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Inventions and Inventors – An unending journey

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

Editorial

Vigyan Prasar - a Rear View Image and a Screen Shot of the Future

The last 100 weeks have been eventful for Vigyan Prasar and very exciting for the author. Leading a team of creative people is always challenging. The mentoring role has often to be compromised to directing in an organisation that has set milestones. Nurturing each team member to be able to perform at optimum levels of creativity was very fulfilling. The task is delicate at the best of times and really an accomplishment at times of stress.

When I look in a metaphorical 'rear view mirror' at the end of my tenure, I realise that we have travelled a long way in a short time. There have been many new paths covered and many of our pennants are flying high. The weekly news programme on developments in science and technology on television, a national festival and competition for science films, workshops on science broadcasting, etc., are very visible markers. In the pipeline over the next few weeks, VP will have more professional presence in exhibitions, an SMS service on science, a second edition of a national science photography competition, a major platform for deliberating on scientific temper, etc.

The initiative for technology communication is off to a flying start and one is optimistic about its impact in the short and the long run if the various leads are pursued. Major institutions –government and non government – seem to have been looking forward to this and VP can play a leadership role as it did for science communication during the last two decades.

Commencing with Women's Day celebration in 2010, the gender focus on science communication is taking a healthy shape. Critical issues have been identified and strategic partners are on board in this programme. Emphasis on gender development was a weakness in the institution and the next few years will witness important contribution to their empowerment efforts.

There are dusty and barren patches on the route that we moved and I would not like to remember these very long. A multi-pronged initiative to involve our partners who receive the products of our efforts has been slow in showing results. Feedback processes for patrons of our radio and television programmes, perceptions of members of VIPNET Clubs, aspirations of users of EduSat service, comments of subscribers of this magazine/newsletter, etc., need immediate attention.

The publication programme needs both direction and velocity in filling specific gaps in the material that we commission in Hindi and regional languages and in addressing requirements of neoliterates. The distribution and sales mechanism needs innovation and entrepreneurship to allow easier access to the books, kits, CD ROMs, etc. The support to Community Radio Programmes has still to materialise. Programmes in synergy with other agencies in general and the National Council for Science and Technology Communication in particular are moving in fits and starts. The time was opportune when we were constructing our chemistry outreach campaign but the follow through has not been smooth.

Efforts to raise the functioning of the institution to international level are still to mature. Our national presence has been strengthened with programmatic collaboration of national science and engineering academies. National level voluntary organisations and important institutions like the Institute of Open Schooling and Science Centre amongst others have partnered for observing Science Day, Technology Day, etc.

Adapting to climate change, understanding costs of commercial energy, careers in science teaching and research-counselling and guidance, reinforcing science and math learning and many current areas of concern need the attention of science and technology communicators. Vigyan Prasar is building capacity to contribute meaningfully in this.

I leave behind a lean institution with a dedicated and hard working team ably supported by a hardly visible administrative force. Many ideas are bubbling in the cauldron that is Vigyan Prasar. I look ahead with optimism and confidence that innovative products and services will be given to the society that will improve its capacity for evidence based decision-making.

My next assignment will be even more challenging and fulfilling. I will share my experiences with you sometime.

Good Wishes for the New Year!

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Inventions and Inventors – An unending journey

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The progress of humankind from Stone Age to Space Age has been possible because of a few hundred key inventions made by great inventors. Today we do not know who invented the first wheel, the first axe, the first pulley, and the first wedge in the distant past. However, we have knowledge of those later inventors, discoverers and innovators who contributed to the industrial era of the past 350 years. Some of them became legends in their lifetime; some amassed huge wealth and became household names; some died without due recognition for the advances they made; some were ridiculed for their unconventional ideas; some did not earn anything from their inventions which later made others wealthy; some failed to see the potential of their own inventions; some voluntarily decided not to make profit from their inventions; some lost whatever they earned and died in penury; and some ended their lives on realising that nothing more they could achieve. It is always fascinating to know about inventors and inventions.

Before we delve into unfathomable depths of the history of invention and get some glimpses from the lives and works of some of the great inventors it is useful to describe what we mean by 'invention', 'innovation' and 'discovery'. An invention is the act or process of inventing, while an innovation is the act of introducing something new. Innovation is far more about refining and adding value than it is about pure invention. Invention makes or develops something that did not exist while discovery is to find something that has already been there.

The entire gamut of the history of invention is too vast to capture in a single article. The inventive process started by our pre-historic ancestors is still continuing and will continue in future. The earliest motivation of human beings to invent was simply self-preservation. The first human beings had nothing to protect them from the wind, rain and other forces of nature that make the weather. In other words they were naked to the elements. What is more, they found themselves in the midst of ferocious animals, their natural enemies. It was not possible for them to fight off their enemies because human beings were not equipped with fangs, tusks or claws. Their speed was not enough to flee from their enemies or pursue their quarries.

Unlike apes, their nearest relative, humans could not escape into the trees. But in spite of such extreme adverse circumstances human beings have not only survived but they have also established domination over all other animals. This they could do because their intelligence level was much higher and they had exceptional manual dexterity. And perhaps the most important thing was that human beings could imagine – a quality which gave them foresight. With their exceptional mental abilities human beings could take stock of things seen or experienced in their surrounding and arrange them logically. Stretching their imagination they could visualise the future use of what they learned. In the beginning they made rudimentary weapons using stones and wood so that they could kill their natural enemies from a distance. As time passed their weapons became more and more sophisticated. They learned to make fire which helped them to frighten off predators, gave them warmth in the chilling cold, and made possible to cook food. They used skins of animals for covering their nakedness. This was made possible because they could skin animals using stone splinters, and later with metal implements.

Fire and furs helped human beings to survive Ice Ages when many other animals became extinct. Starting from early stone implements human beings continued to make tools and instruments for different activities like moving and lifting heavy objects and breaking those which he could not lift; for growing and reaping crops; for making shelters; for making cloth; for making bridges; for measuring and calculating; for writing and printing; for transmitting and recording of pictures, words and music; for lighting; for transporting goods and people; for making medical facilities; for entertaining; and for exploring nature .

It is to be noted that until 17th century specialised craftsmen were usually responsible for making practical inventions. On the other hand scientists (or 'natural philosophers', as they were called in those days) were mainly concerned with theory. However, the search for precision tools and instruments to meet the practical needs necessitated collaboration between the craftsman and the scientist, which led to the birth of applied science or technology.

A number of interdependent inventions – the most important ones being steam engine, electric power, and the telephone – led to the Industrial Revolution, beginning in the second half of the 18th century. The Industrial Revolution involved widespread adoption of industrial methods and production and opened new horizons for inventors.

In the history of human civilisation individual inventors have been responsible for most of the world's major inventions. However, in recent years most significant inventions are the outcome of the joint efforts of multiple brains organised in research and development teams. Giant multinational corporations are mainly responsible for shaping modern inventions.

The concept of research and development was pioneered by Thomas Alva Edison who not only invented new things but also produced commercial products meant to be used by the common masses. It was Edison who codified the process of invention, which we call research and development (R&D), and he was able to turn the process of invention from a cottage industry into an industrial powerhouse. New product prototypes, as designed by Edison and his core team, were made in his legendary West Orange labs (also called 'invention factory') where craftsmen, engineers, toolmakers, technicians and highly skilled workers worked together. Edison brought together people skilled in engineering, physics, chemistry, model-making, metallurgy and materials, economics, mathematics, and marketing. This was the first attempt of building an interdisciplinary team, which

later became mainstay of modern business practice.

Inventors are generally not bound by conventional wisdom; otherwise they would not dare to think differently. It is interesting to note that many inventors made inventions in fields remote from their own everyday work. George Eastman, a book-keeper in bank was the inventor of Kodak colour film. Ladislao Biro (1899-1985), a Hungarian artist and a journalist invented the first practical ballpoint pen. King Camp Gillette (1855-1932), who invented a safety razor and disposable blade, was a travelling salesman in bottle-caps. John Boyd Dunlop (1840-1921), a veterinary surgeon, invented the pneumatic tyre. Christopher Cockrell (1910-199), an American musician, developed the hovercraft. A patents expert Chester Carlson (1906-1968) invented xerography. It may be noted that although Carlson invented xerography in 1938, it was 21 years later that the first copier appeared in the market.

There are many inventions which happened accidentally. Charles Goodyear (1800-1860), an American inventor, had been trying to make rubber hard enough to resist extremes of temperature and pressure so that it could be moulded. He did not succeed even after years of trial but in the process reduced himself to poverty. But then one day in 1839, accidentally he dropped a mixture of rubber and sulphur on a hot stove and suddenly invented the process which he was looking for so desperately. The process is known as vulcanisation. Goodyear patented the process of vulcanisation on 15 June 1844. It has been found that the Mesoamericans used stabilised rubber for making balls and other objects as early as 1600 BC. There are other examples of accidental inventions.

Many inventions have come as by-products of research. One of such major inventions was the X-ray machine. The discovery of X-rays emerged from the investigations of Wilhelm Conrad Rontgen (1845-1923), a German physicist, on the external effects from the various type of vacuum tube equipment when an electric discharge is passed through them. The discovery of X-rays led to the invention of the X-ray machine.

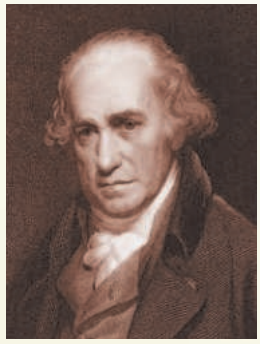
Johann Gutenberg

Right time and right place are often important for an invention to come into existence. Hero of Alexandria (c.10-70 AD), a Greek mathematician, inventor and a scholar, designed a model of steam-driven reaction turbine. But a practical steam turbine must turn very fast and that would require materials that were able to resist high stresses. There were no such materials available at the time of Hero of Alexandria. In writings of Roger Bacon (c.1214-1294), an English philosopher and scientist, we find the mention of the power-driven ship and road vehicle, the aeroplane, the helicopter and miniaturised servo mechanism. But no such machines could have been built at the time Bacon lived. These inventions came much later, after other inventions such as suitable materials, power sources and precision tools were available. Mere ideas and methods are not enough for making an invention to happen. The helicopter design made by Leonardo da Vinci (1452-1519), Italian painter, sculptor, architect, engineer, and scientist, was aerodynamically sound, but it could not have flown as there was no suitable power source available.

Some inventors often failed to appreciate the future possibilities of inventions other than their own. James Watt opposed the British inventor and mining engineer Richard Trevithick's (1771-1833) high-pressure steam engine. Guglielmo Marconi (1874-1937) did not see any future for the television and he told the same to John Logie Baird (1888-1946). Even Baird did not believe that cathode-ray tube had any future, but it proved to be the cornerstone of television development.

After looking at various aspects of inventions we shall take snapshots of some inventors.

Johann Gutenberg (c.1397-1468), German goldsmith, introduced a complete book printing system with movable type. To develop the system Gutenberg not only adapted the existing technologies but also made ground-breaking inventions of his own. He devised the hand mould which for the first time made possible the rapid creation of metal movable type in large quantities. Gutenberg started producing printed books around 1450. A single Gutenberg-style printing press could produce 3,600 pages per day, compared to 40 by hand-printing, and a few by hand-copying. Gutenberg's first major production was a 1,282-page Bible, which later came to be known as the Gutenberg Bible. He produced only 300 copies and today only 48 copies of Gutenberg Bible are in existence. In 1999, a single page of Gutenberg Bible was sold for 26,000 US dollars. Gutenberg's invention ushered in a revolution in book printing, but Gutenberg did not earn much from his invention. In fact Gutenberg was in debt to one of his partners Johan Fust, who later took over the printing presses. Gutenberg died penniless.



James Watt

James Watt (1736-1819) was a Scottish inventor and engineer, who improved the steam engine, making it a commercial success. At the age of 17 Watt left his native place Greenock for Glasgow to become an apprentice instrument maker. Later he was given an opportunity to set up a small workshop within the Glasgow University campus. Four years after opening his workshop, Watt began experimenting with steam engine. His first model did not work satisfactorily. But he continued to do experiments and also started reading everything written about it. Glasgow University had a model of Newcomen engine, but it had been sent to London for repairs. Watt persuaded the University to bring it back and repaired it in 1763. Its efficiency was very poor. Seeing the defects in the working of the Newcomen engine, he hit upon the expedient of a separate condenser. This idea came to him suddenly when he was walking home from his workplace. Later he recalled the incident: "I had not walked further than the Golf House when the whole thing was arranged in my mind: the waste of heat could be avoided by keeping the boiler (i.e. the engine cylinder) at steam heat, and condensing the steam inside a separate cylinder." This was probably the greatest single improvement ever made to the reciprocating steam engine, enabling its efficiency to be increased to about three times that of the old atmospheric engines. In 1776, the first engines developed by Watt were installed and working in commercial enterprises. He made several improvements

and modifications to the steam engine.

Charles Babbage (1791-1871), English mathematician, is regarded by many as the "Father of computing" for his contributions to the basic design of the computer through his 'Analytical machine', which could be programmed by punched cards to perform different computations. His idea was too ambitious to be realised by mechanical devices available at the time. The idea can now be seen to be the essential germ of today's electronic computers. His other inventions included the cowcatcher, dynamometer, standard railroad gauge, occulting lights for lighthouses, heliograph, and ophthalmoscope. Babbage shared his era's enthusiasm for industry.

Charles Babbage

Samuel Morse (1791-1872), US inventor, invented the telegraph. On one of his return voyages from England to USA in 1832, Morse encountered Charles Thomas Jackson of Boston who was well-versed with electro-magnetism. Witnessing various demonstrations with Jackson's electromagnet Morse was inspired to develop the concept of a single-wire telegraph. He would call it electric telegraph. He was devising his telegraph code even before the ship docked. It has been reported that while disembarking at New York, Morse told the captain of the ship: "If you should one day hear about a new world-wonder called the electric telegraph, remember the discovery was made on board your ship." He got totally absorbed with the idea and soon developed a crude telegraph which he further improved. The Morse code, originally called the Morse alphabet, was evolved by him for use with the telegraph.

Samuel Morse

Henry Bessemer (1813-1898), English metallurgist and inventor, is mostly known for the process named after him for the manufacture of steel. Young Bessemer used to enjoy being in his father's foundry. He left school and devoted to learning the trade from his father. Later he decided to make a version of iron (steel) which is much stronger than cast iron. Bessemer patented his process in 1856. He first described the process in a talk titled "The manufacture of iron without fuel." to a meeting of the British Association on 24 August 1856. The process is no longer commercially used. However, at the time of its invention it was of enormous industrial importance because it lowered the cost of production of steel, leading to steel being widely substituted for other substances which were inferior but cheaper. Commenting on how he succeeded in inventing the steel-making process Bessemer commented: "I had an immense advantage over many others dealing with the problem inasmuch as I had no fixed ideas derived from long established practice to control and bias in my mind, and did not suffer from the general belief that whatever is, is right." Among Bessemer's numerous other inventions were movable dies for embossed stamps and a screw extruder for more efficiently extracting sugar from sugar cane. He held at least 129 patents.

Henry Bessemer

Alfred Bernhard Nobel (1833-1896) was a Swedish chemist, engineer, innovator, armaments manufacturer and the inventor of dynamite. He used his enormous fortune to institute the Nobel Prizes. Since 1901, the prize has honoured men and women for outstanding achievements in physics, chemistry, medicine, literature, and for work in peace. Nobel went with his family in 1842 to St. Petersburg, where his father started a "torpedo" works. At St. Petersburg he studied chemistry. After returning to Sweden with his father after the bankruptcy of their family business, Alfred devoted himself to the study of explosives, and especially to the safe manufacture and use of nitroglycerine. Nobel found that when nitroglycerine was incorporated in an absorbent inert substance like kieselguhr (diatomaceous earth) it became safer and more convenient to handle, and he patented this mixture in 1867 as dynamite. He also invented smokeless gunpowder and gelignite or blasting gelatin.

John Dunlop

John Dunlop (1840-1921) was a Scottish veterinary surgeon who ended up in inventing the first pneumatic tyre. In 1887, Dunlop bought a tricycle for his son John. The tricycle was fitted with solid rubber tyres. John complained to his father that the tricycle produced too much jerk when he rode along the unevenly paved streets. Dunlop decided to look into the matter and in 1888 he was able to construct tyres with rubber air-tubes which could pass over the roughest surfaces smoothly. He patented his invention. In 1890, a Belfast firm, which later grew into the Dunlop Rubber Company, commercially produced the tyre developed by Dunlop. The pneumatic tyre not only made cycling popular but also contributed to the growth of the automobile industry. It may be noted that Robert William Thomson, a Scottish engineer, had taken out a patent for pneumatic tyre in 1846. However, Dunlop had no knowledge of it and Thomson did not develop his invention. So it was not difficult for Dunlop Company to establish their rights. Later they also developed and patented other improvements such as rims and valves.

Alfred Bernhard Nobel

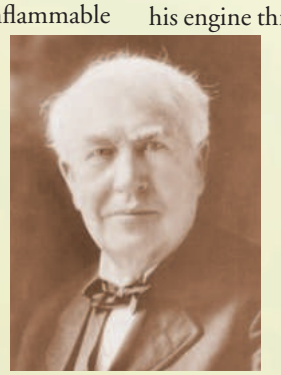
Alexander Graham Bell (1847-1922), Scottish-born US inventor**,** invented the telephone. With both his mother and wife deaf, he studied hereditary deafness in order to better understand the affliction, leading him to a career as a teacher of the deaf. Bell was a Professor of Physiology at Boston University in USA. Bell demonstrated his invention to the public in 1876 at the Centennial Exposition in Philadelphia, which was organised to mark the centenary of

the America's Declaration of Independence. For the demonstration the transmitter was kept 500 feet (about 150 metres) away from the receiver. The Brazilian Emperor Pedro II who was on a state visit to America took part in the demonstration. When the Emperor heard a quotation coming over the wire, he jumped up and shouted "I hear! I hear!' After his retirement Bell settled in an island home in Nova Scotia. It has been reported that he once remarked: "I have become so detached from the telephone that I often wonder if I really invented it – or was it someone else I had read about?" Bell is also credited with the invention of the metal detector in 1881. His other inventions included the metal jacket that assists in breathing, the audiometer to detect minor hearing problems, and a device that locates icebergs.

George Eastman (1854-1932), is known for his invention of the Kodak camera. While on holiday on Mackinac Island, Michigan, in 1877 Eastman decided to take some souvenir photographs but he was irritated by the elaborate and lengthy preliminaries involved in taking photographs. In those days the photographic emulsion had to be made and applied to glass photographic plates at the time of taking photograph, which was quite cumbersome. Eastman decided to improve the procedure, to make photography simple for an amateur like himself. In 1885 he developed a roll film – a roll of paper coated with long-lasting emulsion. Three years later Eastman came up with a hand-held camera, which he called Kodak. For marketing the product, the slogan was "You press the button – we do the rest." Later Eastman replaced the paper film with celluloid. In 1924, celluloid was replaced by much less inflammable cellulose acetate. Eastman became a multi-millionaire. He was a large-hearted businessman and he started profit sharing, medical benefits, life insurance and pensions for his employees. He donated over 100 million US dollars to various medical and educational institutions. In 1932, Eastman committed suicide when he realised there was nothing more that he could achieve.

George Eastman

Thomas Alva Edison (1847-1931), US inventor and physicist, is one of the greatest innovative minds of all time. He is credited with holding 1,093 US patents, a record number for any single person, which still holds. His many inventions included incandescent electric light bulb, phonograph, motion picture projector, automatic multiplex telegraph, carbon telephone transmitter, and alkaline storage battery. When Edison was born there was no electric light, but by the time he died entire cities were lit by electricity. Throughout his life he tried to invent products that everyone could use. His inventions deeply affected the shaping of modern society. As the *Time* magazine wrote, "His inventions not only reshaped modernity but also promised a future bounded only by creativity".



Thomas Alva Edison

Rudolf Christian Carl Diesel (1858-1913), German inventor and mechanical engineer, is known for his invention of the diesel engine. It has been reported that while he was a student at the Munich Technical University he came to learn that only 10 percent of the heat contained in the fuel of an engine could be utilised. It was shocking to him. He decided to build an engine 'in which such profligacy would not occur.' In 1892, Diesel obtained a patent for his 'universal economical engine'. It took him another five years to perfect it. He sold the rights for his engine throughout the world. It has been reported that a manufacturer in USA alone paid him 1 million US dollars. After he lost his fortune in rash property deals and speculations, Diesel suffered a nervous breakdown and became highly depressed and committed suicide.

Rudolf Christian Carl Diesel

Robert Hutchings Goddard (1882-1945), US physicist, rocket engineer and inventor was a pioneer of controlled, liquid-fuelled rocketry. He became interested in space when he read H.G. Well's science fiction classics. At the time he was 16 years old. He developed a fascination with flight, first with kites and then with balloons. In 1919, the Smithsonian Institution published Goddard's groundbreaking work, *A Method of Reaching Extreme Altitudes*. The publication described Goddard's mathematical theories of rocket flight, his research in solid-fuel and liquid-fuel rockets, and the possibilities he saw of exploring the Earth and beyond. It is regarded as one of the pioneering works of the science of rocketry, and is believed to have influenced the work of German pioneers Hermann Oberth and Werner von Braun. The last section Goddard's publication was titled "Calculation of minimum mass required to raise one pound to an 'infinite' altitude." In this section Goddard speculated that one day it would be possible to send a rocket to the Moon. In those days the idea of space flight was considered crazy and ridiculous not only by common people but also by scientists and engineers. *The New York Times* ridiculed Goddard's proposal. It even said that Goddard lacked the knowledge of a high school student. Fortynine years later, on 17 July 1969, the day after the launch of *Apollo* 11, *The New York Times* regretted the error.

Robert Hutchings Goddard

Goddard launched the first liquid-fuelled rocket on 16 March 1926 in Auburn, Massachusetts. The rocket, which was dubbed "Nell", rose just 41 feet (about 12.5 metres) during a 2.5-second flight that ended in a cabbage field, but it was an important demonstration that liquid-fuel propellants were possible. From 1930 to 1935 he launched rockets that attained speeds of up to 885 km/hour. Though his work in the field was revolutionary, he was often ridiculed for his theories. He received little recognition during his own lifetime, but would eventually come to be called one of

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Innovation, Sustainability, Development – A New Manifesto

(A special feature to mark the UN "International Year of Forestry - 2011")

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Forty years after the publication of 'The Sussex Manifesto' on science, technology and development, colleagues at Sussex University in the UK have teamed up with partners from India and around the world to explore how science, technology and innovation might better address today's urgent sustainability and development challenges. On behalf of the STEPS Centre Adrian Ely outlines the objectives of this initiative and the activities involved, and sets out the messages put forward in the 'New Manifesto'.

The Sussex Manifesto

At the tail end of the 1960s the United Nations asked for recommendations on science and technology for development from 'The Sussex Group' - a team led by Prof Hans Singer and drawn from the Institute of Development Studies and SPRU (then the Science Policy Research Unit), at the University of Sussex, UK. The report that they produced was intended as the introductory chapter to the UN World Plan of Action on Science and Technology for Development in the Second Development Decade (the 1970s). In the event, the analysis and recommendations presented in The Sussex Manifesto appeared radical to the scientific and policy establishment at the time, containing challenging budgetary targets for all UN Member States, and at the same time arguing that an increase in the scale of S&T activity was inadequate on its own and was largely 'irrelevant' without appropriate institutional reforms. The report was rejected as an introductory chapter, and discussions within the UN earned the draft the title of 'The Sussex Manifesto'.

A New Manifesto for a different world

Eventually the 'manifesto' was published as an annexe to a UN advisory committee report in 1970, and went on to raise awareness of science and technology in UN circles and beyond. In India, it influenced the government's approach to science and technology in advance of the establishment of the Department of Science and Technology, whilst elsewhere it impacted on the design of development institutions such as the Canadian IDRC and was used in university courses in both the North and the South. Looking back at its recommendations, many are as relevant today as ever; however, the four intervening decades have presented the world with a new series of challenges.

With this in mind, the Sussex-based STEPS (Social, Technology and Environmental Pathways to Sustainability) Centre, which draws its membership from the same institutions as the 'Sussex Group', has been working on a new manifesto in association with one of the authors of the original, Professor Geoff Oldham. The New Manifesto is a product of the STEPS Centre. However, rather than focussing solely on a single manifesto document, the STEPS Centre recognises that centres of science, technology and innovation have shifted, and that notions of 'development' and 'sustainability' mean different things in different places. Whilst recognising that innovation policies and solutions to sustainability and development challenges must emerge from diverse contexts rather than being advocated from outside, the STEPS Centre's New Manifesto nevertheless puts forward some general recommendations, linked to a new political agenda for innovation.

A '3D Agenda' for innovation policies – the New Manifesto's Message

From early on in its conception, the STEPS Manifesto project advocated an increased focus (in academic and political discussions around innovation) on what it termed the '3 Ds' – the **d**irections in which innovation proceeds (rather than merely the rate), the **d**istribution of the costs, benefits and risks associated with these innovations and the maintenance, and enhancement of a **d**iversity of innovation pathways across different social, technological and environmental contexts. The New Manifesto proposes five broad areas of recommendation, targeted to different dimensions and hence actors in innovation systems. Rather than universally applicable solutions, these are intended to catalyse and provoke specific concrete actions in different places and to support ongoing activities that already embody the '3D' agenda.

The first area proposes that the setting of agendas for science, technology and innovation be informed by an explicitly political consideration of innovation direction, distribution and diversity, with institutional architectures that enable inclusive, democratic debate. Within countries and at the international level, we recommend that governments establish and support networked fora that allow diverse stakeholders and the public to scrutinise investments in science, technology and innovation and to influence their future directions.

The second area urges that the funding of science, technology and innovation – whether from public, private or philanthropic sources – be geared much more strongly to the challenges of poverty alleviation, social justice and environmental sustainability. We recommend incentives and institutional mechanisms that advance these objectives among funding agencies and the private sector.

Our third area argues that capacity building for science, technology and innovation must move beyond a focus on elite science and link more directly to diverse social and environmental needs. We therefore urge an extension of capacity-building towards what we term 'bridging professionals' who are able to link technical expertise with particular social, ecological and economic contexts.

Our fourth area focuses on organising

for 3D innovation. We recommend strategic investments in organisations, networks and movements to link public, private and civil society innovation actors. This will help policy and investment to extend its focus from basic science, to emphasise other aspects of the innovation system, including engineering, design, science services, and social entrepreneurship.

Finally, we argue that increased accountability and full transparency must be at the centre of democratised innovation systems. We recommend new indicators, metrics, and reporting procedures are applied, adopting the priorities of poverty alleviation, social justice, and environmental sustainability as the basis for evaluating innovation policies.

More than a Manifesto

The New Manifesto's agenda of opening up and encouraging debates about science, technology and innovation played an important part of the wider project. Over the past three years, we have experimented with a number of approaches that try to highlight diverse viewpoints from around the globe, and the wider project, therefore, consists of much more than a manifesto. The New Manifesto project website http://anewmanifesto.org hosts multimedia material from a number of the project's activities. To initiate the project the STEPS Centre ran a dedicated seminar series at Sussex, and in parallel commissioned a series of background papers either providing historical analyses engaging with contemporary discussions around innovation, sustainability and development or putting forward recommendations in specific domains of food and agriculture, health, water and energy.

In order to chart the history of changing ideas in the field of science and technology for development, the STEPS Centre also used open-source software developed at MIT to create a wiki-timeline http://anewmanifesto.org/section/timeline to which colleagues both from within and outside the STEPS Centre were invited to contribute accounts of documents and events that they felt played an important role in shifting thinking in this area.

Drawing on some of these inputs, a draft manifesto was circulated and formed the basis of discussion at the STEPS Symposium in September 2009. An amended draft was then circulated to convenors of a series of international roundtables. A total of 20 roundtables were held, most hosted by partner organisations and not all involving a representative of the STEPS Centre.

In India, the Regional Office for Central and South Asia of TWAS – The Academy of Sciences for the Developing World hosted a roundtable as part of its gathering "Energy, Climate and Development: A Meeting of Concerned Young Scientists." Individual young scientists were also given the opportunity to outline their personal viewpoints to camera. Videos from these appear on the STEPS Centre's YouTube Channel at http://www.youtube.com/user/STEPSCentre#grid/user/132347B3102AE630.

Another event – where Indian academics and civil society representatives provide constructive criticism to the draft – was held in Delhi. The video and photos of this event are linked out from the STEPS Centre's site at http://anewmanifesto.org/multimedia/video-delhi-roundtable/.

Finally, Marathmoli (an Indian women's empowerment group based in Maharashtra) hosted village-level roundtables in two of the areas where they work – more information at http://anewmanifesto.org/round-table-events/marathmoli-roundtables-reports/.

The discussions at these roundtables produced reports, video and audio materials (including individual 'vox pops') and also, in some cases, manifestos (for example, Marathmoli's manifesto on Science and Technology and Indian Women). Many of these appear in a 'multimedia manifesto' that aims to bring the various perspectives and debates to life http://www.anewmanifesto.org/manifesto_2010/.

Other Manifestos on Science, Technology and Innovation

Alongside the New Manifesto project, a number of other institutions ran independent processes to draw up their own manifestos on science, technology and innovation. The first 'SET-DEV' project ('Science, Ethics and Technological Responsibility in Developing Countries') supported two other manifestos. The first was put together by the African Technology Policy Studies (ATPS) Network, which draws together researchers, policy makers, civil society and private sector actors from across the continent. Originally envisaged as a manifesto for Kenya, the exercise has now expanded across Africa, drawing on inputs from the network's 23 national chapters.

The second SET-DEV manifesto was produced by the Indian 'Knowledge in Civil Society' network, and takes its inspiration from Gandhi's 'Hind Swaraj' (self-rule) manifesto of 1909. Entitled 'Knowledge Swaraj: An Indian Manifesto on Science and Technology', it focuses on the diversity of Indian knowledge and argues that a *swaraj* of science and technology will yield justice, sustainability and plurality.

Moving forward

It is clear that a vigorous new politics of innovation is needed to bring about the changes advocated in the New Manifesto – at local, national, and global levels. With networks of partners, the STEPS Centre is taking forward the messages from its manifesto in an effort to catalyse this new politics and to effect long-term change at multiple levels. At the same time, the STEPS Centre recognises the importance of diverse contributions including those of the other manifestos outlined above.

Adrian Ely was honoured to be invited to give a presentation on the New Manifesto at Vigyan Prasar, Noida on 1 June 2011. In addition, the STEPS Centre co-organised an international seminar on innovation, sustainability and development at the National Institute of Science, Technology and Development Studies (NISTADS) on 28-30 June 2011 (videos available at http://anewmanifesto.org/indian-subcontinent/delhi-june-2011-seminar-on-innovation-sustainability-and-development/). Through making the case described above for the application of science and technology to sustainability and development goals, the STEPS Centre looks forward to working with its partners in India and elsewhere to furthering the Manifesto's goals and aims – aims which are very much in line with those of this publication and of many of its readers.

[Further details on 'Innovation, Sustainability, Development: A New Manifesto' are available at http://anewmanifesto.org. For copies of the New Manifesto (multimedia version), further information on the project or the STEPS Centre, please contact Harriet Dudley on h.dudley@ids.ac.uk in the first instance.]

Search of science in cartoons with Mr Uday Shankar

Unlike visual artists, cartoonists are artists who communicate ideas through a combination of words and pictures. They use their work to tell stories, instruct and guide, and offer commentary on life and society. Cartoons can be used to present scientific and environmental issues to students as well as the masses in an easily understood form. One of the most important qualities of a science cartoonist is the ability to present a science concept in just a few words and a drawing.

Mr Nimish Kapoor with Mr Uday Shankar (left) during interaction

A reputed cartoonist Mr Uday Shankar is working on science cartoons to communicate science, technology and environment related issues to students, teachers and the masses. Mr Uday Shankar's work on science, on chemistry was exhibited under the title "Cartoon Chemistry" recently at National Science Centre, New Delhi during the third week of November 2011. In the exhibition Mr Shankar's cartoons communicating various concepts of chemistry were displayed.

Mr Shankar is a painter, cartoonist and illustrator, with a diverse experience of more than two decades in the field of fine arts. He has worked with almost all mainstream media organisations, the most recent being The Times of India group, with which he was associated with, as a cartoonist and illustrator for almost 14 years.

Mr Nimish Kapoor, Scientist at Vigyan Prasar, interacted with Mr Uday Shankar on his science cartoons. Here are excerpts of the interaction:

Nimish Kapoor: How do you find cartoons to communicate science and environmental issues?

Uday Shankar: Cartoons are a very effective medium since they can convey in a simple humorous way, complex issues of science and environment. For instance, in one of my cartoons, I have shown a globe with a thermometer in its mouth. This portrays that temperatures are rising alarmingly and we have to do something urgently about global warming. Such a portrayal – in a humorous way of a serious subject sticks to the viewer's mind immediately.

NK: Science communication through cartoons is an innovative idea. Please share your experience as a science cartoonist with students and teachers.

US: I have been amazed at the kind of response I have got from students and school teachers all across India. I have visited numerous schools and conducted cartoon drawing exhibitions and workshops. Students like it when they also get to do something. Cartooning is a very interactive process, so it's fun for them. The teachers also find it an innovative way to get the message across.

NK: When did you start cartooning and when and how did the idea of science cartoons clickin your mind?

US: Ever since my childhood, I have had a fascination for sketching and making cartoons. I remember that as a child, the urge to sketch was so great that I used to doodle on the margins of my school notebooks -- an act which helped me practise my sketches, but which was obviously not a hit with my teachers! By the time I completed my graduation, I knew where I wanted to go. I enrolled for a five-year diploma course in commercial art from the Indian College of Arts, Calcutta. While in the second year of college, I got an opportunity to draw illustrations and cartoons for the weekly supplement pages of one of the oldest newspapers in the country, which was situated just opposite my Art College. This was how I started my journey into the field of professional art. As for science cartoons, I wanted to make cartooning more accessible to children. At the same time, I felt that they should learn something about a subject in a fun way. With the concept of science cartoons, both the things clicked together.

NK: Please share your recent work on science cartoons.

US: I did some exclusive cartoons keeping the theme of chemistry in mind, for the "Cartoon Chemistry" exhibition that the National Science Centre so kindly organised. They were extremely well-received.

NK: What kind of programmes may be taken up by science communication agencies to establish science cartoon as a tool of science communication?

US: We now live in an age of information. There is plenty of information available everywhere. The key is how to present it in the best possible way. In this respect, cartoons can play an important role, since they are eye catching and can get a message across to a wide audience – from youngsters to older people. Science communication agencies can capitalise on this innovative medium.

NK: Do you think that regular interaction among scientists and communicators like cartoonists, writers, etc., are necessary to sustain science communication through creative forms

of communication like cartoons?

US: It is always a good idea to have more interaction among people from diverse fields since it helps in spreading knowledge about their respective areas. From a cartoonist's perspective, it is even more important since our work involves observing people as well as imbibing fresh ideas that can be conveyed through our cartoons. For instance, at my recent "Cartoon Chemistry" exhibition that the National Science Centre so kindly organised, I got a chance to interact with many scientists that gave me insights into things I didn't know about. This enabled me to put more thought into my cartoons.

NK: How was the interaction with students and teachers in this exhibition?

US: It was a very fruitful and interesting interaction. I learnt many things while talking to students and teachers and I think they also enjoyed my cartoons.

NK: What is required for one to become a science cartoonist?

US: A keen sense of observation is very important and so is the ability to get across the message in a humorous way.

NK: How does a cartoonist get ideas, especially for science cartoons?

US: One should keep eyes and ears open. You never know when a stray thought, a headline in a newspaper, or even a conversation can trigger an idea. For science cartoons, it is important to be aware of important, contemporary issues in science, for which constant reading is recommended.

NK: What is more important to you in a science cartoon – style or idea?

US: Both, actually. Style defines a cartoonist and the forcefulness of the idea makes his cartoon work.

NK: How much revision/editing do you do in you work?

US: Once the basic idea is in place, there is not much editing thereafter. The cartoon just takes shape within minutes.

NK: What kinds of preparations (workshops, etc.) are required to promote science cartoon in schools and colleges? Are you involved in workshops on science cartoon with schools or colleges?

US: I regularly conduct workshops in schools and colleges. These are interactive workshops where both students and their teachers take part. I teach them how to draw cartoons in an easy manner with the help of computers.

Coordinator of Science Cartoon exhibition Mr Dinesh Malik, Education Officer, National Science Center (left)

NK: Concept cartoons for science subjects have been introduced in schools to help students to think through the scientific ideas associated with a question. How can students feel more confident to put forward their own ideas across by making concept cartoons?

US: The key is practice. They should not get disheartened if they do not get the drawings right in the first place, but keep at it. Also, they should think through their concept and keep on refining it, till they get a perfect idea which will appeal to all.

NK: Let's talk about your process – do you write a script or make up the drawing as you go for science cartoons?

US: I prefer to draw the cartoon with the concept in place. In this way, there is greater clarity.

NK: What tools do you use?

US: I use the computer to make my cartoons. All my cartoons are digitally drawn.

NK: Do you read a lot of science books to get ideas for science cartoons or is making science cartoon you passion?

US: I usually read newspapers and magazines and try to keep myself abreast of new scientific and technological developments.

NK: What are your suggestions to establish cartoons vis-à-vis science cartoons as a professional art form which can be placed in Indian and international market?

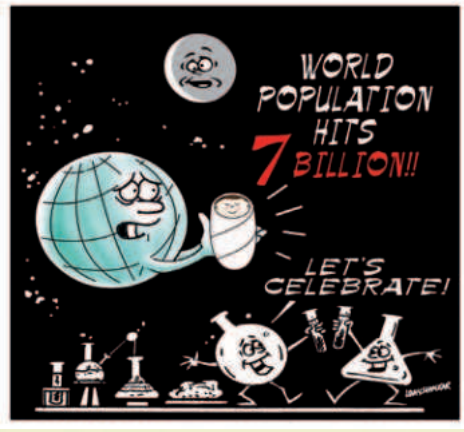
US: I think cartoons are a bit under-rated in our country and not considered an art form, even though they appeal to people cutting across age and class barriers. A lot more needs to be done to elevate cartooning further. With science cartoons, hopefully more students will take to this medium and help raise its profile.

NK: If our readers want to connect with you how can they?

US: They can email me at udaysganguly@gmail.com or visit my Facebook page at facebook.com/udayshankar and http://cartoonofudayshankar.blogspot.com/

NK: Can you give some advice to students and young generation who are interested in science cartooning?

US: Think through the concept you want to portray, decide how you want to make it interesting and funny and then go ahead and do it. Don't be disheartened if you don't get it right the first time. You will improve if you keep at it. Remember, the biggest joy for a cartoonist is to see someone smile on seeing his creation.



Winning Ways with Asthma

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The preservation of health is a duty.
Few seem conscious that there is such a thing as physical morality.
—Herbert Spencer

Prevention and long-term control is the key to preventing asthma attacks. Treatment usually involves learning to recognise your triggers and taking steps to avoid them, and tracking your breathing to make sure your daily asthma medications are keeping symptoms under control. In case of an asthma flare-up, you may need to use a quick-relief inhaler.

Lifestyle and home remedies

Although many people with asthma rely on medications to prevent and relieve symptoms, you can do several things on your own to maintain your health and lessen the possibility of asthma attacks.

Stay away from asthma triggers

Taking steps to reduce your exposure to things that trigger asthma symptoms is a key part of asthma control. Here are some things that may help:

Decontaminate your décor

Minimise dust that may worsen nighttime symptoms by replacing certain items in your bedroom. Encase pillows, mattresses and beds in dust-proof covers.

Remove carpeting and install hardwood or linoleum flooring.

Use washable curtains and blinds.

Keep your home clean

Clean your home regularly. If you're likely to stir up dust, wear a mask or have someone else do the cleaning.

Keep the pollens out

If you are allergic to airborne pollens and moulds, use air-conditioning at home, at work and in your car. Keep doors and windows closed to limit exposure to airborne pollens and moulds. Air conditioning reduces the amount of airborne pollen from trees, grasses and weeds that find its way indoor. It also lowers indoor humidity and reduces your exposure to dust mites.

Keep the indoor air clean

Make sure that you change or clean filters in your air conditioner and air coolers frequently.

If you use a humidifier, change the water daily.

Maintain optimal humidity

If you live in a damp climate, talk to your doctor about using a dehumidifier.

Protect yourself from cold

If your asthma is worsened by cold, dry air, wearing a facemask can help.

Eliminate pet dander

If you are allergic to dander, remove pets with fur such as dogs and cats and those with feathers such as pigeons and parrots from your home and avoid contact with other people's pets. Avoid buying clothing, furniture or rugs made from animal hair.

If you cannot do without pets, at least have them regularly bathed or groomed. This would help reduce the amount of dander in your surroundings.

Keep away from smoke

Avoid all types of smoke, even smoke from a fireplace or burning leaves. Smoke irritates the eyes, nose and bronchial tubes. If you have asthma, you should not smoke and people should never smoke in your presence.

Avoid certain pills

Read labels carefully. If sensitive to aspirin, avoid other medications termed non-steroidal anti-inflammatory agents (ibuprofen, naproxen and piroxicam).

Keep a check on heartburn

Keep a good control over heartburn and gastro oesophageal reflux disease (GERD). It is possible that the acid reflux that causes heartburn may damage lung airways and worsen asthma symptoms.

If you have frequent or constant heartburn, talk to your doctor about treatment options. You may need treatment for GERD before your asthma symptoms improve. Proton pump inhibitors like Pantoprozole 40 mg taken once daily at least half an hour before you eat can easily check gastro oesophageal reflux disease.

Stay healthy

Taking care of yourself and treating other conditions linked to asthma will help keep your symptoms under control. A few things you can do include:

Be active

Years ago if you had asthma, doctors told you not to exercise. Now they believe well-planned regular workouts are beneficial, especially if you have mild to moderate disease. If you are fit, your heart and lungs don't have to work as hard to expel air. However, remember that vigorous exercise can trigger an asthmatic attack, and be sure to discuss the exercise programme with your doctor before you begin.

Adhere to some basic guidelines when you do physical workouts:

Medicate first

Use your inhaled short-acting beta agonist 15 to 60 minutes before exercise.

Start slowly

Five to 10 minutes of warm-up exercises may relax your chest muscles and widen your airways to ease breathing. Work up to your desired pace gradually.

Choose the type of exercise wisely

Non-stop long-distance activities such as running and cold-weather activities such as skiing most often cause wheezing.

Exercise that requires short bursts of energy, such as walking, golf and leisure bicycling, may be better tolerated. Having asthma doesn't mean you have to be less active.

Know when not to exercise

Avoid exercise when you have a viral infection, when the pollen count is more than 100 or in very cold or extremely hot and humid conditions.

Avoid exposure to cold

Keep in mind that exercising in cold weather may trigger asthma symptoms. If you do exercise in cold temperatures, wear a facemask to warm the air you breathe.

Maintain a healthy weight

Being overweight can worsen asthma symptoms, and it puts you at higher risk of other health problems.

Eat fruits and vegetables

Eating plenty of fruits and vegetables may increase lung function and reduce asthma symptoms. These foods are rich in protective nutrients—antioxidants—that boost the immune system.

Educate yourself about asthma

The more you know, the easier it is to control.

Rev up your breathing apparatus

You could rev up your breathing apparatus with yogic 'pranayama' or deep and relaxed breathing exercises.

At first, practice lying on your back while wearing clothing that is loose around your waist and abdomen. Once you have learned this position, practice while sitting and then while standing.

- Lie on your back on a bed.
- Place your feet slightly apart. Rest one hand comfortably on your abdomen near your navel. Place the other hand on your chest.
- Inhale through your nose. Exhale through your mouth.
- Concentrate on your breathing for a few minutes and become aware of which hand is rising and falling with each breath.
- Gently exhale most of the air in your lungs.
- Inhale while slowly counting to four. As you inhale gently, slightly extend your abdomen, causing it to rise about one inch (2.5 cm). You should be able to feel the movement with your hand. Do not pull your shoulders up or move your chest.
- As you breathe in, imagine the warm air flowing into all parts of your body.
- Pause for a second after inhaling.
- Slowly exhale to a count of four. While you are exhaling, your abdomen will slowly fall.
- As air flows out, imagine that tension also is flowing out.
- Pause for 1 second after exhaling.
- If it is difficult to inhale and exhale to a count of four, shorten the count slightly and later work up to four. If you feel lightheaded, slow your breathing or breathe less deeply. Repeat the slow inhaling, pausing, slow exhaling and pausing 5 to 10 times. Exhale. Inhale slowly: 1, 2, 3, 4. Pause. Exhale slowly: 1, 2, 3, 4. Pause. Inhale: 1, 2, 3, 4. Pause. Exhale: 1, 2, 3, 4. Pause. Continue on your own.
- If it's difficult to make your breathing regular, take a slightly deeper breath, hold it for a second or two and then let it out slowly through pursed lips for about 10 seconds. Repeat this once or twice and return to the routine procedure.

Pills and Medications

The right medications for you depend on a number of things, including your age, your symptoms, your asthma triggers and what seems to work best to keep your asthma under control.

Preventive, long-term control medications reduce the inflammation in your airways that leads to symptoms. Quick-relief inhalers (bronchodilators) quickly open swollen airways that are limiting breathing. For some people, medications to treat specific allergies are also needed.

Take all the medications your doctor has prescribed, even if you are not experiencing any symptoms. However, do not also go overboard. Remember, taking more than the prescribed amount of medications can be dangerous.

These medications can be taken using an inhaler, or they may come in liquid, capsule or tablet form.

Long-term control medications

These medications act as 'preventers'. They reduce the inflammation in your airways and also help diminish the production of mucus. The result is a reduction of the spasms in your breathing passages. Take the daily dose of these medications as prescribed to prevent asthma attacks from occurring. In most cases,

these medications need to be taken every day. Types of long-term control medications include:

Inhaled corticosteroids

These medications include fluticasone, budesonide, mometasone, flunisolide, beclomethasone, and others. They are the most commonly prescribed type of long-term asthma medication. You may need to use these medications for several days to weeks before they reach their maximum benefit. Unlike oral corticosteroids, these corticosteroid medications have a relatively low risk of side effects and are generally safe for long-term use.

Leukotriene modifiers

These oral medications include montelukast, zafirlukast and zileuton. They help prevent asthma symptoms for up to 24 hours. In rare cases, these medications have been linked to psychological reactions such as agitation, aggression, hallucinations, depression and suicidal thinking. Seek medical advice right away for any unusual reaction.

Long-acting beta agonists (LABAs)

These inhaled medications include salmeterol and formoterol. LABAs open the airways and reduce inflammation. However, they've been linked to severe asthma attacks. LABAs should be taken only in combination with an inhaled corticosteroid.

Combination medications

Combination inhalers such as fluticasone and salmeterol and budesonide and formoterol also work well. These medications contain a LABA along with a corticosteroid. Like other LABA medications, these medications may increase your risk of having a severe asthma attack.

Theophylline

Theophylline is a daily bronchodilator pill that helps keep the airways open. It relaxes the muscles around the airways to make breathing easier.

Quick-relief medications

These medications act as 'relievers'. They are taken once you are experiencing an asthma attack. Relievers help open narrow airways to allow you to breathe more easily during an attack. Quick-relief medications are used as needed for rapid, short-term symptom relief during an asthma attack — or before exercise if your doctor recommends it. Types of quick-relief medications include:

Short-acting beta agonists

These inhaled, quick-relief bronchodilators can rapidly ease symptoms during an asthma attack. They include albuterol, levalbuterol and pirbuterol. These medications act within minutes, and effects last several hours.

Ipratropium

Your doctor might prescribe this inhaled medication for immediate relief of your symptoms. Like other bronchodilators, ipratropium relaxes the airways, making it easier to breathe. Ipratropium is mostly used for emphysema and chronic bronchitis, but it is sometimes used to treat asthma attacks.

Oral and intravenous corticosteroids

These medications relieve airway inflammation caused by severe asthma. Examples include prednisolone and methylprednisolone. They can cause serious side effects when used long term, so they are used only on a short-term basis to treat severe asthma symptoms.

Treatment for allergy-induced asthma

If your asthma is triggered or worsened by allergies, you may benefit from allergy treatment. Allergy treatments include:

Allergy shots (immunotherapy)

Immunotherapy injections are generally given once a week for a few months, then once a month for a period of three to five years. Over time, they gradually reduce your immune system reaction to specific allergens. However, only a few patients benefit from them.

Omalizumab

This medication is specifically for people who have allergies and severe asthma. It acts by altering the immune system. Omalizumab is delivered by injection every two to four weeks.

Allergy medications

These include oral and nasal spray antihistamines and decongestants as well as corticosteroid, cromolyn and ipratropium nasal sprays.

Don't rely on quick-relief medications

Long-term asthma control medications — such as inhaled corticosteroids — are the cornerstone of asthma treatment. These medications keep asthma under control on a day-to-day basis and make it less likely you'll have an asthma attack.

If you do have an asthma flare-up, a quick-relief inhaler can ease your symptoms right away. But if your long-term control medications are working properly, you shouldn't need to use your quick-relief inhaler very often. Keep a record of how many puffs you use each week. If you need to use your quick-relief inhaler more often than your doctor recommends, see your doctor. You probably need to adjust your long-term control medication.

Risks associated with misuse of bronchodilator inhalers

Inhaling a bronchodilator helps you breathe well immediately during an attack. But the drug doesn't correct inflammation. The maximal daily use of a bronchodilator is two puffs every four to six hours. If you use one more frequently to control symptoms, you need a more

effective medication.

Fast relief may make it difficult to recognise worsening symptoms. Once the medication wears off, asthma returns with more severe wheezing. You are then tempted to take another dose of the medication, delaying adequate treatment with 'preventer' medications.

Overuse of bronchodilators also risks toxic drug levels that may lead to an irregular heartbeat, especially if you have a heart condition. Over-the-counter inhalers also can relieve symptoms quickly—but temporarily. Relying on inhalers can mask a worsening attack and delay treatment with 'preventer' medications.

Gauge severity for better control

Treatment based on asthma control can help you manage your asthma. Asthma treatment should be flexible and based on changes in symptoms, which should be assessed thoroughly each time you see your doctor. Then, treatment can be adjusted accordingly. For example, if your asthma is well controlled, your doctor may prescribe less medicine. If your asthma is not well controlled or getting worse, your doctor may increase your medication and recommend more frequent visits.

Asthma action plan

Work with your doctor to create an asthma action plan that outlines in writing when to take certain medications, or when to increase or decrease the dose of your medications based on your symptoms. Your asthma action plan should also list your triggers and the steps you need to take to avoid them. Your asthma plan may also involve tracking your asthma symptoms or using a peak flow meter on a regular basis.

Self-monitoring with peak flow meter

You may consider using a peak flow meter, a tube that measures how well you are breathing. The flow meter acts like a gauge for your lungs, giving you a number that helps evaluate lung function. A low reading means your air passages are narrow and is an early warning that you may experience an asthma attack. Using a peak flow meter on a regular basis can be a useful aid to monitor how well you are controlling your asthma.

Coping and support

Asthma can be challenging and stressful. You may sometimes become frustrated, angry or depressed because you need to cut back on your usual activities to avoid environmental triggers. You may also feel hampered or embarrassed by the symptoms of the disease and by complicated management routines. Children in particular may be reluctant to use an inhaler in front of their peers.

But asthma doesn't have to be a limiting condition. The best way to overcome anxiety and a feeling of helplessness is to understand your condition and take control of your treatment. Here are some suggestions that may help:

Pace yourself

Take breaks between tasks and avoid activities that make your symptoms worse.

Make a daily to-do list

This may help you avoid feeling overwhelmed. Reward yourself for accomplishing simple goals.

Talk to others with your condition

Chat rooms and message boards on the Internet or support groups in your area can connect you with people facing similar challenges and let you know you're not alone.

If your child has asthma, be encouraging

Focus attention on the things your child can do, not on the things he or she can't. Involve teachers, school nurses, and friends and relatives in helping your child manage asthma.

Prevention

Working together, you and your doctor can design a step-by-step plan for living with your condition and preventing asthma attacks.

Follow your asthma action plan

With your doctor and health care team, write a detailed plan for taking medications and managing an asthma attack. Then be sure to follow your plan. Asthma is an ongoing condition that needs regular monitoring and treatment. Taking control of your treatment can make you feel more in control of your life in general.

Identify and avoid asthma triggers

A number of outdoor allergens and irritants — ranging from pollen and mould to cold air and air pollution — can trigger asthma attacks. Find out what causes or worsens your asthma, and take steps to avoid those triggers.

Monitor your breathing

You may learn to recognise warning signs of an impending attack, such as slight coughing, wheezing or shortness of breath. However, since your lung function may decrease before you notice any signs or symptoms, regularly measure and record your peak airflow with a home peak flow meter.

Identify and treat attacks early

If you act quickly, you are less likely to have a severe attack. You also won't need as much medication to control your symptoms. When your peak flow measurements decrease and alert you to an impending attack, take your medication as instructed and immediately stop any activity that may have triggered the attack. If your symptoms don't improve, get medical help as directed in your action plan.

Take your medication as prescribed

Just because your asthma seems to be improving, don't change anything without first talking to your doctor. It is a good idea to bring your medications with you to each doctor visit, so your doctor can double-check that you're using your medications correctly and taking the right dose.

Pay attention to increasing quick-relief inhaler use

If you find yourself relying on your quick-relief inhaler such as albuterol, your asthma isn't under control. See your doctor about adjusting your treatment. ■

Continued from page 35 (*Inventions and Inventors – An unending journey*)

the pioneers of modern rocketry for his life's work.

Sir Robert Alexander Watson-Watt (1892-1973), Scottish physicist, is considered as the "inventor of radar". Radar development was first started elsewhere, but Watson-Watt created the first workable radar system, turning the theory into one of the most important war-winning weapons. Watson-Watt's academic career was disrupted by the First World War. During the war he worked as a meteorologist at the Royal Aircraft Establishment, Farnborough. He learnt that engineers of the local Post Office detected interference in radio reception as aircraft flew close to their receivers. Watson-Watt thought that this kind of interference could be used to detect the approach of enemy aircraft. In 1935, he prepared an important paper, "The detection of aircraft by radio methods" and submitted it to the Government for consideration. It may be noted that principles behind radar are relatively simple. Radio waves are reflected strongly off large objects like aircraft. However, it was very difficult to pick up the very weak reflected signals. Watson-Watt was able to get over this problem and build a workable radar.

Sir Robert Alexander Watson-Watt

One of the greatest inventions of the 20th century was conceived in a muddy hay field on a farm in Rigby, Idaho, USA. The invention was television and the inventor was **Philo Taylor Farnsworth** (1906-1971). Many names are associated with the invention of television – Nipkow, Baird, Zworykin and a dozen others. But it was Farnsworth who made many contributions that were crucial to the early development of all-electronic television. He is perhaps best known for inventing the first all-electronic image pickup device or video camera tube. Farnsworth invented many other things and held 300 US and foreign patents. *The Time* magazine named Farnsworth as one of the greatest scientists of the 20th century.

It may be said that since the first primitive human beings started using stone tools, the progress of humankind has been marked by milestones of invention and discovery. There is no limit to the inventive power of the human mind and so the journey of invention and inventors will continue till the last days of human beings on Earth. The Earth can sustain human beings for a very long period provided we do not exhaust its resources mindlessly. It is also true that the Earth cannot remain habitable for human beings forever. Does it mean then that the existence of human beings is totally dependent on the habitability of the Earth? At present it seems so. But then who knows that by their inventive power human beings would not leave mother Earth to settle elsewhere in the seemingly infinite universe.

Recent developments in science and technology

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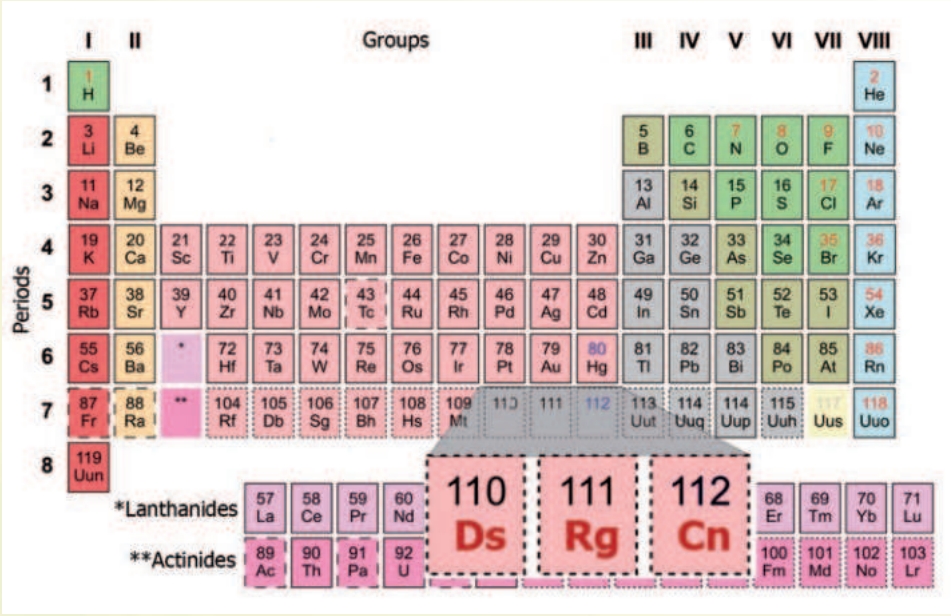
Three new elements added to the Periodic Table

Three new elements, including one named after famous astronomer Nicolaus Copernicus, have been added to the Periodic Table. The General Assembly of the International Union of Pure and Applied Physics (IUPAP) approved the names darmstadtium (Ds), roentgenium (Rg) and copernicium (Cn) for the new elements numbered 110, 111, and 112, respectively. The General Assembly, which consists of 60 members from different countries, approved the new names at its meeting held at the Institute of Physics (IOP) in London in November. Although the names of the new elements have only just been approved for inclusion in the Period Table, the elements were discovered a long time ago.



New elements in the Periodic Table

All man-made elements heavier than uranium decay radioactively, and generally speaking, the heavier the element, the faster the decay. The three recently named elements belong to the same category. But latest analytical techniques make it possible for scientists to study even a few atoms of a short-lived chemical element.

The first atom of the chemical element with atomic number 110 was detected at the Institute for Heavy Ion Research in Darmstadt, Germany in November 1994. The isotope of element 110 that was discovered had an atomic mass number of 269, which means its nucleus had 159 neutrons. The new element was produced by bombarding a target of lead isotope (Pb-208) with a beam of nickel (Ni-62) nuclei. Chemically, the element 110 belongs to the same group as nickel, palladium, and platinum, but unlike these lighter atoms, element 110 decays after a small fraction of a thousandth of a second into lighter elements by emitting alpha-particles which are the nuclei of helium atoms.

The creation of element with atomic number 111, with a nucleus containing 111 protons and 161 neutrons, was announced in December 1994. It was also created in the same lab in Germany by bombarding a target of bismuth with a beam of nickel atoms. Only three atoms of a new element were produced and studied, although the atoms survived for less than two-thousandths of a second.

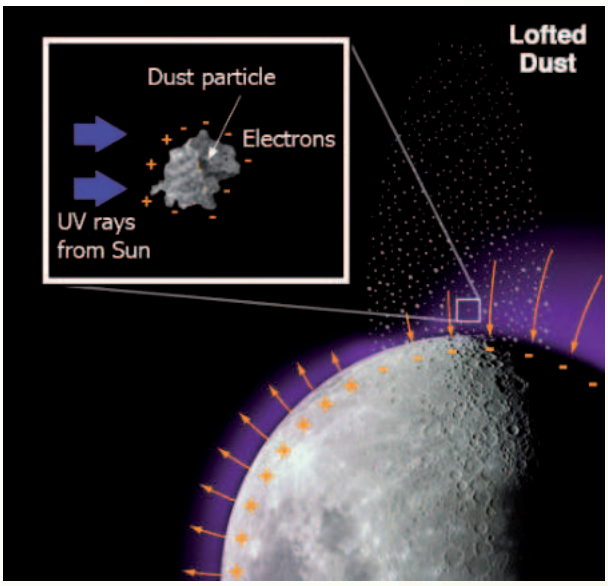
Usually it is difficult to investigate the chemical and physical properties of an element during the ephemeral existence of only three atoms, but because of the number of protons in its nucleus, Element 111 was known to belong to the same column of the Periodic Table as copper, silver and gold, so it is presumably a metal. The element was not named at that time.

The element 112 was discovered in 2009 by an international team of scientists, again in the same lab in Darmstadt, Germany. Element 112, which contains 112 protons and 165 neutrons in the nucleus, was created by bombardment of zinc (at. no. 30) ions onto a lead (at. no. 82) target. As the element is extremely short-lived and decays after a split second, its existence could only be proved with the help of extremely fast and sensitive analysis methods. Twenty-one scientists from Germany, Finland, Russia and Slovakia were involved in the experiments that led to the discovery of the new element. As only a few atoms of copernicium have ever been made, its reactivity with other elements is unknown. However, its behaviour can be expected to be similar to that of mercury (immediately above copernicium in the periodic table) and cadmium (two places above).

Soon after its discovery, the discoverers of element 112 had named the new element 'copernicium' after the 16th century Polish astronomer Nicolaus Copernicus. But at that time it was not an accepted name, as it needed approval by IUPAP, which it has done now. So now the Periodic Table is left with only five elements with atomic numbers 113 to 117, which have been discovered but not yet named.

The mystery of Moon's ionosphere solved

The Moon is one of the most explored celestial objects and the only one which has been visited by humans. It is well known that the Moon has no atmosphere. Also it has been known for many years that the Moon has an ionosphere. But how there can be an ionosphere without an atmosphere was a big puzzle for lunar researchers. A paper published in a recent issue of *Planetary and*



Dust grains floating above the lunar surface are ionised by solar UV radiation.

Space Science (October 2011 | doi:10.1016/j.pss.2011.05.011) provides a possible answer.

Ionosphere is a layer of ionised gas that exists high above Earth's atmosphere. It is created by ionisation of gas atoms in upper atmosphere by ultraviolet rays from the Sun. On Earth, the ionosphere plays a vital role in long-distance communications and navigation. For instance, it reflects radio waves, allowing shortwave radio operators to bounce transmissions over the horizon for long-range communications.

The first evidence for an ionosphere around the Moon came in the 1970s from the Soviet probes *Luna*-19 and 22, which went in orbit around the Moon. Circling the Moon at close range, two spacecraft sensed a layer of charged material extending a few tens of kilometres above the lunar surface. The density of charged particles above the sunlit lunar surface was quite large – as many as 1,000 electrons per cubic centimetre – which was a thousand times more than any theory could explain. Radio astronomers also found hints of the lunar ionosphere through radio occultation measurements, when distant radio sources passed behind the Moon's limb. So there was doubt that the Moon indeed had an ionosphere. But there had to be a mechanism of its formation on an airless Moon.

But, as was discovered later, the Moon is not quite as airless as most people think, because small amounts of gas created by radioactive decay seep out of the lunar interior and meteoroids and the solar wind also blast atoms off the Moon's surface. The resulting shroud of gas so formed is, however, too thin to be called an 'atmosphere.' The density of the lunar gas shroud is about a hundred million billion times less than that of air on Earth, which is not dense enough to support an ionosphere as dense as the ones the Luna probes found. According to the researchers, an ionosphere made of dust instead of gas is new to planetary science.

The Moon has been known to be an extremely dusty place, naturally surrounded by a swarm of dust grains. When these floating grains catch the light of the rising or setting Sun, they create a glow along the horizon, which were seen by *Apollo*-15 astronauts. Stubbs and colleagues realised that floating dust could provide the answer; ultraviolet rays from the Sun hit the grains and probably ionise them and that this process could dominate the formation and evolution of the lunar ionosphere. According to their calculations, this process produces enough charge (positive grains surrounded by negative electrons) to create the observed ionosphere. According to the researchers, an ionosphere made of dust instead of gas is new to planetary science.

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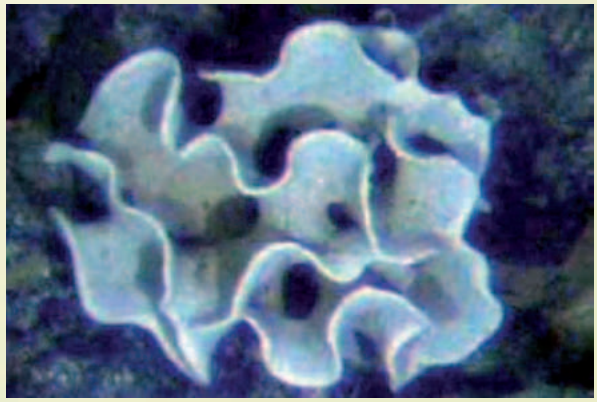
Strange life found in deepest ocean

The Mariana Trench in the Pacific Ocean is the deepest point on Earth, situated just east of the Mariana Islands near Japan. It is 11,641 metres deep. At the bottom of the trench, the water column above exerts a pressure over one thousand times the standard atmospheric pressure at sea level that would make any form of life almost impossible to exist. Yet life does exist there. Recently scientists have found giant amoebas living in the depths of the Mariana Trench; the creatures are called xenophyophores. Lisa Levin, a deep-sea biologist and director of the Scripps Center for Marine Biodiversity and Conservation described the creatures as "fascinating giants that are highly adapted to extreme conditions but at the same time are very fragile and poorly studied."

According to Scripps scientists, xenophyophores are among the largest individual cells in existence, often growing larger than 10 cm in size. Recent studies indicate that by trapping particles from the water, xenophyophores can concentrate high levels of lead, uranium and mercury and are thus likely highly resistant to large doses of heavy metals. They also are well suited



Xenophyophores were recently photographed 10.6-km deep in Pacific Ocean. (Credit: NOAA)

Dropcams before being lowered into the sea.

to a life of darkness, low temperature and high pressure in the deep sea. According to the researchers, the xenophyophores are just the tip of the iceberg when it comes to considerations of the nature and diversity of life at extreme depths.

The discovery was made during a July 2011 voyage to the Mariana Trench, by researchers of Scripps Institution of Oceanography/University of California, San Diego and National Geographic engineers. To reach the bottom of the ocean required specially designed equipment that could withstand the extreme pressure at ocean bottom. The instruments used to spot the mysterious animals were 'Dropcams' developed and used by National Geographic Society Remote Imaging engineers Eric Berkenpas and Graham Wilhelm, who participated in the July voyage.

The Dropcams are versatile autonomous underwater cameras containing an HD camera and lighting inside of a glass bubble. By wrapping high-resolution cameras in a thick-walled glass sphere, scientists were able to drop cameras capable of withstanding the extreme pressure found at that extreme depth. At a depth of more than 11 kilometres, the water above exerts more than a ton per square centimetre of pressure.

The Dropcams were created by National Geographic engineers to allow scientists and filmmakers to capture high-quality footage from any depth in the ocean. The devices were baited and used 'camera-traps' to capture imagery of approaching marine life. Scripps researchers hope to one day capture and return novel living animals to the laboratory for study in high pressure aquariums that replicate the trench environment.

Human blood protein from rice

Human serum albumin (HSA) is the most abundant protein in human blood plasma. It is produced in the liver. Albumin constitutes about half of the blood serum protein. Serum albumin is widely used in clinical and cell culture applications such as the treatment of blood loss, serious burns, and abdominal fluid retention caused by cirrhosis of the liver. In addition, HSA is also used as a vehicle for vaccine and drug delivery, and as a cell culture supplement in the production of vaccines and pharmaceuticals.

Conventional production of HSA from human blood is limited by the availability of blood donation and the high risk of viral transmission from donors. Now scientists have genetically engineered rice to produce a safe and pure form of the much-needed human plasma protein, according to a report published in *Proceedings of the National Academy of Sciences* (31 October 2011 | doi: 10.1073/pnas.1109736108). The work was carried out by an international team of researchers led by Daichang Yang of Wuhan University, China. Use of the rice-derived protein in place of its blood-derived counterpart will not only ease demand but also eliminate the risk of spreading diseases such as hepatitis and HIV through infected blood products.

Scientists have genetically engineered rice to produce a safe and pure form of the much-needed human plasma protein

To eliminate the potential risk of viral contamination, regulatory agencies have encouraged pharmaceutical companies to use non-animal-derived sources for pharmaceutical production. Thus, the development of a low-cost method for the production of recombinant HSA (rHSA) was considered essential as a safer and potentially unlimited alternative to plasma-derived HSA (pHSA).

Although this was not the first to attempt at genetically engineering HSA production in other species, none of the earlier attempts, which included transgenic potatoes and tobacco, provided sufficient yield to be cost-effective. Plant seeds, especially cereal crop seeds, are promising vehicles for producing recombinant proteins because they can achieve high accumulation of recombinant protein, display high levels of protein stability, stored for long periods of time, and are well controlled on a production scale.

So, to increase the yield, Yang and his colleagues turned to rice (*Oryza sativa*). Specifically, they targeted the part of rice we eat, the endosperm inside the seed, which is the main nutrient storage organ, and thus an excellent site for the accumulation and long-term stable storage of recombinant proteins. By driving expression of the HSA gene in the rice endosperm, the team managed to obtain 2.74 grams of pure HSA protein per kilogram of rice seed, more than 25 times the 0.1 grams of HSA collected from one kilogram of tobacco leaves.

In addition to obtaining a high yield, the rice-derived HSA shared the same molecular weight, crystal structure, molecular binding sites, and other biochemical characteristics as that of blood-derived HSA. The rice-derived HSA also displayed an equivalent immune response to that of plasma HSA. In other words, animals injected with either rice HSA or plasma HSA developed similar immune reactions.

Despite these similarities, however, before rice HSA can be used in humans it will need to go through extensive clinical trials. Furthermore, to generate sufficient quantities of HSA to meet global demand, which at present is estimated at around 500 tons a year, production will need to be scaled up to open-field farming, which will depend on public response to GM rice cultivation.

Celebration of Science Fortnight (IYC 2011) on the theme 'Chemistry in Daily Life'

Vigyan Prasar, jointly with Navyug School, Lodhi Road, New Delhi and Indian Association for Physics Teachers (IAPT), organised a two-day sensitisation programme for science teachers during 8-9 November 2011 at Navyug School, Lodhi Road, New Delhi. About 50 science teachers from different NDMC Schools, MCD Schools, NCT Delhi Schools, Central Schools and teachers from Private/Public Schools were invited to attend the workshop. The objective of the programme was to sensitise teachers towards the appreciation of chemistry in day-to-day life, including awareness on latest development in the field of chemistry. The programme included the following: (i) discussion on the IYC 2011 and lectures on different facets of chemistry; (ii) demonstration of innovative teaching materials; (iii) presentation by teachers; (iv) discussion on global experiment "Water: A chemical solution"; and (v) Chemistry Quiz for the students of NDMC schools.

A lecture on "International Year of Chemistry 2011" by Dr S Mahanti, Scientist 'F', VP

Students participating in demonstration session on chemistry experiments

The celebration of science fortnight was inaugurated by Prof. Ved Ratan of IAPT and Prof. Ravi Bhattacharya from Delhi University. Director, Navyug School Educational Society (NSES), Shri Sher Singh, Principal, Navyug School, and Shri Kapil Tripathi, Scientist, Vigyan Prasar were present at the inaugural session.

In his inaugural remarks Prof. Bhattacharya talked about science in everyday life and emphasised on the method of science. Prof. Ved Ratan presented an introduction of science fortnight and Director NSES, New Delhi delivered the keynote address.

The first session of the programme started with a lecture on "Effective teaching of science" by Dr. Anil Vashisht, DEO, Government of National Capital Territory of Delhi. He highlighted several innovative experiments done by scientists in the past and focussed on the issues related to appropriate methods for teaching chemistry. After this, there was a lecture on "Global experiment on chemistry" by Shri Kapil Tripathi, Scientist 'D', Vigyan Prasar. These global experiments are being conducted throughout the world by students. In his talk, he discussed about the methods of doing the experiment and also about the future plans of Vigyan Prasar related to this activity.

In the second session, a demonstration on "Food adulteration kit" by Dr. B M Sharma of Society of Pollution and Environmental Conservation Scientists (SPECS), Dehradun (Uttarakhand). He demonstrated several experiments/methods to find out the adulteration commonly seen in our day-to-day food stuffs. It was followed by another demonstration on "Chemistry behind miracles" which was done by Shri Rajpal of Indian Resource Development Association, Kurukshetra, Haryana. Both the demonstrations were highly appreciated by the participants and useful interaction/debate was generated after the session.

The second day's programme started with a talk by Dr. Subodh Mahanti, Scientist 'F', Vigyan Prasar. He expressed his views on the importance of International Year for Chemistry and its activities. He also motivated students by telling interesting facts related to famous scientists of past. After this, there was a lecture on "Innovation in chemistry" by Prof. R S Sindhu, Head Chemistry, Department of Education in Science and Mathematics, NCERT, New Delhi, he spoke about today's advancements in the field of innovations in chemistry and also presented a future scenario of this field. After this, there was an invited talk by Prof. L S Kothari, on "Innovation in learning of science". Prof. Kothari interacted with the students and teachers and explained innovation of learning method by doing simple hands-on activities and shared his experience of teaching with the participants.

Science teachers demonstrating chemistry experiments

A view of participant

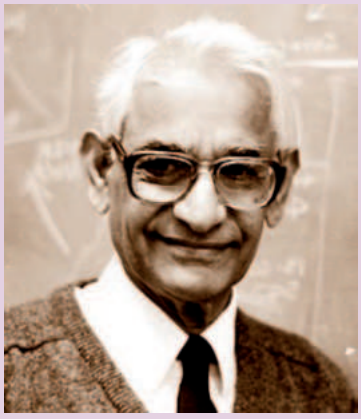
A view of VP book exhibition

After the lunch, the teachers of Navyug School conducted a quiz for students from various NDMC Schools, in an innovative format where

the questions were based on experiments in various subjects i.e. physics, chemistry, biology, developed by science teachers of Navyug School, Lodhi Road, New Delhi. During the two-day programme an exhibition was also organised where students displayed various science models and experiments. Vigyan Prasar also displayed its publications at the exhibition. One of the important outcomes of this two-day programme was that teachers also came forward to show their experiments designed to understand various concepts of chemistry. Dr. Hukum Singh, Head DESM, NCERT, New Delhi, Prof. R S Sidhu, Head Chemistry, DESM, NCERT, Prof. Ved Ratan were the jury members for the quiz programme. Dr. Hukum Singh in his remark said that the science can be taught in very simple and interesting manner and students need do hard work to achieve in science.

Er. Anuj Sinha, Director, Vigyan Prasar, addressed the participants in the concluding session. He focused on the current challenges in chemistry teaching and urged the participants to make themselves up-to-date in their field. He also honoured the winners of the quiz competition. Vigyan Prasar gave participation certificates to all the participants along with books and kits developed by VP.

Hargobind Khorana (1922-2011)



Har Gobind Khorana, Indian-born American biochemist, Nobel laureate, died in Concord, Massachusetts, USA on 9 November 2011 at the age of 89. Khorana was born in Raipur, a small village in Punjab (now in Pakistan). His father was an agriculture taxation clerk for the British colonial government and was dedicated to educating his five children. "We were practically the only literate family in the village inhabited by about 100 people," Khorana wrote.

Khorana attended Punjab University at Lahore (now in Pakistan) and the University of Liverpool, England, on government scholarships. He obtained his PhD at Liverpool in 1948, and began research on nucleic acids during a fellowship at the University of Cambridge (1951) under Sir Alexander Todd. He then worked in Switzerland and Canada before becoming co-director of the Institute for Enzyme Research at the University of Wisconsin in USA in 1960, working on unravelling the genetic code.

Khorana's main contribution has been in deciphering the genetic code by using synthetic genes. In the 1960s, while at the University of Wisconsin, Khorana confirmed Marshall Nirenberg's findings that the way the four different types of nucleotides - adenine (A), cytosine (C), guanine (G), and uracil (U) - are arranged on the spiral "staircase" of the DNA molecule determines the chemical composition and function of a new cell. He was the first to synthesise the first wholly artificial gene – found in the bacterium Escherichia coli.

Khorana was awarded the 1968 Nobel Prize for Physiology or Medicine, jointly with Robert W. Holley and Marshall W. Nirenberg, for research that helped to show how the nucleotides in nucleic acids, which carry the genetic code of the cell, control the cell's synthesis of proteins. The three scientists showed how triplets of these bases act as three-letter words to code for the different amino acids in proteins.

Khorana subsequently became interested in replicating this process synthetically. He moved to the Massachusetts Institute of Technology (MIT) in Cambridge in 1972, and in 1976 made another breakthrough with his colleagues there – chemically synthesising an artificial gene, and coaxing it to work inside a living cell. Later in his career, Khorana became interested in other cellular components, including biomembranes and rhodopsin, a pigment involved in the biological perception of light. He retired from MIT in 2007.

Letters to the editor

Enriching

As an elderly person with deep inclination to enrich my knowledge on Mother Nature, I was delighted to read the useful excerpts of the interaction with Prof. Pramod K. Verma, in your esteemed science magazine Dream 2047 (October 2011). The interview has widely travelled through the length and breadth of the universe, to enlighten all groups of readers, with the wonders of the universe, in which we live. The article on Nutrigenomics, will, I'm sure, help people to live a better life.

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A treasure of knowledge

As a reader of Dream 2047, I thank you from the bottom of my heart for this valuable magazine. I feel excited to read about the scientists. I got lot of information about many scientists who were not familiar to me before. I got lot of information about many strange diseases. Dr Yatish Agarwal's column keeps us informed about preventive measures, and characters of many unfamiliar diseases. For students like me who live in village, your magazine is a treasure of knowledge.

Manjunath Guralingappa Shivanagi
'Basar Nivas'
A/P: Maindargi – 413217
Taluk: Akkalkot, Distt.: Solapur, Maharashtra

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Science vs mythology

I read Biman Basu's article 'Planet around two Suns discovered'. (Dream 2047, November 2011). Such discoveries are amazing and force us think and correlate with mythological events. I consider 'myth' as 'hypotheses'. They should be tested and verified experimentally. According to Hindu Mythology there's a possibility of our solar system having two suns in remote past, more than 10 billions years ago when Hanumanji gobbled up the Sun in his childhood. It's not possible for a man or ape-man to gobble up Sun. There's only one possibility left that the other Sun in our solar system died in its stage of infancy.

Anirudh Kumar Satsangi
6, Dayalkunj, Dayalbagh, Agra-282005

[Author's response: It is not proper to link a purely scientific discovery to mythology. There is no scientific evidence that our Sun had a twin any time in the past.]

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