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Aiming for the Bull's Eye

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

Aiming for the Bull's Eye

Abhinav Bindra was tied for the first position with Henri Häkkinen of Finland for his final shot in the men's 10 metre air rifle final at Beijing. He pulled the trigger; and bang! It was the bull's eye! He became the first Indian to win a gold medal in an individual event for the country in its 88-year-long Olympic history! Bindra's remarkable feat was later added on to by another two bronze medals, for boxing by Vijender Kumar and for wrestling by Sushil Kumar, making it a total of three Olympic medals for the country – the highest ever for India. And yet, India managed to finish a poor 50th in the overall medals tally!

Surely, China dominated in every department, and in every respect. The organisation was flawless, the spectacle grand, and the facilities superb. In 1984 at Los Angeles, China won its first gold medal. In 2008, it topped the medal table capturing 51 gold and exactly 100 in total, ranking only next to U.S.A. which had a haul of 110 medals including 36 gold medals. It is a testament to China's investment in youth and sporting excellence.

International Olympic Committee (IOC) president Jacques Rogge was not surprised by China's domination. He pointed out that China's population of 1.3 billion gives it variety and a huge base from which to select and nurture world-class athletes. Next, China has taken it as a challenge to project a healthy image, not only as a sporting superpower but as a country with a healthy economy and a world-class lifestyle. The first observation of Rogge, in toto, applies to India as well, and the second one only to a limited extent. But, the fact remains that since 1928 we have managed to win only 18 medals, 11 of which were for Field Hockey. Incidentally, our hockey team did not even qualify to play at Beijing! How is that? And what applies to our performance in Olympic Games, applies to other fields as well to a greater or a lesser extent.

A strife-torn Georgia managed to win 6 medals (3 gold) with a contingent of just 35 sportspersons. Zimbabwe clinched 4 (1 gold), Ethiopia 7 (4 gold), Kenya 14 (5 gold), and Jamaica 11 (6 gold). Surely, it cannot be the population of the country alone. Nor can it be the economic resources alone available to its athletes. Otherwise how do we explain tiny and poor countries like Zimbabwe or Ethiopia putting up a spectacular performance at the Olympic Games, even far superior to India? So, what holds us back in a country of a billion plus that provides variety and a huge base for selection and nurturing of world class athletes?

While it is definitely a time to celebrate and feel proud of the achievement of Abhinav, Sushil and Vijender, it calls for introspection as to why our athletes fail to perform at world level competitions. Though they won Olympic medals for India, how much credit do they owe to the Government or any of the sports bodies in India? While Abhinav was provided with a private air-conditioned shooting range at home by his father, Vijender and Sushil fought their way through adversities with the help of local clubs and their coaches.

When we talk about sports in India, we often hear that we are not a sporty nation; we have no sports facilities, and that the government needs to fix a lot of the infrastructure. But there are a few important lessons India must learn from Beijing and the athletes whom we have watched and admired. To begin with, we need to build a sporting culture in the country. And in this, every one of us needs to play an active role, and not just give advice on what to do. When was the last time we played a game, ran, or cycled? In school? In college? True, we are a cricket crazy nation. However, the only time most of us have anything to do with cricket (or any other sport for that matter) is when we watch a cricket or tennis match on television. And yet, we are also the first to shout at Dhoni or Sehwag on the screen telling them what they should do!

Where do we begin? Sports such as running, swimming and cycling are important for keeping us fit and in tune for any other sport. These are the basic activities that need to be encouraged at home, school and the state level. Team sports such as football, volleyball, kho-kho, and kabaddi help us learn team skills while developing individual competence. Tennis and table tennis sharpen our reflexes. Rock-climbing

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Editor : **Dr. V. B. Kamble**
Address for correspondence : Vigyan Prasar, C-24, Qutab Institutional Area, New Delhi-110 016; Tel : 011-26967532; Fax : 0120-2404437
e-mail : info@vigyanprasar.gov.in
website : http://www.vigyanprasar.gov.in

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Fred Hoyle

The Most Versatile Astrophysicist of the 20th Century

☐ Subodh Mahanti
E-mail: subodh@vigyanprasar.gov.in

"There is a coherent plan in the universe, though I don't know what it's a plan for."

Fred Hoyle

"Hoyle's enduring insights into stars, nucleosynthesis, and the large-scale universe rank among the greatest achievements of 20th century astrophysics. Moreover, his theories were unfailingly stimulating, even when they proved transient."

Martin Rees, in Hoyle's obituary in *Physics Today* (November 2001)

"…..even his (Hoyle's) critics admit his unique creativity, originality and extraordinary perception. It would not be an exaggeration to call this extraordinary personality, the Galileo of modern times."

J. V. Narlikar in Hoyle's obituary in *Current Science* (October 2001)

Fred Hoyle is regarded 'as the most original and versatile astrophysicist' of the 20th century. Hoyle together with the British cosmologist and mathematician Hermann Bondi (1919-2004) and the Austrian-American astronomer Thomas Gold (1920-2004) proposed the Steady State theory of the universe, which was later discarded by most cosmologists in favour of the Big Bang theory. Irrespective of its present fate the Steady State theory will always be regarded as one of the highest points of intellectual development in human history. To many, Hoyle's fame as scientist primarily rests on his work on nucleosynthesis in stars; that is, the idea that the chemical elements were synthesised from primordial hydrogen and helium in stars. His work on stellar evolution is also highly significant.

To give a glimpse of Hoyle's diverse research works here we quote the well-known India astrophysicist J.V. Narlikar, who worked with Hoyle: "Hoyle's researches have given new directions to many branches of astrophysics. The origin of solar system, the evolution of stars, the origin of cosmic rays, the mystery of dust in the interstellar space, the phenomenon of accretion on stars, the formation of the Milky Way, radio sources, pulsars, quasars and, of course, his favourite branch cosmology…. In today's era of narrow specialization, it is extremely rare to find a scientist with such a variety of research interests and with such a seminal record of contributions with high impact factor".

Hoyle rejected many well-established theories, like chemical theories explaining the origin of life and Darwin's theory of evolution. He also propounded many unorthodox ideas. He was a great populariser of science, particularly of astronomy. He wrote many popular science books and was also a highly accomplished science fiction writer. Hoyle established the Institute of Theoretical Astronomy in Cambridge in 1967 and he was its first Director.

Fred Hoyle

Hoyle was born on 24 June 1915 at Bingley in West Yorkshire, England. Hoyle's father George Hoyle worked in the wool trade. His mother Mabel Hoyle (*nee* Pickard) was an expert in music. She had studied music at the Royal College of Music at London and excelled in playing the piano. Hoyle displayed unusual analytical ability at a very early age. He also developed an interest in the piano. At the age of three he was able to work out the way to read the clock and tell the time all by himself. At four he could write out the multiplication tables up to 12×12 =144. In his childhood Hoyle was much influenced by books such as Arthur Eddington's *Stars to Atoms* and T. E. Lawrence's *Seven Pillars of Wisdom*. Hoyle's interest in astronomy developed at a very young age.

Hoyle's primary education began at the Morning Road School in Bingley and he later studied at the Bingley Grammar School. Hoyle was anti-establishment since his childhood. Throughout his life he was "at war with the system." Hoyle himself wrote: "Between the ages of five and nine, I was perpetually at war with the educational system. My father always deferred to my mother's judgement in several crises of my early educational career, because she had been a school

Hermann Bondi

teacher herself…events would suggest that my mother was unreasonably tolerant of my obduracy. But, precisely because she had been a teacher herself, my mother could see that I made the best steps when I was left alone."

Hoyle did not take anything for granted until he was satisfied with it. In this context an interesting episode of Hoyle's childhood, described by Narlikar, may be worth quoting. "In his first primary school, a teacher once taught in the class that a certain type of flower has five petals. The next day, Fred produced a flower of the same kind with six petals and asked the teacher to justify her statement. The teacher, embarrassed and angered by this counter example, smote the boy's ear. Shocked by this unjustified response, Fred left school at once and came back home. He told his mother that he would never go to the school where such injustice prevailed. His mother supported his stand and argued his case with the school authorities, who finally gave her permission to change the boy's school. Later in his life, Hoyle had to face many such incidents, whenever he challenged the set attitudes of the establishments."

Hoyle joined the Emmanuel College in Cambridge where he was taught by some of the most outstanding scientists like Max Born (1882-1972), Arthur Stanley Eddington (1882-1944) and Paul Adrien Maurice Dirac (1902-1984). In 1936, he passed the Mathematical Tripos. He was among the top ten students of that year and was awarded the Mayhew Prize for being the best student in applied mathematics. He continued to do research in applied mathematics at Cambridge. For his outstanding work he was awarded the top Smith's Prize in 1938. In 1939, Hoyle published a major research paper on quantum electrodynamics in the *Proceedings of the Cambridge Philosophical Society*. After this his interest shifted towards mathematical problems in astronomy. In May 1939 Hoyle was elected to a Fellowship at St John's. He also received a highly prestigious award from the Commission for the Exhibition of 1851. With all these developments he was to embark upon a successful research career, but the outbreak of the Second World War disturbed everything. Hoyle had to join the war efforts. He worked for the Admiralty Signals Establishment where he worked on the development of radar with Hermann Bondi and Thomas Gold. The three together discussed astronomy in their spare time.

In 1944 Hoyle visited the US. Though he went there in connection with his work on radar, it gave him an opportunity to get familiar with the work on the atom bomb project. Here he became interested in nucleosynthesis, the process by which elements were produced in stars. After the War was over Hoyle came back to Cambridge and started working in astronomy.

The theory of the origin of most of the elements was worked out by Hoyle jointly with William Alfred Fowler and the husband-wife team of Geoffrey and Margaret Burbidge. This theory is referred to after its four authors as the 'B^2 FH theory'. Their work was published in 1957 in the *Reviews of Modern Physics.* The conclusion reached in this classic paper has stood the test of time. This work earned William Alfred Fowler the Nobel Prize in Physics, jointly with the Indian-born astrophysicist Subrahmanyan Chandrasekhar in 1983. Many thought that Hoyle was denied the rightful claim to the Prize. In fact, Fowler himself in an autobiographical sketch prepared for the

Thomas Gold

Nobel Foundation wrote: "The concept of nucleosynthesis in stars was first established by Hoyle in 1946. This provided a way to explain the existence of elements heavier than helium in the universe, basically by showing that critical elements such as carbon could be generated in stars and then incorporated in other stars and planets when that star "died". The new stars formed now start off with these heavier elements and even heavier elements are formed from them. Hoyle theorised that other rare elements could be explained by supernovas, the giant explosions which occasionally occur throughout the universe, whose temperatures and pressures would be required to create such elements."

Nucleosynthesis is the process of creating elements by nuclear reactions. First, hydrogen is converted to helium by the proton-proton reaction or the carbon-nitrogen cycle. In proton-proton reaction, four hydrogen nuclei (that is, protons) fuse to form one nucleus of helium. The reaction also produces a number of intermediate nuclei such as deuterium and isotopes of lithium, beryllium, and boron. The carbon-nitrogen cycle converts hydrogen into helium and in the process releases nuclear energy. Carbon, nitrogen, and oxygen act as catalyst to speed up a six-stage reaction. It is also known as carbon-nitrogen-oxygen cycle. At temperatures below 18 million Kelvin the

Paul Adrien Maurice Dirac

proton-proton reactions becomes more important than the carbon-nitrogen cycle. However, as temperatures go above 18 million Kelvin then the carbon-nitrogen cycle takes over the proton-nitrogen reaction.

Hoyle jointly with Bondi and Gold proposed a theory of the origin of the Universe. This theory is known as the 'Steady State Theory'. According to this theory, the universe has no beginning and no end. It has remained unchanged with time. The theory assumes that the universe is homogeneous and isotropic. To take care of the known expansion of the universe the theory stipulates that matter is spontaneously created and that is how the mean mass density of the universe remains at a constant value. To explain the appearance of new matter Hoyle postulated the existence of so-called the "creation field" or just the "C-field". This hypothetical field was thought to have negative pressure in order to be consistent with the conservation of energy. The C-field anticipated the later development of cosmic inflation.

It is interesting to note that that a ghost film provoked Hoyle and his co-workers Bondi and Gold to finally propose the Steady State Theory. The film was in four parts but linked the sections together to create a circular plot in which the end of the film became its beginning. From this film Hoyle got the idea, as he later admitted, that it was not necessary that unchanging situations had to be always static. Thus the universe could perhaps be both unchanging and dynamic.

The steady-state model is based on four assumptions collectively known as the perfect cosmological principle:

1. Physical laws are universal. This means that any science experiment, if performed under identical conditions, will have the same result anywhere in the universe.
2. On a sufficiently large scale the universe is homogeneous.
3. The universe is isotropic; that is, there is no preferred direction in the universe.
4. Over sufficiently long time the universe looks essentially the same at all times.

The Steady State Theory was the only serious alternative to the Big Bang theory, which was in agreement with the Hubble's red-shift observations. According to the Big Bang theory, the universe originated from the initial state of unimaginably high temperature and density and it has been expanding ever since its origin. The theory of general relativity predicts the existence of a singularity at the very beginning, where the temperature and density of matter were infinite. The Big Bang theory also accounted for the expansion of the universe, the cosmic background radiation, and the abundance of light nuclei such as helium, helium-3, deuterium, and lithium-7.

Hoyle disagreed with the assumptions of the Big Bang Theory. To Hoyle the very idea of a universe with a beginning seemed to be philosophically troubling. A beginning implies a cause and there should be someone (a creator!) to begin it. The Steady State Theory attempted to demonstrate how the universe could be eternal and essentially unchanging while still expanding where the galaxies we observe move away from each other.

Incidentally, the term "Big Bang" was coined by Hoyle, and it was reported that the term was meant to make fun of the theory, which competed with Hoyle's

Arthur Stanley Eddington

own theory on the creation of the universe. However, Hoyle had no such thing in mind. The expression was intended to help his listeners to grasp the ideas behind the theory. In fact Hoyle himself explicitly stated that he had no intention to be insulting. He coined the term just to emphasise the difference between the two theories for radio listeners.

In 1993, a newer version of the Steady State Theory known as 'Quasi-Steady State cosmology' (QSS) was proposed by Hoyle, Geoffrey Burbidge, and Jayant V. Narlikar. It was an attempt to explain additional features unaccounted for in the initial proposal. The theory suggests pockets of creation occurring over time within the universe, sometimes referred to as 'mini-bangs', 'mini-creation events', or little bangs. According to the theory the creation events are linked with strong gravitational fields and can occur on various scales, with our part of the universe being in created about 15 billion years ago. After the observation of an accelerating universe, further modifications of the model were done.

Hoyle was highly critical of theories of chemical evolution used to explain the origin of life. He strongly believed in extra-terrestrial origin of life. He suggested that biological molecules such as amino acids are synthesised in space on dust particles. Hoyle also believed that infective agents such is viruses arrived from space. With

Subrahmanyan Chandrasekhar

Chandra Wickramasinghe, Hoyle promoted the theory that life evolved in space, spreading through the universe via panspermia, and that evolution on Earth is driven by a steady influx of viruses arriving via comets.

In his book *Evolution from Space* (co-authored with Chandra Wickramasinghe), Hoyle calculated that the chance of obtaining the required set of enzymes for even the simplest living cell was extremely remote. He argued that even a whole universe full of primordial soup would grant little chance to evolutionary processes. He claimed: "The notion that not only the biopolymer but the operating program of a living cell also could be arrived at by chance in a primordial organic soup here on the Earth is evidently nonsense of a high order." He further stated: "The chance that higher life forms might have emerged in this way is comparable with the chance that a tornado sweeping through a junk-yard might assemble a Boeing 747 from the materials therein…I am at a loss to understand biologists' widespread compulsion to deny what seems to me to be obvious."

Hoyle believed that the universe is governed by a greater intelligence. Hoyle presented 'Evolution from Space' for the Royal Institution's Omni Lecture. After considering the very remote probability of evolution he concluded: "If one proceeds directly and straightforwardly in this matter, without being deflected by a fear of incurring the wrath of scientific opinion, one arrives at the conclusion that biomaterials with their amazing measure or order must be the outcome of intelligent design. No other possibility I have been able to think of..." In his book *Evolution from Space* (1982), he distanced himself completely from Darwinism. He was of the opinion that "natural selection" could not explain evolution. In his book *The Intelligent Universe* (1983) he wrote: "Life as we know it is among other things dependent on at least 2,000 different enzymes. How could the blind forces of the primal sea manage to put together the correct chemical elements to build enzymes?"

In one of his early papers Hoyle made an interesting use of the anthropic principle. While trying to figure out the routes of stellar nucleosynthesis, he observed that one particular nuclear reaction generating carbon called the triple-alpha process would require the carbon nucleus to have a very

Max Born

specific energy for it to work. The presence of large amount of carbon in the universe demonstrated that this nuclear reaction must work. Based on this assumption Hoyle made a prediction of the energy levels in the carbon nucleus. This was later proved to be correct experimentally. However, those energy levels, while needed in order to produce carbon in large quantities, were statistically very unlikely. Hoyle later wrote:

William Alfred Fowler

"Would you not say to yourself, 'Some super-calculating intellect must have designed the properties of the carbon atom, otherwise the chance of my finding such an atom through the blind forces of nature would be utterly minuscule.' Of course you would . . . A common-sense interpretation of the facts suggests that a super-intellect has monkeyed with physics, as well as with chemistry and biology, and that there are no blind forces worth speaking about in nature. The numbers one calculates from the facts seem to me so overwhelming as to put this conclusion almost beyond question."

Hoyle wrote a large number of popular science books. Some of the titles are: *Frontiers of Astronomy* (1955); *Astronomy: A history of man's investigation of the universe* (1962); *Nicolaus Copernicus* (1973); *The Intelligent Universe* (1983); *Evolution from Space: A Theory of Cosmic Creationism* (1984); *Home Is Where the Wind Blows: Chapters from a Cosmologist's Life (Autobiography)* (1994); and *Mathematics of Evolution* (1987).

Hoyle played a great role in popularising science, particularly astronomical sciences, through his radio talks, popular science writings and science fictions. Commenting on his science popularisation efforts the citation of the Royal Medal of the Royal Society stated: "…his popularisation of astronomical science can be warmly commended for the

descriptive style used and the feeling of enthusiasm about his subject which they succeeded in conveying."

Hoyle wrote about 40 books on science fiction, many of which he co-authored with his son Geoffrey Hoyle. Some of his science fiction works are: *The Black Cloud* (1957); *Ossian's Ride* (1959); *A for Andromeda: A Novel for Tomorrow* (Co-authored with John Elliot, 1962); *Fifth Planet* (co-authored with Geoffrey Hoyle, 1963); *Andromeda Breakthrough* (co-authored with Geoffrey Hoyle, 1965); *October the First Is Too Late* (1966); *Element 79* (1967); *Rockets in Ursa Major* (co-authored with Geoffrey Hoyle, 1969); *Seven Steps to the Sun* (co-authored with Geoffrey Hoyle, 1970); *The Inferno* (co-authored with Geoffrey Hoyle, 1973); *The Molecule Men and the Monster of Loch Ness* (co-authored with Geoffrey Hoyle, 1973) ; *Into Deepest Space* (co-authored with Geoffrey Hoyle, 1974), *The Incadescent ones* (co-authored with Geoffrey Hoyle, 1977); *The Westminster Disaster* (co-authored with Geoffrey Hoyle, 1978); and *Comet Halley* (1985).

He was elected to many academies and learned societies including the Royal Society of London (1957), the National Academy of Sciences of the United States of America (1969), the Royal Irish Academy (1977), and the American Philosophical Society (1980). He was the Vice President of the Council of the Royal Society. He was the President of the Royal Astronomical Society. Among the awards received by Hoyle included: Gold Medal of the Royal Astronomical Society (1968); Bruce Medal (1970): Henry Norris Russell Lectureship (1971); Royal Medal (1974); Klumpke-Roberts Award of the Astronomical Society of the Pacific (1977) and Crafoord Prize from the Royal Swedish Academy of Sciences, with Edwin Salpeter (1997). It may be noted here that the Crafoord Prize is a highly prestigious award given by the Swedish Academy in recognition of outstanding basic research in fields not covered by the Nobel Prize. Asteroid '8077 Hoyle' is named in his honour. He was awarded the United Nations' Kalinga Prize in 1968 for his contributions in the field of science popularisation.

Chandra Wickramasinghe

Besides his autobiography, other important biographical works include: *Conflict in the Cosmos: Fred Hoyle's Life in Science* by Simon Mitton (2005); *The Scientific Legacy of Fred Hoyle* by Douglas Gough (ed) (2005); *A Journey with Fred Hoyle: The Search for Cosmic Life* by Chandra Wickramasinghe (2005); and *Fred Hoyle's Universe* by N. C. Wickramasinghe, Geoffrey Burbidge and J. V. Narlikar (Editors) (2003).

J.V. Narlikar

J. V. Narlikar wrote: "Hoyle believed that a scientist should be sensitive to the issues affecting society and he himself did not hesitate to express his opinions publicly. In the 1970s, he wrote a book arguing that nuclear power alone can solve the energy crisis of the world. He had published a scholarly book which seeks to relate the old relics at Stonehenge in England to practices related to astronomy in the ancient civilization. He gave well-argued lectures on the dangers of the future growth of population."

Hoyle died on 25 August 2001 in Bournemouth, England.

In the last page of his autobiography Hoyle wrote: "After a lifetime of crabwise thinking, I have gradually become aware of the towering intellectual structure of the world. One article of faith I have about it is that, whatever the end may be for each of us, it cannot be a bad one."

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(The article is a popular presentation of the important points on the life and work of Fred Hoyle available in the existing literature. The idea is to inspire the younger generation of know more about Fred Hoyle. The author has given the sources consulted for writing this article. However, the sources on the Internet are numerous and so they have not been individually listed. The author is grateful to all those authors whose works have contributed to writing this article.)

SCIENCE, TECHNOLOGY AND TRANSITION TO A KNOWLEDGE SOCIETY

Critical Concerns and Issues

H. L. Nigam+ & U. C. Agarwala*

E-mail : dr_nigam@sify.com

Our lives in the 21st century are going to be transformed by unprecedented developments in science and technology, bringing revolutionary changes not only in our life-styles but also in our behaviour. Nanoscience and technology, information and communication technology, bioscience and technology and nuclear science and technology may be named as these incipient technologies. These technologies have exponential growth and hence there is acceleration in the pace of change.

Nanoscale science involves the study, understanding and control of matter at the atomic level (In the nanometre scale, one nanometre equals one millionth of a millimetre.) By manipulating individual atoms, self-assembly techniques are exploited for manufacturing electronic circuits in which individual components will be molecular switches and molecular wires made of carbon nanotubes. The cost of these circuits will be about a thousand times less than silicon-based circuits. The day is not far when nanotechnology will allow people to unobtrusively wear a computer as a watch-like appliance or jewellery or inside the frame of a pair of glasses or as woven inside clothing to keep people connected, informed and entertained. Imagine what type of wild cards could nanotechnology create? The inter-stellar probes to be launched may be about the size of a baseball as against the size of a big bus at present. The small size is going to make launching easy and at low cost.

Talking about information and communication technology and keeping in mind the recent advances in microelectronics, it is apt to say that hardly any area of modern life has been left untouched. The extensive production and use of electronic devices such as microchips, computer monitors, mobile phones, and the Internet are changing the ways in which people connect to the world at large. Information and communication technologies have become a driving force of rapidly globalising economy.

With the advent of genetic engineering, biotechnology has emerged as a new powerful key technology of the future. Deciphering of the human genome, the 100,000 genes encoded by three billion chemical pairs in our DNA has become the most important breakthrough of all time. In fact, genetic engineering has the potential to conquer cancer, grow new blood vessels in the heart, and create new organs from stem cells. Even human cloning may be possible in the near future.

Nuclear technology, considered as an immensely destructive technology for military purposes, is now being used to produce unlimited amounts of cheap and clean energy. The future possibility of muon-catalysed cold fusion and the production of anti-particles leading to the existence of an anti-world may soon be understood more fully.

However, the societal effects of these advances are fraught with many dangers. The nano dust can have harmful effects if it gets into the human blood. The British Government has asked the Royal Society and Royal Academy of Engineering to investigate the potential effects of nanotechnology, though most scientists believe that the benefits of nanotechnology will outweigh any harmful effects. Interference in privacy of individuals, and even Governments, has to be taken care of when advantage is being taken of information technology. Intellectual property rights will have to be taken care of by proper legislation. Even terrorists and criminals can invade cyberspace and destroy civilization. In wrong hands, human cloning, if freely allowed, may lead to production of chimeras (half man-half animal) and draconian demons. However, the aim of science is to work for betterment in general, health, prosperity and good life for human beings through understanding laws of Nature.

The technologies are meant to be used for creating resources. Considering the present rate of advance in knowledge and umpteen possibilities of future marvels it is easy to realise that the Knowledge Policy is different from the Science Policy or Research Policy because it has political implications. Carl Sagan once said "It is suicidal to create a society dependent on science and technology in which hardly anybody knows anything about science and technology. A network has therefore to be created which would give everyone in our society a window into the best advice science has to offer and help prepare us for what lies ahead. Science ought to be available on demand 24 hours a day, 7 days a week like water from a tap."

India today stands poised to reap the benefits of a rapidly growing economy and a major demographic advantage that will see the country having the largest pool of young people in the world in the next few decades. There is now need to utilise this young talent pool in institution building and for creating excellence in the field of education, research and capability building. This is precisely the requirement of a 'Knowledge Society' and if India has

to be a leader in the world, it is high time to take necessary steps to create conditions for transition to a knowledge society.

With this aim in view the Government of India constituted the National Knowledge Commission in June 2005. The Commission has rightly expressed the view that "no country in its path to becoming a knowledge society can allow a sizeable proportion of its population to remain illiterate. The 2001 census indicates that literacy level is about 65% with nearly 304 million non-literates. The Commission has analysed five aspects of the knowledge paradigm, namely, access to knowledge, concept and creation of knowledge, application of knowledge, and delivery of services. Following an interactive, constitution-based methodology to deliberate on different steps required to create a knowledge society in India, the Commission has submitted its recommendations to the Government of India in 2007. It is a comprehensive brilliant account of team work done by the mastermind members of this expert body and the government would possibly take steps to implement the recommendations partly or fully as it thinks proper. A public analysis of the subject may bring out points of relevance that would help the government in particular and the public in general to take notice of the critical issues and concerns in the light of the recommendation of the Commission.

Access to knowledge

First of the five paradigms of knowledge society, viz., access to knowledge, is through education. Right to education through central legislation and universal education is indisputably the first step as the Commission has pointed out. "The significance of language not only as medium of instruction or a means of communication but also as determinant of access to higher education cannot be overemphasized".

The Commission has recommended that along with the first language (either the mother-tongue or the regional language), English as a language may be introduced, starting from class I, as has been done by six states of the Northeast and three Union Territories. One is left guessing as to what would be the national language of India (Hindi) if the entire country adopts this! Without getting into any controversy about the importance of English language we would like to suggest that a three-language formula be adopted up to the High School stage and Hindi be taught compulsorily. Countries like China, Japan, Korea stick to their own national language even in their research journals and so long as facilities for translation into English are available at subsidized cost, there would be no difficulty in access to literature in science and technology in higher education.

The Commission has also recommended building a national knowledge network with gigabits capabilities to connect all universities, libraries, laboratories, hospitals, and agricultural institutions to share data and resources across the country. The Commission appears to have overlooked the reforms required at the Secondary Education level, which is in a pathetic condition in the country. For building a pyramid of higher education, the base of the Secondary Education must be very strong. At present only 15% students enrolled in schools reach the secondary stage and the teaching of science is not given due importance. The laboratory work done is almost negligible and without a strong foundation, the upper reaches of scientific knowledge would be difficult to scale.

The undergraduate education in the country is in a dismal state. There is no proper equipment in most colleges. Recruitment of teachers needs a dressing. Laboratories do not have adequate number of apparatus and instruments. The college libraries have very few books and the teachers read only abridged text-books and remain busy in earning extra money by coaching. The Commission recommends establishment of Central Board of Undergraduate Examinations. This amounts to making one such Board in every State of India! It will be very difficult to coordinate courses and syllabi and this would create many regulatory problems. Credit courses to earn a degree, as suggested by the Commission, is a welcome suggestion. In fact most foreign universities have this system. Autonomous colleges after proper accreditation may improve the situation. Internal assessment must be raised from 25% up to 50% as recommended by the Commission in the context of examination reforms.

The Commission is of the view that "there is a clear, almost unanimous view that higher education needs a systematic overhaul". The objective of reform and change in our higher education system must be expansion, excellence and inclusion". Only about 7% students in the age group 18-25 get admission in degree classes. There are only 350 universities. The Commission has estimated that 1,500 universities nationwide could attain a gross enrolment ratio of at least 15% by 2015. Also at least 50 National Universities should be created which would be department-based and shall not have any affiliated colleges. The appointment of vice-chancellors must be freed from direct or indirect intervention on the part of the Government. The appointments should be based on search process and peer judgment alone. The need is for smaller universities which are responsive to change and easier to manage. The Commission also feels that there should be no inbreeding in the appointment of teachers in the universities.

These suggestions are very valuable and if implemented, shall go a long way in achieving the desired goal. The Commission has emphatically asked for the establishment of an Independent Regulatory Authority for Higher Education (IRAHE) to take over the entire work of Universities Grants Commission except distribution of grants. The IRAHE will also perform most of the functions of Medical Council of India (MCI), Bar Council of India (BCI) and All India Council of Technical Education (AICTE), although IRAHE may occasionally consult these bodies, supervising the medical, legal and vocational education respectively.

The Commission observes, "We attempted to create stand-alone research institutions, pampered with resources in the belief that research should be moved

out of the universities. In this process we forgot an essential principle. There are synergies between teaching and research that enrich each other. And it is universities which are the natural home for research. It is time to reverse what happened in the past and make universities the hub of research once again". The Government would do well to take note of this recommendation of the Knowledge Commission.

It is an established fact that basic research is carried out by and around a gifted individual. Educationally, this has a bearing on teacher-pupil relationship. The history of science is replete with examples where based on *Guru-shishya* relationship, genealogies can be traced. Taking examples from chemistry, Leibig was a pupil of the great French chemist, Gay-Lussac who in turn was a pupil of Berthollet. From Leibig can be traced successive generation of scores of Nobel Prize winners in chemistry including Kekulé. A similar genealogy of teacher-pupil family can be traced from Von Bayer to Otto Warburg to Emil Fischer to Hans Krebs and several other distinguished chemists. These are names in chemistry without whose pioneering work the science of chemistry would have remained in the Alchemy stage. According to the great educationist, J.B. Conant, "there is only one approved method of assisting advancement of pure science and that is, picking men of genius, backing them heavily and leaving them to direct themselves. Even small groups around gifted men would be able to deliver the goods better than high investment-intensive large institutions". The policy-makers and administrators may keep these considerations in mind while planning for future.

In spite of rapid quantitative increase in science and scientific manpower and enormous investment in science and technology in India, the peaks of excellence have been rare. The point of flow of excellence, unfortunately, appears to have dried up. It seems that too much emphasis on equality and democracies has helped the circumstances to operate against the development of excellence in science. Quality has been the worst victim. It is imperative therefore that steps be taken to strengthen quality at every level of scientific research to prepare the generation to meet the challenges of the 21st century.

The edifice of scientific knowledge consists of "a database, an array of methodologies, and an array of concepts. By the same logic, technology can be looked upon as the process of production and delivery of goods and services encompassing concept to successful delivery". The two processes of science and technology therefore would be synergistic in acquisition of knowledge. The debate regarding basic versus applied research should be stopped. In fact, basic research is an integral component of a self-reliant base of science and technology. There is imperative need for emphasis on training our scientists in instrumentation on the one hand and making them deeply aware of learning theoretical treatment of research problems on the other, for improving the quality of research. Something has to be done to minimize emphasis on proliferation of mundane research papers and unhealthy race for producing PhDs. The entire process of investigation including "everything from identification of the problem to assessment of validity of result, through a whole gamut of selection of methodology, instrumentation, delineation of protocol, execution of protocol, the reduction of data and development of constructs leading to the result must be very deftly handled". A concerted effort has to be made to identify thrust areas with special reference to national relevance and convert the scientific talent available in the country into a task force dedicated to investigate those areas of scientific research. Adequate funding must be made available either by government or by public-private funding.

The Knowledge Commission in its recommendation has dealt in great details with the knowledge network, intellectual property rights, higher education, legal education, medical education, vocational education, management education, and the need for translation. In fact, translation into regional languages is the simplest and very effective way to the access of knowledge. We would like to add that especial attention be paid to translate our Sanskrit texts into English and regional languages because we firmly believe that there is an inexhaustible storehouse of knowledge lying there, particularly in the field of herbal medicine, mathematics and meta-physics. By reviving our traditional knowledge stock, we can give back some important components of a knowledge society.

The Knowledge Commission has mooted an excellent idea of establishing web portals dedicated to information on basic items like water, energy and agriculture. Work on many portals on biodiversity and teacher-training are in progress. The Commission has also suggested the use of E-governance to make things expedient and efficient. There has to be very close co-operation between the industries and the universities, which is sadly lacking in our country. For studying the impact of scientific regimes on society, the Commission has suggested establishment of a National Science and Social Science Foundation (NSSSF), but the terms of such foundation remain rather vague .

When we talk about knowledge society, we have also to think about knowledge politics. As we mentioned earlier, the march to a knowledge society will face issues relating to health, environmental safety, security and privacy, intellectual property rights and ethics. It is too early to say what kind of regime will emerge and how existing regimes will be reorganised. While research aims at innovation to improve national competitiveness, knowledge policy is required to regulate, control and govern the production of knowledge.

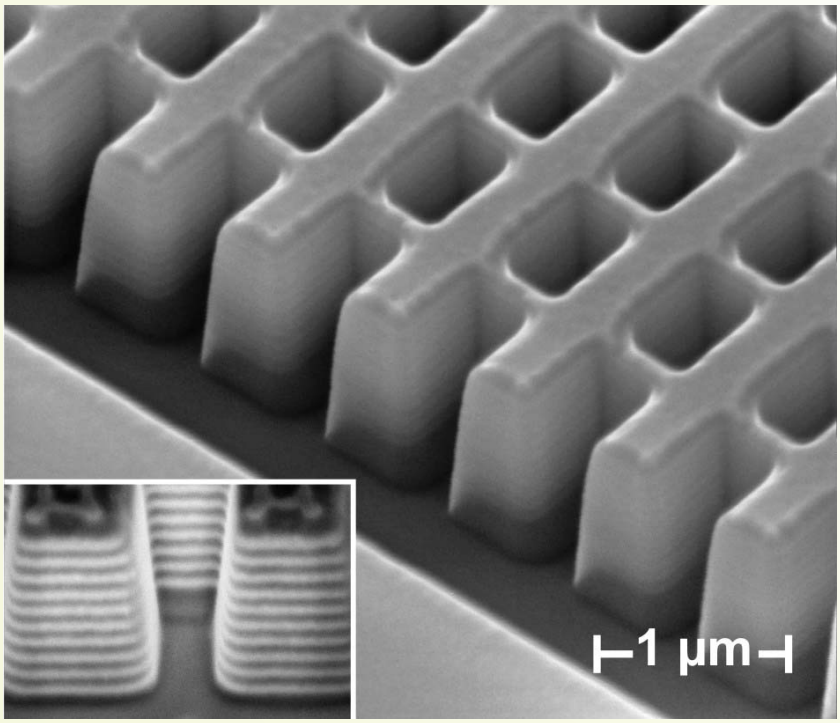
The major developments in science and technology in the last few decades have led to even closer connections between them and many science-based industries have come up that affect numerous societal domains. It is therefore necessary to analyse configurations of science and technology with respect to interdependency of social and technological change. Transnational perspectives must be kept in mind as national competitiveness in the world of commerce, trade and economic monopolies may lead to inequities.

(Contd. on page...25)

Making Objects Invisible

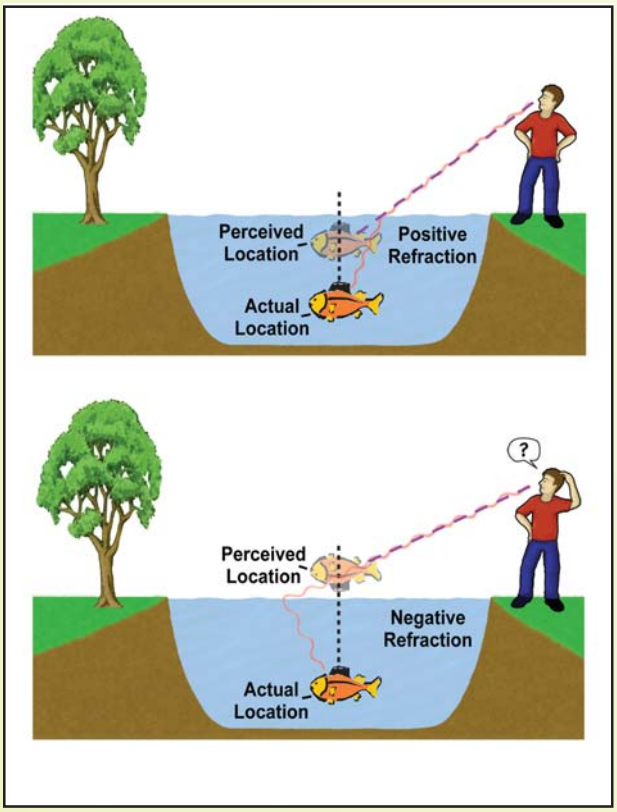
□ Biman Basu
Email: bimanbasu@gmail.com

Fans of Harry Potter may be familiar with the concept of an invisibility cloak. As its name suggests, the invisibility cloak renders Harry invisible. Of course, Harry is a fictional character and so is his invisibility cloak. But it may not be too long before the idea becomes a reality. The first steps towards achieving that goal have already been taken. Materials that could one day make objects invisible to visible light have been devised by scientists at the University of California at Berkeley, USA.



A scanning electron microscope image of the first 3-D 'fishnet' metamaterial that can achieve a negative index of refraction at optical frequencies.

Credit: Jason Valentine/UC Berkeley



An illustration of how a fish in water is seen by an observer, with the red lines marking the refraction of light and the purple lines representing the path towards the perceived location of the fish, which appears above its actual location.

Credit: UC Berkeley

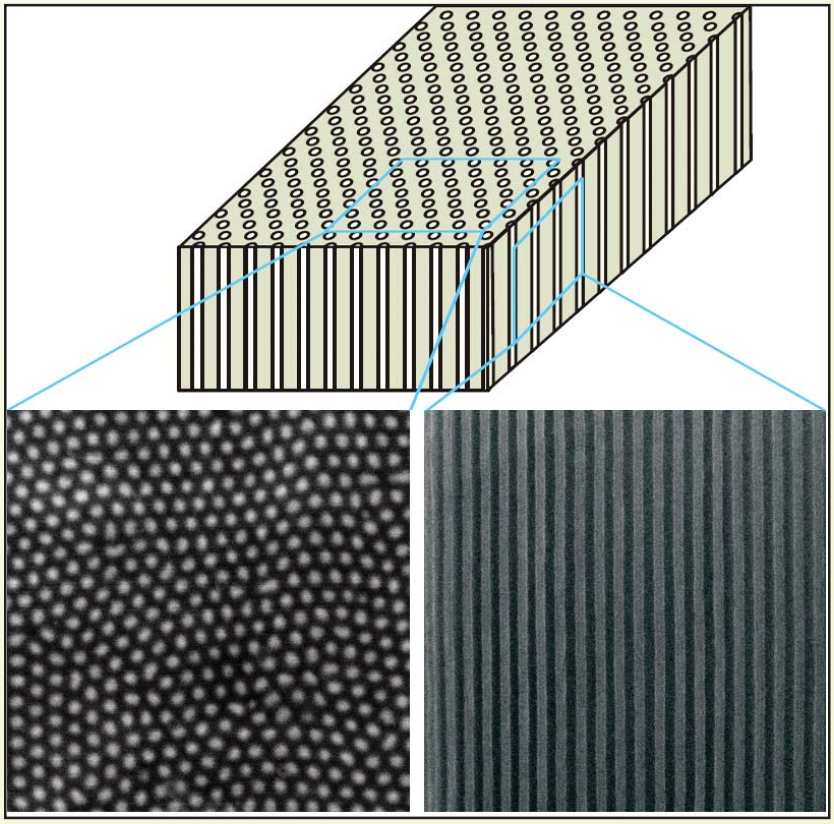
It is well known that when light passes from one medium into another it bends. While passing from a lighter medium to a denser medium a ray of light normally bends towards the normal. The refractive index describes the way the light waves bend when they enter and leave the material and the speed at which they propagate. The refractive index of normal materials is always positive, e.g., 1.0003 in air, about 1.5 in ordinary glass, 2.1 in zircon, and 2.4 in diamond.

In the mid-1990s, some scientists realised that it could be possible to construct artificial materials in which the refractive index could be negative. The trick was to assemble an array of components that resonate with the electric and magnetic fields of the light waves as they pass through. It was known that these materials would be unlike any conventional substance; hence they were dubbed "metamaterials". Metamaterials are artificially engineered structures that have properties, such as a negative refractive index, not attainable with naturally occurring materials.

Although discovered only six years ago, materials with negative refractive index have been the target of intense study, drawing researchers from physics, engineering, materials science, optics, and chemistry, and two breakthroughs in the development of metamaterials were reported separately in the online issue of *Nature* (13 August 2008; doi:10.1038/nature07247), and in *Science* (15 August 2008).

In *Nature*, Xiang Zhang and colleagues of the University of California, Berkeley, report creation of a 3D optical metamaterial made of

cascaded 'fishnet' structures, with a negative index existing over a broad spectral range. The materials can reverse the natural direction of visible and near-infrared light and could help form the basis for higher resolution optical imaging, nanocircuits for high-powered computers, and, to the delight of science-fiction and fantasy buffs, cloaking devices that could render objects invisible to the human eye.



A schematic and two scanning electron microscope images with top and side views of a metamaterial developed by UC Berkeley researchers. The material is composed of parallel nanowires embedded inside porous aluminium oxide.

Credit: Jie Yao/UC Berkeley

The metamaterial described in the *Science* paper by the same authors takes another approach to the goal of bending light backwards. It is composed of silver nanowires grown inside porous aluminium oxide. Although the structure is about 10 times thinner than a piece of paper, it is considered a bulk metamaterial because it is more than 10 times the size of a wavelength of light. The authors of the *Science* paper observed negative refraction from red light wavelengths as short as 660 nanometres. It is the first demonstration of bulk media bending visible light backwards.

For most of the applications touted for metamaterials, such as nanoscale optical imaging or cloaking devices, both the nanowire and fishnet metamaterials can potentially play a key role. While the researchers welcome these new developments in metamaterials at optical wavelengths, they also caution that they are still far off from invisibility cloaks and other applications that may capture the imagination. For instance, unlike the cloak made famous in the Harry Potter novels, the metamaterials described here are made of metal and are fragile. According to the researchers, developing a way to manufacture these materials on a large scale will also be a challenge.

SCIENCE, TECHNOLOGY AND... *(Contd. from page...27)*

"Because of perceived strategic importance of science and technology for economic competitiveness in the transformation process towards Knowledge Society, it is no surprise that the universities have become increasingly subject to, at times, far reaching organisational changes."

In conclusion, it must be remembered that advances in science and material benefits have led to social expectations on the one hand and induced life-style changes creating diverse cultural ethos in society on the other. "There is more and more emphasis on devoting to the technologies of production; techniques of coordinating man, machine and material; logic of national tasks and economic planning to achieve twin goals of raising standards of living and establishing socio-economic justice. While it is desirable that the intellectual, economic and administrative orientation of our society lean on the cognitive maps of science and technology-born developmental ethos, it is equally important that the emotive maps of our culture should continue to define not only the system of sentience and being but also becoming and other tasks of national goal". We have to make sure that proneness of our society to technological developments is not allowed to widen the gap between the emotive and cognitive maps. For the simulation of new technologies, it would be imperative to allow integration and proper consolidation. Undoubtedly, identity with the diverse ethos must be kept but resilience of the social design should also be kept alive. The transition to knowledge society should be made to establish convergence and congruence. It should provide us with a sense of well being while moving towards newer frontiers of science and technology.

* **Umesh Chandra Agarwala,** FNA, formerly Prof. & Head, Chemistry Dept. Indian Institute of Technology, Kanpur. 295 A, Block C-1, Indira Nagar, Kanpur 208026

+ **Hira Lal Nigam,** FNA, formerly Vice Chancellor, APS University, Rewa and Prof., Dept. of Chemisrty, Allahabad University. B-332B, Sector A, Sitapur Road Scheme, Lucknow 226024

Management of Obsessive Compulsive Disorder

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

> The mind is not a hermit's cell, but a place of hospitality and intercourse.
>
> – Charles Horton Cooley
> in *Human Nature and the Social Order*

Obsessive-compulsive disorder is a strange disorder of the mind. It fills the mind with wanton thoughts, impulses and images that haunt endlessly. Even though the illness appears bizarre, there is no point in being secretive about it. Medication can check symptoms and control the illness in two months or more. Behaviour therapy can also lend a useful hand.

Understanding obsessive-compulsive behaviour

Let us take a dig at what in reality are obsessions and what kind of a functioning falls under the term of compulsions.

A person having *obsessions* has:

- Recurrent and persistent ideas, impulses, or images that are experienced at least initially as interfering, haunting and senseless. For example, a religious person having blasphemous thoughts, or a person having repeated thoughts to hurt his child who he loves dearly.
- The ideas, impulses, or images are not simply excessive worries about real-life problems.
- The person attempts to ignore or suppress such thoughts, impulses, or images, or to neutralize them with some other thought or action
- The person recognizes that these thoughts, impulses, or images are a product of his own or her own mind, and not imposed from without as happens in thought insertion.

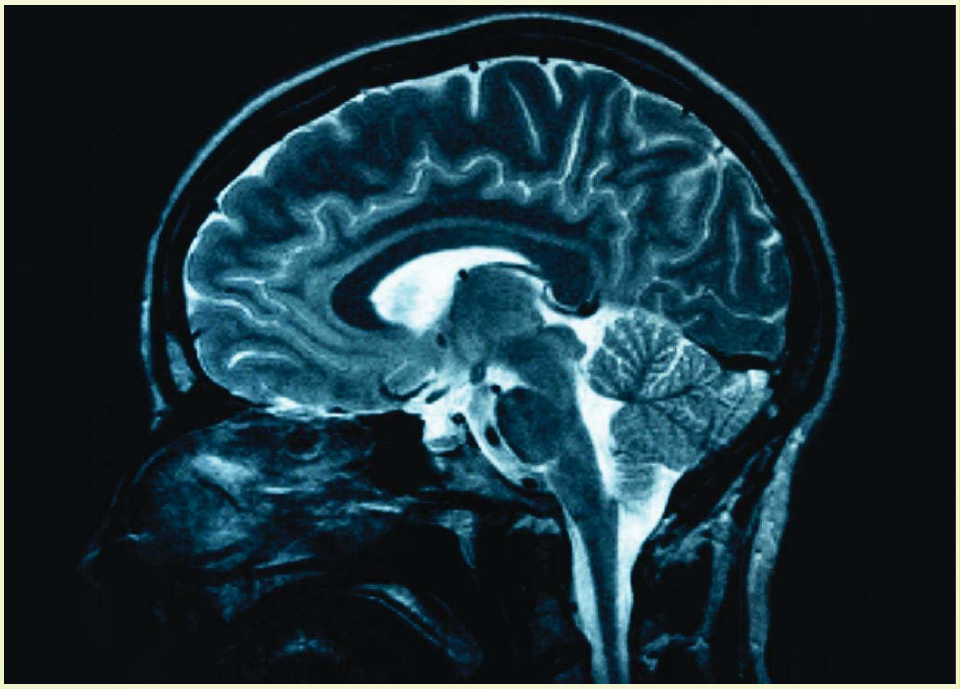
A person experiencing *compulsions* would perform:

- Repetitive rituals, for example, hand washing, checking, ordering; or mental acts, such as counting, praying, or repeating words silently. The person feels driven to do this in response to an obsession according to certain rigid rules or in a stereotyped fashion.
- These mental acts are designed to neutralise or to prevent discomfort or some dreaded event or situation. However, either the activity is not connected in a realistic way with what it is designed to neutralise or it is clearly excessive.

All adult recognizes at some point that the obsessions or compulsions are excessive or unreasonable. A child with obsessive-compulsive disorder may not however realise this fact. The obsessions or compulsions cause marked distress, and consume time, taking up more than one hour a day or significantly interfere with the person's normal routine, occupational or academic functioning or usual social activities.

Causes

The current concept about the genesis of obsessive-compulsive disorder is a mixed one, and psychodynamic and biological factors probably work in tandem. Obsessions and compulsions often seem to symbolise unacknowledged wishes, impulses and fears and to reflect psychological adaptations to unwanted aggressive or sexual urges. People seem to develop obsessive-compulsive disorder specifically when they learn that some thoughts are dangerous or unacceptable and, while attempting to suppress these thoughts, develop



anxiety about the recurrence of the thoughts and about the perceived dangerousness and intrusiveness of the thoughts.

Some people have a genetic vulnerability towards the illness. Research suggests that abnormal levels of the neurotransmitter serotonin may also play a role in the disorder, and brain scans of people with obsessive-compulsive disorder have revealed abnormalities in the activity level of the brain regions called orbital cortex, cingulate cortex, and caudate nucleus. The disorder probably develops when both biological and psychological influences combine and precipitate the illness.

Complications

The disorder may handicap the lives of those affected severely. People may seemingly become very inefficient and take a great deal of extra time to complete routine tasks. They may not be able to fulfil their obligations, and their irrationality may surface to make things extremely difficult. Their bizarre mental thinking and behaviour can seriously impact their relationships. Family members may feel angry because a compulsive behaviour may intrude on their time or interfere with the family's functioning. For example, a person's obsession with cleanliness may mean that one of the bathrooms in the house remains unavailable to other family members for long intervals. Likewise, in a situation where each minute is precious, a person's obsession to check and recheck may delay the family and cause them severe annoyance.

These circumstances may drive them towards avoidant behaviour, alcoholism, and abuse of sleeping pills and tranquillisers, and depression. Their marital, social, and occupational life can take a severe nosedive. A few also are at risk of suicide.

Treatment

Treatment for obsessive-compulsive disorder includes medication, behaviour therapy, and supportive psychotherapy. Many physicians prefer to use medication as the first-line of therapy. The selective serotonin reuptake inhibitors, particularly fluoxetine, fluvoxamine, and trazodone; and the tricyclic antidepressant, clomipramine, are the preferred medicines that can help relieve the symptoms. The good effect of these medications is visible only after a person has been taking them for two months or more. They need to be continued for at least six to twelve months before an attempt is made to taper them off. Many patients relapse when they stop the medication.

Exposure and response prevention, a type of cognitive-behavioural therapy, is probably the most effective form of psychotherapy. In this technique, the therapist exposes the patient to feared thoughts or situations and prevents the patient from acting on his or her compulsion. For example, a therapist might have patients with cleaning compulsions touch something dirty and then prevent them from washing their hands. This technique helps in 60 to 75 per cent of the cases. Thought

stopping, flooding your mind with other thoughts, and aversive therapy have also been found useful in the management of the disorder.

Psychotherapy, in the form of regular contact with a sympathetic and encouraging psychologist, can offer significant support to a patient at a time when he or she is plagued with difficulties at work and in family and social life. The family members can also take help and advice at such times.

Occasionally, a person who is severely troubled by obsessions may need hospitalisation. This is primarily aimed at removing the person from external environmental stressors. Once the symptoms become controllable he can return home.

About 80 per cent of people with obsessive-compulsive disorder do well with a combination treatment of medication and behavioural therapy and can resume normal lives.

Recent Developments in Science and Technology

□ Biman Basu
Email: bimanbasu@gmail.com

Popular plastics chemical not safe

Bisphenol A is a common chemical component of certain plastics used for making food and water containers, baby bottles and the lining of aluminium cans. Although it was considered safe, a new study has found that the chemical may increase the risk of heart attack, and Type-II diabetes. The study was published online in *Environmental Health Perspectives* (14 August 2008).

Bisphenol A in plastic bottles may be a health hazard.

Bisphenol A degrades over time and naturally leaches from food and beverage containers, and human exposure to the chemical is widespread. The study, which examined the effects of bisphenol A in human fat tissue found that the chemical suppresses a hormone called 'adiponectin' that protects people from heart attacks and Type-II diabetes. Bisphenol A doses examined in the study were typical of what is found in human blood.

In the body, bisphenol A mimics the hormone oestrogen. But the chemical's precise mode of action remains a puzzle. Recently, evidence has accumulated that oestrogen-sensing molecules, or receptors, play an important role in metabolic disorders. Oestrogen receptors also seem to be involved in the body's management of insulin in the liver and skeletal muscle. So it is not surprising that something like bisphenol A, which also interacts with these receptors, might interfere with metabolism.

Hundreds of studies have documented bisphenol A's ability to meddle with the development and function of a wide range of tissues. The chemical, which is the starter material for many plastics and epoxy resins, has a number of adverse health effects in lab animals, including reproductive problems, certain cancers and asthma. But, surprisingly, it is still not considered unsafe by the US Food and Drug Administration, according to which "the chemical is safe at current exposure levels."

Treating diabetes without insulin

Type-I diabetes, also known as juvenile diabetes, is an autoimmune disease in which the immune system attacks and kills insulin-producing cells in the pancreas. About 10 percent of people with diabetes have this form of the disease. The only treatment for Type-I diabetes hitherto has been intramuscular administration of insulin. But soon a new line of treatment may be available using the hormone leptin. Recent studies with rodents suggest that a little extra production of leptin through gene therapy can bring terminally ill rodents with Type-I diabetes back from the brink of death (*Proceedings of the National Academy of Sciences*, 25 August 2008).

Leptin is a hormone made by fat cells and plays a key role in regulating energy intake and energy expenditure. It also helps control eating behaviour. A new study suggests that it can also treat diabetes, the first demonstration that the disease can be treated without replacing insulin.

Researchers at the University of Texas Southwestern Medical Centre at Dallas, USA used adenovirus to insert extra copies of the leptin gene in diabetic mice and rats. The rodents recovered from the most severe side effects of diabetes, even though they were not given insulin. The terminally ill diabetic rodents making extra leptin recovered with no trace of insulin in their bodies, and leptin produced more sustained health improvements than insulin injections did. These included normalising blood sugar for up to 80 days without insulin, stopping the overproduction of glucose by the liver, improving sugar use in the muscles, and allowing the animals to gain weight. The gene therapy also corrected ketosis – a process characteristic of diabetes in which the body burns fat, producing sweet-smelling chemicals called ketones.

According to the researchers, excess leptin probably blocks the action of glucagon, a hormone that works as a counterpoint to insulin, which helps cells use glucose for energy. Glucagon signals the liver to produce glucose from fats and other non-carbohydrate sources. In diabetics, high glucagon levels just raise blood sugar levels even higher and lead to other side effects.

The researchers are not sure whether injections of leptin will work as well as making extra leptin through gene therapy does. But it is known that persons given injections of leptin for other reasons do show some improvement in blood sugar levels.

Severe rainstorms may increase with global warming

That the Earth is growing warmer is now well established and the impact of global warming is visible everywhere – from melting polar ice caps, receding glaciers,

migration of plants, and erratic global weather. Now climate scientists have issued a fresh warning over the future risk of flooding after research showed heavy rainstorms are likely to become even more intense than predicted as the global temperature rises. A team of American and British researchers has found that the increase of extreme rainfall was higher than what has been predicted in current computer models, according to a study published in the journal *Science* (www.sciencexpress.org/7 August 2008). According to the scientists, one of the biggest concerns regarding climate change is that heavy rainstorms will become more common and intense in a warmer climate due to the higher evaporation and the consequent higher moisture available for condensation. Besides, intense rains would also increase the risk of flooding that could have substantial impacts on societies and economies, they said.

Researchers from Reading University in UK and Miami University in USA used satellite data from 1987 to 2004 to see how natural changes in sea surface and air temperatures caused by El Niño weather events influenced rainfall over the tropics. El Niño is an occasional seasonal warming of the central and eastern Pacific Ocean that upsets normal weather patterns from the western seaboard of Latin America to East Africa, and also has significant impact on the southwest monsoon in India.

Studying satellite observations from the past 20 years, the scientists found heavy rain events increased during warm periods and decreased during cold times. The countries near the tropics experienced far more rainfall as temperatures rose. However, whereas according to the study, rainfall is expected to increase with global warming, the extent to which rainfall patterns will change in the future is unclear. Still, the study should ring alarm bells in countries like India, which already suffers extensive flood damage every year during the monsoon.

Editorial (Contd. from page 35)

and other adventure sports get us to appreciate and learn a lot about trust and nature. But, a mix of these activities would be ideal. Charity begins at home. Let us run every day for some time and encourage our children to run. That would be the easiest way to initiate a change in our attitude towards sports, and the manner we view sports. Running makes us healthier and gives confidence as we cross several milestones, for sure.

In particular, sports/physical education need to be made a compulsory subject up to high school level, encouraging schools to provide exposure to the sports in a structured manner. Sports federations/bodies must be made responsible to maximize participation at all levels. Next, it is necessary to get rid of fiefdoms and help grow local, district and state level competitions. Incentives to athletes in terms of adequate financial aid, acclaimed coaches, reasonably good facilities, sport medicine, and tax breaks could go a long way in nurturing and retaining sporting talent in the country. We shall also need to build world class sporting infrastructure and encourage public-private partnerships on the field. Further, we shall need to overhaul our present policies and earnestly implement them if we need to produce world class athletes. Once we create these facilities and infrastructure, its maintenance demands a huge budget. But, with the system in place no such problems would arise, as is the case in China. Next, let us refrain from any blame game, and let us get rid of the *chalta hai* attitude. Let us focus on world class, quality, and timeliness, and concentrate on what must be done rather than on why something cannot be done, replicated or adapted. At the same time, our athletes must realise that only *good* performances bring in the viewers and with them the money; and that money, and more money does not necessarily mean good performance.

The time to act is now. Set high standards and fix responsibility and accountability for team leaders and officials. It is just not enough to make provision of adequate budget. It is equally necessary to make it available to the athletes in a timely manner. Get rid of doubting Thomases, and review the progress periodically. Our next stop is the Commonwealth Games in 2010 at New Delhi. Let us start mobilizing and training volunteers now and get corporates involved in specific activities. What matters is determination to excel – excel in everything we do. That is what China demonstrated at Beijing; and it included everything – roads, sewage, transportation, volunteers, hospitality, pollution management, and much more. If we learn these lessons, we too could become a major sporting power in not too distant a future. What is required is the stern effort to promote the games by the government, the private sector as well as the general public.

Allegorically, what is stated here applies not only to our performance in sports, but even to fields like education, R & D institutions and labs, industries and business houses. We need a system that does not breed mediocrity. We need to invest in academies that fire the imagination of our kids and instill a desire to excel in everything they do; and invest in schools and colleges that encourage and promote excellence. We must learn to ask tough questions to our heroes, officials, managers, and institutions. Only then shall we be able to appreciate that talent, energy, creativity, and inspiration need to be harnessed systematically to take on a demanding and exacting world. Further, media must play a proactive role and help develop a rational outlook. Let us aim for the bull's eye – nothing lower than that. Anything lower would be a crime.

☐ **Vinay B. Kamble**

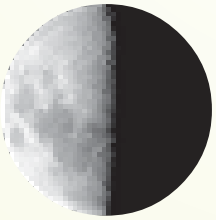
Sky Map for October 2008

Full Moon

14 October

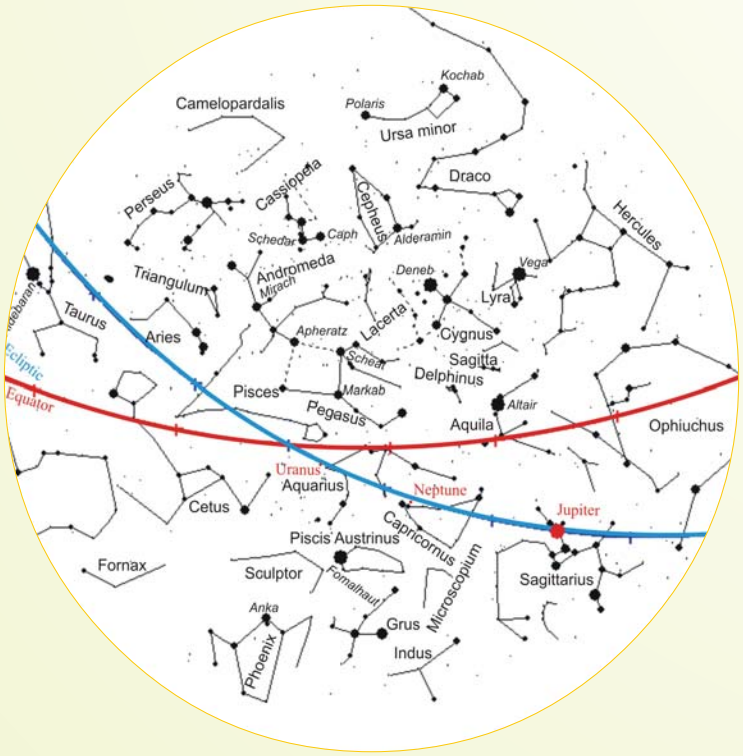
North

Moon - Last Quarter



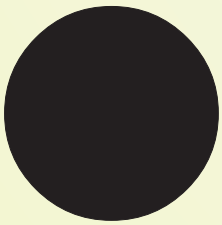
21 October

East



West

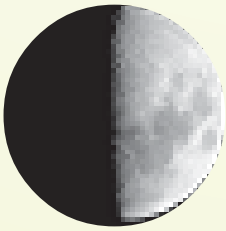
New Moon



28 October

South

Moon - First Quarter



7 October

The sky map is prepared for viewers in Nagpur (21.09^0 N, 79.09^0 E). It includes bright constellations and planets. For viewers south of Nagpur, constellations of the southern sky will appear higher up in the sky, and those of the northern sky will appear nearer the northern horizon. Similarly, for viewers north of Nagpur, constellations of northern sky will appear higher up in the sky, and those of the southern sky will appear nearer the southern horizon. The map can be used at 10 PM on 01 October, at 9 PM on 15 October and at 8 PM on 31 October.

Tips for watching the night sky :

(1) Choose a place away from city lights/street lights (2) Hold the sky-map overhead with 'North' in the direction of Polaris (3) Use a pencil torch for reading the sky map (4) Try to identify constellations as shown in the map one by one.

Planet/Dwarf planet round-up :

Jupiter : In the constellation Sagittarius (*Dhanu Rashi*) up in the south-western sky.

Uranus : In the constellation Aquarius (*Kumbha Rashi*) up in the zenith sky.

Neptune : In the constellation Capricornus *(Makar Rashi)* up in the south-western sky.

Pluto : In the constellation Sagittarius (*Dhanu Rashi*) near south-western horizon.

Prominent Constellations: Given below are prominent constellations with brightest star therein (in the parenthesis). Also given are their Indian names.

Eastern Sky : Aries / *Mesh Rashi*, Perseus, Taurus (Aldebaran)/ *Vrishab Rashi (Rohini)*, Triangulum.

Western Sky : Aquila (Altair), Hercules, Lyra (Vega) / (*Abhijeet*), Ophiuchus.

Southern Sky : Cetus, Capricornus / *Makar Rashi*, Grus, Fornax, Indus, Microscopium, Phoenix, Piscis Austrinus, Sagittarius / *Dhanu Rashi,* Sculptor.

Northern Sky : Camelopardalis, Cassiopeia, Cepheus (Alderamin) / *Vrashaparva*, Draco, Ursa Minor (Polaris) / *Dhruvamatsya (Drhuvataraka)*.

Zenith : Andromeda, Aquarius, Cygnus (Deneb), Delphinus, Lacerta, Pegasus, Pisces / *Meen Rashi,* Sagitta.

□ **Arvind C. Ranade**
E-mail : rac@vigyanprasar.gov.in

Physics and Astronomy Workshop at Parbhani (Maharashtra)

Vigyan Prasar in collaboration with Socio Economic Development Trust (SEDT) and Government of Maharashtra (Zilla Parishad, Parbhani) conducted a two-day Physics Workshop and a two-day Astronomy Workshop for 50 teachers from Parbhani district. The workshops were conducted from 19 to 22 August 2008 at Discovery Science Centre, Kerwadi, Parbhani. The objective of the workshops was to develop the skill of making physics and astronomy interesting to school children. During the workshop nearly 50 VIPNET clubs were formed within the district of Parbhani.

Arvind C. Ranade, Scientist, VP, delivering a lecture on astronomy.

The workshop was inaugurated by Shri Suryakant Kulkarni, Executive Director, SEDT.

Lectures on different topics of physics like, optics, classical mechanics, quantum mechanics, electricity, magnetism, and demonstration of the Physics Kit developed by VP was given by Shri. Ajay Mahajan, Lecturer, Swami Dyanand Science College, Latur. Arvind C. Ranade and R. K. Yadav of Vigyan Prasar, and Shri Samir Dhurde of IUCAA, Pune, provided inputs on different topics of astronomy like magnitude scale in astronomy, origin of the Universe, Sun and the Solar System, types of eclipses, astronomy in different wavelengths, constellations and the Zodiac. Demonstration of the Astronomy kit and night sky watching were also organised. Resource material comprising VP kits on 'Astronomy', and 'Emergence of Modern Physics', and the book *The Sun* were given to each registered participant. The certificates were distributed through the Chief Executive Officer (CEO), Dr. Ramesh Majrikar, Zilla Parishad, Parbhani.

Astronomy Workshop for the VIPNET clubs of Madhya Pardesh

Vigyan Prasar and Science Centre (Gwalior), Bhopal jointly conducted a five-day astronomy workshop for 40 teachers from different districts of Madhya Pradesh. The workshop was conducted from 6-10 September 2008 at AICUF Ashram, Bhopal. The objective was to develop enthusiasm for astronomy among school children.

R. K. Yadav giving a demonstration on astronomy kit.

The workshop was inaugurated by Prof. R. R. Dash, Secretary, Science Centre (Gwl), Bhopal. Lectures and demonstrations on different topics of astronomy like, magnitude scale in astronomy, origin of the Universe, basic of telescope, Sun and the Solar System, origin of the Solar System, types of eclipses, astronomy in different wavelengths, constellations and Zodiac, etc., were conducted by Arvind C. Ranade, Scientist (Vigyan Prasar). Demonstration of Astronomy kit, assembling of 39-mm simple refractor, and night sky watching was conducted by Shri R. K. Yadav of Vigyan Prasar and Shri Raigaonkar, Education Officer, Regional Science Centre, Bhopal, also talk about astronomy in general. During the workshop VP videos 'Shukra Paragaman', 'Yek Khagoliya Yikahi Ki Khoj', 'Relativity', 'Aaisa hi Hota Hai', etc. were also shown to the participants. Resource material comprising VP books, *The Sun*, *Venus and its transits*, and Astronomy kits were given to each registered participant.

During the workshop 40 simple 39-mm refractor telescopes were assembled by the participants. Each participant was allowed to take the fabricate telescope to start astronomical and sky watching activities in their club on a regular basis.

Letters to the Editor

Indian work on potato

I read the article 'The potato story' by Dr Venkateswaran (September 2008) with great interest. The content of the article was lucid and very informative. We appreciate the efforts put in by him. However, he should also have made reference to the R&D work being carried out in India. I would like to inform your readers that under the aegis of Indian Council of Agricultural Research, the Central Potato Research Institute at Shimla is doing commendable work on potato and has developed several new varieties.

Dr.A..P.Gandhi
Principal Scientist (Biochemistry)
Soybean Processing and Utilization Center
Central Institute of Agricultural Engineering, Bhopal (MP)

Strong link between science and common man

I have been a regular reader of the *DREAM 2047* since my student days. It is really a worthy publication which has established a strong link between the current science and the common reader.

Prieeti Deve
Astt. Professor, Food & Nutrition
E-mail:preetidietcare@gamail.com