



Vigyan Prasar

DREAM 2047

March 2010

Vol. 12

No. 6

Rs. 5.00

Global Genomic Revolution

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A New Commitment

Over the past two decades Vigyan Prasar has pioneered science communication using different formats and developed core competence in several areas. In its first decade Vigyan Prasar could be described as an outreach institution for initiatives conceived by Rashtriya Vigyan Evam Prodyogiki Sanchar Parishad (RVSP). The necessity for developing an autonomous institute was amply justified in this role where procedures would have taken precedence over purpose. The period witnessed some remarkable experiments with lessons for communicators.

The next decade has seen complementarity between science outreach campaigns of RVSP and software developed by Vigyan Prasar that have been used for activities under the 'International Year of Physics' (2005), 'International Year of Astronomy' (2009), and total solar eclipses of 2009 and 2010.

The scientific and technical manpower in the institution is skilled and has rich experience in the functions allotted. Several universities, Prasar Bharati (AIR and Doordarshan), some centres of National Council of Science Museums, S&T Councils of states and union territories, and many science based voluntary organisations have contributed to the effort.

Science and technology communication in the country requires multi-directional initiatives for accelerating capacity building in all sections of society. I propose to use this column to share some thoughts in my first editorial.

(a) Research:

The efforts by scientists and experts to understand various elements of science

communication, its impact, need assessment, etc., have been sporadic. Academicians and policy makers have contributed little to the designing and implementation of outreach campaigns. Research in all areas of public understanding of science may be nurtured to make Vigyan Prasar a dynamic centre for outstanding development work. Academic partnerships and adequate autonomy will be useful in this.

(b) Training:

The success of every campaign is dependent on well-trained field activists. RVSP and Vigyan Prasar have trained high school science teachers and activists of science based voluntary organisations in various locations as part of many campaigns. There is need for orchestrated training and orientation programmes with proper selection, assessment and follow-up, etc., using highly skilled and trained master resource persons. This would result in more effective outreach activities. These may be designed to optimise infrastructure of institutions.

(c) Software development:

Vigyan Prasar has some regular publications and a number of publications in the form of books commissioned to science writers. A strategic action-plan based on assessment of gap areas has to be developed and authors commissioned to prepare manuscripts for addressing these gaps in a time-bound manner. Translation of such books in Hindi and regional languages needs to be streamlined. The output must go up several folds since commercial houses have not invested in this area.



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Vigyan Prasar has collaborated with Development Education Communication Unit of ISRO, Ahmedabad to bring out a number of interesting video films that have been telecast on Doordarshan. Film makers on its panel have been selected for specific assignments depending on the campaigns planned. From the level of current efforts of about five hours of fresh programmes per month we need to move ahead and produce about 120 hours of fresh programme in order to consider sustaining a science channel on TV. Innovative mechanisms will have to be designed to ensure high quality and a wide variety in the programmes.

Books, kits, posters, CD ROMs and DVDs produced by Vigyan Prasar are in constant demand but require a mechanism to be accessible to students and teachers across the country.

(d) Outreach :

Vigyan Prasar has strong field programmes in popularising astronomy, HAM Radio, environmental activities, etc., and VIPNET Clubs (over 10,000 are active) sensitised to different programmes to arouse curiosity about science. In order to make the efforts effective, the kits, manuals and resource persons need to be systematically deployed along agreed channels to encourage 'hands-on' experience to vast number of members of VIPNET Clubs.

Readers' response will be a key factor in the directions that Vigyan Prasar takes over the next few months.

□ Anuj Sinha

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Published and Printed by Dr. Subodh Mahanti on behalf of Vigyan Prasar, C-24, Qutab Institutional Area, New Delhi - 110 016 and Printed at Aravali Printers & Publishers Pvt. Ltd., W-30, Okhla Industrial Area, Phase-II, New Delhi-110 020. Ph. : 011-26388830-32 Editor : Dr. V. B. Kamble

Joseph Priestley

The Founder of Pneumatic Chemistry



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“The more elaborate our means of communication, the less we communicate”.

—John Boynton Priestley

“In completing one discovery we never fail to get an imperfect knowledge of others of which we could have no idea before, so that we cannot solve one doubt without creating several new ones.”

—Joseph Priestley

“He (Priestley) had a simple character, much personal charm and exceptional intelligence, and wrote on theology, education, history, philosophy, politics, physics, chemistry and physiology and knew at least nine languages. He was an amateur in science, with little use for theory, but he was the greatest English-speaking experimental chemist of the 18th century, even though his interpretation of his results was usually unsound.”

— *The Cambridge Dictionary of Scientists* (2nd edition), 2002

Joseph Priestley is regarded as the greatest English-speaking experimental chemist of the 18th century. Priestley was the founder of pneumatic chemistry or the chemistry of gases. He discovered ten new gases including oxygen. Before Priestley there were only three gases known—ordinary common air, carbon dioxide and hydrogen. He invented devices for collecting and studying gases. He determined the relative densities of various gases by weighing balloons filled with them. He studied gaseous diffusion, conductivity of heat in gases and the effect of electrical discharge on gases at low pressure. He discovered the process of photosynthesis. His book on the history of electricity remained the standard history of electricity for over a century. He demonstrated that charcoal could conduct electricity.

It is interesting to note that Priestley had no formal training in science. In fact he never took a formal science course. In 1766, while on a trip to London he met the American statesman, scientist and inventor Benjamin Franklin (1706-1790). His meeting with Franklin was a turning point in his career. It was Franklin who made Priestley interested in science. Priestley was a theologian and throughout his life he attempted to fuse Enlightenment rationalism with Christian theism. For Priestley science

was no different from theology. He viewed science as an integral part of the theology that he practised. His avowed aim was to synthesise theism, materialism and



Joseph Priestley

determinism. He firmly believed in the phlogiston theory even after Lavoisier convincingly disproved it.

Priestley was a prolific writer. He published over 150 works. His contribution to pedagogy is quite

significant. He published a seminal work on English grammar. He recommended modern languages instead of classical languages. He was of the opinion that education of the young should anticipate their future practical needs. Many consider Priestley as the most important English writer on education between the 17th century English philosopher John Locke (1632-1704) and the 19th century English philosopher Herbert Spencer (1820-1903). He promoted the education of women, which was a very progressive idea in those days. He invented the modern historiography. He stressed on the need for teaching modern history. He believed that the study of history would enable people to perceive and to advance human progress. In fact his educational writings were among his most popular works. His philosophical works were considered by leading philosophers including the English philosopher, economist and jurist Jeremy Bentham (1748-1832), the English philosopher and jurist John Stuart Mill (1806-1873), and the English philosopher Herbert Spencer (1820-1903) as the primary sources for utilitarianism (the doctrine that the



Benjamin Franklin

purpose of all actions should be to bring about the greatest happiness of the greatest numbers).

Priestley was an ardent advocate of civil right and liberty. He was a strong believer in human progress and perfectibility. He strongly believed in the free and open exchange of ideas. He helped to found Unitarianism in England (a new Christian denomination established with the objective that it would not restrict its members' belief).

Joseph Priestley was born on 13 March 1733 in Birstall village, in West Yorkshire, England. His parents were Jonas Priestley and Mary Swift. The Priestley family was a so-called Dissenting family that is they did not accept the doctrines of the Church of England. His father was a cloth merchant. At the age of one Priestley was sent to live with his grandmother. Five years later, when his mother died, he came back home. But again in 1741 when his father remarried he went to live with his aunt, his father's sister, Sarah Priestley Keighley who was a devout Calvinist. In his childhood Priestley attended local schools and learnt Greek, Latin and Hebrew. His aunt, who made arrangements for providing him the best possible education, wanted him to be a Calvinist clergy (Calvinism is the doctrine propounded by John Calvin (1509-1564), a Protestant reformer).

Around 1749 Priestley suffered serious illness, which left him with a permanent stutter (an act of stammering). Because of this handicap Priestley

temporarily left the idea of becoming a religious preacher and left his theological studies. He planned to join a relative in trade in Lisbon, Portugal. He studied French, Italian, German, Chaldean, Syrian and Arabic. His tutor also introduced him to mathematics, natural philosophy, logic and metaphysical thought.

Priestley did not pursue the career of a tradesman and returned to his theological studies. In 1752, he joined the Daventry Academy. It was a dissenting academy. The liberal atmosphere of the academy made him a rational dissenter that is who believed in rational analysis of natural world and the Bible. A rational dissenter did not believe in dogma and religious mysticism.

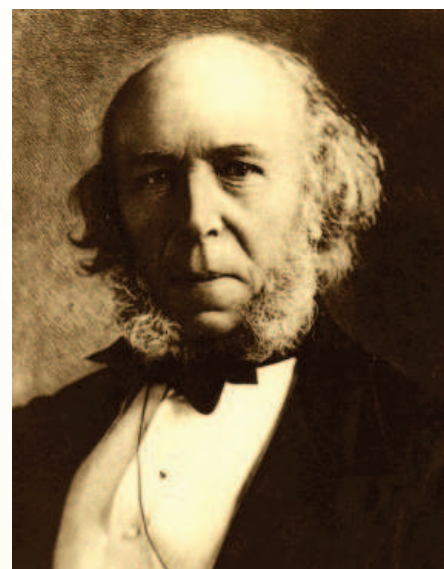
In 1755, Priestley joined as a minister at Needham Market, Suffolk, a small rural town. He considered the profession of a religious preacher as "the noblest of all professions." His first religious assignment was not a success because people did not like



John Locke

his heterodox views and so they stopped patronising the church managed by Priestley. As a result the income of the church reduced substantially. His aunt also did not support him when she realised that he was no longer a Calvinist in his theological views. To augment his income Priestley decided to open a school but then the local families refused to send their children to the proposed school. However, his series of scientific lectures on the "Use of the globes" was well received.

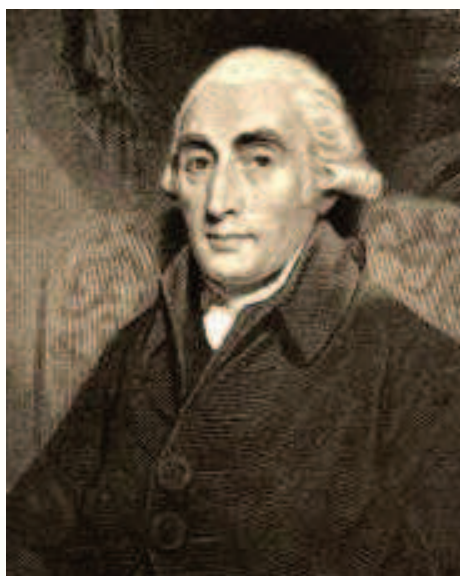
In 1758, Priestley moved to Nantwich, Cheshire, where he was offered a position as a minister. Here he opened a



Herbert Spencer

school for girls and boys. He purchased instruments for his students so that they could conduct experiments. On realising that there was no good quality English grammar available, he himself took upon the task of writing a proper grammar book. He published his *The Rudiments of English Grammar* in 1761. He dissociated the English grammar from Latin grammar and is regarded by many as "one of the great grammarians of his time."

In 1761, Priestley joined the dissenting academy at Warrington as tutor of modern languages and rhetoric. Encouraged by Benjamin Franklin, Priestley wrote the history of electricity. It was titled *The History and Present State of Electricity* and contained 700 pages. In the first half of this publication Priestley described the history of the study of electricity till 1766. The second part contained the contemporary theories about electricity and suggestions for future research. It also contained some of Priestley's own discoveries. Priestley had demonstrated the conductivity of charcoal and other substances. His experiments demolished the then accepted idea that only metals and water could conduct electricity. He was first to anticipate that electrical force followed an inverse-square law but he did not elaborate upon it. The law was clearly spelt out by Charles Augustin de Coulomb. It remained a standard work on history of electricity for over a century. Eminent scientists like the English astronomer, chemist and physicist William Herschel (1792-1871), the Italian physicist



Joseph Black

Alessandro Volta (1745-1827), and the English physicist and chemist Henry Cavendish (1731-1810) relied on Priestley's book. In 1764, he was awarded a doctor of law degree from the University of Edinburgh for his work on education.

Priestley took over as Presbyterian parish at Mill-Hill Chapel at Leeds in 1767. While working in Leeds as minister Priestley became interested in gases. His interest in gases was caused by the brewery next door to his new home at Leeds. He was affected by the unusual odour coming from the brewery. He became particularly interested in the air (at the time of Priestley the term 'gas' was not yet coined) over the fermentation vats. After taking due permission from the brewery owner Priestley started exploring this phenomenon. At the time only three gases were known—ordinary common air, carbon dioxide (studied by Joseph Black) and hydrogen (studied by Henry Cavendish). After studying the gas produced in the fermentation vats for several days Priestley observed that it was heavier than common air, it extinguished flame and it was readily soluble in water. He decided to produce the gas on his own. Earlier he had read that Joseph Black had produced a new gas named "fixed air" by heating limestone. While trying to repeat Black's method, Priestly developed a better method for producing the gas—by heating chalk with water adding "marine acid" (now known as hydrochloric acid).

For collecting gases for his studies, Priestley made improved version of

pneumatic trough. He collected the gases soluble in water over mercury. The results of his experimentation on gases were published in many papers and books, but the most important among these was *Experiments and Observations on Different Kinds of Air and other Branches of Philosophy*, published in six volumes during 1774-86.

Priestley produced and identified what are now called nitric oxide (NO), nitrogen dioxide (NO₂), nitrous oxide (N₂O), ammonia (NH₃), hydrogen chloride (HCl), sulphur dioxide (SO₂), silicon tetrafluoride (SiF₄), nitrogen (N₂) and carbon monoxide (CO). In 1774, Priestley produced oxygen. Using a powerful magnifying glass to concentrate sunrays, he heated mercuric oxide confined in glass tubes. The oxide on heating produced large amounts of a gas. In this gas Priestley found a candle would burn with an enlarged flame. First Priestley identified the gas as nitrous oxide. However, soon he found that unlike nitrous oxide the



Joseph Priestley

gas was hardly soluble in water. He then thought the gas was nothing but ordinary common air. But then again his conclusion was not correct. He found that a mouse lived in this gas longer than in a similar volume of ordinary air. It may be noted that oxygen was first discovered by Carl Wilhelm Scheele in 1772. However, he published his findings in 1777. Antoine Lavoisier discovered oxygen in 1775 by repeating Priestley's experiments. It was Lavoisier who first recognised oxygen as an element and coined its name "oxygen" by combining two Greek words to mean "acid-producer".



Antoine Lavoisier

Commenting on the large number of discoveries made by Priestley, Humphrey Davy (1778-1829) said: "no single person ever discovered so many new and curious substances."

Priestley studied the phenomenon of photosynthesis. In fact he was the first person to observe photosynthesis. While working with gases, Priestley had observed that plants were capable of converting 'foul air' into 'pure air'. He decided to carry out more experiments to understand this phenomenon. He filled a number of bottles with water and kept them inverted over bowls containing water. Some of the bottles had green algae obtained from local ponds but the rest of the bottles had only clean water. All the bottles were kept outside in the sunlight. Priestley observed that the water in the bottles containing algae was displaced by the end of the day. Similar effect was not observed in the bottles containing only clean water. This meant that the green plants produced a gas, which displaced the water. When Priestley placed glowing ember in the gas it burst into flames, which meant it was oxygen (dephlogisticated air). Then he repeated the experiments by placing some bottles containing green plants in the dark. This time no gas was produced.

After leaving the position with Lord Shelburne, Priestley settled at his home Fair Hill on the outskirts of Birmingham. At Birmingham he joined the Lunar Society, a small informal group, the members of which were interested in natural science and



Alessandro Volta



William Herschel



literature. Its members included English potter Josiah Wedgwood (1730-1795); manufacturer of buckles and buttons Matthew Boulton; the Scottish inventor of steam engine James Watt (1736-1819); and the English naturalist, physician and poet Erasmus Darwin (1731-1802), grandfather of Charles Darwin.

In 1772, Priestley published *The History of the Present State of the Discoveries relating to Vision, Light and Colours*. It was not as popular as the book on the history of electricity. The book was written in hurry and it did not contain any practical section. However, it remained as the only book on optics in English for 150 years.

Priestley's open support to the French Revolution made him very unpopular. On 14 July 1791, on the second anniversary of the fall of Bastille prison in Paris, a mob violence broke out in Birmingham. Obviously Priestley became a target. Priestley's home, library and laboratory were destroyed by the mob. He was forced to flee to London. From London they moved to Tottenham and then to Hackney. In 1794, they went to the United States. He lived his last ten years of his life in Northumberland County, Pennsylvania.

In America Priestley was welcomed by many learned societies including the American Philosophical Society. He was even offered a chair of chemistry at the University of Pennsylvania. However, he refused to accept any official position. He

continued his scientific investigations in America. He established a laboratory for carrying out his investigations. This was possible because of the arrival of several pieces of equipment sent by Josiah Wedgwood and others from England. However, he was not getting the latest scientific news from the Europe and so he could not keep up with the latest scientific developments. In those days America was much behind Europe in scientific research. He planned to determine the amount of phlogiston in different metals. In 1799, he discovered carbon monoxide by heating coal in small amount of air. His last scientific paper was on phlogiston theory. It was titled "The Doctrine of Phlogiston Established."

Priestley was the member of several international societies and academies - the American Philosophical Society, founded by Benjamin Franklin; the Royal Society of London (1766); the French Academy of Sciences (1772); and St. Petersburg Academy (1780). He was awarded the highest scientific honour of the Royal Society of London, the Copley Medal.

Priestley died on 6 February 1804. He was buried at Riverview Cemetery in Northumberland, Pennsylvania. The epitaph on Priestley's tomb reads:

Return unto thy rest, O my soul, for the
Lord hath dealt bountifully with thee.
I will lay me down in peace and sleep till
I awake in the morning of the resurrection.

In honouring his distinguished services to chemistry, the American Chemical Society established the Priestley Medal in 1922.

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(The article is a popular presentation of the important points of the life and work of Joseph Priestley available in the existing literature. The idea is to inspire the younger generation to know more about Joseph Priestley. 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.) ■

Global Genomic Revolution



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On 9 December 2009 India entered the portals of a Scientific Club which, till then, had included only USA, UK, China, Japan and Korea as members. This was because only these countries had succeeded in mapping the entire genetic complement (genome) of a human being. Now India has cracked the human genome too.

A genome is the entire DNA in an organism, including all its genes. A gene is just a short length of DNA and the basic unit of inheritance, which carries the coded instructions for making proteins. Proteins, in turn determine traits such as skin colour, texture of hair and how well food is metabolised, etc. Genetic information is stored in the genes as linear sequences of the bases adenine (A), thymine (T), cytosine (C), and guanine (G). Each triplet of bases, e.g., ACG, specifies one particular amino acid, which goes to make up a protein. The relationship between the nucleotide sequence in DNA and the amino acid sequence in proteins is called genetic code. Sequencing means determining the exact order of the base pairs in a segment of DNA.

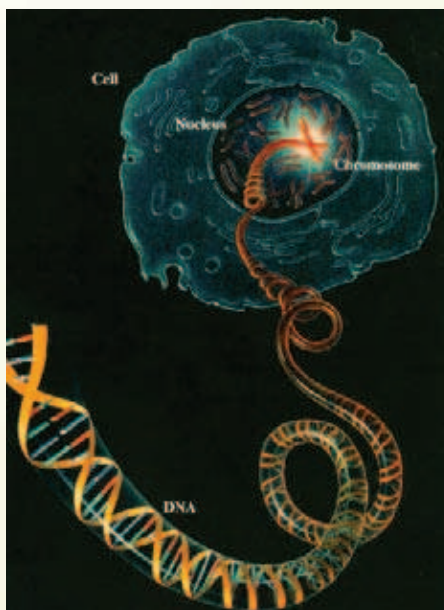
Sequencing a human genome requires high computational capability and technological know-how in handling sophisticated machines and analysing huge volumes of data. It is resource intensive and till recently, was extremely time consuming. So not all countries across the world have, as yet, managed this feat. India recently rose to the occasion thanks to the scientists of the Council of Scientific and Industrial Research (CSIR) working at the Indian Institute of Genomics and Integrative Biology (IGIB), Delhi.

History of Human Genome Sequencing

The Human Genome Project was begun in October 1990 and part of the dream was to identify all the genes in human DNA and also to determine the sequences of the 3 billion base pairs. Initially USA, UK, France, Germany and Japan made up the International Human Genome Project consortium. China joined in the late 1990s

and completed 1% of the genome. Unfortunately, resource crunch prevented India from participating at this point in time. However, later India did take the initiative to analyse secondary information from the genome data available in public domain.

The first rough draft (Working draft) of the human genome sequence was announced on 26 June 2000, by the International Human Genome Sequencing Consortium. It covered 90 percent of the



A genome is the entire DNA in an organism, including all its genes

genome and had an error rate of one in 1,000 base pairs. There were more than 150,000 gaps and only 28 percent of the genome had reached the finished standard. It was like a road map to an estimated 90% of genes on every chromosome. Roughly three years later (April 2003) came the fine-tuned version of the human genome sequence. It had less than 400 gaps and 99 percent of the genome was finished with an accuracy rate of less than one error every 10,000 base pairs. The first sequence and analysis of the human genome was published in *Science* in 2001 by Dr. Craig Venter and colleagues at Celera Genomics. The publicly funded genome project also published their version of the human genome at the same time in the journal *Nature*.

When the Human Genome Project was begun, it was estimated that it would take 15 years to sequence the 3 billion base pairs and identify all the genes. Thanks to technology it just took 13 years. The Indian Genome was decoded in a mere 45 days! Thanks to technology, again.

Genetic matter was taken from a healthy Indian citizen and decoded to present the first complete and entirely Indian genome. The name of the individual, whose genome was decoded, has not been revealed in keeping with the ethical code laid down by the Indian Council of Medical Research. However, some details about this anonymous icon of Indian science are known. He is 52 years old, 167 cm tall, weighs 52 kg and is from Jharkhand.

The idea of decoding an Indian genome came from Prof. Samir K. Brahmachari, now Director-General CSIR, when he was Director, IGIB. Rajesh S Gokhale, currently, Director of IGIB provided the leadership. Sridhar Sivasubbu and Vinod Scaria, both Scientists at IGIB, gave the primary guidance and six young students at IGIB were also part of the team that did the sequencing. The work was made possible by the CSIR Supercomputing facility at IGIB which has a cluster of computers capable of delivering processing-power estimated at an incredible one teraflop (one trillion floating-point operations per second), which is roughly 10,000 times faster than an average desktop.

Over 51 Gigabases of data was generated using cutting-edge sequencing technology that allows scientists to do massively parallel sequencing of millions of genomic fragments of 76 base pairs. These were then mapped back to the reference genome.

It is a matter of pride that this was an Indian effort using Indian genetic material

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The Indian Genome

and the brainpower of Indian researchers based in the country. It marked the dawn of a new era in disease diagnostics & treatment and set the stage for India's entry into predictive Genomics

Why an Indian Genome?

The molecule that encodes the genetic legacy that our parents gifted us and which make us who we are, is called DNA (short for Deoxyribo Nucleic Acid). DNA consists of two, entwined chains of simple units called nucleotides, with backbones made of sugars and phosphate groups joined by ester bonds. These two strands run in opposite directions to each other. The nucleotide bases are: Adenine (A), Guanine (G), Cytosine (C), and Thymine (T). It is the sequence of these four bases along the backbone of the DNA molecule that encodes genetic information. Interestingly, A bonds only to T, and C bonds only to G. This is called complementary base-pairing. All human genomes contain approximately 3 billion base pairs. So why do we need to decode genomes of different people ...why not decode just one human genome and declare it a standard?

The problem is that there is no Universal Prototype Genome Standard (like say the single-piece, metallic artefact that serves as the international Prototype Kilogram) that will match every human being on the globe. No individual (except perhaps identical twins) is an exact copy of another. We are all unique individuals. Roughly at about one in every 1,200 bases, (on average) the DNA sequences differ between two individuals. There are over 6 million differences at the basic genetic level between two unrelated individuals. This is the perfect example of unity in diversity—we use the same genetic blue print or DNA code yet we are all unique! Each one of the billions of human beings who walk this Earth is an exclusive individual...literally peerless!

We are different because of genetic variations. Genetic variation among individual humans occurs on many different scales. It may be a gross alteration in the human chromosome complement (as when a person is born with an extra chromosome or even missing one). Usually, the changes lie in the fine structure of the genetic

material. It is in these fine structures that the mysteries of variation lie.

Variations at the level of single nucleotides are called single nucleotide polymorphism (SNP). Another commonly seen variation is called is copy number variation, in which the same gene exists in multiple copies. There are also inversions, in which a stretch of DNA has been knocked out of its chromosome and reinserted the



Dr. Craig Venter, whose team published the first sequence and analysis of the human genome in 2001

wrong way around.

Thus the genetic sequences of different people are remarkably similar but not identical. Initially, it had been estimated that two individuals would be identical in 99.9 percent of their DNA, but it now appears that the figure is around 99.5 percent. Interestingly, the Indian Genome has also revealed a large number of hitherto unknown variations in the genome. This includes single nucleotide changes and insertion/deletions.

Most variations arise randomly and do not affect survival. However, some variations have consequences for the person. Whether or not overt consequences are seen as a result of variations, all genetic variations are important. Variation is the key to evolution. It is also, often enough, the key to changed physiological processes. Sometimes even a minor change in the base-pair sequence could actually translate into a crucial change in some important protein. This could also mean the onset of a disease. Complex disorders are often a consequence of the

cumulative effect of a large number of variations that independently have small effects that are, individually neither necessary nor sufficient, to cause the disease. Of course, the interplay of environment, diet and lifestyle can be triggering factors.

So, just knowing that variations are present in a given genome is not enough. The functional role of these variations has to be understood so that disease-associated variations can be identified. Once this is done, it will be possible to predict the predisposition of a person to that disease. The individual can then be forewarned about the genetic booby-trap waiting to be sprung and can then take steps (for example, adopt lifestyle changes) to minimise the risks of detonating the genetic time-bomb. If this really comes to pass, it would herald the age of affordable, personalised and predictive healthcare and medicine will take a quantum jump from being reactive to proactive.

Constraints of Individual Genome Sequencing

It is the formidable size of the diploid human genome that prevents the routine application of sequencing methods to decipher complete individual human genomes. The cost of genome sequencing was prohibitively high in the initial years. Just six years ago it cost a billion US dollars to sequence a genome. In August 2009, Stephen R. Quake, (Stanford University) invented the Heliscope Single Molecule Sequencer, which is a new technology for decoding DNA and used it to decode his own genome for less than \$50,000. He published the findings in *Nature Biotechnology*. The Indian genome was decoded at a cost of Rs. 15 lakhs (-\$ 30,000) which is substantially lower than \$50,000. Of course this did not include the cost of infrastructure or manpower.

It has been reported in *Science* that some companies in USA plan to provide personal genome sequencing for a 300,000-350,000 U.S. dollars. Many believe that it will be medically useful to sequence a patient's genome when the cost of sequencing falls to around \$10,000 or less. Some technologists predict the \$10,000 genome will be attained in a few years. The dream is now to bring down the cost such that every person finds it an affordable



James Watson, who co-discovered the structure of DNA in 1953, had his genome not only sequenced, but also handed to him on a DVD in May 2007.

option and globally, scientists are eyeing the price tag of \$1,000—as an achievable target and there is talk in the media about “gene scan” machines on the doctor’s tables in the future!

Individual Genomes sequenced

Given the constraints it is clear why till date only about 14 individual genomes have been sequenced worldwide. Some of the notable amongst these are:

Craig Venter’s Genome. J. Craig Venter Institute along with collaborators at The Hospital for Sick Children in Toronto, Canada and the University of California, San Diego decoded the diploid genome sequence of Craig Venter (HuRef). It took them about \$100 million and nine months. The HuRef analysis found 3.2 million SNPs and nearly one million non-SNP variants. Stephen W. Scherer, a co-author of the study said, “This is the first time that anyone has had an accurate representation of how much variation there is in a human genome”. Dr. Craig Venter summed it up best when he said, “...we have shown that human-to-human variation is five to seven-fold greater than earlier estimates proving that we are in fact more unique at the individual genetic level than we thought.It is clear however that we are still at the earliest stages of discovery about ourselves and only with additional sequencing of more individual genomes will we garner a full understanding of how our genes influence our lives.” (More information: <http://huref.jcvi.org/>)

James D. Watson’s Genome. James Watson, who co-discovered the structure of DNA in 1953, had his diploid genome not

only sequenced, but also handed to him on a DVD in May 2007. Watson’s genome was sequenced by a company called 454. Scientists at Baylor College of Medicine (USA) collaborated on the project. It cost ~ 2 million dollars and took two months. 454’s sophisticated machines ran the sequencing reactions on chips smaller than a playing card, drilled with 800,000 tiny holes. Each chip ran hundreds of thousands of sequencing reactions in a single experiment, compared with the mere 96 reactions possible when the human genome was first sequenced. Scientists identified several hundred genetic variations that might affect the function or expression of a gene. While many mutations of this type have no observable effect, 25 of Watson’s variants have been linked to some phenotypic effect in other studies. Reportedly, Watson’s reaction after receiving it was, “I am putting my genome sequence on line to encourage the development of an era of personalised medicine, in which information contained in our genomes can be used to identify and prevent disease and to create individualized medical therapies.” It does not seem too distant a dream because obviously the price of sequencing, and the time taken, are both plummeting. Hopefully genome decoding will soon be done in a flash at a price that suits the purse of every person. (More information: <http://jimwatsonsequence.cshl.edu/cgi-perl/gbrowse/jwsequence/>)

On 11 October 2007, Beijing Genomics Institute announced that it had completed sequencing the first diploid genome sequence of a Han Chinese, a representative of Asian population. The

genome was named YH for YanHuang—a term coined in honour of Emperors thought to be the ancestors of China’s largest ethnic group. This was the first step of the YanHuang Project, which aims at sequencing 100 Chinese individuals in three years. The next major dream is to sequence the genomes of thousands more people, including ethnic groups from other Asian countries. (More information: <http://yh.genomics.org.cn/index.jsp>)

Human Genome Structural Variation Project

There are other human genome variation projects which include the NHGRI Structural Variation Project and the Genomic Structural Variation Consortium. The database of Genomic Variants is perhaps the most comprehensive database for the deposition, retrieval and visualization of phenotypically (observable) normal human structural variation.

In May 2008, *Nature* reported the high-resolution integrated genetic mapping and sequencing of structural variation from eight human genomes. These eight individuals were part of the first phase of the *Human Genome Structural Variation Project* and included four individuals of Yoruba Nigerian ethnicity and four individuals of non-African ethnicity. It studied genetic variation on an intermediate scale—particularly insertions, deletions and inversions affecting from a few thousand to a few million base pairs.

Indian Genome Variation Project

India is not lagging behind either. The CSIR-led Indian Genome Variation project, which was spearheaded by Prof. Samir Brahmachari, was a huge project involving over half a dozen Institutes and more than 150 CSIR scientists. The CSIR research laboratories included IGIB; Centre for Cellular and Molecular Biology (CCMB), Hyderabad; Indian Institute of Chemical Biology (IICB), Kolkata; Central Drug Research Institute (CDRI), Lucknow; Industrial Toxicological Research Centre (ITRC), Lucknow; and Institute of Microbial Technology (IMTECH), Chandigarh. The Indian Statistical Institute



The IGIB team which sequenced the entire genome of an Indian.

(ISI), Kolkata; Anthropological Survey of India; and The Centre for Genomic Applications (TCGA), a public-private partnership of CSIR, were closely involved in the study aimed at studying the diversity of 1,000 biomedically important and pharmaco-genetically relevant genes in populations representing the genetic spectrum of India.

The Indian Genome Variation project has successfully completed mapping the genetic diversity of the populations in the country, making India the first country to have a map of its genetic diversity. This has tremendous relevance because India is home to almost 1/6th of the world population and it is a huge melting pot of human diversity, brought about by wave upon wave of human migrations followed by admixtures with the existing populations. The Project sought to provide answers to questions such as, “which genetic marker(s) predisposes an individual to a certain genetic disease/disorder placing a person at greater risk or, how do certain groups of people respond to a given drug. It focussed on actions that can be initiated with the current levels of knowledge; with disorders where the number of genes involved is known. For example, eye/muscular problems, diabetes and drug metabolism/response genes.

The 1000 Genomes Project

Individual genomes are difficult to interpret unless there is a large database of other human genomes (in addition to

personal characteristics, medical histories etc) to compare it against. Only such additional information enables the correlation of specific variations with different medically useful traits. The ability to use unbiased, high throughput, sequencing methods with advanced computational analytic methods allows scientists to characterise the wide variety of individual genetic variation. This, in turn, creates the opportunity to study the prevalence and impact of these variants on diseases in human populations. Therefore there is the need to have complete data on many more genomes and this is what a study of global trends show.

On 22 January 2008 an international research consortium announced the 1000 Genomes Project. This is an ambitious effort involving sequencing the genomes of at least a thousand people from around the world. The dream is to create the most detailed and medically useful catalogue of human genetic variation. The target variants are those that are present at 1 percent or greater frequency in the human population across most of the genome, and down to 0.5 percent or lower within genes. The donors of genetic material will remain anonymous and medical information about them will not be collected. It is anticipated that the catalogue will have enormous potential for use in future studies of people with particular diseases. As with other major human genome reference projects, data from the 1000 Genomes Project will be made swiftly available to the worldwide scientific community through freely accessible public databases. (More

information: <http://www.genome.gov/26524516>).

Grand Prize in Genomics

Of course, such advances are not possible unless young and talented researchers and experienced leaders are motivated to push boundaries. Towards this end intellectual challenges with lucrative rewards have been posed. In September 2003 the J. Craig Venter Science Foundation offered the \$500,000 Innovation in Genomics Science and Technology Prize with the aim of stimulating development of less expensive and faster sequencing technology. Later, this was combined with the Archon X Prize for Genomics.

The Archon X Prize for Genomics is worth \$10 million. It will be awarded to the first Team that can build a device and use it to sequence 100 human genomes within 10 days or less, with an accuracy of no more than one error in every 100,000 bases sequenced, with sequences accurately covering at least 98% of the genome, and at a recurring cost of no more than \$10,000 per genome. The competition hopes to encourage the development of radically new technology that will dramatically reduce the time and cost of sequencing genomes, and accelerate a new era of predictive and personalized medicine. On 17 November 2009 the first Asia-based contender entered the arena when the Taiwanese team, Cracker, became the newest team accepted to compete for the Archon X Prize for Genomics. The entry made it a global competition with teams representing three continents.

Future Perfect?

It is clear that genomics science is coming of age. With the technology divide being bridged, more and more nations are gearing up to push the boundaries of knowledge. Optimists feel that the new genomics projects are harbingers of a new era—the era of affordable, swift, personalised and predictive medicine when medicine will be truly proactive. Realists warn that this will also be an era of new ethical/social challenges since genetic data can reveal personal information that many might prefer to keep private. ■

The Art of Living

Simple Recipes for Dissipating Stress



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

Measure your health by your sympathy with morning and spring. If there is no response in you to the awakening of nature—if the prospect of an early morning walk does not banish sleep, if the warble of the first bluebird does not thrill you—know that the morning and spring of your life are past. Thus may you feel your pulse.

—Henry David Thoreau *Journals*

Stress is an inescapable element in life. You can fight it and fail, or you may, instead, learn to flow with it. The secret of good health lies in developing an appropriate stress response. A number of simple, easy to follow, stress reduction techniques can help you prevail over stress. Many of these psychological techniques are time-tested and have been handed down the ages. The key is to develop an optimistic approach towards life, resist frustration, and build rational strategies to dissipate stress. The art of living focuses on developing the coping mechanisms and adapting a positive lifestyle true to the dictates of good health.

of humour, and recreation sports to dissipate stress. Let us see how.

Develop positive mental coping mechanisms

A positive mental and emotional approach towards life situations can help you cope with stress. You just have got to believe in self and hold that you can control much of all that happens to you. Researchers have found that people, who hold a positive attitude about their abilities, do not get easily frustrated, remain optimistic, and persevere. They tend to cope well with stress. On the other hand, negative personality traits, such

think. It is simple. If we think gloomy and negative thoughts, we feel miserable and unhappy. If we think anxious thoughts, we become tense and nervous. Conversely, if we think healthy thoughts, we feel happy. A positive self-talk that focuses on our capabilities and inner strengths eases stress, while a negative self-talk can push back even geniuses.

Set realistic goals

Setting our goals unrealistically high invites failure. Take a reality check. Assess your strengths, abilities and resources before deciding on the goals. Think big, but be



Stress management simply aims at training your thoughts and actions and being in control of your self. A positive mindset, perseverance, and self-belief are the first prerequisites to overcome stress, but the game plan also includes developing a social support group, using appropriate behavioural and mental techniques to relax, and turning to time-tested formulae of exercise, balanced diet, sleep, regular dose

as low self-esteem and an outlook of gloom and negativity can trip people even if they have everything working in their favour. Bolster your psychological defence by equipping your self with the following mental strategies:

Think positive

It has been asserted in the Vedanta that our thoughts become reality. We are what we

pragmatic. Overstepping your limits can only lead to disappointment, frustration, and stress.

Prepare adequately

Plan your work in a step-by-step manner. Specify your target and work out all the details. Rehearse in your mind what the job will require of you. Then divide the target into small accomplishable tasks. While



washy attitude and watch television for hours on end to prevent having to think about or study for the exams (emotion-focussed coping).

Dissipate your anger healthily

If you experience anger, it needs to be expressed, but carefully. Count to 10, compose yourself and respond in an effective manner. Give the provoker the benefit of the doubt, and if you still feel aggrieved, make it known without attacking the other person. Let him know about your disagreement with tact and positive communication skills.

At the same time, also learn the art of forgiving. It has a positive psychological value for you. It makes your inner self glow, lowers your blood pressure and heart rate, and your breathing calms.

Develop a social support system

Discuss your concerns with a trusted friend or family member. Talking helps relieve stress and put things in perspective; it may also lead to a healthy plan of action. A positive social support system provides us with emotional sustenance, tangible resources and aid, and information when we are in need. It makes us feel cared about and valued by others and we also have a sense of belonging that can come in handy in moments of despair.

Many large community surveys have linked social support to good health and a superior ability to cope with stress. In general, people with extensive social ties live longer and healthier than those with few close social contacts. Even the perception of social support can help people cope with stress. Studies have found that the promise of availability of social support by itself mitigates the stressors, irrespective of the actual support received in need.

Even a pet at home can help lower the stress. The companionship acts as a balm to your bruised mind. Studies have found that in times of stress, people with pets made fewer visits to the doctor than those without pets.

(More techniques about how to dispel stress in the next issue)

finalizing the plan, also keep an allowance for some extra time and expense. Events beyond your control will happen and jeopardise your planning, and if you account for them, it is easy on the nerves.

Prioritise

Concentrate on what's important. Decide on your priorities and concentrate on the things most important to you. If more jobs come your way, do not take them unless you are comfortable.

A polite regret sometimes works better

A polite 'no' is much better than failing to deliver later. If you have too many things on your hands, do not add to your stress by accepting another job. It is wrong to think that another person will feel offended if you are honest.

A wishy-washy attitude gets you nowhere

Psychologists have found that people use two broad types of coping behaviours to triumph over stress: problem-focussed coping and emotion-focussed coping. The goal of both is to control stress level. In problem-focussed coping, people try to short-circuit negative emotions by taking some action to modify, avoid, or minimise the threatening situation. They adapt themselves to deal with the stressful situation. In emotion-focussed coping, people try to moderate or eliminate

unpleasant emotions through mechanisms that may not be ideal. For example, faced with a difficult situation you might prepare yourself and deal with it or conversely, indulge in wishful thinking and deny the situation. Both approaches may ease your immediate stress, but relief is temporary if you adopt the latter strategy.



To understand these responses, consider the example of a biochemistry student who is due to appear for his final examinations. He knows he must get top grades in order to have a chance at acceptance to the PhD programme. This situation is a potential source of stress. To cope, he could devote himself fully to master the course materials systematically (problem-focussed coping). Or he may take a wishy-

Recent Developments in Science and Technology



□ Biman Basu

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Hubble images asteroid impact

The asteroid belt between the orbits of Mars and Jupiter contains millions of rock pieces and it is no wonder that some of them may collide occasionally. But till recently astronomers had no evidence of such collisions happening. Now NASA's Hubble Space Telescope has imaged a mysterious X-shaped debris pattern and trailing streamers of dust that suggest a head-on collision between two asteroids.

pressure from sunlight to create straight dust streaks. Embedded in the filaments are co-moving blobs of dust that likely originate from tiny unseen parent bodies.”

Normal comets are usually seen in the inner regions of the solar system and come from icy reservoirs in the Kuiper Belt and Oort cloud. As comets come near the Sun and heat up, ices near the surface vaporise and eject material from the solid comet nucleus via jets that become visible as 'tail'.



NASA Hubble Space Telescope picture of a comet-like object called P/2010 A2. The inset picture shows a complex structure that suggests the object is not a comet but instead the product of a head-on collision between two asteroids travelling five times faster than a rifle bullet (5 kilometres per second). [Credit: NASA, ESA, and D. Jewitt (UCLA)]

The comet-like object imaged by Hubble, called P/2010 A2, was first discovered by the LINEAR (Lincoln Near-Earth Asteroid Research program) sky survey on 6 January. New Hubble images taken on 25 and 29 January show a complex X-pattern of filamentary structures near the nucleus. At the time of the Hubble observations, the object was approximately 300 million km from the Sun and 140 million km from Earth.

According to the principal investigator David Jewitt of the University of California at Los Angeles (UCLA), “The appearance of P/2010 A2 is quite different from the smooth dust envelopes of normal comets. The filaments are made of dust and gravel, presumably recently thrown out of the nucleus. Some are swept back by radiation

But P/2010 A2 orbits in the warm, inner regions of the asteroid belt where its nearest neighbours are dry rocky bodies lacking volatile materials.

This leaves open the possibility that the complex tail of debris is the result of an impact between two bodies rather than ices from a parent body simply turning into vapour. Asteroid collisions are energetic, with an average impact speed over 5 km/s, or five times faster than a rifle bullet, which is powerful enough to create a shower of debris that is swept back into a tail from the collision site by the pressure of sunlight. An impact origin would also be consistent with the absence of gas in spectra recorded using ground-based telescopes.

Dinosaur colour revealed

The dinosaurs that millions of viewers saw in the blockbuster movie Jurassic Park were not real. They were created by computer graphics and the colours they sported were imaginary because no one had any idea of what colours dinosaurs really had. Indeed, for nearly two centuries, people have struggled to imagine what the great extinct dinosaurs looked like. Although their shapes, masses, and even how they might have moved and interacted could be deduced on the basis of modern palaeontology and physiology, one of the most basic questions about their appearance, their colouring, remained a mystery till recently. But now a new study has revealed the presence of colour pigments in dinosaur fossils that, according to researchers, “may open up a new world of prehistoric colour, illuminating the role of colour in dinosaur behaviour and allowing the first accurately coloured dinosaur re-creations.” Findings of the study team, led by Fucheng Zhang of China's Institute for Vertebrate Palaeontology, were published in *Nature* (28 January 2010).

The team identified fossilised melanosomes – pigment-bearing organelles – in the feathers and filament-like ‘protofeathers’ of fossil birds and dinosaurs from northeastern China. Melanosomes are nano-size packets of pigment found in the feathers of living birds. They were first reported in fossil bird feathers in 2008.

Previously, palaeontologists had discovered signs of black pigment in fossilised feathers. The new findings provide tantalising clues that dinosaurs and early birds were not limited to a drab colour scheme. For instance, the pattern of melanosomes in the fossils of *Confuciusornis* – a bird that lived about 125 million years ago in what is now China – show the creature likely had patches of white, black and orange-brown feathers. *Sinosauropteryx*, a dinosaur that lived in the same area a million or so years after *Confuciusornis*, probably sported alternating rings of white and orange-brown bristle-like filaments on its tail, the researchers propose.

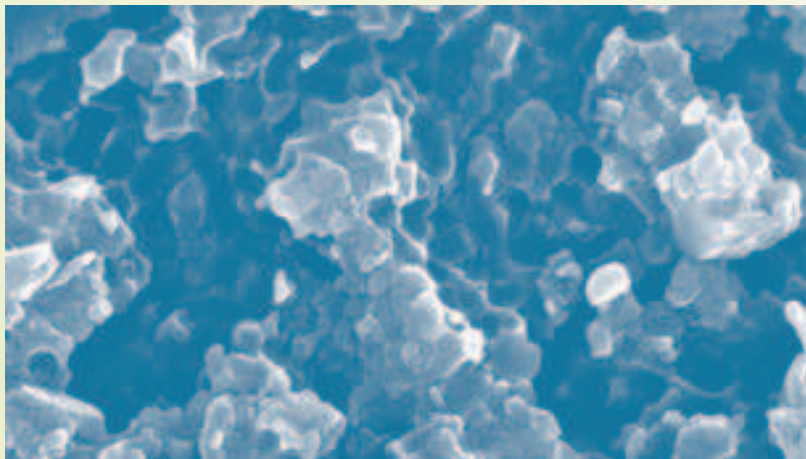


An illustration showing how *Sinosauropteryx* would have looked with their orange-and-white striped tails. (Credit: Chuang Zhao and Lida Xing)

The melanosomes that have been found no longer exhibit their original colours because their chemical properties have changed in the intervening millions of years. But researchers can still ascertain the original colours by looking at the particles' sizes and shapes, which correspond to those in living animals.

remains of the small colour-containing bodies.

The new finding is significant in that until now no one had found the pigments in dinosaurs – other than birds, which many palaeontologists consider to be dinosaurs. And no one had used melanosome shape and density to infer colour.



This scanning electron microscope image of a *Sinosauropteryx* fossil shows the spherical melanosomes impressions that indicate an orange colour. (Credit: University of Bristol)

In modern birds and mammals, sausage-shaped melanosomes carry black and grey pigments and spherical ones carry orange and brown colours. The scientists used a scanning electron microscope to find the fossilised

Four-legged creatures appeared 18m years earlier than thought

For a long time it was believed that four-legged animals (tetrapods) evolved about 375 million years ago when fish crawled out of

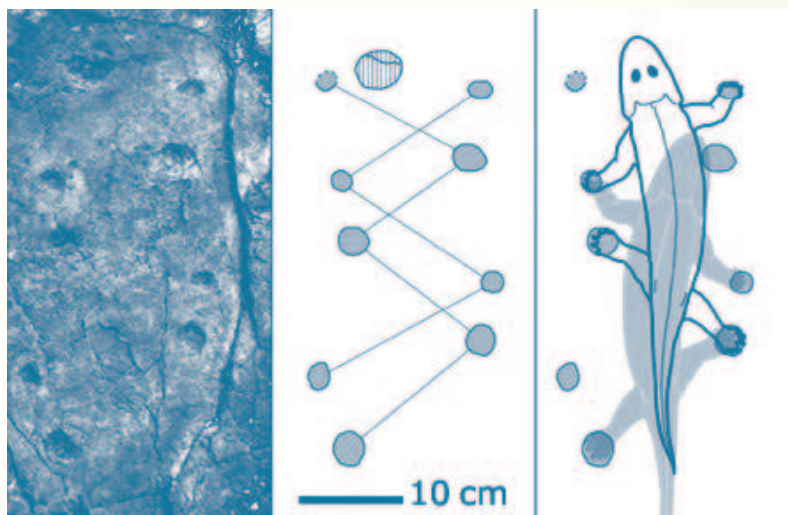
the water onto land to evolve into reptiles. Now a team of scientists from Poland and Sweden has found the oldest footprints of four-legged creatures in an old quarry in Poland that pushes back the evolution of tetrapods by 18 million years. The discovery, reported in the journal *Nature* (7 January 2010), was made in a former quarry in the Holy Cross Mountains in south-eastern Poland. The fossil foot prints – many individual impressions, as well as some arranged in sets called trackways – are preserved in 395-million-year-old rocks in the quarry. The Polish and Swedish scientific team analysed the trackway patterns to reconstruct how the ancient creatures would have moved their 'hips', 'elbows' and 'knees'. Their findings confirm that only true four-legged animals, or tetrapods, could have left the marks.

Because the rocks do not contain any body fossils, it is difficult to interpret what type of organism made the tracks. However, the arrangement of footprints in one trackway – including stride length and relative spacing, as well as the absence of an impression from a sagging tail – suggest that a four-legged animal between 40 and 50 centimetres long left the tracks. Other footprints at the site, however, were made by a larger, similar creature and include signs of toes. The largest of those prints is about 15 centimetres wide and was probably made by a tetrapod about 2.5 metres long, the research team estimates.

Until now, experts had believed that the earliest tetrapod fossils had split from their fishy ancestors about 375 million years ago and then gone on to conquer the land. The recently discovered footprints are 18m years older than the earliest, previously confirmed fossil remains of tetrapods.

Another implication of the new discovery is that while previous studies had suggested that the first tetrapods hauled up on lake shores or in freshwater deltas, the newly found trackways hint that the water-to-land transition could have happened in a shallow marine setting.

The paper's co-author, Per Ahlberg from Uppsala University in Sweden, describes several tracks of different sizes and characteristics as well as a number of isolated prints around 15-cm wide. There are distinct 'hand' and 'foot' prints, with no evidence of a dragging body or tail, because the animals'



Trackways preserved in 395-million-year-old rocks push back evidence for tetrapods by at least 18 million years, researchers say. The middle diagram depicts individual footprints and the schematic drawing at right shows a walking style that may have produced this pattern. (Credit: P. Ahlberg *et al.*)

body weight would have been partly supported by water.

According to the research team, the new explanation of the evolution of tetrapods made sense because it would have allowed marine ancestors of tetrapods gradually to acquire terrestrial competence while accessing a new and essentially untouched resource of food washed up with the tides.

Quantum mechanics in photosynthesis

Quantum mechanics evolved as a new branch of theoretical physics during the first few decades of the 20th century in an endeavour to understand the fundamental properties of matter. It began with the study of the interactions of matter and radiation. Certain radiation effects could neither be explained by classical mechanics, nor by the theory of electromagnetism. In particular, physicists were puzzled by the nature of light. Spectral lines were systematically catalogued for various substances, yet nobody could explain why the spectral lines are there and why they would differ for each substance. It took about one hundred years, until a plausible explanation was provided by quantum theory. According to a study published in the journal *Nature* (4 February 2010), the complicated interactions between matter and energy predicted by quantum mechanics appear to play a role in photosynthesis too.

Photosynthesis makes use of sunlight to convert carbon dioxide into useful biomass and is vital for life on Earth. Special proteins called light-harvesting complexes are used in

photosynthesis to capture sunlight and funnel its energy to nature's solar cells – other proteins known as reaction centres. Physical chemist Gregory Scholes of the University of Toronto and his colleagues isolated light-harvesting complexes from two different species of marine algae and studied their function under natural temperature conditions using a sophisticated laser



By hitting single molecules with quadrillionth-of-a-second (10^{-15} second) laser pulses, scientists have revealed the quantum physics underlying photosynthesis, the process used by plants and bacteria to capture light's energy at extremely high efficiencies.

experiment known as 'two-dimensional electronic spectroscopy'. By examining the light-harvesting systems of the two species of photosynthetic algae, they observed that energy introduced to the system acted in a distinctly quantum manner, even at ambient temperatures.

In these algae, the absorption of sunlight is carried out by bilin pigments – a series of yellow, green, red, or brown

nonmetallic compounds that are formed as a metabolic product of certain porphyrins (any of a class of pigments whose molecules contain a flat ring of four linked heterocyclic groups, sometimes with a central metal atom). In addition to their presence in the bile pigments of mammals, bilins also occur in invertebrates, lower vertebrates, red algae, and green plants. Bilin pigments not only impart various colours to certain animal parts or products but are also indispensable in a number of processes in green plants and act as accessory pigments in the photosynthetic process in red algae. Absorption of solar photons excite their electrons and the resulting excitation energy then moves to complexes of proteins called reaction centres, where it is converted to chemical energy by a series of biochemical events.

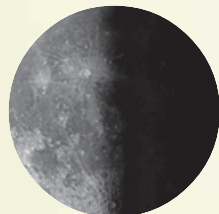
One of the most intriguing and most studied features of photosynthesis has been the extreme efficiency with which energy can be transferred within photosynthetic complexes. The photosynthetic apparatus of marine algae is odd – its pigments are farther apart than is expected for efficient functioning. A new spectroscopic study confirms earlier hints that quantum effects might be at play. According to the researchers,

the observation suggests that distant units within the proteins are 'wired' together by what they call 'quantum-coherence' to enhance light harvesting efficiency.

According to Scholes, the latest experiments show that normally functioning biological systems have the capacity to use quantum mechanics in order to optimise a process as essential to their survival as photosynthesis. ■

Sky Map for March 2010

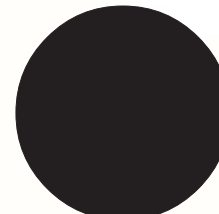
Moon - Last Quarter



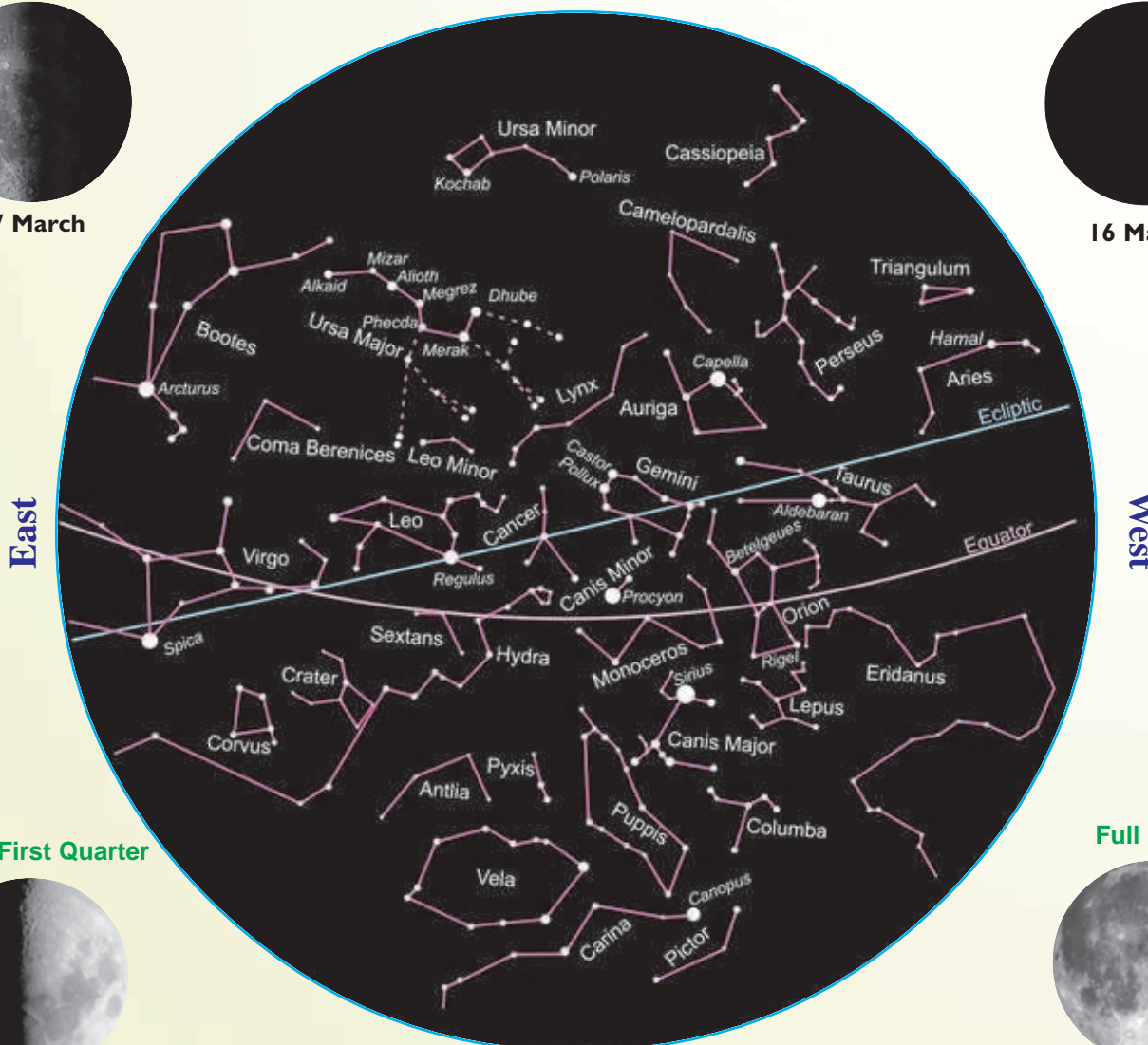
7 March

North

New Moon



16 March



East

West

South

Moon - First Quarter



23 March

Full Moon



30 March

The sky map is prepared for viewers in Nagpur (21.090 N, 79.090 E). It includes constellations and bright stars. 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 viewer 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 1 March, at 9 PM on 15 March and at 8 PM on 31 March.

Tips to use sky map:

- (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 constellation as shown in the map one by one.

Visibility of Planets (IST)

	Rising	Setting	In the Zodiac
Mercury	06:31	18:29	Aquarius-Pisces
Venus	07:16	19:28	Aquarius -Pisces-Aries
Mars	14:24	03:33	Cancer
Jupiter	05:52	17:37	Aquarius
Saturn	18:50	07:01	Virgo
Uranus*	06:30	18:28	Pisces
Neptune*	04:54	16:24	Capricorns-Aquarius

*Time shown is subject to vary (± 1 hr) from place to place.
*Not naked eye object

Sky Event

Date IST	Event
12	20:37 Moon Apogee
17	16:53 Uranus Conjunction
21	04:02 Vernal Equinox
22	10:24 Saturn Opposition
26	00:27 Moon-Mars
28	15:26 Moon Perigee

□ Arvind C. Ranade
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YOUR OPINION

Dream 2047 has been inviting your opinion on a specific topic every month. The reader sending the best comments will receive a popular science book published by VP. Selected comments received will also be published in *Dream 2047*. The comments should be limited to 400 words.

This month's topic:

“Are genetically modified crops/vegetables essential for ensuring India’s food security?”

Response should contain full name; postal address with pincode and email ID, if any; and should be accompanied by a recent passport size photograph. Response may be sent by email (opinion@vigyanprasar.gov.in) or by post to the address given below. If sent by post, "Response: *Dream 2047* March 2010" should be clearly written on the envelope.



Vigyan Prasar

A-50, Institutional Area, Sector-62, NOIDA 201 307 (U.P.)

Phone: 91-120-240 4430/35 Fax: 91-120-240 4437

Email: info@vigyanprasar.gov.in Website: www.vigyanprasar.gov.in

Winners of “Your Opinion” contest for December 2009

Topic: “Can mere government actions do much to tackle climate change without people’s active participation?”



Dr. Ranjan Kumar Mohanta

Ph.D. Scholar

Animal Nutrition Division

Indian Veterinary Research Institute,
Izatnagar, Bareilly, UP-243122.

“Climate change has origin from cumulative action of anthropogenic factors and natural sources. This has already reached a point of no return, and unless stringent measures are taken the situation may become worse. There is urgent need to cut down the release of green house gases responsible for global warming. It has to be checked both at policy making and ground level. Wastage of food, water, electricity and fuel is also a common cause as it indirectly results in more production of CO₂ and other greenhouse gases for production of these resources. Thus, public participation is a must to combat global warming. Mere governmental actions cannot be effective. People need to know what they can do to perform to their best without affecting the environment in real life situations in day to day actions. Use of more environment friendly vehicles, instruments and equipment needed in daily life and conserving all the natural resources as much as possible without affecting our progress need to be our motto. Sustainable development with clear policy from government and commitment with proper action from people is the need of hour.”



Dr. Vishwanath G. Makne

Engineering Colony,

New Ausa Road,

Latur – 413 512 (M.S.)

“The issue of climate change, i.e., global warming has become a serious issue today. The broad strategy for combating the climate change problem would be the use of public transport rather than individual cars, use of solar energy wherever possible, use of local foods instead of packed or frozen foods, and extensive tree planting. All these measures would depend on people’s active participation and could help reduce the emission of CO₂, which has great collective effect on climate change.”

Jaleel Ahmed

R/o Badhal, P/o Kotranka,

District Rajouri, Jammu & Kashmir

“As far as the government is concerned, it can be active or inactive in their actions regarding climate change. But people’s participation is a must for the proper use and conservation of our natural resources as well as fighting climate change. Without people’s active participation we cannot hope that the problem of climatic changes can be solved. No doubt governmental action is necessary, but without our own thinking and acting it may not be possible to solve this problem.”

The winners will receive a copy of VP Publication

Corrigendum : The top photo which appeared in page-32 in English and page-5 in Hindi of February 2010 issue of *Dream 2047*, Vol.12, No.5 is not that of Science College, Calcutta, but it is new building of Indian Association for the Cultivation of Science after it was shifted to Jadavpur from Bowbazar. We regret for the error. **-Editor**

National Observation Camp for Annular Solar Eclipse

14-16 January 2010

14 January 2010

Vigyan Prasar in collaboration with Tamilnadu Science and Technology Centre (TNSTC), Chennai organised a National Observation Camp on viewing the annular solar eclipse on 15 January 2010. The other partners in this programme were Rashtriya Vigyan Evam Prodyogiki Sanchar Parishad (RVPSP) and St. Anthony Sr. Sec. School, Kanyakumari.

the camp. Some distinguished scientists and science communicators were the special invitees for the programme.

During the 3-day camp, a series of programmes and activities were conducted for the participants. The programme started with the lighting of lamp followed by a welcome song sung by the students of St. Anthony's H.S. School. The District Collector of Kanyakumari, Shri

observing the annular solar eclipse. He also explained the phenomenon of the annular eclipse and its uniqueness.

In his presidential address Er Anuj Sinha made an appeal to the younger generation to become scientists through hard work, keen observation, and gain new knowledge about the universe. He also spoke about the role of science communicators in society and said, "The



Sun in various phases of Eclipse January 15, 2010, as seen from Kanyakumri

For this Camp members of VIPNET clubs were selected on the basis of the projects submitted by them to Vigyan Prasar. The project ideas relating to astronomical activities were circulated among the VIPNET clubs through *VIPNET Newsletter* and correspondence. Two young scientists from each state who participated in the National Children's Science Congress and the members of about 100 most active VIPNET clubs were also invited for this camp. In total, 827 participants representing more than 26 States/UTs registered for

Rajinder Ratnoo, IAS, Dr. V.B.Kamble (Ex-Director Vigyan Prasar), Er Anuj Sinha (Ex-Head RVPSP, DST), Dr. Arul Gerald Prakash (Director, Kerala State Science and Technology Museum), Dr. P. Iyamperumal, Executive Director, TNSTC, Smt Ujjwala T. Trikey Scientist E, (NCSTC) were present.

In his welcome address Dr. Iyamperumal spoke about the special features and peculiarity of Kanyakumari and what was so special for selecting Kanyakumari for organising the camp for

great scientists are those, who not only solve problems, but also pose new questions.

Former Director of Vigyan Prasar Dr. V.B. Kamble recalled how scientific attitude and scientific temper is being promoted in the country, especially regarding eclipses, since the total solar eclipse of 1995. He said an amazing change is taking place in the ways of thinking among the people. They are now coming out of the mire of superstitions, dogmas and unscientific and wrong beliefs.



Inaugural session by Shri Rajinder Ratnoo, IAS commissioner



A technical session in progress

Shri B.K. Tyagi, principal scientific officer, VP presented a brief report about how the children were selected for the camp and gave an account of the programmes and activities to be organised during the three-day programme. The vote of thanks was proposed by Dr. S. Soundarajaperumal, Joint Director, TNSTC.

On the first day three parallel technical sessions were organised in which a series of lectures, demonstration and discussions were organised. The lectures by scientists were on subjects covering various aspects like understanding eclipses, the anatomy of eye and science of vision, and how to view eclipses safely. The demonstra-

At 6 in the evening, a written quiz for the participating children was organised. About 400 children participated in the quiz. At the same time an important interaction session with the teachers and coordinators was organised in which Dr V.B. Kamble, Er Anuj Sinha, Smt. Ujjwala Tirkey, and Smt. Indu Puri participated. The basic objective of this discussion was to involve the VIPNET clubs in programmes relating to empowerment of women and issues relating to their health, sanitation and nutrition, etc. Shri Nimish Kapoor also briefed the coordinators about the programme and

observations and readings as part of the activity. The team leaders and volunteers were also provided with additional material for the activities. Regular announcements were made to instruct all about the first and the last contact and precautions to be observed during the entire period by Dr Arvind C. Ranade. Everyone watched the eclipse with the filters provided for the purpose. Scientists and volunteers assisted the children in conducting the activities during the eclipse. About 300 children submitted reports of their findings to the organisers that are being analysed.



Participants viewing the eclipse at the heliport

tion of the kit, developed by VP, was also given to the participants in all the three parallel sessions. A briefing session on how to perform activities during the eclipse was also organised. Each child was assigned an activity, which he/she was supposed to perform during the eclipse. The required material for performing the activity along with activity sheets with instructions was also made available to group leaders.

The four activities were:

- 1) To find the angular size of the Sun and the Moon
- 2) To find the percentage of eclipse
- 3) To find the maximum time of annular eclipse
- 4) To record any effect on flora and fauna

activities, which could be undertaken by the clubs in the coming years as part of International Year of Biodiversity-2010.

15 January 2010

This was the day of the annular solar eclipse. All the participants gathered at 9.15 a.m. in the school campus. Necessary instructions were given and precautions to be taken were told again. After this, volunteers guided the participants to the observation site.

At the observation site, telescopes were arranged for projecting the image of Sun during the eclipse. Small mirrors fixed to balls were distributed for projecting the image of Sun on screens for taking necessary

16 January 2010

The last day of the camp was devoted mainly to experience sharing and distribution of prizes and participation certificates. All the participants assembled at 10.00 a.m. The first session began with a briefing about the International Year of Biodiversity.

As was apparent from the feedback received, for majority of the participants the three-day camp was a unique experience. During the valedictory function, the winners of quiz competition were given prizes in the form of books and CDs of Vigyan Prasar. The children who put up the best 15 projects were also honoured and special gifts in form of VP's publications, kits, and software were presented to him. ■



Vigyan Prasar

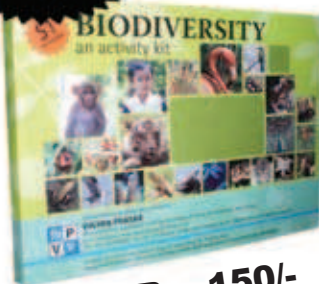
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