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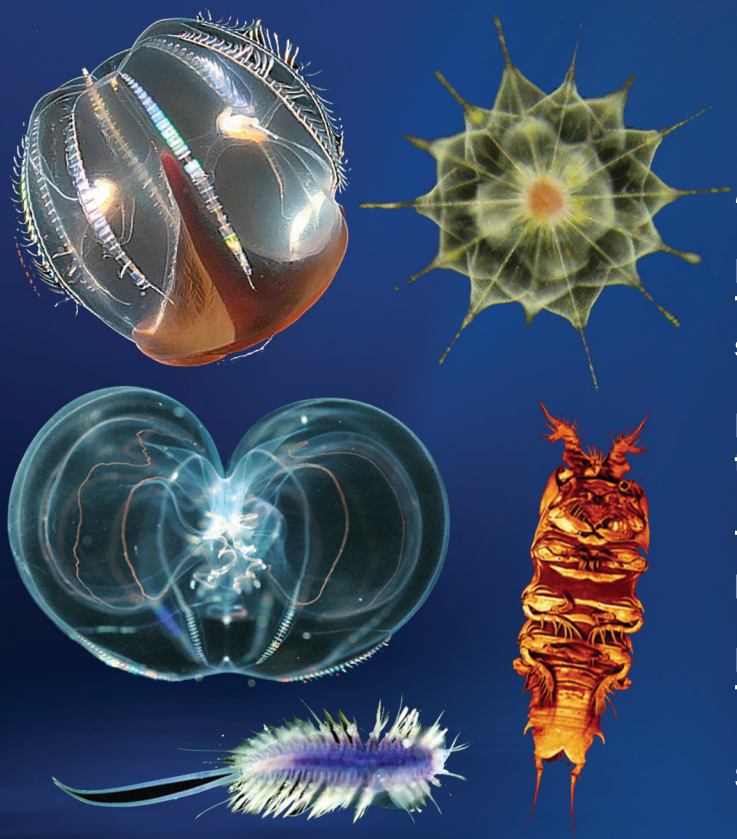
Census reveals bounty of oceanic life

Robert Burns Woodward
(The greatest deviser of organic syntheses)

(1917-1979)



Inside

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

Framework for science news

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The media, both print and electronic, play an important role in opinion formation. As in politics so also in science related matters, the ideological slant of the management is reflected in features, editorials and also in news stories. Enlightened viewers and readers, it is blithely hoped, are aware of this and use correctional filters to absorb the key issues.

Recent weeks have witnessed analytical features on the Indo-US technological deals with stress varying from 'the changing geo-political equations in the subcontinent and the increasing strategic importance of India' to the 'gains likely to the industrial military complex in the US because of the opening of opportunities in India.' The impact on Indian economy, say 'better availability of electrical power and its impact on industry' does not find adequate space in the discussions.

The common man is more likely to become engaged in a story if it appeals to a broader public interest. This is more so if the story has a straight forward and consistent narrative. The review of pulse polio campaign in view of fresh reports of polio cases finds prominence in some national newspapers. Most stories, however, do not carry reflections of scientists and deal with the contents rather superficially. The approach of 'science report for the sake of science' is not likely to retain attention of the audience.

Let us review the news channels in many European nations. They frequently dwell on 'climate change' and 'global warming' and take an alarmist view on these phenomena. The features generally establish clear connections between science, policy and public interest. 'The thinning of ozone layer' and 'climate change' are discussed in similar frames. These tend to seek answers to questions like what the public needs to know about climate change.

Is there a model that can be adopted for increased public understanding of issues in science and development like climate change? How can we have a more informed public that can influence policy? What have we learnt from media coverage of complex developmental issues like climate change?

The space for discussion on science, technology and development is limited and not likely to increase dramatically in the mass media. The civil research establishments (agriculture, medical, industrial, etc.) do not have clear mechanisms of interfacing with journalists and communicators. News is characterised by timeliness and accuracy both requiring a shift in priorities of the laboratories in the public sector and the universities.

One could argue that people are indiscriminating in their understanding of issues and their impacts. Opinion leaders are confused about priorities and strategies. Consumerism is a subtle but powerful driver for many decisions and therefore a convenient punching bag. Is absence of scientific understanding deliberate and comfortable? Is it not important enough?

There are notable radio and television channels and serious print formats that have high credibility and are committed to reach audience with issues that help development debates. The challenge is to impress this public with well-presented stories that meet their practical and strategic needs. Communicators must contribute with balanced reporting on complex matters and reduce the ideological bias consciously.

Will more science matters in the media increase its public understanding? How can communicators address the enormity of development debates through a short news story? Is there a limit beyond which the outreach effort will become propaganda? Will newsmakers be willing to cooperate with the reporters in this effort? What should be a good period to review and revise the strategy?

The building blocks for better understanding of science and clearer opinions are in science news and features in the mass media. The next few weeks will witness an initiative on television that takes this issue further with a regular news telecast. There can be exciting spin-offs by integrating the effort with other channels provided by ICT. The question on how this is likely to contribute to public debates meaningfully can then be considered for answering.

☐ **Anuj Sinha**

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Robert Burns Woodward
The greatest deviser of organic syntheses

Subodh Mahanti
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"Woodward's career was marked throughout by brilliance. He went to the Massachusetts Institute of Technology when he was only 16, was 'sent down' for a year for 'inattention to formal studies' but nevertheless emerged with his PhD at 20. Soon he moved to Harvard, and remained there. He did major work in most areas of organic chemistry, but his most striking work was in the synthesis of complex natural products."

The Cambridge Dictionary of Scientists (2nd Edition), 2003

"In 1944 Woodward, with William von Eggerts Doering synthesised quinine from the basic elements. This was a historic moment for it was the quinine molecule that William Perkin had, first prematurely, attempted to synthesise in 1885."

A Dictionary of Scientists, Oxford University Press, 1999

"Woodward's research productivity was remarkable, a result both of the intensity of his work habits and his extraordinary skills. His memory of the details of the chemical literature was legendary and he quickly mastered every innovation in his field. In particular, he led in understanding the possibilities of new instruments of the organic chemical laboratory in the 1930s and 1940s: infrared and ultraviolet spectrometers, mass spectrometers and nuclear magnetic resonance."

Alan J. Rocke in *The Oxford Companion to the History of Modern Science* (2003)

Robert Burns Woodward is regarded as the pre-eminent organic chemist of the twentieth century. His knowledge of organic chemistry was unsurpassed. He had mastered the skill of creating complex natural organic molecules in the laboratory from the simplest possible starting materials. It was no ordinary skill. As Alan J. Rocke wrote: "Successful natural product synthesis requires a combination of rigorous thinking, ingenuity of approach and method, a high level of skill in laboratory manipulations, and an almost intuitive sensibility for how molecules can and will combine." Among the most important molecules synthesised by Woodward and his group were cholesterol (1951), cortisone (1951), strychnine (1954), LSD or lysergic acid diethylamide (1954), reserpine (1956), chlorophyll (1960), cephalosporin C (1966), and vitamin B_{12} (1971).

Woodward was a pioneer in stereospecific synthesis; that is, synthesis of a particular configuration of a molecule in three-dimensional space. Stereospecific synthesis acquires special importance because of the fact that most natural products of medicinal value are effective as medicine only in a particular form of stereochemistry. Today's organic chemists use stereospecific synthetic route routinely but it was not the case in Woodward's time.

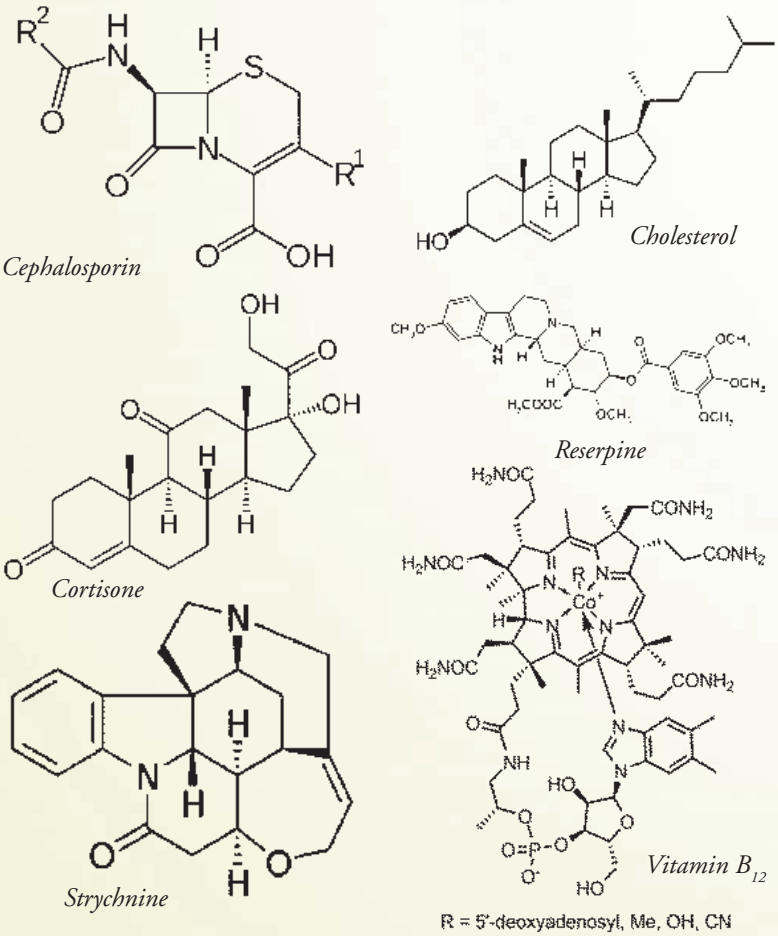
Robert Burns Woodward

Each of his synthetic work was marked by the elegance and ingenuity of the process. He could make a valuable and highly complicated product from simple starting materials using a large number of chemical steps. His methods often provided novel general synthesis of other compounds. Woodward ushered in a revolution or opened up a new era (often called 'Woodwardian era') in organic synthesis. He made synthesis of complex organic molecules a commonplace practice, which was earlier thought to be impossible. Woodward once wrote: "The structure known, but not yet accessible by synthesis, is to the chemist what the unclimbed mountain, the uncharted sea, the untilled field, the unreached planet, are to other men." In 1965, Woodward was awarded the Nobel Prize in Chemistry for his "collective contributions to the art of organic synthesis."

Woodward's contribution was not confined to synthesis of natural products alone. His work in structure determination was equally path-breaking. He solved several important structural puzzles. Among the natural products the structures of which were elucidated by Woodward and his group were penicillin (1945), patulin (1948), strychnine (1947), oxytetracycline (1952), cevine (1954), carbomycin (1956), gliotoxin (1958), ellipticine (1958), calycanthine (1960), oleandomycin (1960), streptonigrin (1963), and tetrodoxin (1964). Woodward's determination of the structure of magnamycin revealed a previously unknown family of natural products of macrolide antibiotics. Woodward jointly with Geoffrey Wilkinson proposed a structure for ferrocene, an organic compound incorporating iron atom. This was the beginning of the field of organometallic chemistry, a field which has grown into an important industry. Wilkinson got the Nobel Prize in 1973 for his work on ferrocene. Many thought that Woodward should have shared the Prize with Wilkinson. Woodward himself thought so.

Woodward and Roald Hoffmann introduced the principle of conservation of orbital symmetry which proved to be a major theoretical advance and provided a deep understanding of a wide group of chemical reactions. To understand how orbital symmetry comes into picture in chemical reactions we need to realise the fact when a reaction takes place there is a

change in bonding among the atoms; that is, bonding in the reactants or the substances undergoing reaction to the bonding in products. Now as we know, bonding results from overlap of orbitals which requires that portions of different orbitals occupy the same space and are of same phase. The Woodward-Hoffmann rules are a set of rules in organic chemistry that predict the stereochemistry of pericyclic reactions (reactions that involve conjugated polyenes and proceed by single step or concerted reaction mechanisms) based on orbital symmetry. It may be noted that in concerted reactions several bonds are made or broken simultaneously and in such reactions orbital symmetry effects are more pronounced. Based on their rules, Woodward and Hoffmann described certain reaction paths as symmetry-allowed and others as symmetry-forbidden. It may be noted that although the concept that the course of chemical reactions can be controlled by orbital symmetry may look to be very straightforward, it was a revolutionary step. In fact it was one of the really giant steps forward in chemical theory.



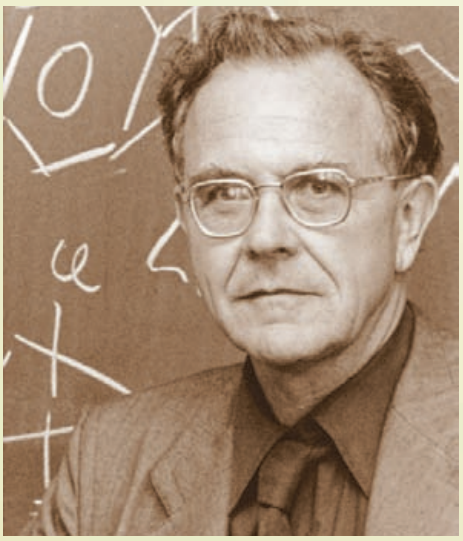
Some of the molecules synthesised by Woodward and his group

Woodward was the first to propose the correct biosynthetic pathway to the steroidal hormones in living organism.

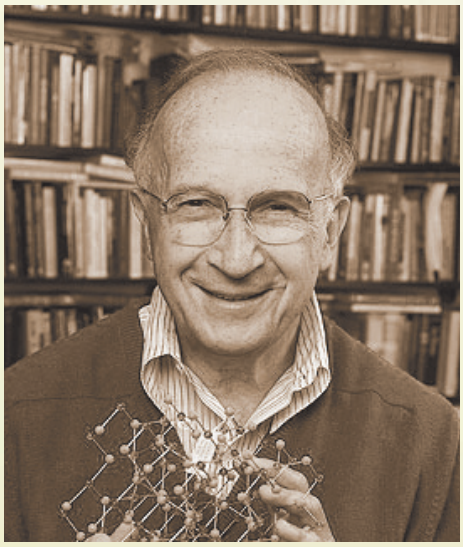
Woodward was born on 10 April 1917, in Boston, Massachusetts, USA. His father Arthur Chester Woodward died of influenza when Woodward was just 18 months old. His mother Margaret Woodward (nee Burns) had to work hard to support her son's education. The family settled in Quincy, Massachusetts. Woodward attended the public primary and secondary schools of Quincy. He finished his grammar and high schools in just nine years as he was allowed to skip three years. Woodward developed a fascination for organic chemistry at a very early age. He undertook private study of organic chemistry. It is said that by the time he entered high school he could perform most of the experiments described in Ludwig Gattermann's textbook of experimental chemistry, a book then widely used. In 1928, Woodward (when he was just 11 years old) thought it necessary to get certain original research papers of organic chemistry published in German journals. He managed to do so with the help of the Consul-General of the German consulate in Boston and one of those papers was the original communication of Diels and Alder about the Diels-Alder reaction. In later years Woodward studied this reaction again.

In 1933, at the age of 16, Woodward joined the Massachusetts Institute of Technology. However, just after one year Woodward was expelled from the MIT. The reason for his expulsion was that he hardly paid any attention to formal studies. Fortunately MIT readmitted Woodward in 1935 and within one year after his readmission he received his Bachelor of Science degree. What is more, just one year later he was awarded the PhD degree. It was certainly an extraordinary feat. Woodward's doctoral work was concerned with the investigations related to synthesis of the female sex hormone oestrone. His research advisor at MIT was Avery A. Ashdown but it is not certain whether he took any of his advice.

After his PhD degree from MIT, Woodward taught summer school at the University of Illinois for a brief period before



Geoffrey Wilkinson



Roald Hoffmann

Kurt Alder

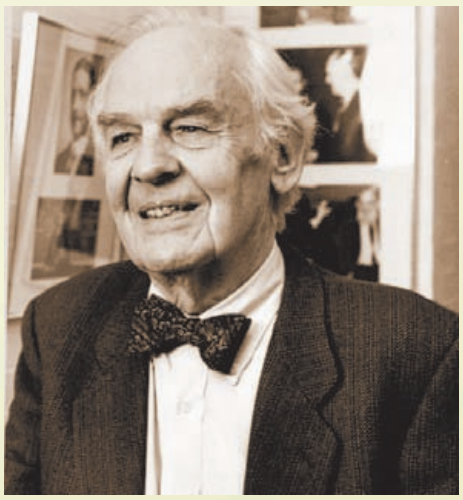
moving to Harvard University as an assistant of Professor E. P. Kohler and later he became a full professor. He remained at Harvard University till his death in 1979.

Woodward's first major research contribution was made in the early 1940s. This was a series of papers describing how ultraviolet spectroscopy could be applied in the elucidation of structure of natural products. He devised a series of rules for determining the structures of newly synthesised natural substance from ultraviolet spectroscopic data. These rules are now called Woodward's rules, which could also be applied to non-natural synthesised molecules.

1n 1944, Woodward, jointly with his student William von Eggers Doering, achieved the synthesis of quinine, an alkaloid used for treating malaria, from its elements. It was a landmark for chemical synthesis. It may be noted that its synthesis was publicised as a breakthrough for making quinine easily available, which otherwise was to be imported from Southeast Asia. However, Woodard's synthesis was not commercially viable. But this in no way diminished the importance of Woodward's work. It was the first multi-step synthesis undertaken by Woodward. It should be remembered that when Woodward achieved the synthesis of quinine, organic synthesis was largely a matter of trial and error. In fact, nobody really thought that such a complex structure could really be synthesised. It was Woodward who demonstrated that organic synthesis could be made into a rational science and that well-established principles of reactivity and structure could be applied in achieving synthesis of complex molecules.

The epitomes of synthetic achievements of Woodward were the syntheses of chlorophyll and vitamin B_{12}. Woodward's work on chlorophyll greatly increased our knowledge of this important substance, the green plant pigment which absorbs the energy radiated by the Sun and transforms it for use of plants.

The total synthesis of vitamin B_{12} took over 12 years and it was the result of a unique collaborative effort between Woodward's group at Harvard and Eschenmoser's group at ETH (Eidegenossische Technische Hochschule or Swiss Federal Institute of Technology) in Zurich. Elkan Blout commenting on vitamin B_{12} synthesis wrote in *Biographical Memoirs of the National Academy of Sciences*, USA: "The two major challenges posed by the vitamin B_{12} structure were the novelty of the ligand chromophore and the stereochemical complexity of the ligand's periphery. Woodward's main focus was the latter. This led him to create a great synthesis of the so-called 'Harvard component'—the part of the B_{12} molecule that is the most complex and contains rings A and D. The synthesis, both in design and execution, appears today as the apotheosis of all that constituted the Woordwardian art and science in natural products total synthesis. Forever in the history of chemistry, it will also remain connected with that creative insight of Woodward that eventually grew into the message of the Woodward-Hoffmann rules, changing the way organic chemists think about the reactivity of organic molecules."



William von Eggers Doering

Derek Harold Richard Barton

As mentioned earlier, Woodward's contribution to structure determination was highly significant and path-breaking. Derek Harold Richard Barton, a colleague of Woodward and the recipient of Nobel Prize in Chemistry in 1969, wrote: "The most brilliant analysis ever done on structural puzzle was surely the solution (1953) of the terramycin problem. It was a problem of great industrial importance, and hence many able chemists had performed an enormous amount of work trying to determine the structure. There seemed to be too much data to resolve the problem, because a significant number of observations, although experimentally correct, were very misleading. Woodward took a large piece of cardboard, wrote on it all the facts and, by thought alone, deduced the correct structure for terramycin. Nobody else could have done that at the time."

Woodward was known for giving long lectures. Very often Woodward's lectures lasted for 3 to 4 hours. In fact, his students defined a unit of time called "woodward", which was the measure of longest known lecture given by Woodward and then his other lectures would be so many "milli-woodwards" long. His lectures were not known merely because of their length, but because they were models of clarity, originality, and insight. He did not use slides for his lectures. Instead he would himself draw beautiful structure by using chalks of different colours. He truly enjoyed giving lectures to students and colleagues, but this was not the case with formal courses

or regular teaching. He believed in teaching in the laboratory, in seminars and public lectures. He once said: "I teach all the time so that I don't have to teach formal courses."

Woodward had a fascination for blue colour. All his suits, his car and even his parking place was coloured (painted by some of his students) in blue.

Woodward was a great teacher. He trained more than 200 PhD students and postdoctoral fellows, many of whom went to become distinguished chemists. Among his best known students are: Robert M. Williams, Yoshito Kishi, Stuart Schreiber, Steven A Benner, Kendall Newcomb Houk, and Kevin M. Smith. Woodward was a scientist who could transmit the excitement of doing science to his students. One of his students wrote: "I owe a lot to R. B. Woodward. He showed me that one could attack difficult problems without a clear idea of their outcome, but with confidence that intelligence and effort would solve them. He showed me the beauty of modern organic chemistry, and the relevance to the field of detailed careful reasoning. He showed me that one does not need to specialize. Woodward made great contributions to the strategy of synthesis, to the deduction of difficult structures, to the invention of new chemistry, and to theoretical aspects as well. He taught his students by example the satisfaction that comes from total immersion in our science. I treasure the memory of my association with this remarkable chemist."

Besides his Nobel Prize in 1965 Woodward received 26 medals and awards including the most prestigious ones in the field of chemistry: John Scott Medal from the Franklin Institute and City of Philadelphia (1945); Davy Medal from the Royal Society of London (1959); Roger Adams Medal from the American Chemical Society (1961); Pius XI Gold Medal from the Pontifical Academy of Sciences (1969); National Medal of Science of the Unites States of America (1964), Lavoisier Medal from the Societe Chimique de France (1968), the Order of Rising Sun, second class from the Emperor of Japan (1970); Hanbury Memorial Medal from the Pharmaceutical Society of Great Britain (1970); Pierre Brunylants Medal from the University of Louvain (1970); AMA Scientific Achievement Award (1971); and the Cope Award (jointly with Roald Hoffman) from the American Chemical Society.

Otto Paul Hermann Diels

Woodward was elected fellow of numerous academies and learned societies. It may be noted that he was elected to the National Academy of Sciences (1953), when he was just 36 years old. He received 24 honorary degrees from around the world.

The Ciba pharmaceutical company founded the Woodward Research Institute in Basel, Switzerland. It was a unique honour. Woodward himself directed the research activities of this institute.

Woodward died on 8 July 1979 in Cambridge, Massachusetts. At the time of his death he was working on the synthesis of the antibiotic erythromycin. If Woodward lived for another two years he would have certainly shared the Nobel Prize in Chemistry for 1981 for their work on orbital symmetry.

What is the legacy left behind by Woodward? To answer this we quote from the Nobel Award Ceremony Speech. It noted: "Professor Woodward's research work covers vast and various fields in organic chemistry. A leading feature is that the problems have been extremely difficult and that they have been solved with brilliant mastery. He has attacked them with a maximum of theoretical knowledge, a never falling practical judgement and, not least, a genial intuition. He has, in a conspicuous way, widened the limits for what is practically possible. As a stimulating example he has exerted profound influence on the organic chemistry of today." There is no doubt our young scientists particularly young chemists have lot of things to learn from the life and work of Woodward.

The following publications will prove to be useful for more information on the life and work of Woodward:

1. Benfey, Otto Theodor and Morris, Peter J. T., eds (2001). *Robert Burns Woodward: Architect and Artist in the world of Molecules*. Philadelphia: Chemical Heritage Foundation.
2. James, Laylin K., ed (1993). *Nobel Laureates in Chemistry 1901-1992*. Washington, DC: American Chemical Society: Chemical Heritage Foundation.
3. Woodward, Robert Burns (1963), "Art and Science in Synthesis of Organic Compounds: Retrospect and Prospect," in *Pointers and Pathways in Research*, ed. Maeve O'Connor: CIBA of India.

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1. Heilbron, J.L. (ed.), T*he Oxford Companion to the History of Modern Science*; Oxford: Oxford University Press, 2003.
2. Morrison, Robert T., and Boyd, Robert N., *Organic Chemistry* (4th edition), Boston: Allyn & Bacon, Inc., 1983.
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4. Bagchi, Asoke K, *Hinduja Foundation Encyclopaedia of Nobel Laureates 1901-1987*, New Delhi: Konarak Publishers Pvt. Ltd, 1990.
5. *100 Years with Nobel Laureates*, New Delhi: Encyclopaedia Britannica (India) Pvt. Ltd., 2001
6. *The Cambridge Dictionary of Scientist (2nd Edition)*, Cambridge: Cambridge University Press, 2001.
7. *A Dictionary of Scientists,* Oxford: Oxford University Press, 1999.
8. Available information on the Internet.

(The article is a popular presentation of the important points of the life and work of Robert Burns Woodward available in the existing literature. The idea is to inspire the younger generation to know more about Robert Burns Woodward. 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 and the sources of the pictures reproduced here.)

For marketing tie-ups

To what extent have the objectives that were set out for Vigyan Prasar been fulfilled?

Vigyan Prasar was established with the following objectives: establishment of an expert system for identification and development of content; development of knowledge networks in the area of science and communication; selection and deployment of the right communication and delivery system; and undertaking activities that communicate the joy of pursuing science.

As far as delivery of designed objectives, we are reasonably happy. So far, the organisation has focussed largely on child-centric programmes and segments of society which remained uninitiated to a large extent. I have been able to seek some responses about VP's work from the youth at the school level. I must say that there has been a favourable perception among students for its products.

Which activities have really succeeded? How can these be capitalised upon to make VP more visible?

Vigyan Prasar is a small organisation and is engaged in a number of activities. One of its strengths is content generation and the publishing of printed materials. Particularly in subjects like astronomy and various topics in physics, VP brought out good and valuable publications. DREAM 2047 is an excellent outreach material.

The science clubs of VP form an excellent outreach, which are sought after by schools. Some of the video and audio-visual materials developed by VP have attracted wide appreciation. Since VP does not enjoy a large marketing network, these products have not yet penetrated the market. VP's core strength lies in design and development of science communication products. It has to develop synergies with other organisations and agencies to deliver its strength into the community.

The National Council for Science and Technology Communication (NCSTC), a wing of the DST, and VP are engaged in similar activities. Is it necessary to demarcate their roles to achieve the goals of science dissemination?

The NCSTC and VP are two complementing arms, with VP enjoying functional and process autonomy within the budgetary provisions and the NCSTC benefiting from the wider choice of purpose and goals. Effort is being made to avoid overlaps in functions and programmes. The heads of VP and the NCSTC are members of the decision-making bodies of both organisations. The NCSTC offers scope for public-public partnerships and global alliances in science outreach and communication.

"V.P.'s core strength lies in the design and development of science communication products."

— T. Ramasami

For example, the Children's Science Congress is an activity of the NCSTC that demands Centre-State connectivity and partnerships. Science Express is an output of Indo-German partnership and involves string linkages with other departments. These activities are better accomplished as a departmental activity of the DST. Development of content, e-books, new educational tools and activities like science club, etc., which involve partnerships with stakeholders and target audience and flexibility combined with a close relationship to the scientific community, offer VP a unique strength unavailable to the NCSTC.

Is there a need for the strength of and funding for VP to be increased if it has to assume a bigger role?

Its small size is its strength. This strength also imposes restrictions on diversification of activities. I would advise VP to intensify rather than diversify.

The role and funding of organisations like VP should be viewed in relation to their context and comparative strengths. VP has grown under an input-led growth model. It should move towards an output-led and outcome-linked development path. That is, it should enrol partnerships for marketing and outreach which involve financing mechanisms too. If VP relies only on the DST and governmental sources for finance, the NCSTC and VP will be fighting for the same space.

In my opinion, VP needs a business plan, market alignment for products and alliances with other network partners, including in the private sector. The meaningful programmes of VP shall not suffer for want of funds, but the public investments into V.P. will have to be linked to value propositions of the product outputs and social outcomes.

By A Special Correspondent

[The above interview with Dr T. Ramasami, Secretary of the Department of Science and Technology (DST), is reprinted from *Frontline* (5 November 2010).]

'Poised for a leap'

Which activities of Vigyan Prasar have really succeeded? How can these be used to promote VP?

Vigyan Prasar in its brief history has attempted many innovative projects. We composed a ready-to-print full page on science with a weekly frequency, which many newspapers published with a change in masthead. The project was moving towards self-sustenance when the TV boom arrived. We learnt early use of the web with a popular e-magazine, COMCOM. This attracted many experts, who contributed to the online discussion forums and other features.

The Exhibition on Wheels was mooted by Shri M.V. Kamath, Chairman, governing body. This special train had 12 coaches and, in a period of about eight months, visited over 50 places. This was a forerunner to the Science Express of the National Council of Science and Technology Communication (NCSTC), which we have designed and operated over the last four years. Many of our activity books have had repeat print runs. Our portal has many features that compel repeat visits by teachers, communicators and activists.

You were the head of the NCSTC. Which organisation is more suited to achieving the objectives of science communication and dissemination?

Vigyan Prasar was conceived to provide operational leverage to science communication. The roles of these organisations have been well etched out and are complementary. This institute is for research and development and large-scale dissemination of books, CD ROMs, kits, etc. The NCSTC, on the other hand, helps in policy formulation and considers grant-in-aid for innovative project proposals from scientists in laboratories, universities and voluntary organisations.

In many national campaigns, the two organisations have leveraged their respective strengths to deliver good resource material for use by activists. The Planet Earth Campaign (2008/10), Year of Astronomy (2009), and Year of Biodiversity (2010) witnessed close collaboration (between the organisations). We are working on components of the Year of Chemistry (2011) with each other.

What are the activities VP can diversify into?

" Many of our activity books have had repeat print runs."
— Anuj Sinha

The first two decades have established the fundamentals of Vigyan Prasar and it is poised for a leap. The next phase should focus on developing innovative communication material for gender empowerment, addressing needs of neo-literates and increasing our footprint in technology communication. There is scope for improving the capacity for rational decision-making in large sections of the society. The means and media will have to match the requirements of the trainers, communicators and activists.

Do you think the strength of VP has to be increased if it is to assume a bigger role?

We are increasing our reach and will raise resources from different agencies, including greater support from the parent department. Recently, the UNFPA (the United Nations Population Fund) assigned us a task through competitive bidding. We are discussing partnering with other agencies to leverage our strengths. A lesson from my long experience of working has been that good programmes do not suffer because of resource constraints.

There is a general feeling that the marketing reach of VP needs to be improved substantially. How do you think this can be achieved?

I agree. With low-priced quality products, the lack of interest of private distributors is not unexpected. Sales at exhibitions are encouraging, but such exposures are designed generally for branding and exposure. The issue has not been resolved satisfactorily. We are increasing sales outlets while facilitating e-payment. We are examining new opportunities, and shortly our products and publications will be on sale in many towns and cities.

VP's programmes on Doordarshan (DD) and All India Radio (AIR) do not seem to get prime time slots. How can this be remedied?

Prasar Bharati and its constituents AIR and DD value the necessity and importance of quality science programmes. Within the space for negotiation, we drive bargains for good slots. With both AIR and DD, there is better visibility on the regional language stations than on the national channel. We are increasing the number of programmes, adding more variety and exploring more channels to reach audiences.

By A Special Correspondent

[The above interview with Anuj Sinha, Honorary Director of Vigyan Prasar is reprinted from *Frontline* (5 November 2010).]

Rocket science helps rescue of trapped miners

T V Venkateswaran
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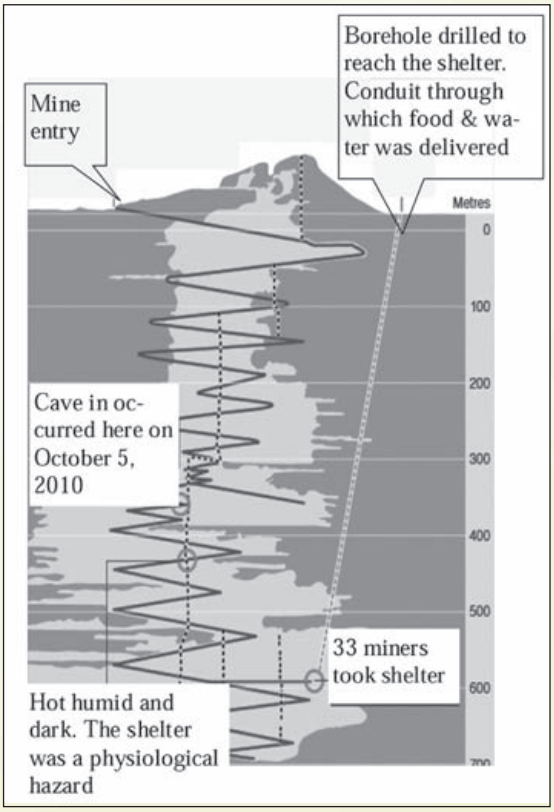
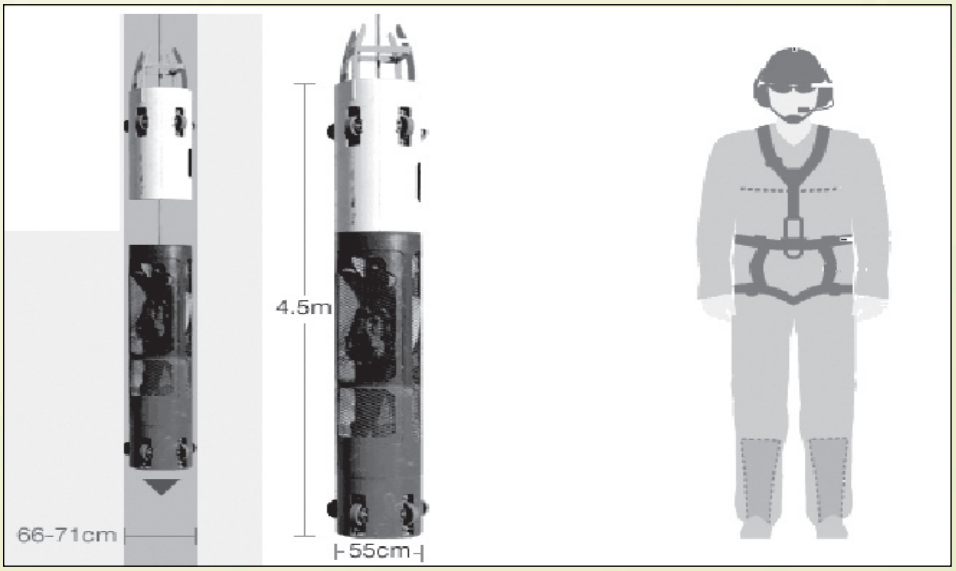
The world let a sigh of relief on 13 October 2010, as one by one, thirty three miners were winched back from the collapsed San Jose mines in Chile. Ending an ordeal for almost 69 days entrapped beneath the surface in a collapsed mine all the 33 miners survived and came back alive to the joy and relief of their family members and millions who were watching the events unfold before them on live TV. It was indeed emotion filled and sensational story of the disaster, tribulations and subsequent rescue. However it is essentially a tale of triumph of human will and science and technology.

On 5 August 2010, there was a terrible accident at the 121-year-old San Jose copper-gold mines in Chile. An estimated 700,000 tonnes of rock collapsed trapping 33 miners 600 metres below the surface. Science and technology used to place humans in space was used to save and rescue the trapped miners.

Typically, mine tunnels are used for ore extraction, enabling labourers or equipment to access the mineral and metal deposits deep inside the Earth. These tunnels are made using similar techniques as other types of tunnels, but mines are built at a fraction of the cost. Mine tunnels are not as safe as tunnels designed for permanent occupation and hence are often prone to cave-ins and collapse. To provide safe haven for the miners in the event of a disaster, mines are often built with shelters that are strong and sturdy to withstand cave-ins and collapse. The safe shelters are stocked with a few days' of emergency rations and water.



The 33 Chilean miners were indeed in one such shelter measuring about 50 sq metres, eating their lunch when the disaster struck. As the dust from the collapse settled, the miners found that about two kilometres of galleries were intact around the shelter. Having found adequate elbow room, they were sure that there is no danger of asphyxiation; enough oxygen was there for them to survive for many days. Of course, the problem was potable water, food and psychological fear. Days passed. All attempts by the rescue team to reach the accident zone proved futile as more and more tunnels collapsed like a pack of cards.



As days passed the families of the trapped miners and rescuers were not optimistic at all. The miners were also losing all hope. As a last-ditch attempt the rescuers drilled a borehole through the hard rock to reach the shelter. If there were any survivors, the rescuers knew they would be in the shelter. Lo and behold, as the drill was pulled out from the 600-metre deep borehole, they found a piece of paper taped to the drill head. The ingenious miners had written "We are okay in the shelter, the 33" and pasted it to the drill head. Now the world knew that the miners were not dead but alive. However, this was the seventeenth day.

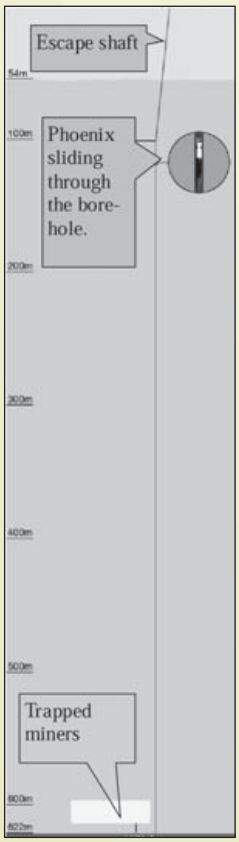
The safe shelter had two days' supply of emergency rations. The miners knew that they would have to survive on these meagre resources for many days. Hence they decided to ration the available food and managed to survive for all these seventeen long days with only bits of food. Each person was given two mouthfuls of canned tuna fish, a sip of milk, and half a biscuit; hardly sufficient to satisfy the hunger. As they were starving, each of them lost about 8-10 kg of weight in the seventeen days.

This borehole provided a conduit for communication between the rescuers at the surface and trapped miners in the bowels of Earth.

The borehole was lined with PVC tube and the rescuers nicked name this umbilical cord as "pigeon". Now the rescuers could supply water and food through this tube. Soon letters from families, cable to connect video phone were being sent through the tube.

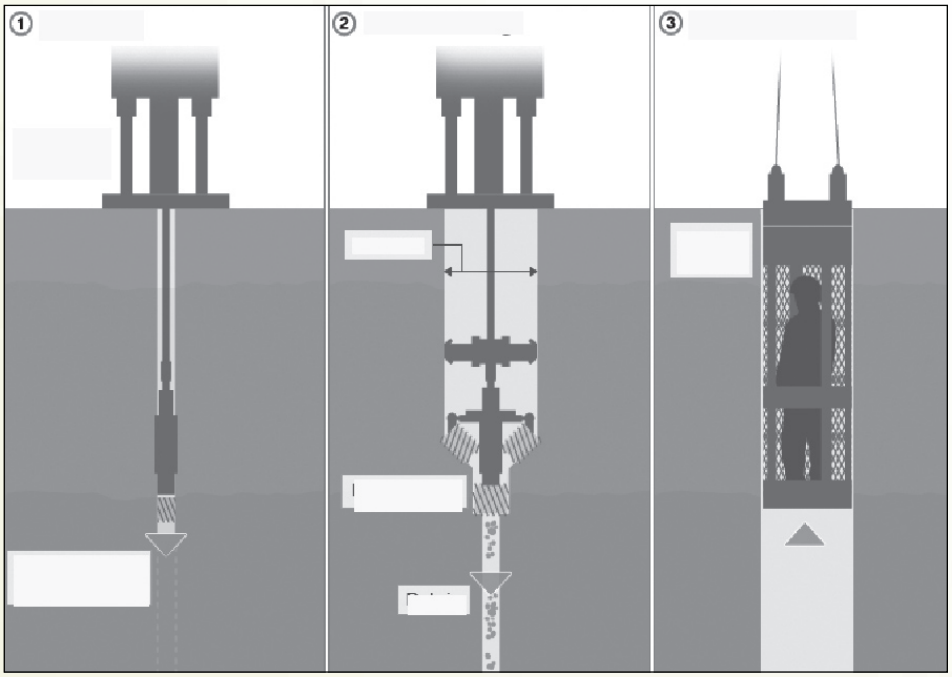
Rescuers had located and contacted the miners, but the miners could not be fed immediately. As hardly any food was available for the seventeen days and the miners were starving, they could not be provided with normal carbohydrate-rich food. As we starve, our body tries to extract stored fats from our muscle to meet the minimum metabolic and energy needs. Slowly the digestive system and insulin production shut down. If people on starvation diets are given carbohydrate-rich food too quickly they may die; as the body struggles to make insulin in response to carbohydrate, it can upset the electrolyte balance, stopping the heart. This was well known from the experience of starvation in the battle front and in the concentration camps during Second World War.

Deep inside a mine may be different from the vast expanse of space, but in some respects they are the same inaccessible, isolated and lacking access to resources. Travel in submarines and spacecrafts is very similar to being trapped in a collapsed mine. Therefore the rescuers approached NASA and the Chilean navy.



NASA's space medicine knowledge helped design special diet for the trapped miners; it came up with unique diets to recoup the starving miners. Liquid gels with protein and vitamins, the kind used in the International Space Station, were sent down the 7.5-cm 'pigeon' tube in packets. Miners were told to drink nearly double the amount of water they drank. Slowly their digestive system was brought back to normalcy.

Pilot hole was drilled | *The hole was widened* | *Rescue capsule slide though the shaft*



If starvation was a physical danger, isolation was a mental hazard. Humans find it strange to be confined and isolated in a closed space. Prolonged confinement makes them lose mental balance. Cosmonauts have long experience in living in the isolation of confined space in space stations. As advised by the space medicine experts, the miners were given a daily regime of exercise and routine work that made the miners fit and spirited even after confinement of 69 days. The camaraderie was such that when the rescue ultimately materialised, the workers did not jostle each other and scramble for the first place in the escape vehicle, but encouraged the old and the ill and their colleagues to go out first, calmly waiting for their turn.

Bringing them up from the depths of Earth was a huge engineering challenge. How to reach 600-metre depth through hard rock? Drilling a 7.5-cm hole is one thing and bore a shaft wide enough for a human to crawl out is another thing. Even if a shaft wide enough is built, how to ensure that the hole will not collapse? Even if a shaft is bored, one cannot use a basket and pulley like drawing water from a well to heave the trapped miners. The basket could get entangled midway, jeopardising the rescue effort.

In what is described as an engineering marvel, a special escape vehicle was designed with the help of NASA and fabricated by Chilean navy. Named after the mythic bird that rose from its ashes, the "*Phoenix*" capsule was designed to ferry the miners one at a time up a narrow shaft lined with steel pipe. The hi-tech capsule, painted in the red, white and blue colours of the Chilean flag, was equipped with an oxygen supply, communications equipment, and retractable wheels to help it travel up and down the rescue shaft and an escape hatch in case anything went wrong. The exterior wheels helped it to slide down the borehole as it was lowered by a massive crane mounted on a nearby hillside.

To lower the escape vehicle one had to dig a shaft wide enough for the capsule to move up and down. Using a specialist mining drill, at first a pilot hole was drilled. The pilot hole reached 600 metres below the surface where the miners had taken refuge. After creating the pilot hole the shaft was widened enabling the rescue capsule to be lowered and raised for each man. A Chinese-made colossal crane was deployed to lower and raise the rescue capsule *Phoenix* through the shaft. As the world watched, all the 33 miners were brought back to safety, after 69 days of ordeal, thanks to a modern-day secular miracle made possible by science and technology.

(Figures courtsey: bbc.co.uk)

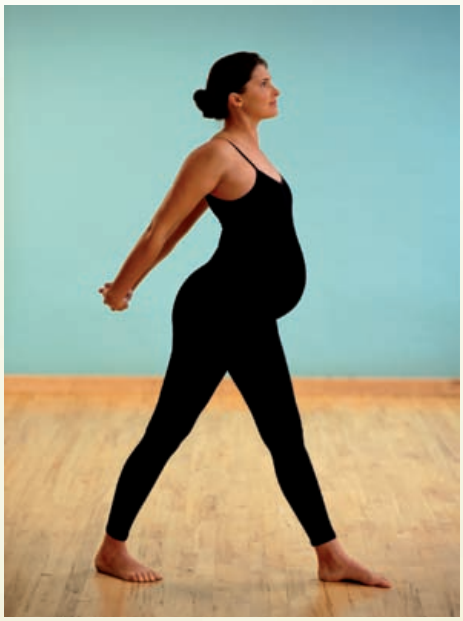
Tiding over the common problems of pregnancy

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

> "It is odd but agitation or contest of any kind gives a rebound to my spirits and sets me up for a time."
>
> —Lord Byron

Backache

From early months of pregnancy until about six months after the birth, you could suffer from backache. There are a number of possible causes. During pregnancy, the ligaments which support the spine become softened. There is also a shift in your centre



of gravity, as you get bigger. Sitting or standing badly can worsen the condition.

What to do

Most women can avoid bad back problems by following some simple guidelines:

Adopt good posture habits:

- Do not lean backward while standing, even though you may feel comfortable that way. The correct standing posture is to stand straight, keeping the feet apart.
- Sit with your back supported.
- While lifting or picking objects from the floor, avoid bending forward. Keeping the back straight, bend from the knees and then lift.
- Hold heavy objects close to your body.
- Avoid stooping as far as possible.
- A firm mattress is very beneficial. If yours is soft, a piece of hardboard under the length of mattress will make it firmer.
- Massage can also help to ease an aching back. Also in the later months ensure you get enough rest.

If the backache persists, talk to your doctor. A physiotherapist will also be able to give you advice and suggest some helpful exercises.

Constipation

Constipation is a common complaint during pregnancy. It occurs due to the effect of progesterone, a hormone. Iron supplements may also add to the problem. But you must never take stimulant laxatives, including some over-the-counter preparations sold in the guise of ayurvedic pills, because they can sometimes stimulate the womb as well.

What to do

- Take plenty of fibre in your diet. Your diet should include lots of fruits, vegetables, *roti*, wholemeal bread and high-fibre breakfast cereals.
- You should also have plenty of fluids.
- A simple laxative like lactulose may be taken occasionally.
- Some women find that a hot drink first thing in the morning also helps.
- If you continue to have constipation, you increase your risk of getting piles. As it is, the pressure of the growing baby on the blood vessels of the region increases the risk.

Piles

Piles are caused by constipation and straining. It also occurs in pregnancy because of hormonal changes. You can usually feel the lumpiness of the piles around the back passage when you wash yourself after going to the loo, and they may ache a bit. The condition nearly always normalises within a week or two of delivery.

What to do

- Eat plenty of food that is high in fibre to prevent constipation—*roti*, wholemeal bread, fruit and vegetables.
- Avoid standing for long periods if you can.
- If the piles stick out, use a lubricating jelly and push them gently back inside. Your doctor can suggest an anaesthetic ointment for you.

Bleeding gums

Dental care should not be neglected during pregnancy. The cause of bleeding gums, whether you are pregnant or not, is the build-up of plaque (bacteria) on the teeth. This irritates the gums.

What to do

During pregnancy, pay special attention to cleaning your teeth. Brush really well, at least twice a day, before retiring at night and after breakfast, to remove all the plaque. Use a soft brush and teach yourself the correct method to brush.

Nose bleeds

Nosebleeds are quite common in pregnancy. Usually short, on occasions the bleeding can be quite heavy. So long as you do not lose a lot of blood, there is nothing to worry about. Blow your nose gently, and try to stifle sneezes.

What to do

To stop a bleed, pinch the nose. The bleeding will soon stop.

Itching

As your baby grows, the skin of your abdomen gets tighter and may itch a lot. There is little you can do about this, though it is very annoying.

What to do

- It can help to wear smooth materials next to the skin, and to wear loose dresses so that there is no waistband to rub against you.
- Some women find it soothing to apply hand cream or lotion or talcum powder. Bathing also helps.

Varicose veins

The leg veins can swell during pregnancy. This happens due to the pressure effect of the growing uterus on the pelvic veins. The good thing about them is that these often settle by themselves after childbirth and although uncomfortable, they do not usually bleed or thrombose.

What to do

- Avoid standing for long periods. Do not sit with your legs crossed.
- Do not put on more weight than you should.
- To ease the discomfort, sit with your legs up as often as you can, and wear support tights.
- You can also try sleeping with your legs up on pillows, or even to raise the bottom end of your bed to keep your legs higher than the rest of your body.

Swelling in the ankles and feet

It is very common during the later part of pregnancy to have swelling in the ankles, feet and hands. This happens simply because the body holds more water than usual. Towards the end of the day, especially if the weather is hot or you have been standing a lot, the extra water tends to gather in the lowest parts of the body.

What to do

- Wear comfortable sandals and shoes, and put your feet up as much as you can. Try to rest by lying flat in bed for at least one hour during the day. The important thing is to lie with your feet higher than your heart.
- If your hands are getting puffy, take the rings off before they become stuck.
- Occasionally some pregnant women develop a clot in the deep veins of the leg. This also may show up as swelling in the affected leg. So, if the swelling is limited to one leg and the calf muscles are hot and tender, consult your doctor.
- You should also guard against a condition called pre-eclampsia. The other signs found in this condition are high blood pressure and protein in the urine. If you develop swelling in your ankles, feet or fingers, the safest course, therefore, is to check with your doctor.

Swelling and varicose veins of the vulva

The vulva is the area around the vaginal opening, including the clitoris and labia. It is normal for the vulva to look purple during pregnancy. Sometimes the vulva becomes swollen and you may get a very heavy feeling. This is because the pressure of the baby's head interferes with the flow of blood and the veins in the vulva become congested.

What to do

Take plenty of rest. The swelling usually goes within 24 hours of delivery.

Vaginal discharge

Almost all women have more vaginal discharge in pregnancy. So long as the discharge is clear, you are not sore or itching, do not fret, and think of it as normal.

Soreness or irritation, or a coloured or smelly discharge, probably means you have some sort of vaginal infection. Candidiasis is the commonest. It is a fungal infection, which covers the vaginal wall with a white, curd-like material.

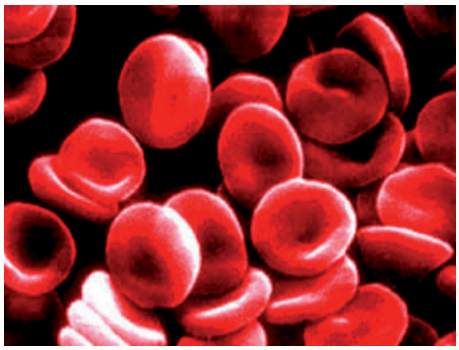
What to do

- Wearing cotton pants could help. Wear a tampon if you need to.
- The treatment for candidiasis is simple. There is rapid relief with anti fungal pessaries such as nystatin or clotrimazole vaginal tablets; one inserted each night as high in the vagina as possible. While nystatin must be used for 15 nights, a normal course of clotrimazole gets completed over six nights.

Anaemia

Anaemia, or low haemoglobin in the blood, is a common problem in pregnancy. Some anaemia is natural at this time, since the blood gets diluted due to the increase in fluid component. But often the drop is more severe. If the haemoglobin level falls below 10 g per dL, it is a cause for concern. This calls for active treatment.

This deficiency of haemoglobin is rather common in Indian mothers, and the most common cause is iron deficiency. As pregnancy advances, more and more demands are made upon the mother's reserves of iron. During the last 12 weeks, baby's requirement of iron becomes very large. Unless the mother has been taking a healthy balanced diet with iron supplements and has sufficient reserves of iron, the demand far exceeds the supply. In that case, mother's blood cells do not get sufficient iron and she develops anaemia. In many women, the shortfall occurs even before the pregnancy. A



poor diet ensures the deficit, which is made worse by the menstrual loss.

Keeping a tab on haemoglobin level is an essential component of good antenatal care. You should undergo the haemoglobin test many times during pregnancy: at the first antenatal visit, then during the 28th week, and finally in the 36th week of gestation. This will allow you to take corrective steps on time.

Unless the fall in haemoglobin is severe, you may not notice the symptoms. But if you feel any abnormal fatigue, a shortness of breath, paleness or swelling in the legs, think that it could be anaemia.

What to do

- Take preventive steps. Never neglect to take the iron pills that the doctor has prescribed for you. A variety of preparations exist, hence, if one produces side effects, another can be tried.
- If anaemia has set in, you still need not panic. Mild or moderate anaemia responds well to treatment. However, if the deficiency is severe, then you may need iron shots.
- If your pregnancy has progressed far, you may need more definite treatment. You may require a large dose iron dextran infusion through the veins.
- In some mothers, folic acid deficiency is a compounding factor. You must not therefore forget taking the folic acid pills. Be particular about them both during pregnancy and in the immediate period following your baby's birth.

[This column is primarily intended to educate the reader about the basics, and the do's and don'ts in a medical situation, and not as a substitute for professional medical advice. Before starting any form of treatment, please consult your physician.]

Recent developments in science and technology

Biman Basu
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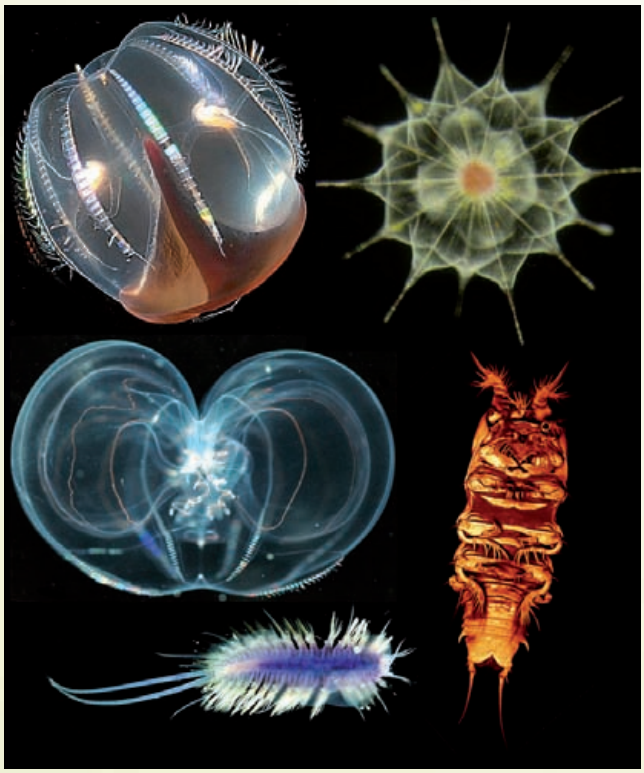
Census reveals bounty of oceanic life

The first global Census of Marine Life, an ambitious project to catalogue all life in the sea, has revealed more than 6,000 new species during its "decade of discovery." The findings of the census, announced on 4 October 2010 in London, brought to an end the most comprehensive ever survey of marine life across the globe, involving some 2,700 scientists from more than 80 countries including India, who spent over 9,000 days at sea on more than 540 expeditions, plus countless days in labs and archives. The scientists combined information collected over centuries with data obtained during the decade-long census to create a catalogue of species in 25 biologically representative regions – from the Antarctic through temperate and tropical seas to the Arctic. The forbidding ice oceans of the Arctic and Antarctic have revealed a trove of secrets to Census of Marine Life explorers, who were especially surprised to find at least 235 species living in both polar seas despite an 11,000-kilometre distance in between. The census was also able to identify those regions that are richest in diversity, which include the Gulf of Mexico and the Australian coastline. However, the Galapagos Islands turned out to have less biodiversity than the chilly South Orkney Islands, in the Southern Ocean near Antarctica.

The documents released in London include maps, three landmark books, and a summary of highlights. The documents present an unprecedented picture of the diversity, distribution, and abundance of all kinds of marine life in the Earth's oceans, ranging from microbes to whales, from the icy poles to the warm tropics, from tidal near shores to the deepest dark depths. The cold, dark ocean floor was found to be teeming with huge communities of different species, as were the mouths of thermal vents and rifts that seep nutrients into the ocean

The tremendous diversity of marine life is demonstrated by nearly 30 million observations of 120,000 species organised in the Ocean Biogeographic Information System (OBIS) – the global marine life database of the census. As a result of the census, almost 250,000 marine species have now been identified, but according to the researchers there may be at least 750,000 more species waiting to be discovered.

The census tracked migrations of species across seas and up and down in the water column and revealed omnipresence of many species, demonstrating connections among oceans. Through comparisons of the present ocean with the bountiful ocean life portrayed in old archives the census also documented the changes – both declines and some recoveries – of marine abundance.



Bizarre deep-sea animals discovered during the decade-long Census of Marine Life.

Scientists participating in the International Census of Marine Microbes (ICoMM) – a field project of the Census of Marine Life that inventories microbial diversity – uncovered an astonishing array of hard-to-see marine life forms, including microbes, zooplankton and larvae. Till recently, traditional research methods had isolated some 20,000 marine microbes, but new data suggests the true numbers are much higher, may be closer to a billion. These microbes function as key recyclers, turning atmospheric carbon dioxide absorbed by the ocean into carbon that goes back into the ground. They perform similar functions for nitrogen, sulphur, iron, manganese and other elements. The research was conducted at more than 1,200 sites worldwide, allowing scientists to amass 18 million DNA sequences of marine microbial life.

Constituting 50 to 90 percent of all ocean biomass, marine microbes are the tiniest links in the planetary food web. Yet they remained largely hidden from humankind until technological marvels of this millennium such as high-throughput DNA sequencing revealed the stunning extent of this microscopic world. According to the researchers, microbial cells in the oceans number roughly 10^{30} and collectively weigh the equivalent of 240 billion African elephants! This marine life is responsible for over 95 percent of respiration in the oceans, thereby helping to maintain the conditions humans need to survive on Earth. Among other discoveries made by the research was the location of massive "mats" of microbes that carpet areas of sea floor.

Secrets of silk production revealed

Silks spun by spiders and insects such silkworms is incredibly durable, possessing a tensile strength comparable with that of steel. These properties combine to make silk a highly desirable product for making apparel and dress material. But despite being

The common silkworm, Bombyx mori.

ubiquitous in luxury textiles for centuries, the process of silk formation inside the body of silk worms has remained something of a mystery. Till recently, scientists did not have any idea of exactly how silk is produced in the insect body. Now a team of researchers led by Cedric Dicko of the University of Oxford, UK, has for the first time studied the production of pure silk, extracted in small quantities from silk worms.

One of the practical limitations of studying silk production in the past has been the tiny amounts of silk's precursor proteins present at any given time inside the body of a silk worm. So any scientific programme to study silk required the upkeep of large numbers of silk worms followed by the careful extraction of silk samples. In view of these difficulties, scientists have been using "regenerated" silk proteins, obtained by breaking down silk worm cocoons with high salt concentrations and then mixing samples. So the original silk proteins could not be studied using this technique.

Dicko and his team used a series of small angle neutron-scattering experiments at the Institut Laue-Langevin, an international research centre in Grenoble, France, and were able to analyse relatively small samples of the large biological molecules that make up silk. The use of neutrons to study silk was better because they offered advantages over other diffraction experiments, such as X-rays, which can damage the samples under study. The team discovered that proteins are abundant inside the silk worm, with concentrations of up to 400 mg/ml. But despite this large concentration, the proteins showed very little interaction and instead formed a compact helical structure. However, the situation changed as the researchers diluted the silk solution with water, which caused the proteins to unfold and start to combine into the ordered filaments of silk. The researchers found that, as the concentration dropped with dilution the proteins began to expand and flow, until they eventually clumped together to form the filament. This was the reverse of what was expected (*Soft Matter*, 2010, 6, 4389-4395 DOI: 10.1039/C0SM00108B).

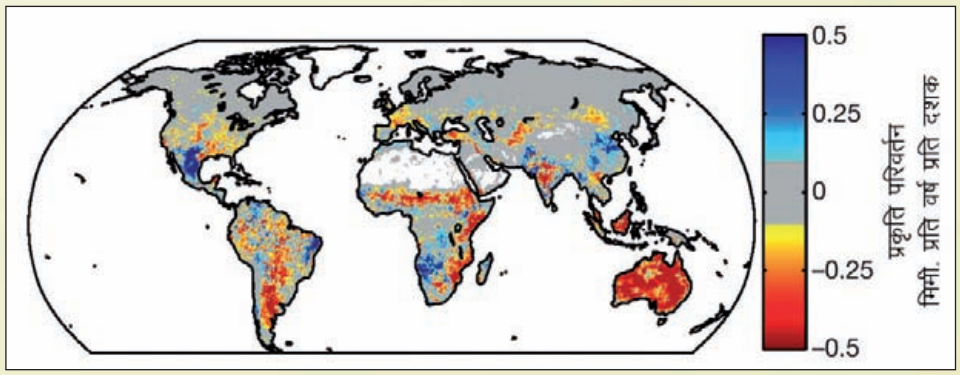
According to the researchers, the finding that water plays such a key role in giving silk its strength has implications for the upkeep of silk products. According to them, dry-cleaning silk can strip away the moisture and weaken the fibres in silk garments, leaving them more likely to get damaged. However, a dry-cleaned silk garment can be returned to its original condition by steaming it gently.

World's soils are becoming drier

Evapotranspiration is the process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants. Evapotranspiration returns about 60% of annual precipitation back to the atmosphere, using more than half of the solar energy absorbed by land surfaces. Thus it forms a key component of the global climate system, linking the cycling of water with energy and carbon cycles.

Most climate models had suggested that evapotranspiration would increase with global warming because of increased evaporation of water from the ocean and more precipitation overall. Data indeed show that some areas are wetter than they used to be. Recent studies, however, indicate that the soils in large areas of the Southern Hemisphere, including major portions of Australia, Africa and South America, have been drying up in the past decade, thereby significantly reducing the rate of evapotranspiration. Results of the new study, published online in the journal *Nature* (10 October 2010 | doi:10.1038/nature09396), found that global evapotranspiration did indeed increase from 1982 to the late 1990s on average by around 7 millimetres per year per decade. But in 1998, this significant increase "seems to have ceased." According to the report, in large portions of the world, soils are now becoming drier than they used to be, releasing less water and offsetting some moisture increases elsewhere.

According to the researchers, the study suggests that the late 1990s marked a transition period in which there was a decrease in the global land-evapotranspiration trend. But the data do not indicate whether this is part of a natural climate oscillation or part of a longer-lasting global change. Whatever be the case, the consequences of the reduction in soil moisture would be decreasing terrestrial productivity and a resultant reduction in



Map showing the change in global evapotranspiration trend between 1982–1997 and 1998–2008 in millimetres per year per year.

terrestrial carbon sink, which may intensify global warming.

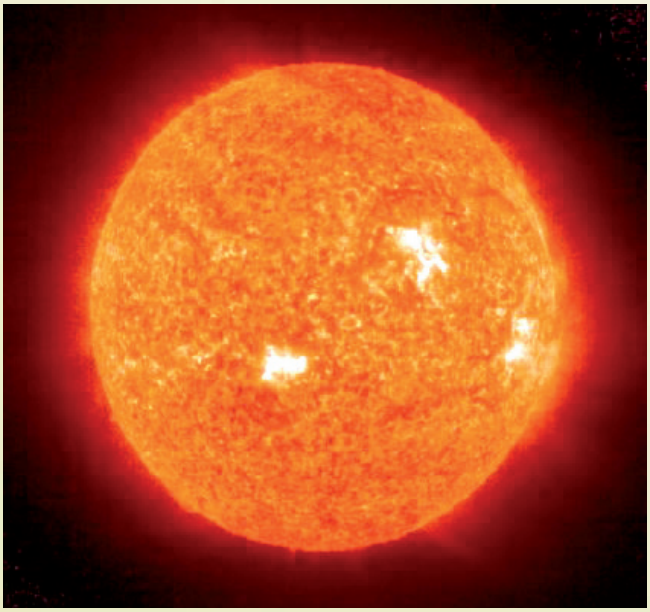
The study was authored by a large group of international scientists, with lead author Martin Jung from the Max Planck Institute for Biogeochemistry in Germany, and researchers from the Institute for Atmospheric and Climate Science in Switzerland, Princeton University, the National Center for Atmospheric Research in Colorado, and Harvard University in USA, and other groups and agencies.

New finding on Sun's effect on Earth's climate

The Sun's activity has recently affected the Earth's atmosphere and climate in unexpected ways, according to a new study published in the journal Nature (9 October 2010). The study, conducted by researchers from Imperial College London, UK, and the University of Colorado, USA, shows that a decline in the Sun's activity is not always linked to a cooler Earth. The researchers used satellite data and computer modelling to analyse how the spectrum of radiation and the amount of energy from the Sun has been changing since 2004. Instruments on NASA's *Solar Radiation and Climate Experiment* (*SORCE*) satellite have been measuring the Sun's energy output at many different wavelengths. The researchers fed the data from *SORCE* into an existing computer model of the Earth's atmosphere and compared their results with the results obtained using earlier, less comprehensive, data on the solar spectrum.

The Sun is known to have an activity cycle during which the number dark spots on its surface called sunspots increases and decreases in a cyclic manner over a period of 11 years. It is also well established that as the Sun's activity wanes; that is, the number of sunspots decreases, the overall amount of radiation reaching the Earth also decreases. On the other hand, during high activity, despite the presence of more sunspots on the solar surface, the total solar radiation reaching Earth increases due to more bright networks and solar surface features known as 'faculae'. As a result the Earth receives more solar radiation when the Sun is more active. The *Nature* study looked at the Sun's activity over the period 2004-2007, when it was in a declining part of its 11-year activity cycle and found just the opposite happening. Although the Sun's activity declined over this period, it may have actually caused the Earth to become warmer. Contrary to expectations, the amount of energy reaching the Earth at visible wavelengths increased rather than decreased as the Sun's activity declined, causing this warming effect. The data, collected by the *SORCE* satellite between 2004 and 2007, revealed that the intensity of the ultraviolet light in the Sun's rays fell by six times more than predicted over that period, while the amount of visible light exceeded expectations.

Following this surprising finding, the researchers believe it is possible that the inverse is also true and that in periods when the Sun's activity increases, it may cool, rather than warm, the Earth. However, according to Joanna Haigh of Imperial College London, the lead author of the study, these results only show us a snapshot of the Sun's activity, and its behaviour over the three years of the study could be an anomaly. If further studies find the same pattern over a longer period of time, this could suggest that we may have overestimated the Sun's role in warming the planet, rather than underestimating it. ■



Bright spots on the Sun known as faculae appear during high solar activity.

Letters to the editor

Excellent article on Periodic Table of elements

The article on Dmitri Ivanovich Mendeleev (June 2010) was marvellous. After school days, I went through this type of article for the first time. It was very informative too. Kudos for Dr Subodh Mahanti for giving us such a good article. The article on volcanoes was also excellent.

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*****

Good biographies of scientists

Dream 2047 is the best magazine among all Indian magazines. I like it very much because it gives us very good knowledge about scientists.

Mukund Kumar
R.A.M. School (Piprahi),
District – Sheohar,
Bihar – 843 334

*****

Unsung at home

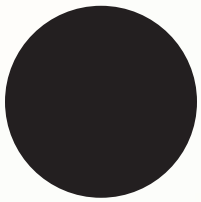
It was indeed a pleasure to go through the interview with Dr. S. Krishnaswamy who has a multi-faculty personality who works with independence and innovation on the jobs he undertakes (September 2010). I noted with some remorse that the Government of India did not acquire his historic work 'Indus Valley to Indira Gandhi'. He had to sell its rights to the American Company, Warner Brothers! Foreigners are acquiring our national treasures while we retain copies of national history that were written with coloured eyes to please the rulers of the day in our pious and holy land.

Narendra Nath,
Formerly Professor and Head,
Physics Department,
Kurukshetra University

*****

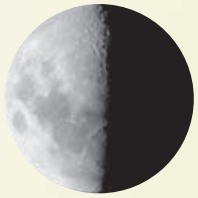
Sky map for December 2010

New Moon

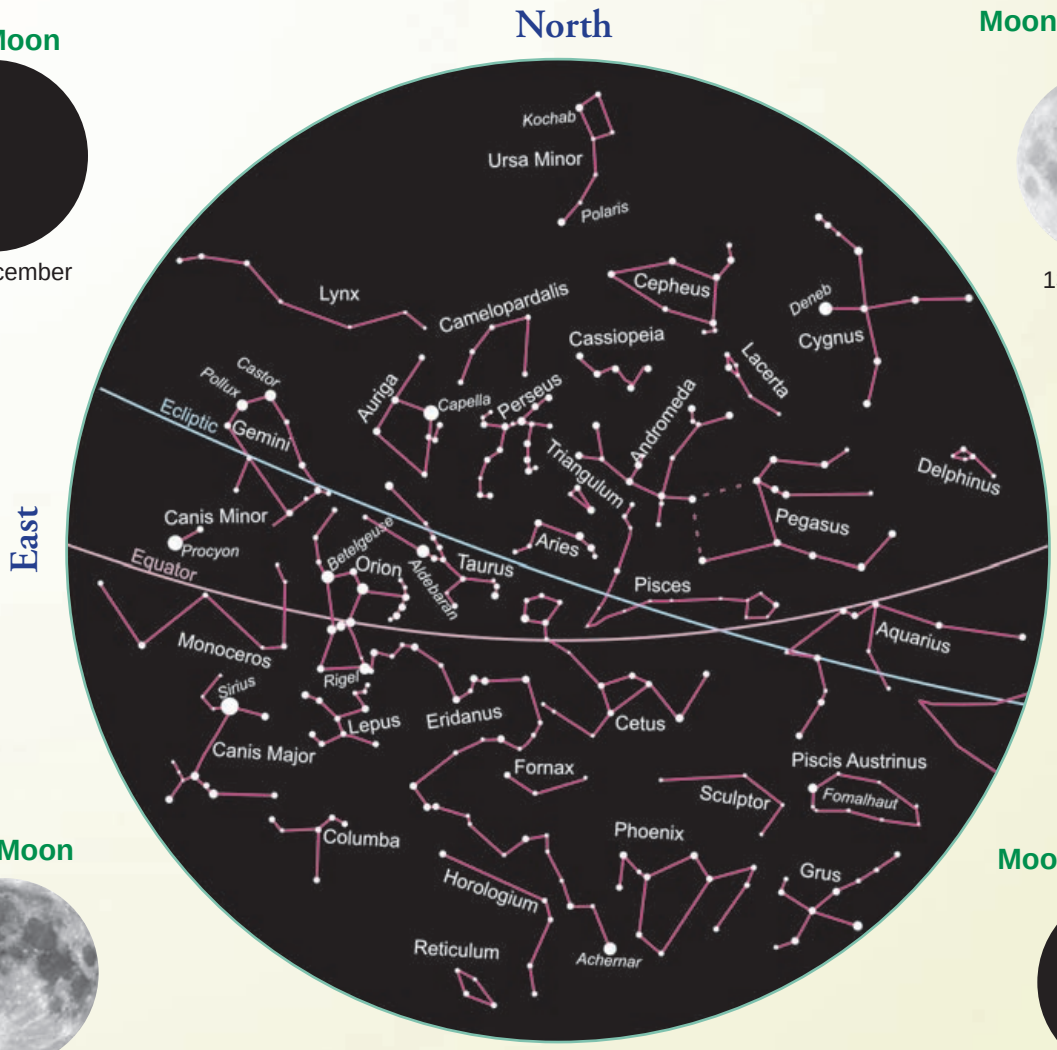


05 December

Moon-First Quarter



13 December



Full Moon

21 December

Moon-Last Quarter

28 December

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 northen 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 December, at 9 PM on 15 December and at 8 PM on 30 December.

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	09:04	16:35	Sagittarius- Capricorns
Venus	04:06	14:03	Virgo-Libra
Mars	09:23	16:34	Sagittarius
Jupiter	14:18	02:13	Aquarius- Pisces
Saturn	12:07	00:04	Virgo
Uranus*	12:29	00:17	Pisces
Neptune*	11:38	21:17	Capricorns

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

Sky event

Date	IST	Event
01	01:39	Moon at perigee
01	22:29	Mercury elongation: 21.5° E
13	15:04	Moon at apogee
14	17:32	Geminid shower
20	07:45	Mercury at inferior conj.
21	14:48	Total Lunar Eclipse
22	06:08	Northern winter solstice
25	18:54	Moon at perigee

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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:

"In spite of stringent anti-pollution laws and crores of rupees spent on pollution control programmes, why do our rivers and air remain highly polluted?"

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* December 2010" should be clearly written on the envolope.

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 September 2010

Topic: "Is it worthwhile to plan for human settlements in space, to escape disasters on Earth in future?"

Dr. Busnur Rachotappa Manjunatha
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The mother Earth is the only planet, particularly in our solar system, which is ideal for the existence of life and evolution. Natural disasters such as earthquake, volcanic eruptions, landslide, cyclones, avalanches, tsunami, etc., do kill people and cause damage to property and environment. More than this type of catastrophic disaster is the mass extinction of life, which has happened several times in the past.

However, it may not be worthwhile to plan for human settlements in space to escape from natural disasters or mass extinction of life on Earth in the future. There are several limitations of establishing a human settlement either in space or on the Moon or other planets. Our nearest satellite Moon and planet Mars are too far away from in terms of transport/voyage. Moreover, there is no atmosphere including ozone layer to protect against ultraviolet rays from the Sun.

Nevertheless, space colonies may be created for rich people for excursion or recreation and conducting experiments to preserve human beings for the next biological world assuming that mass extinction of human beings is going to occur soon.

Instead for planning human settlement in the space, it may be worthwhile to identify some safe regions on Earth, geologically known as 'shield areas'. These regions are generally 2.0-3.5 billion years old and are relatively plain land where threat from catastrophic geological processes such as earthquakes, volcanoes, tsunamis, floods, etc., are generally minimal. Shield areas are found on all continents, for example, in Southern India, Africa, North America, South America, Australia, etc.

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Jagriti Kiran Sharma
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It is not worthwhile to plan for settlements in space because of a few reasons:

1. No nation is that much economically strong to support huge expenses of settlement, supplies and other facilities.
2. Even if any nation supports it then who takes the guarantee that there would not be any disaster in the space?

So rather than going to space, it would better to stay on Earth.

Further, on Earth new advanced materials are available that can be used to construct shelters to protect us in case of a disaster such as flood or earthquake.

In other words, we can say that settlement on Earth with improved materials and construction techniques is better and safer than to settle in space.

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Human society cannot live for long without natural flora and fauna. Without green plants, oxygen cannot be produced for breathing. Humans have also become accustomed to the gravitational pull and atmospheric pressure on Earth. The same is not true of space, where conditions will hamper movement. Further, growing food in the vacuum of space would be a big problem. There may not be adequate water for use in day-to-day life as well as for cultivating crops. So it would not be worthwhile to plan for human settlement in space to escape disasters on Earth in future.

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India and World Science: Are we there?

Mr Thejao Kevin Sekhose of Nagaland makes his presentation in his traditional dress.

Er Anuj Sinha being honoured by Dr G Padmanabham, Chairman, Governing Body, NCSM

Visveswarya Industrial and Technological Museum, Bangalore hosted the 29th National Science Seminar on 8 October 2010. Organised by the National Council of Science Museums, the seminar was inaugurated by Prof CNR Rao, Hon'y President, JNCASR, Bangalore. Thirty-five state finalists made brilliant presentations that were appreciated by the judges.

Er Anuj Sinha, Hon'y Director, Vigyan Prasar was part of panel of judges and later interacted with the participants. The house concluded that developments in science and technology are not measurable in the nature of a race. There are disciplines and areas where our research work is ahead and in others we are a close second with the developed world. Participating in such debates is an important step and reflects the aspiration of our brilliant youth to contribute to the development process.

SAARC workshop on biodiversity conservation

Delegates of SAARC workshop

Vigyan Prasar's posters on Planet Earth were displayed during the SAARC workshop

Vigyan Prasar participated in a SAARC workshop on Biodiversity Conservation organised by Banaras Hindu University, Varanasi on 21 – 22 September, 2010. Delegates from Sri Lanka, Nepal, Bangladesh, Pakistan and India participated in the workshop.

The workshop was inaugurated by Dr. P. Pushpangadan, Director General, Amity Institute for Herbal and Biotech Products Development, Trivandrum in the presence of Prof. D. P. Singh, Vice Chancellor, Banaras Hindu University (BHU).

Vigyan Prasar's biodiversity related books and set of posters were exhibited during the seminar. Dr B. Raza Bhatti, Director, Centre for Biodiversity and Conservation, Shah Abdul Latif University, Khairpur (Mirs), Pakistan; Dr Gamini Gamage, Director, Biodiversity Secretariat, Ministry of Environment, Sri Lanka; and Dr Rezaul Sikdar, DFO, Wildlife Management and Nature Conservation Division, Dhaka, Bangladesh showed keen interest in these publications.

Mr. Nimish Kapoor, Scientist, VP participated in the workshop as resource person and delivered a lecture on "Developing resource material for mass awareness programmes on biodiversity conservation".

Science Communication and Hindi: A seminar

As part of the Hindi Pakhwara, Vigyan Prasar organised a seminar on 'Science Communication and Hindi' at its Noida office on 28 September 2010. The scientists of the institute presented their ideas at this seminar.

Er Anuj Sinha, Director, described the science communication work being done by VP scientists as a challenging job. He said the potential and talent of our scientists as well as the achievements of the institute are of very high standard. Referring to the 'Millennium Development Goals' declared by the United Nations in 1999, Er Sinha said we have to achieve these goals by the year 2015. To do that, science dissemination work at VP will have to be focussed on the eight areas identified by the UN, namely poverty eradication, global elementary education, gender equity, infant mortality, improvement in mother health, control over HIV and AIDS, sustainable development. In this perspective, Vigyan Prasar is contributing in the life-skill based content development for adolescents, under a project initiated by UNFPA.

While delivering the keynote address, Dr. Subodh Mahanti, Scientist 'F' and academic head of Vigyan Prasar, spoke about science journalism, audio-visual programmes based on science, popular science writing, and other experimental presentations in the field of science communication. He said science communication can be used as a powerful tool for the development of rational outlook in the society It is important to arouse the curiosity and this is possible through effective science communication. In fact, science is embedded in our day-to-day thought process. Dr. Mahanti said that we should not be terrified by purely scientific issues like the experiments being conducted at the Large Hadron Collider.

In the technical session Shri B. K. Tyagi, Scientist 'D', delivered a lecture on 'Redefining the conceptual framework of S & T communication in the context of globalisation'. He stressed the importance of implementing necessary strategies to disseminate science among the masses in our highly diversified country.

Shri Rintu Nath, Scientist 'E', described the discovery and history of 'Zero' in his presentation titled 'Significance of Zero'. He recalled the discovery of zero in India and described how the zero is so significant.

Speaking on 'Applied astronomy' Dr. Arvind C. Ranade, Scientist 'D', said astronomy is directly attached with our life. For example, why do we see Dhakshinayan and Uttarayan? Why does the Moon rise daily with a delay of 50 minutes? In addition to these, he also spoke about the ancient mythologies based on planets and the Moon and advised that these celestial bodies must not be looked at in the perspective of anybody's destiny. Dr. Ranade emphasised that science communication in regional languages could provide easily understandable justifications of the various observed astronomical phenomena.

Shri Kapil Tripathi, Scientist 'D', spoke on 'Uses of science communication'. He said that decision making capability in the common people may be developed through scientific attitude, which may help them to be involved in the mainstream of development.

Speaking on 'Media and science communication' Shri Nimish Kapoor, Scientist 'C', advocated making science communication interesting. He said science communication should be done in such a manner that it is comprehensible to each and every reader, listener, and viewer.

In the closing session Er Anuj Sinha urged everyone to work more in Hindi. He said science communication should be done in Hindi at the national level. At the end of the symposium, Dr. Subodh Mahanti thanked all speakers and participants. The programme was anchored by Shri Nimish Kapoor.

(Translation: M. M. Gore) ■

Dr Mahanti giving a keynote address during seminar 'Hindi aur vigyan sanchar'

Er Anuj Sinha delivering his inaugural address

A view of the participants

Hindi *Pakhwara* 2010

Hindi *Pakhwara* programme was organized in Vigyan Prasar office from 14 to 28 September 2010. During this event the staff members participated in different Hindi competitions including extempore, typing and assay on the topic 'Karyalaya men Hindi ke Prayog ko kaise bhadaya jaye'. All of these competitions were organized for Hindi speaking and non Hindi speaking staff members seperately. The winners of the competitions were rewarded with cash prizes by the Director, Vigyan Prasar on 28 September 2010. During the concluding ceremony of this pakhwara, a seminar on 'Science Communication and Hindi' was organized.