western music. He himself was a good singer. Among his other interests were theatre, painting, and sculpture.

Sivaramakrishna Chandrasekhar

Chandrasekhar was born on August 06, 1930 at Kolkata (then Calcutta). He belonged to a large family distinguished in both science and public service. His father R. B. S. Sivaramakrishnan was Accountant General. His mother Sitalakshmi was the younger sister of the Nobel Laureate Chandrashekhar Venkata Raman. He was the fourth among five brothers. Among his four brothers was S. Ramaseshan, a well-known material scientist of India. Subrahmanyan Chandrsekhar who was awarded Nobel Prize in 1983 was his first cousin.

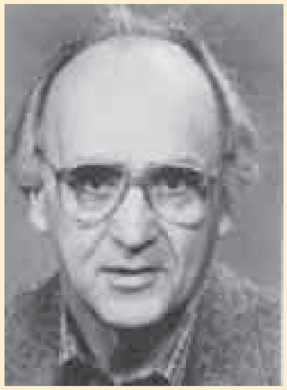
He studied at the Catholic Institution, Loyla College, Chennai (then Madras). In 1951 he obtained his MSc degree in physics with first rank from Nagpur University. He was 21. He received a DSc from Nagpur University in 1954 while working with C. V. Raman at the Raman Research Institute, Bangalore. In 1954 he went to Cavendish Laboratory as an 1851 Exhibition Scholar. At the Cavendish Laboratory he worked on crystallographic problems. He obtained a second PhD degree from the University of Cambridge. He then worked with Kathleen Lonsdale at University College, London and Lawrence Bragg at the Royal Institution, London on crystallographic problems. In 1961 he returned to India to join Mysore University as the first Head of the Department of the Physics. At the Mysore University he started his pioneering research work on liquid crystals. Chandrasekhar and his groups did pioneering work in liquid crystal physics especially on pressure effects on liquid crystal phase transition and their discovery of the optical analogue of the Borrman effect. In 1977 Chandrasekhar and his colleagues discovered a new type of liquid crystals known discotic crystals. This class of liquid crystal was distinct from those arising from previously known rod-like molecules. The molecules which made these crystals had the shape of discs rather than the well-studied rods. The paper announcing their discovery was published in an Indian physics journal, *Pramana*. This paper is one of the most highly cited papers in the field of liquid crystals. Chandrasekhar's discovery attracted increasing interest from scientists from all over the world. It is now estimated that about 3000 discotic molecules have been synthesized in laboratories worldwide.

In 1971 Chandrasekhar moved from the University of Mysore to Raman Research Institute to establish a Liquid Crystal Research Laboratory. It became one of the leading centrel of liquid crystal research in the world. After retiring from the Raman Research Institute in 1990, Chandrasekhar started the Centre for Liquid Crystal Research in a building made available by Bharat Electronics Ltd. (BEL).

In 1992, he co-founded the International Liquid Crystal Society and he was its first President. In 1998 he was elected as one of first Honoured Members of this Society. Other Honoured members were George W. Gray, Pierre-Gilles de Gennes, and Alfred Saupe.

Chandrasekhar was the editor of the journal, *Molecular Crystals and Liquid Crystals* for 20 years. He organized several international conferences in Bangalore including the Ninth International Liquid Crystals Conference in 1982 and the Second Asia Pacific Physics Conference in 1986. He set up bilateral scientific collaborations between India and many other countries.

He was elected Fellow of all the three science academies in India, the Royal Society of London, the Institute of Physics of London, and the Third World Academy of Sciences. Among the many awards that he received included: *Bhatnagar Award* of the Council of Scientific and Industrial Research (1972), *Homi Bhabha* (1987) and *Meghnad Saha* (1992) medals of Indian National Science Academy, *C. V. Raman Centenary Medal* of the Indian Association for the Cultivation of Science (1988), *the Freedericksz Medal* of the Russian Liquid Crystal Society (1986), *The Royal Medal* of the Royal Society of London (1994) for his discovery of discotics and his book on liquid crystal, the *Niels Bohr UNESCO Gold Medal* for his outstanding contributions to the development of liquid crystals, the advancement of science in developing countries and teaching of physics (1998), *Padmabhushan Award* of the Government of India (1998), *Karnataka Rajyotsava Award* (1986) and entitlement '*Chevalier dans L' order des Palmes Academiques'* of the French Government (1999).



Alfred Saupe

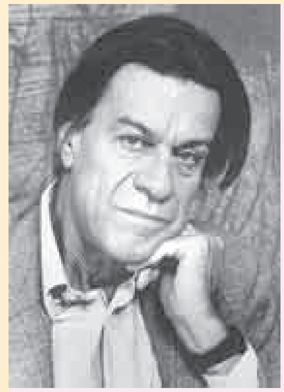
Chandrasekhar died on March 08, 2004.

Liquid Crystals

Liquid crystals have entered our daily lives—they are to be found in wristwatches, calculators and many other appliances. However, the term liquid crystal may seem to many as contradictory to commonsense understanding. There are three common states of matter that most people know about. They are solids, liquids and gases. A crystal is ideally defined as a homogeneous solid made up of an element, chemical compound or isomorphous mixure throughout which atoms or molecules are arranged in a regular repeating patterns. By crystal we usually refer to crystalline solid. The atoms or molecules in a crystal stay in a fixed position and orientation with a small amount of variation from atomic or molecular vibrations. This means the molecules or atoms in a crystal are constrained to point only certain directions and to be only in certain positions with respect to each other. To keep the molecules or atoms in a fixed position large forces are required and this is why a crystalline solid is not easy to deform. Unlike in solid state, the molecules in liquid state have no fixed position or orientation. In liquids, the molecules do not have any positional or orientational order. Their positions or the directions they point are random. In liquid state the intermolecular forces are strong enough to hold the molecules fairly close together. However, the molecules in liquid state are free to move in random fashion. The liquid state has less order than the solid state. As the intermolecular attractive forces are not strong enough, a liquid can be easily deformed.

Centre for Liquid Crystal Research at Bangalore

Liquid crystal is another phase of a matter whose order is intermediate between that of a liquid and that of a crystal. The molecules in liquid crystal have no positional order. However they exhibit a certain degree of orientational order.



Pierre-Gilles de Gennes

This means that the molecules in liquid crystals tend to point more in one direction over time than other directions. This preferred direction is called director of the liquid crystal. Not all substances can have a liquid crystal phase. A liquid crystal is more like a liquid than it is like solid. Liquid crystal is an anisotropic material. The properties of an anisotropic material differ on what direction they are measured. An anisotropic substance means it shows different behaviou in different direction. For example, because of anisotropic property of liquid crystals, they allow light to pass through into one direction but stop it into the other. The liquid crystal molecules are typically rod-shaped organic moieties about 25 angstroms in length.

There are many kinds of liquid crystals. For examples Nematic liquid crystal, Chiral nematic crystal, semetic liquid crystal, lytropic liquid crystal. Nematic liquid crystal exhibit thread-like formations. The word nematic comes from the Greek word for "thread". Chiral nematic liquid crystals exhibit a twisted or helical structure. The helical structure is exploited in several ways in making flat-panel displays. Smectic liquid crystal has a soapy texture and concentrate in planer layers. The lytropic liquid crystal are made by mixing different kinds of liquid crystals. This class of liquid crystals are extremely important in display applications.

More than 150 years ago the existence of liquid crystal was observed but without realizing its significance. Around 1850s Virchow, Mettenheimer and Valentin observed that the nerve fibre they were investigating formed a liquid substance when left in water and which exhibited unusual properties when viewed using polarized light. In 1877, Otto Lehmann while investing the phase transition of various substances with a polarized microscope found that one substance would change from a clear liquid to a cloudy liquid before crystallizing. Lehmann failed to realize its significance. He thought that the phenomenon observed by him was simply an imperfect phase transition from liquid to crystalline. It was Reintzer who in 1888 who first suggested the cloudy liquid observed before crystallising is a new phase of matter. Reintzer is recognized as the discoverer of liquid crystals. The first synthetic liquid crystal was produced in 1890 by Gatterman and Ritscheke. It was para-azoxyanisole. After the production of the first synthetic

Raman Research Institute, Bangalore

liquid crystal more such synthetic crystals were produced. Today it is possible to synthesise liquid crystals with specific predetermined properties.

Till 1950 there was not much activity in the field of liquid crystal. This is because many important features of liquid crystals were not known till then. The works of Brown in USA, Chistiakoff in the erstwhile USSR and Gray and Frank in UK in the 1950s led to a revival of interest in liquid crystals. Their works helped demonstrate variety of phenomena exhibited by liquid crystals. The scientists working at Radio Corporation of America (RCA) first demonstrated a liquid crystal display in 1968. This demonstrated enormous commercial interest of liquid crystals.

Sivaraj Ramaseshan

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Vigyan Rail – The Last Leg

In its last leg of journey, Vigyan Rail covered two States, Punjab and Hariyana, before it returned to Delhi Safderjung station. In Punjab, it stopped at four places: Ferozepur, Amritsar, Pathankot and Jalandhar. In Hariyana, it stopped at Kurukshetra. In all the places Vigyan Rail received wide coverage through print and electronic media. Volunteers were trained to explain the exhibits in local language.

Vigyan Rail reached Ferozepur on July 27, 2004 and was stationed there till July 30, 2004. Shri Dharam Singh, Divisional Railway Manager, Ferozepur Division inaugurated the exhibition. Mr. Ranjeet Singh, Deputy Commissioner, Ferozepur also visited the exhibition. Schools from Bathinda, Fazilka, Abohar, Makhu, Guruharsahi and other places visited Vigyan Rail. Over 30,000 people visited the exhibition.

Vigyan Rail then moved to Amritsar and was stationed there for five days from July 31, 2004 to August 04, 2004. Dr. S. P. Singh, Vice Chancellor, Gurunanak Dev University, Amritsar and Shri M. S. Chalia, Sr. Divisional Commercial Manager, Ferozepur Division, inaugurated Vigyan Rail on July 31, 2004. Over 55,000 people visited the exhibition.

Vigyan Rail was scheduled to reach Pathankot during early hour on August 05, 2004. However, heavy rain disrupted the normal schedule of the train movement and Vigyan Rail reached Pathankot at 18:30 hrs. It was inaugurated on August 6, 2004 by Shri Harjeet Singh, Dy. Commissioner, Gurdaspur. Shri Singh also announced that the students may write an essay on Vigyan Rail in about 300 words and 5 best essays will be selected for prize, to be given during district function on August 15, 2004. About 40,000 people visited the exhibition during its four days halt.

Vigyan Rail reached Jalandhar on August 9, 2004 and was stationed there up to August 12, 2004. Shri Ashok Kumar Gupta, District Collector, Jalandhar inaugurated the exhibition. About 300 students were present during the inaugural function. Over 1,50,000 people visited the exhibition.

Vigyan Rail next moved to Kurukshetra. Similar to Pathankot, here also heavy rain delayed the inauguration of Vigyan Rail by one day. Shri Subhash Goyal, District Collector, Kurukshetra inaugurated the exhibition on August 14, 2004. Vigyan Rail was stationed there up to August 15, 2004. Over 20,000 people visited the exhibition.

School students inside CSIR coach at Ferozepur station

Long queues awaiting to see the Vigyan Rail at Kurukshetra

Snoring: 12 Tips to Silent Sleep

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

If you gurgle, snort, or make loud throat noises during sleep and your family members complain about it or move out of the bedroom, it is time to sit up and take notice. This advice is not for their sake alone! Surprising, as it may seem, snoring can take a major toll on its victim. The loud noisy snores can sometimes be punctuated by short periods of cessation of breathing—a condition called sleep apnoea—which carries serious risk to life. Even if the situation is not so dire, for your family's sake, it is best to grasp the basics and take steps to resolve the situation.

What Causes Snoring?

The sound of snoring is produced when air inhaled through the mouth vibrates the soft palate—the tissue in the roof of the mouth near the throat. As the soft tissue vibrates, the lips, cheeks, and nostrils can also vibrate, making the snoring even louder.

The din becomes worse, if the air passage gets narrowed. Snoring reaches a crescendo and turns into a harsh or rattling noise. Floppy throat muscles, a large tongue, blocked nose, obesity, enlarged adenoids and tonsils, and alcohol use—all can lead to such a situation.

The Gender Divide

Almost everyone snores occasionally, but men are the worst sufferers. They usually snore more often than women and children. The results of some community studies also may not be music to the ears of the fairer sex, with nearly two out of three snorers being men. Those individuals, who are overweight, are more likely to raise a din.

Recognize The Danger

When snoring and rapid, heavy breathing are punctuated by frequent seven- to ten-second periods of stoppages in breathing (at least five times an hour), the problem may be "obstructive sleep apnoea", a more serious disorder. The problem occurs when the soft tissues of pharynx relax and become floppy during sleep and the upper airways get obstructed because of it. The breathing ceases until the levels of oxygen in the blood drops so low that the victim responds by waking up and taking a deep snorting breath.

Sleep apnoea carries serious health risks. Its symptoms may include:

- Restless, unrefreshing sleep
- Sleepiness during the day
- Poor memory and concentration
- Headache in the morning
- Frequent passage of urine at night
- Change in personality

The dangers include:

- Accidents while driving or at work
- Rise in blood pressure
- Wayward heart rhythm (irregular heart beat, arrhythmia)
- Pulmonary hypertension (abnormally high pressure in the blood vessels supplying the lungs, which imposes extra burden on the right side of the heart)

Diagnosis

If you fulfil the diagnostic criteria of sleep apnoea, your doctor will examine your nose and throat to rule out an obvious cause of obstruction to your breathing. You may require an endoscopy of the nose and throat, X-rays or CT scan of the head and neck region. To confirm the diagnosis, you may have to undergo sleep studies, in which variables such as your breathing, oxygen levels in your blood, and your heart rate are measured while you are asleep.

REMEDIES AND CURES

Maintain a healthy weight : Eat a well-balanced diet designed to keep your weight within a healthy range for your height, age, and body type. If you are overweight, go on a diet and begin an exercise programme to tone your muscles and lose body fat. Even a modest weight reduction can work a cure and stop you from giving others sleepless nights.

Sleep on your side : If you sleep on your back, try changing this. Sleep on your side. It may work magic.

Actually, when you sleep on your back, the upper airway is more likely to get partly blocked. A simple change in posture can correct the situation.

Sleep easy : If you are overly fatigued, you are more likely to snore. Deep sleep draws the flabby throat muscles into the airway, and invites snoring. Therefore, do not fret too much if you happen to snore after a long exhausting day.

Treat the cold : A cold or upper respiratory infection can make breathing difficult and cause snoring as the person struggles to draw air through blocked nasal passages and throat during sleep.

Even though it is difficult to treat a cold, you could try decongestant nasal drops and take plenty of fluids and vitamin C.

Maintain the patency of nose : If the wall (nasal septum) that separates the nasal cavity into the right and left nostril is misshapen, or there is a swelling in the nasal cavity, such as a nasal polyp, the nasal passage can get blocked. This is a common cause of snoring. Both a deviated nasal septum and nasal polyp can be treated by surgery. Just see an ENT surgeon.

Treat allergies : Keep your allergies under a check. Upper respiratory allergies can partly block the upper airways and cause snoring. Take care to reduce bedroom allergens—dust, pet dander, mould—which are notorious

for pulling the allergy trigger. Use a humidifier in your bedroom if the air is too dry. Else, keep some water in a broad-based utensil and leave it in a corner of the room.

Never neglect tonsils or adenoids : If your child has swollen tonsils or adenoids (lymphoid tissues located at the back of the throat), fix an appointment with an ENT doctor. If the glands are chronically inflamed and need removal, do not shy away from surgery.

Avoid getting tipsy : Alcohol makes the muscles of the upper airway tipsy. If a person has one too many, he can be sure of raising a din one-way or the other! If you yearn for a silent night, it is best to avoid alcoholic drinks. If you must wet your throat, do so in moderation and avoid going to sleep till at least three hours of logging in alcohol, so that the body is able to metabolise some of it.

Stay away from the medicine chest : Avoid sleeping pills, tranquillisers, and anti-histamines (anti-allergic pills) before going to bed. They can have a depressant effect on the muscles of the soft palate, and this can lead to heavy snoring.

Consult your doctor : Simple self-care remedies can often help. If they don't and you face any of the following situations, see a physician who is trained in the area of sleep medicine.

- If a family member notices that you experience cyclical stop-and-start breathing spells, or violent jerking or snorting during sleep.
- If you suffer from lack of concentration, sleepiness, fatigue, or ruffled nerves despite a full night's sleep.

Try positive pressure ventilation : If you suffer from short periods of breathing stoppages during sleep on a regular basis (sleep apnoea), it could be serious. If simpler measures do not yield result, you may need positive pressure ventilation. In this procedure, air is steadily pumped through a tightly fitting nasal mask. The high pressure of the pumped air keeps the upper airways open. The treatment needs to be carried out every night during sleep, and it can be easily given at home. However, some people have difficulty in sleeping with a mask on. The device is also rather expensive.

If nothing works, think of surgery : If positive pressure ventilation is not effective, it may be necessary to reconstruct the soft palate by doing surgery.

Dr. Yatish Agarwal, Mrs. Rekha Agarwal receiving the Meghnad Saha Award of Rs. 1 Lac Instituted by Raj Bhasha Vibhag of DST for their book `Khile Matritva: Gunjen Kilkariyan from Professor V.S. Ramamurthy, Secretary, Department of Science & Technology at a function organised at Technology Bhawan on September 06, 2004. The book has been published by Vigyan Prasar

The Search for Advanced Extraterrestrial Life in the Universe

❑ P.K. Mukherjee

The genetic basis of life as it exists on Earth is the double-stranded DNA molecule. Today, we have a wealth of information about the genetic material called DNA. However, a question that still perplexes the scientists is how did life originate on Earth. Who sowed the seeds of our beginning? Prevalent among the scientists are two viewpoints on this. According to some scientists the life arrived on Earth from the outer space. The supporters of this theory are astronomers like Fred Hoyle who claim that life was possibly carried piggyback to Earth on hurtling meteors, asteroids and comets. But, refuting this, other scientists say that the life on Earth did not come from anywhere else. Rather, it originated and developed on Earth itself. Whatever may be the case, one can witness the life thriving on almost every part of the Earth¾from desolate Polar ice caps to hot deserts, from deep down inside the Earth to the ocean floors and even in the boiling water streams.

Carl E. Sagan

This naturally raises a pertinent question, whether the physical conditions congenial to support life exists only on Earth? A section of scientists believe that we are not alone in the universe, that is, life can also exist elsewhere.

It may be mentioned that besides visible light new windows in the form of X-rays, gamma rays, infrared-rays etc. have also been opened for observing the universe. Powerful radio telescopes have also been constructed. These high-quality telescopes and other instruments available today are widening our horizons and our perceptions of the universe. They have also led to intensification of efforts by scientists and astronomers for search of civilisations other than our own. Thanks to these efforts, a whole new science called exobiology (also sometimes dubbed as astrobiology) has now come into being.

Sir Fred Hoyle

In 1996, the NASA scientists after carefully analysing a potato-shaped meteorite, called Allan Hills, created a sensation the world over by announcing that unicellular microorganisms existed on the Planet Mars about four billion years ago. But, a hot debate followed questioning the veracity of the finding itself.

In 1997, the pictures of the Jupiter's satellite Europa taken with the help of satellites revealed that, like Earth, Europa too has an icy surface. This suggested the existence of warm oceans up to a depth of about 100 kilometers beneath the icy cover which, said the scientists, could host some form of life.

In 2G82.NASA's spacecraft Mars Odyssey suggested the existence of an icy ocean beneath the surface of the red planet Mars. The possibility of the existence of water has definitely enhanced the probability of some form of life being found there.

On the other hand, millimeter-wave telescopes revealed important information to the astronomers that the interstellar space contains complex molecules, organic as well as inorganic. This information regarding the existence of such molecules in space is a pointer to the fact that life might also exist elsewhere in such a vast universe.

To explore the possibilities of the existence of life on Mars, NASA sent its rovers Spirit and Opportunity to the red planet in June and July, 2003 respectively. Both these rovers touched Mars in January, 2004 and are busy looking actively for the signs of life on Mars.

However, the search for life in the universe by the scientists and astronomers has only reinforced the fact that probably intelligent form of life does not exist on any other planetary body of the solar system, barring Earth, although one cannot point blank deny the existence of some micro form of life elsewhere.

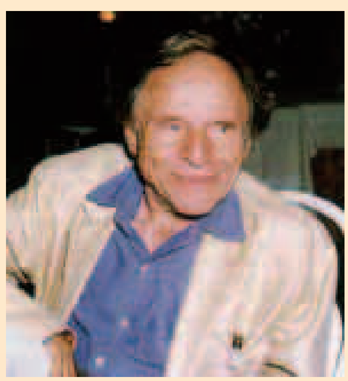
Even so, some scientists are highly optimistic of the existence of intelligent form of life in the universe. It does not seem logical, reason these scientists, that the birth and evolution of life took place only on Earth. After all, sun is just an ordinary star of a vast multitude of stars called Milky Way, the galaxy we live in, which contains some 200 billion stars. The Milky Way, our galaxy, is very vast indeed. But, the universe extends well beyond our galaxy. Astronomers have been able to discover millions of galaxies of different shape and size in the entire universe. In such a vast universe containing millions of galaxies with each galaxy containing billions of stars, is it possible that origin and evolution of life took place on an ordinary planet of a star that is by no means unique? The scientists negate this by saying that it is highly implausible.

Enrico Fermi

Notably, over the last one decade, the astronomers have been able to discover more than 100 extra-solar planets. Most of them are isolated planets that orbit their parent stars although at least four stars have been discovered whose planetary systems contain multiple planets. However, most of the planets discovered so far go around their parent stars in orbits that are sharply elliptical. Such orbits would make the planet freeze and heat to extremes of temperature as the planet comes close to its star and then pulls away from it. Such planets obviously do not seem to be the fit candidates for hosting life.

Incidentally, two of the planets discovered so far are found to orbit the star 47 Ursae Majoris. Like solar planets both these planets move in nearly circular orbits around their star. Also, between the two planets a vast empty space, like the space in our solar system, has been found. The astronomers speculate that small planets might exist in this space in which all the conditions congenial for hosting life may be present. The discovery of planetary systems outside the solar system belonging to the star Ursae Majoris, has once again made the scientists believe that probably we are not alone in the universe. There may be extra-Terrestrial Intelligent (ETI) beings inhabiting other civilisations.

The search for ETI beings was first advocated by Philip Morrison and Gieuseppe Cocconi in 1959. The search for intelligent beings in the universe was subsequently dubbed as SETI (Search for Extra-Terrestrial Intelligence). Under these efforts, radio signals were transmitted to space from time to time with the hope of that someone out there will respond.



Philip Morrison

In 1974, radio signals were sent from the giant, 300-metre radio telescope at Arecibo, Puerto Rico to the globular star cluster M-13, about 25,000 light years (light year is the distance travelled by light *in* one year and it is approximately 10,000 billion kilometers) away from us, situated in the constellation of Hercules. The message sent was coded using the computer's binary system. However, this binary signal failed to evoke any response.

The efforts to contact the intelligent beings are indeed fraught with many problems. Nonetheless, the efforts are still continuing. Besides radio signals audio-visual messages have also been sent to the space in the hope that some hitherto unknown intelligent beings might listen to or view these messages. One such effort was made in 1972 when a spacecraft called Pioneer10 was launched on a voyage into space. The spacecraft contained a plaque on which along with the hydrogen atom and sketches of a man and a woman without clothes, sketches of a spacecraft and the solar system were also made. The scientists hoped that as the spacecraft left the solar system and continued its journey farther out, some intelligent extraterrestrial beings picking up the information supplied on the plaque might come looking for us. Thus, instead of our finding them we leave it to them to find us. The spacecrafts Voyager I and II were also subsequently sent into space. Along with many audio messages recorded in LPs they also carried some pictures disclosing our whereabouts.

It may not be out of place to mention here that the American radio astronomer Frank Drake,who is one of the optimists about ETI, proposed in 1960 an equation which has, in toto, eight factors. Dubbed as Drake equation, it helps us to calculate the number of extraterrestrial super-civilisations in the galaxy. However, the final answer as to the estimated number of such extraterrestrials cannot be given yet with any degree of confidence. According to Carl Sagan, the number of extraterrestrial super-civilisation in universe should be around a million while according to some other more optimists this number could well be several billions.

However there are still some pessimists who held the firm view that Earth is the only location of life. They are obviously strictly opposed to the idea of the existence of ETI beings. One such pessimist was the noted Italian physicist Enrico Fermi himself who in 1950 asked his colleagues: “Where are they?” Fermi probably wanted to ask that if ETIs existed then how come that they did not visit the Earth. This is known as the ‘Fermi's puzzle’.

The scientists believing in the existence of ETIs answer the question posed by Fermi by arguing that the advanced extraterrestrial super-civilisations colonising the galaxy are constantly keeping a vigil on all our activities although purposely they are not interfering. The ETIs are watching us to study our growth, progress and our development as human civilization just as animals and birds are protected in a zoo. This viewpoint is known as the Zoo Hypothesis.’

In any event if one believes in the existence of the intelligent beings, they would also be sending their messages to establish contact with human beings. We must, therefore, try to catch these signal or messages, say the astronomers.

The first attempt in this direction was made by Frank Drake. Using the 28-metre radio telescope at National Radio Observatory at Green ‘Bank, Virginia, Drake tried to detect signals coming from the sun-like stars, *Tau Ceti* and *Epsilon Eridani*, which are about 12 light years away. This search venture of Drake was dubbed as the project Ozma. Subsequently, an Institute called SETI also came into being.

SETI's Claim to detect the fiest radio signal from an alien civilization

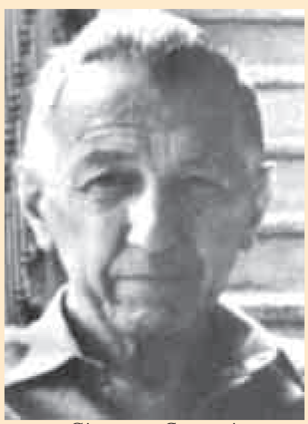
Scientists from SETI, the worldwide project for search for Extraterrestrial Intelligence, have recently claimed to have detected what they believe to be the first radio signal from an alien civilization. A faint pulse has been detected by the 300-metre Arecibo radio telescopes in Puerto Rico, supposed to be the worlds biggest single-dish telescope the signal originated from a planet located somewhere between the two constellations of Pisces and Aries, say the scientists.

Can't the received signal be the result of interference from Earth, satellites or other cosmic sounds? Scientists have negated this possibility "It boggles my mind. We are looking for something that seams 'Artificial' but this just doesn't do that", says aric korpela, a scientist with SETI.

Intect, the signal was first detected by two home computer users in Germany and the United States, following which SETI redirected the Arecibo telescope towards the source.

The report on this finding will be published in the science journal *New Scientist.* "The signal is moving rapidly in frequency. You would expect this from a transmitter on a rapidly rotating planet", the journal quoted SETI scientist Eric Korpela as saying.

This privately-funded Institute, with Drake as its President, looks for signals coming from the intelligent extraterrestrial civilisations.



Giuseppe Cocconi

However, the greatest problem in this search venture was to decide about the wavelength range that is possibly used for intrastellar communication by ETIs. After lot of churning out, the scientists finally were convinced that the 21 centimeter-waves emitted by tile free atoms of hydrogen would serve the purpose, for hydrogen is the element that is present in abundance in the universe.

So far, however, no confirmed extraterrestrial signals have been detected by the scientists. However, they have yet not given up all hopes. The SETI efforts are, therefore, continuing maybe in their own modest way.

Recently the SETI Institute is busy constructing a radio telescope that is expected to start operating from 2005. This giant telescope, called Allen Telescope Array, named after the sponsor and Microsoft cofounder Paul Allen, will have a network of more than 350, six-meter satellite dishes with a collecting area exceeding that of a 100-metre telescope. Planned to be built at the Hat Creek Observatory, Allen Array telescope will be able to search the signals coming from about one million stars at least hundred times faster. This search will continue twenty four hours a day, seven days a week.

Frank Drake

The senior astronomer with the SETI Institute, Seth Soshtak, says that he is convinced of the existence ETIs. However, their appearance may not be that loveable or pleasant. If like us humans, they share the same carbon-based chemistry then some of their body features might as well resemble us. They would probably have a central processing system eyes, legs and some form of reproduction, says Soshtak.

Nonetheless, all these efforts to look for life elsewhere in the universe raise the hope that the 'silence' in space would certainly 'be broken one day and we will be able to establish contact with an advanced extraterrestrial civilisation'.

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2. Life chase by D. Balasubramanian, Science Reporter, May 1999
3. Science in 21st Century by Dilip M. Salwi, Konark Publishers Pvt. Ltd., Delhi, 1993
   (see the article 'Hello! Hello! Anyone out there on p.277 compiled in the book)

The Journey has just Begun (contd. from page....35)

for Science and Technology Communication to run Vigyan Rail till December 31, 2004. Accordingly, after mandatory maintenance by the Railways, Vigyan Rail will soon be on track once again and will travel to places it could not cover in its first phase.

Vigyan Rail has created ripples in several countries. There have been requests from France for information on Vigyan Rail. A scientific delegation from Argentina visited Vigyan Rail in Delhi. A member of the delegation expressed, "If we are carrying something back to our country, it is the concept of Vigyan Rail!" A member of the American Embassy who visited the train exclaimed, "Now I want to have a science train in California, my home State!" There also have been numerous requests from Asian countries about Vigyan Rail.

Vigyan Rail could reach only about five million people of the country in eight months - indeed, a drop in the ocean for a country with a population of over a billion! How shall we reach the rest? What should be our strategy? It is a challenge. The journey has just begun!

❒ V. B. Kamble

Recent Devlopments in Science & Technology

Fuel-cell technology

Scientists in the USA have developed a new technology to generate energy which may be of use in lighting up villages in India, besides being useful for cars and cell phone batteries.

The new technology called fuel cell technology can be used for off grid power generation . Dr Thomas M.Connelly, Global Chief Science and Technology Officer of Dupont, the company which has developed the technology told he is seeing tremendous opportunities in India. Fuel cell technology could also be used for running cars and cell phones. However, for using it in cell phones, scientists are working to produce microfuel cells.

Microfuel cells for example of 2.5 Kilo Watt per hour capacity, might act as portable energy source and be used to even light up a room, he said. When used in cell phones, fuel cells would allow users to avoid the need to charge the battery every day.

Source : PTI News

Gold charges up electron by electron

Now a days nanotechnology researchers are putting a lot of energy to control over the building blocks of matter. That control has now reached a new level. Instead of moving atoms individually, IBM scientists say that they can change their electrical charge, electron by electron. People have been moving atoms around for ten years. Here they go one step further, leaving the atoms where they are but changing their status," says Karsten Horn, a physicist at the Fritz Haber Institute of theMax Planck Society in Berlin,Germany.

The electrical charge of an atom is one of its most fundamental properties. It influences the way the atom reacts with the rest of the world, and also how the atom transfers electricity to its neighbours. Jascha Repp, a physicist at IBM's Zurich Research Laboratory in Switzerland, and his team used a scanning tunnelling microscope (STM) to deliver a single electron to individual gold atoms, giving each one a negative charge. Invented in the 1980s, an STM contains a tip that narrows to an atom-sharp point. As the microscope scans over a surface, individual atoms change the electrical current flowing through the tip.

Source Nature.com

Telescope Network Detects Distant Planet

Telescopes need not be huge to make large discoveries. Astronomers have discovered a new Jupiter-size gas giant orbiting a star 500 light-years away from Earth that was found using telescopes as small as four-inches in diameter.

The Trans-Atlantic Exoplanet Survey (TrES) is comprised of smaller, relatively inexpensive telescopes located around the world. TrES uses the so-called transit technique, which looks for shadows caused by a planet passing between its star and Earth, to scan the skies for signs of faraway worlds. In a paper submitted to *The Astrophysical Journal Letters,* the team dubbed the first planet found TrES-1.

Subsequent observations with the 10-meter-diameter Keck telescopes in Hawaii— behemoths compared to the ones that make up TrES—confirmed that TrES-1 is orbiting a star in the constellation Lyra. It circles its star every 3.03 days at a distance of just four million miles, which would suggest that temperatures on TrES1 could reach a staggering 1,500 degrees Fahrenheit. Notes study co-author Guillermo Torres of CfA, "This discovery demonstrates that even humble telescopes can make huge contributions to planet searches."

Source : Scientific American .com, August 2004

Computer chips get tough

Silicon carbide (SiC) is a semiconductor with certain advantages over pure silicon that make it desirable in high-power, high-frequency and high-temperature applications. Silicon carbide (SiC) is much better than silicon at carrying current in an electronic circuit, so it could potentially reduce the amount of energy wasted in every electronic device in the home or office. It can also operate at much higher temperatures, meaning that silicon carbide-based sensors could even monitor jet engines from the inside.

Scientists have long recognized the potential of silicon carbide to replace silicon chips, but until now it has proved tricky to make sufficiently large crystals without introducing defects that interfere with reliability.

Unlike most industrial semiconductors, SiC does not have a liquid form, which means that entirely novel techniques had to be developed to grow large crystals from SiC vapor. Unfortunately these processes result in structural defects that affect the performance of chips made from the resulting SiC wafers. Kazumasa Takatori of Toyota Central R&D Laboratories and his colleagues were able to reduce the number of defects in a single SiC crystal by growing it in multiple directions. The basic structure of SiC is a silicon-carbon bilayer in which silicon atoms sit on top of hexagons of carbon.

Takatori expects that once reliable components are made, SiC could appear in power converters, cars, and household appliances, as well as amplifiers for communication base stations. SiC semiconductors are expected to use in practical purpose at around year 2010-2012.

Source: Nature.com

Compiled by : Kapil Tripathi