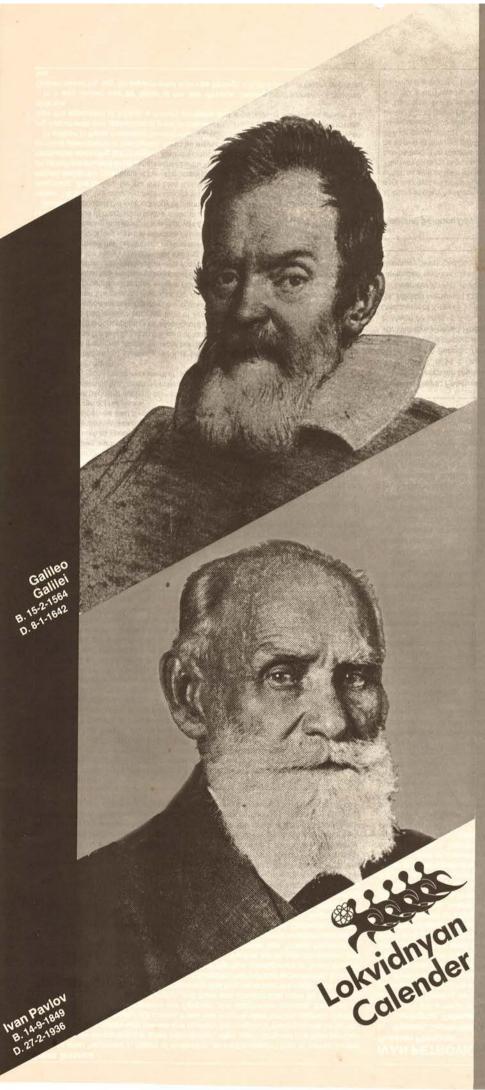


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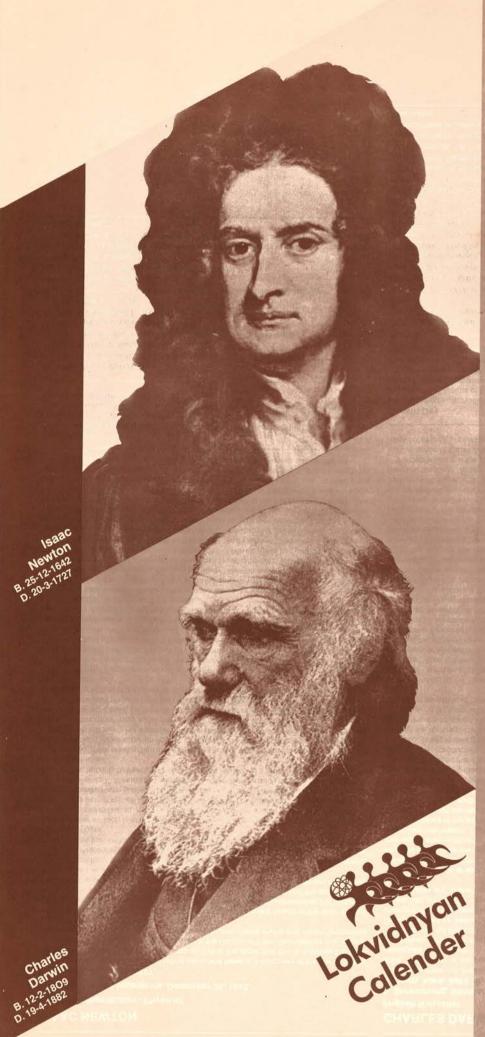
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To Commemorate
INDIAN SCIENCE CONGRESS
Platinum Jubilee January 1988 PUNE

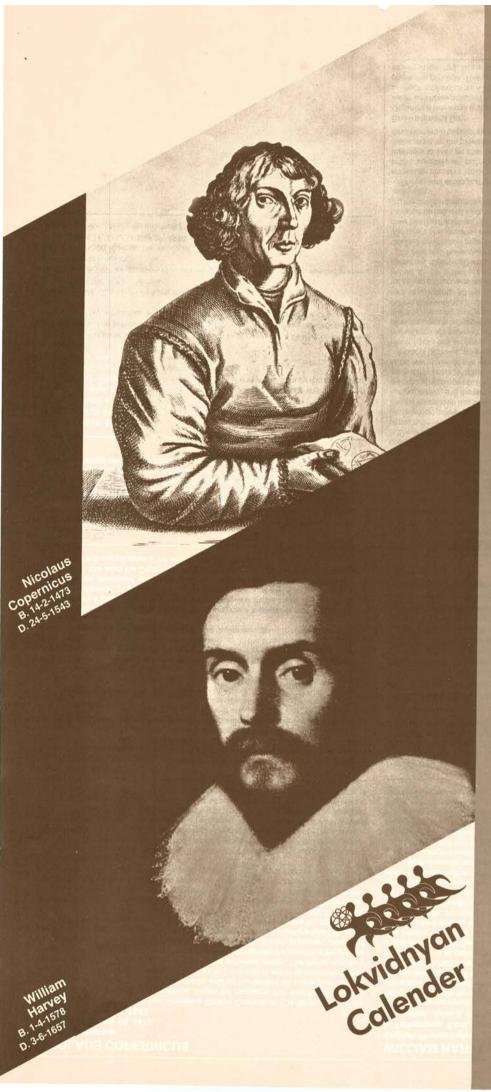


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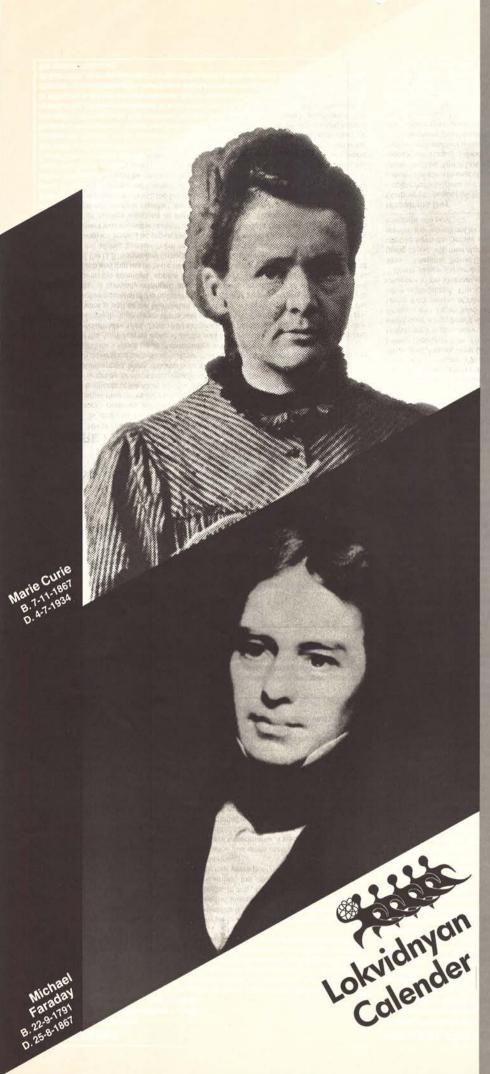


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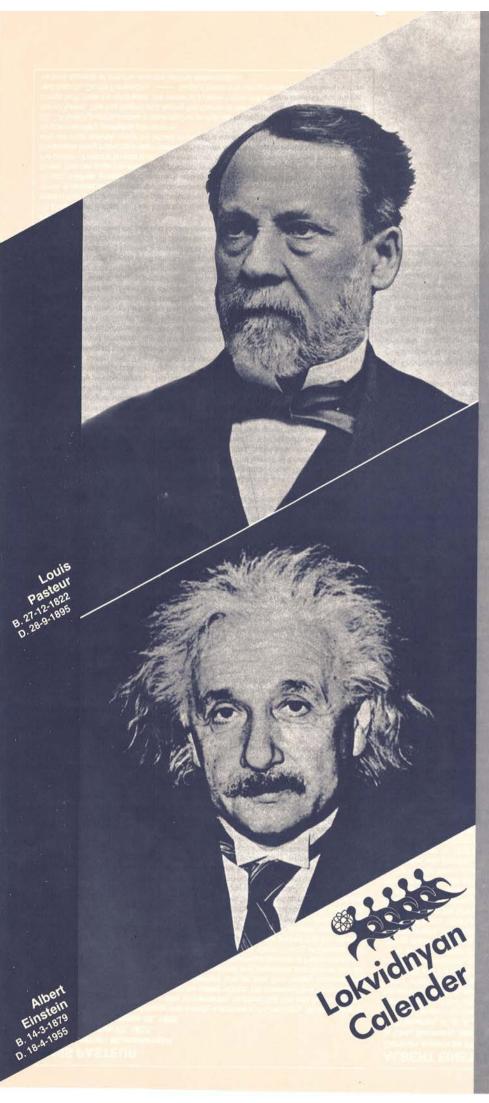


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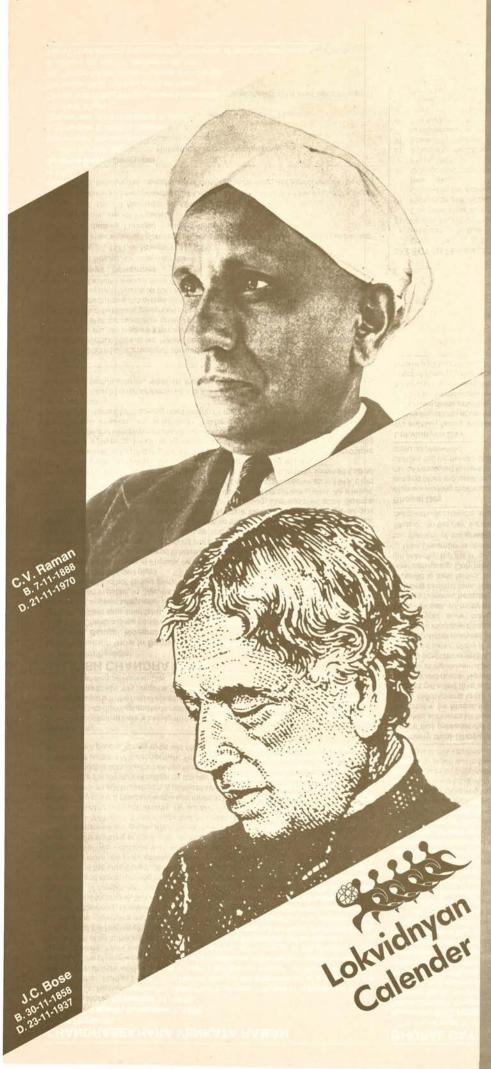
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INTRODUCTION

The 'Lokvidnyan Movement' is inspired by the aim of disseminating science and inculcating scientific outlook among all sections of the society and making the scientific community people-oriented.

The Lokavidnyan Sanghatana, Maharashtara, has undertaken several action-programmes over the last eight years from this point of view and is trying to reach the people through the use of media like slide-shows, exhibitions, articles, pamphlets, meetings, science-songs....etc. The issues which the Sanghatana has tried to handle so far include : solar eclipse, trickery by 'godmen', women's reproductive helath, misconceptions about tonics, injections...etc., alternatives in energy, 'No more Hiroshima', scientific management of water and land resources, analysis of famines and long-term measures to combat famines, the Bhopal-disaster and the pollution problem, government's drug-policy, the novel science-test

A new initiative taken up by the Sanghatana's Pune branch is the publication of this science-calendar with the following view: Despite the application of science and technology in our daily routine, a scientific approach to life rarely forms a part of our mental makeup. One of the ways to make science a part of our intellectual-cultural life is to observe the days which mean so much for science.

The present calendar indicates the death-anniversaries of 47 great scientists. It is hoped that schools, colleges, science-groups...etc. would be able to observe one day per month in the name of 'Science' and one day to commemorate a scientist. In view of this, contributions of 13 great scientists have been described. A couple of lines have been given about each of the other 34 scientists. 'Hiroshima-day', 'Environment-day', 'Bhopal-day', find a special place in these pages. This is meant to highlight the problems which are engendered by the misuse of science. In the final analysis, it is a people's movement alone which has the power to prevent the misuse of science. The science-days derive their significance precisely from the need to strengthen collective effort, every where. Some concrete suggestions about how to organise appropriate activities on different science-days, have therefore been purposefully included.

This Calendar, in English, based on the Marathi version, is being published with the hope that it will help science groups and science-lovers all over India to render this information in different Indian languages, and to observe science-days and thereby help to make science a part of intellecutal-cultural life of our society. The information about scientists in this calendar has been subject to limitations of space and the aim of addressing the lay-reader. For further information, a select bibliogrphy given at the end would be of help.

MEGHNAD SAHA

Indian Physicist.

b. Seoratali, Dacca District, October 6, 1883.

Calcutta, February 16, 1956.

Meghnad Saha was not only one of the pioneering scientists amongst the first generation of modern Indian Scientists, but one who left a distinctive people-oriented heritage both in the development of science and its use.

At the young age of twenty five, his theoretical endeavours in Astrophysics bore the invaluable fruit in the form of the famous Saha-equation of Stellar Spectra which put India on the world-map of the fundamental discoveries in modern physics. Like the sunlight, the star-light also decomposes into its constituent colours when it passes through a prism. The decomposed stellar spectrum appears as a band of bright or dark lines called spectral lines. Gustave Kirchoff had shown that these spectral lines revealed the elemental composition of the sun, but astronomers could not make out what caused them. Saha applied the theory of the atomic structure as propounded by Rutherford and Bohr to explain the bewildering complexity of the stellar spectra. His ionization, formula also enabled the caluculation of the temperature, pres sure and other aspects of the interior of the sun or any other star. This was a breakthrough in Astrophysics. It has been amended in important details by the work of Fouler, Milne and others, but all subsequent progress in this field is a further elaboration of the original and seminal ideas of Saha

Saha tried to build up a tradition of his own and to keep India abreast of the developments in the world. On his initiative, nuclear physics was taught for the first time in India at the Cal-cutta University. In 1948, at Calcutta, he founded what is today known as the Saha-Institute of Nuclear Physics. He had the foresight to order from abroad, the first cyclotrone (so important in the modern atomic research) for the benefit of researchers in India. Saha was elected President of the Indian Science Congress in 1934; and was the Science policy advisor to the Indian National Congress. In the tradition of the first-rate nuclear scientist all over the world, Saha was fully committed to the purely peaceful uses of the atom. He fervently argued against buiding-up a centralized, monolithic, secretive establishment in the form of the Atomic Energy Commission; and pleaded for a non-secret, open nuclear research programme compatible only with purely peaceful aims and conducted in a decentralized, democratic organizational framework. But in vain!

Nationlist from his school-days and committed to the cause of the poor, he founded and edited a magazine: 'Science and Culture' through which he criticized the wrong policies of the Government, the exploitation by the foreign and Indian industrial magnates and pleaded for a pro-people policy of vigorous industrialization in the public sector; universal education, agricultural co-operatives...etc. According to him, the main task of scientists in Independent India was the wide-spread dissemination of technical know-how at all levels in order to take the Indian economy on to the 'take-off-stage.' The latter years of his life were primarily devoted to this cause, and this made him one of the most popular figures in Calcutta. That he won a parliamentary seat in the 1952 elections as an independent candidate is an indicator of his involvement in social life and his popularity.

Acknowledgements

A number of sympathisers and well-wishers have been of great help in several ways in preparing Lokvidnyan Calendar, 1988 and the Lokvidnyan Sanghatana is extremely thankful to them all. Special mention must be made of Shri Uday Bandivadekar who had undertaken the responsibility for the design and art work of the Calendar in the true spirit of helping the Lokvidnyana movement, M's Frontrankers for completing the photocomposing work speedily and elegantly and Shri Sujit Patwardhan of Mudra for printing the Calendar with his usual good will towards the Sanghatana and concern for quality.

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ORIGIN AND DEVELOPMENT OF SCIENCE IN ANCIENT SOCIETIES

An understanding of how science originated, and how and to what extent it developed in different ancient civilizations is not only interesting but also gives an insight into the nature of science and its development.

Origin of Science

cience developed owing to the superior intellectual capacity of humans, but it is a capacity that does not lie only in the brain as is commonly believed. It is rooted in the complex process of evolution of man including an erect position, an opposable thumb and hence an extremely versatile hand. This hand enabled him to shape natural material like wood and stone into tools. The ability to plan and execute changes in nature according to this plan separates man from animals. This planning ahead, demanded an organized body of continuous observations, a record of their recurrence, and discovering casual relations between different agents of nature. This is the essence of science, which started right from the beginning of human his-

With the development of tools, arose new possibilities and hence new needs. For example, once how to light fire was known, various needs of cooking arose. The satisfaction of more and more developed needs impelled man to know more about nature and to control it. This gave rise to new tools and the spiral process continues to date.

With settled agriculture, a whole range of new possibilities, needs and techniques arose. Science developed to fulfil these needs. Geometry and arithmatic were needed to map out and measure land, to make and lay bricks of different sizes and to measure grain. Astronomy helped to appropriately time the sowing and harvesting of crops. The urban civilizations arose out of the surplus of agriculture. New craft and techniques like carpentry, masonry, metallurgy arose out of the needs of the urban civilizations and new branches of science developed with them. Thus the increasing needs of day to day life created the need for the origin and development of science; and man's inherent capacities of exploration, abstraction, logical thinking ful-filled these needs through the medium of development of newer and newer intellecual and mechanical tools. Inspite of considerable differences, one common factor is found at the backbone of scientific progress in different ancient societies: settled agricultural and urban

A very brief outline given below of some of the milestones of development of science in different ancient societies, will show to what extent this process had progressed in the ancient

Science In Ancient India

Science in Ancient India can be traced back to at least about 4000 years in the Indus valley civilization. Sites of cities like Mohenjodaro and Harappa have revealed a well developed economy, complex town-planning and engineering, a knowledge of surveying and mensuration, geometry, animal and plant life, chemical processing.. etc. However, as the written language is as yet undeciphered, exact achievements of the Indus civilization are not known.

A major contribution of Ancient Indian Science is the concept of numeral system with O (zero), a discovery, that in mathematics, is as important as the controlling of fire in human history. The earliest surviving inscription recording a system of nine digits and a zero with place notation for tens and hundreds is dated 595 A.D. These Hind numerals were adopted in Arab mathematics in the nineth century A.D. Three centuries later the 'Arabic numerals' as they were called, entered Europe when Arabic Works were being translated into Latin. The precondition for development of mathematics in Europe was the adoption of Indian numerals during the Renaissance.

Unlike China, India did not enjoy relatively long periods of unified Imperial rule. It was mainly during the relatively stable times of Gupta, Rashtrakuta and Chalukya and with the pat-ronage of these dynasties, astronomy and related mathematics developed. We have a galaxy of noted mathematician-astronomers like Aryabhata, Varahmihir, Brahmagupta, Bhaskara. Arising out of the rich agricultural and urban civilization and then developing on its own, ancient Indian astronomy and mathematics were in many respects far ahead of other ancient societies. But with the further consolidation of the priestly caste, this progress stagnated after 11th century A.D.

The development of astronomy and astrology began to be more and more bound by ritualistic ceremonial observances. The priestly caste had developed an elaborate and complicated system of rituals and with their power to regulate religious life, they controlled the intellectual life of the society. This inhibited the growth of spirit of enquiry and obstructed further progress in science. Because of the rigidity of caste system, the productive techniques were confined to the Shudras and handed down as craft-lore in the form of precepts among them. The Brahmins thought it derogatory to learn from Shudras and thus remained separated from the actual knowledge of Nature and its laws. This separation of intellectual and manual work acted as a hindrance for the futher development of science. Besides, the emphasis on learning by rote, rather than by method and thought, and in Sanskrit only, also brought stangnation.

Science In Ancient China

In the ancient past, the Chinese have been centuries ahead of the world in scientific and technological developments. There are several reasons for their relative strength. The first, a relative isolation from invasions and conquests for a long enough period to make for the establishement of a central rule and centralization of surplus of the settled agricultural civilization; the second, a common development of written script directly in a modified form of the ideogram that preceded it; and the third, the Buddhism that grew in India for reasons of meeting the needs of developing trade, took roots in China and despite Taoism, became an important promoter of scientific progress due to its almost atheistic/materialistic outlook.

China was the first civilization to develop a system of competitive examinations for administrative posts in the Government. The state was actively involved in collection of facts and in organizing them. Astronomy in China was an official science. The state recorded systematically observations on events like movements of planets, eclipses, sunspots, rainfall, snow and wind, rainbow and Aurora borealis, etc. To understand how developed was China in science and technology, one can look at a few dates of inventions in China and Europe. China was ahead of Europe in the invention of the magnetic compass by 11 centuries, in smelting iron and paper making by 10 centuries, in printing by five centuries, in gun powder by six cen-

However, the very reasons for this success in one age became fetters in the further development. The bureaucratic control meant that the urge to explore and to break away from orthodoxy was lacking. The civil service attracted the best brain but they remained subservient to the state. The merchants subjected to sumptuary laws and heavy taxation could not attain positions of power and accumulate capital. China's isolation also became a problem. The Chinese began to think of their country as the centre of the universe and foreigners were the 'foreign-devils.' In the face of foreign traders and colonialists from Europe, the hierarchical form of government, and bureaucracy, and obscurantism spelt its doom.

However, the contribution that China made to the progress of science and technology till 16th century A.D. must be fully recongnised. It is overlooked due to the Eurocentric world-view. Many Chinese inventions travelled through India and Arabia to Europe and provided the basis for the industrial leap in Europe once the socio-economic conditions were ripe.

Greek Science

As has often happened in history of civilization, an earthy peasant type or nomad society with its relatively simple forms of social organization, often, upon conquest of a more complex civilization, absorb rapidly with interest and curiosity the insights of these cultures for its own purpose and advance rapidly. (Of course, these new insights often turn into dogmas of a later age.) When the Greeks discovered the Egyptian and Babylonian cultures, they had no organized structures of belief and myths, and there was considerable room for speculative thought. The great contribution of the Greeks was that they separated the magic from the science in the cultures of foreign civilizations, and discarded many of their superstitions, thus dissociating natural enquiry from ritual. The period of vigorous development of Greek thought between 600 B.C. to 200 A.D. can be divided into three: the first, Ionian Age; the second, age of Plato and Aristotle; and the third, Hellenic period. In the Ionian age, Thales, Hippocrates, Pythagoras, Democritus were the well known Philosophers. Pythagorian mathematics set up an important connection between mathematics, science and philosophy. Democritus put forward a form of atomic theory and introduced the concept of void in philosophy. Hippocrates is well known in medicine even today. In the Platonic age, Plato, Aristotle were mostly concerned with organizing systems of thought and knowledge already existing and creating notions of method and logic. In that period Greek science, however was stagnating due to the consolidation of slave society and separation of thought and physical work. It was only in the Hellenic period when Alexandar came into contact with other civilizations, including India, that Greek Science erupted with vigour. In Alexandria, Euclid, Ptolemy, Galen and Archimedes made epochal contributions respectively in the fields of Geometry, Astronomy, Physiology, mechanics and hydrostatics. All the general problems-the nature of heavens, or man's body or the working of universe were formulated by the Greeks and solved in their particular logical and beautiful way. That these concepts were accepted for centuries till the modern scientists transcended them with great difficulty, shows the inherent strength of these logical constructs

Arabic Science

During the middle ages when feudalism reigned almost all over the world, there seems to be a temporary eclipse of science. However, this is not entirely true as the vigorous growth of science in Arabia shows. With the birth of Islam, a philosophy which united the Arabs, the vigorour imbued by it led to decades of conquest by the new united tribes. Soon cities grew and once again a free thinking people became hungry for knowledge. Baghdad, the capital of Islamic culture bacame the home of even refugee scientists, as Greece had been earlier. Greek and Indian scientific works were brought to Arabia and systematically translated. They also developed Algebra, Astronomy, Trignometry, Medicine, Geography. The Arabs thus performed the crucial role in the history of human civilization and history of science, at a time when there was an eclipse world over. They preserved the accumulated scientific knowledge of the past civilizations (which the Greeks had done in the case of Egyptian and Babylonian civilizations) and made it available, some times filtered through the sieve of Islamic culture, to Europe. This was their bequest to the late medieval West and thus to the development of modern science in the West. Yet in Arabia with the rise of religious dogmatism 'free thinking' was condemned and religious dogma had its sway. Traditionalism, inimical to independent scientific thinking arrested scientific progress in the Islamic world from 12th century while the Latin translations of the rich wealth of Arabic works provided basis for the progress of science and technology in the West.

GALILEO GALILEI

Italian Astronomer and Physicist.

b. Pisa, February 15, 1564.

d. Near Florence, January 8,1642.

On 21st June 1633 Galileo had to face the Inquisition. His book "Dialogue on the Two Chief World Systems" written in Italian for the common man supported the heliocentric world-view of Copernicus; this raised a storm.

Galileo, assembling his own telescope, a new invention during his time, used it for astronomical observations for the first time. The telescope revealed a new world-the Milky-way composed of millions of stars, the four satellites of Jupiter, the phases of Venus, the Sunspots and the hills on the moon. On the basis of these observations he found support for the heliocentric model of Copernicus and challenged the Aristotelian world view that the heavens were perfect and unchanging and only the earth was subject to the laws of change.

Galileo's views were a threat to the authority of Church and the feudal order, who believed universe and man as special creation of God. Earlier, in 1600, Bruno, a philosopher who also supported heliocentric idea of universe, was condemned and burnt to death. Now in 1633, 70 years old Galileo was also threatened with torture and despite having adequate evidence, was forced to retract his views.

This was the period of the birth of modern science. Scientists in 17th century Europe were in pursuit of scientific truth even in the face of threat of death. However, their sustained efforts over a century led to the development of rational scientific methodology and put an end to the authority of the church.

The most brilliant of Galileo's work is his contribution towards the establishment of mechanics as a science. Some valuable but isolated theorems had been previously proved, but Galileo was the first to grasp the idea of force as mechanical agent, and he extended to texternal world the conception of invariability of the relation between cause and effect. Science of equilibrium had existed from the time of Archimedes but Science of motion began with Galileo. The important result of this new science was his determination of the laws of falling bodies. Till then the popular view was the Aristotelian belief that held the rate of falling bodies. Till then the popular view was the Aristotelian belief that held the rate of salling stall with the same rate. He also showed that a body moves along an inclined plane with a constant acceleration. The Aristotelian view maintained that a force had to be applied continuously to keep the body in motion. The moving planets must therefore be pushed by angels. But Galileo proved that continuous motion does not require continuous application of force. Implicit in his analysis was the principle of inertia. He introduced the revolutionary concept that uniform motion in a straight line is physically equivalent to a state of rest, thereby transforming science of mechanics from a static to a kinematic basis.

Galileo introduced the methodology of planned experimentation along with detailed observation. Till then, the common methodology was detailed observations followed by inductive reasoning. But Galileo for the first time introduced planned 'thought' experiments. These helped decide the conditions of the experiment and the mathematical model helped to decide on certain parameters to be experimented with. The actual physical experiment could then be conducted according to this model. Thus mathematics became a language of mechanics and physical phenomena in mechanics, could be expressed in mathematical terms.

In adiition to these theoretical developments in science, Galileo also contributed by inventing instruments and appliances of great practical utility. These include an instrument to measure the expansion of liquids, a military compass and a calculating instrument similar to a sliderule.

In a way Galileo was the father of the new Physics. Defying blind worship of Aristotle, Galileo paved the way for experimental sciences through a fruitful union of theory and practice.

IVAN PETROVICH PAVLOV

Russian Physicist

b. Ryazan, September 14, 1849.

d. Leningrad, February 27, 1936.

Pavlov's first seminal contribution was in the field of physiology of digestion. With hardly any financial backing, he conducted research on the digestive system for more than twenty years and worked out the nervous mechanism controlling the secretion of the digestive glands. His researches were crucial in establishing the importance of autonomic nervous system. In 1904, he was awarded the Nobel Prize for his work on the physiology of digestion. Before Pavlov the method of physiology was essentially confined to exploring the functions of individual organs. As a result experimentators disrupted the natural course of processes underway in an organism. This method could not probe into the dynamic relationship between different physiological processes. Pavlov introducted "chronic experiment" whereby studies were counducted for a long time using intact or preoperated animals. He strove to investigate organisms in their natural conditions. Tubes were permanently implanted in the bodies of experimental animals to reach for internal organs and extract their secretions without disrupting their functions or their interaction. This new method of conducting 'Chronic experiments' is a unique contribution in this field.

The greatest significance of Pavlov's work lies in the fact that he brought psychic activity within the realm of phenomenon to be studied and explained by the normal objective methods of natural science. That the mind, which cannot be felt by sense-organs can be studied like other organs, was an unthinkable proposition for most people. This shows how far ahead was Pavlov of his time.

Pavlov is best known for his theory of conditioned and unconditioned reflexes. 'Pavlov's dog' has become a legend. Though, to the popular mind, Pavlov is known for his experiments on animals, his ultimate aim was the study of the human mind. He minutely studied human behaviour in normal persons and psychiatric patients; and stressed the quantitative and qualitative uniqueness of man. He pointed out that unlike animals human reflexes are infinitely enriched by "upbringing, education and culture."

Galileo Day

The fourth scene from the drama: "The life of Galileo," written by the famous German Dramatist, Bertold Brecht, may be enacted on this day. This scene depicts a situation wherein, at Florence, Galileo invited the officials of the Church and the Government to observe through his telescope, the satellites of the Jupiter; but they refused to even look through his telescope, arguing that anything which contradicts the truth of the Ptolemic system cannot exist. (A copy of the script can be obtained from the Lok Vidnyan Sanghatana.)

Pavlov Day

Loveable, obstinate, cooperative, efficient, timid..... these are different types of personalities. How such personalities are shaped and what are the conditions for a healthy development of personality from childhood, is an interesting topic. A seminar or lecture by educationists, psychologists, followed by a question-answer session can be arranged on the Pavlov-Day.

Science Days: January

6. Gregor Johann Mendel, Austrian Geneticist,

b. July 22, 1822, d. January 6, 1884.

Developed the concept of genetic transmission of characters and laid foundation of the Science of Genetics.

10. Carolus Linnaeus, Swedish Botanist,

b. May 23, 1707, d. January 10,1778.

First to frame principles for defining genera and species of organisms and to create a uniform system of classification and nomenclature.

14. Edmund Halley, English Astronomer and Mathematician,

b. November 8, 1656, d. January 14, 1742.

First to calculate the orbit of a comet (later named after him). In 1705, accurately predicted return of the comet (seen in 1682) in 1758, 1835 and so on.

24. Edward Jenner, English Physician,

b. May 17, 1749, d. January 24, 1823.

Developed and used vaccines to create immunity to small pox (1798) for the first time in the Western World.

Science Days: February

2. Dmitri Ivanovich Mendeleeff, Russian Chemist,

b. February 7, 1834, d. Feb. 2, 1907.

Developed the Periodic Table of chemical elements (1869), which proved to be the great unifying scheme of inorganic chemistry.

10. Wilhelm Konrad Roentgen, German Physicist,

b. March 27 1845, d. Feb. 10, 1923.

Discoverer of X-ray (5-11-1895).

24. Nikolai Ivanovich Lobachevsky, Russian Mathematician,

b. December 2,1793, d. February 24, 1856.

Developed non-Euclidean geometry. (Hungarian mathematician Janos Bolyai also simultaneously developed non-Euclidean geometry).

National Science Day

1) 28th February has been declared as a National Science Day since 1987. It would be pertinent to collect information about the scientific contribution by ancient and modern Indian scientist, as well as their limitations and their role in social development in respective periods. This may be done in groups prior to this Day. An essay and debating competition on this topic can be held. The material collected can be presented in the form of a pictorial exhibition, to be shown at different public places.

2) As a group activity, 'watch the night sky' with the help from a knowledgeable person can be organised. 'Star-Map-Kit' a publication of Nehru planetorium, Teen Murty House, New Delhi 110011 (price Rs. 10) provides excellent information.

Delhi 110011 (price Rs. 10) provides excellent information.

3) You can obtain from Publishers' Associates 202, Oceanic, Carter Road, Bandra, Bombay 400050, a kit (Price Rs. 40/-) called 'Galactic Dome' to make a Three Dimentional Sky. You can make a model of planetorium with this kit.

ISAAC NEWTON

English Mathematician - Physicist

b. Woolsthorpe, Linconshire, December 25, 1642.

D. London, March 20, 1727.

The famous anecdote about the falling apple and Newton's discovery of the law of gravity has acquired as much (or more) currency as that of the apple that Eve is supposed to have asked Adam to bite at the behest of the snake in the Garden of Eden. Such stories may appear to make science interesting to the reader but they also create myths and misunderstanding about the process of scientific discovery.

Before Newton, a great deal was already known about the real nature of the solar system and the orbits of the planets, yet a number of questions remained unanswered. For instance, did the same laws apply to all the objects on earth on the one hand and the stars and the planets on the other? If the earth is rotating on its axis, why does the earth not move from under our feet when we jump? Why are the orbits of the planets constant?

These questions could not then be answered in a consistent manner, and unscientific, theological misconceptions about the cosmos prevailed. In pursuit of answers to these questions, Newton discovered the principle of gravity. The incident of the falling apple perhaps only acted as a trigger.

As a matter of fact, even the notion of gravity was not Newton's .Such a concept had already occured to Gilbert, Kepler, Hooke, Wren, and other scientists. What Newton did was to give a consistent system of answers to quetions that had remained unresolved in the conceptions inherited from Galilleo. His friend Halley once asked Newton "How do you make so many discoveries?" Newton answered that he did not make such discoveries through sudden insights; but only by thorough investigation and exploring a problem to its depth, was the answer ever found.

As early as 1666, Newton had undertaken the task of working out the equations of gravitational attraction. Since accurate figures for mass of the earth and the moon, distances between the two etc., were not available, Newton failed in his attempt. It was only in 1682, when French astronomer Picard came out with more accurate and reliable figures that Newton reworked the equations; he also developed calculus and with its help proved the Laws of Gravity. Three laws of motion and the principle of gravity enabled Newton to chart out the system and the structure of the universe. Such an achievement in science, till then, was unparalleled in its magnitude.

Due to Newton's mathematical elaborations of Galileo's theories about the velocity of falling bodies, the development of the laws of gravity and the resultant precision, the exact degree of gravitational attraction, velocity and position of mass in motion and the positioning of planets, could all be accurately measured and even predictions born out of these became possible. It was Newton's equations of gravity that made it possible for Halley to predict subsequent reappearance of the comet he had discovered. This was proof indeed. But even before Halley's comet was sighted again, Newton's laws had already made it possible to predict the exact future positions of the planets.

Newton's contribution to mathematics was in a sense 'Incalculable'. Later, the calculus that he developed - the mathematics of very small increments was used in many other fields.

Along with mathematics and the laws of gravity, Newton's work on the nature of light is basic. He discovered that white light is made up of seven different coloured rays. He favoured the corpuscular theory that light travels as particles - while Huygens had put forward the wave theory of light - that light travels in the form of waves. And it is Newton's towering scientific stature that prevented the wave theory from being taken seriously for years to come, though now we find that both are needed and complement each other in their description of light.

For 250 years, physics and astronomy developed within the confines of Newtonian framework. Only at the end of the 19th century they seem to have become fetters to further knowledge. Einstein then showed through his theory of relativity that Newton's laws were only a special case of the general laws of relativity. And with Einstein on the scene, as mechanics moved out of the central place in physics, so did mechanical materialism, and the belief that 'science was the 'new religion', unchangable and basically Newtonian, was shattered.

Newton Day

Astronomers before Newton had propunded a heliocentric structure of the Universe; but they could not scientifically explain some important phenomena, whereas Newton's gravitational theory could do so. A lecture which explains this Newtonian Revolution can be arranged to commemorate Newton Day.

Science Days: March

11. Alexander Fleming, Scottish Bacteriologist,

b.August 6, 1881, d. March 11, 1955.

Discoverer of Penicillin (1928) that prepared way for antibiotic therapy for infectious diseases. Nobel Laureate- 1945.

16. Yakov Isidorovich Perelman, Russian popular science writer,

b. 1882, d. March 16, 1942.

Popular works - "Physics for Entertainment", "Mechanics for Entertainment", "Fun with Maths and Physics', etc.

26. James Hutton, Scottish Physician and Naturalist,

b. June 3, 1726, d.March 26, 1797.

Originator of one of the most fundamental principles of geology - uniformitarianism (1758). Explained how rain is formed. Published "Theory of Earth", in 1785, challenged biblical account of creation.

CHARLES DARWIN

English Naturalist

b. Shrewsburg, Shropshire, February 12, 1809.

d. Down, Kent, April 19, 1882.

Darwin's theory of 'Evolution' has a unique place among the revolutionary theories of science. Publication of his book 'Origin of Species' in 1859 tore asunder the conservative idealogues in Europe as his theory dealt a crushing blow to the myth about the creation of the world given in the Bible and challenged the authority of the church.

Darwin was not the first to think of 'Evolution'. Elements of the theory were in the air prior to Darwin. A century earlier, Frenchman Jean Meslier had put forward a conjucture about changeability of the animal world. Darwin's grandfather, Erasmus Darwin, Lamarck and some others had glimpsed a vision of evolutionary continuity. The accumulated discoveries and observations and Darwin's painstaking lifelong work culminated in the historic theory of Evolution.

The vast amount of specimen and observations that Darwin had accumulated during his 'Beagle' voyage had convinced him that the animal world was by no means immutable. But why? By which force the changes were wrought? He was not content with Lamarcks 'Internal motives'. Darwin worked for 15 long years; made careful observations, experimented and collected vast information. The more he worked the more his conviction grew that the 'perfection' and expediency of the animal and plant kingdom, hitherto thought to be due to the wisdom of the 'creator', were the result of none other than the "struggle for survival". The cue to the riddle of how and why, evolution took place was suggested by (a) the principle of natural selection observed in the process of breeding of domestic animals and (b) the Malthusian argument of growth of food supply in arithmatic progression keeping in check the population growing in geometric progression as applied to plants and animals.

ing in geometric progression as applied to plants and animals.

Darwin proposed that a constant struggle exists amongst life forms for food and mate i.e. for survival and reproduction. In this struggle, only those species which possess characters to live successfully in their given environment survive i.e. get selected. This process of selection through the rigours of competition within and between life forms and their interaction with the environment was called Natural Selection. Darwin also observed that myriad of variations occur in living organisms. Organisms possessing suitable variations get selected and the variations get perpetuated through heredity.

This concept of the "survival of the fittest in the struggle for existence through Natural Selection" is the heart of Darwin's theory. It is necessary here to emphasise that "survival of the fittest" does not mean survival of the strongest or the superior. The word 'fittest' refers to characters or adaptation suitable to cope up with the environment.

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The publication of Darwin's book "Origin of Species by means of Natural Selection or Preservation of Favoured Races in Struggle for Life", undermined the established beliefs regarding 'creation' which were propagated by the Church. Darwin's theory was challenged by the orthodoxy. However, at the "battle of Oxford" attended by over thousand persons, waged between the Church represented by Bishop Wilberforce and the Scientific community, Huxley convinced the audiance that theories of science must be judged on the basis of facts and reasons and not by the authority of dogma.

While Darwin was working on his theory, a young scientist, Alfred Wallace had made similar observations independently, propounding a theory of evolution. He sent his paper to the Royal Society and this created a controversy about the original propounder of the theory. However, considering Darwin's extensive work, Wallace accepted Darwin's priority and the paper was published under the joint authorship of Darwin and Wallace.

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Darwin published his book "Descent of Man" in 1863 which established that man is a descendent of the primates, though the precise relationship was ambiguous. The theory of evolution provided a framework for ordering and explaining the whole living world. It introduced historical element into the field of science, thus breaking the orthodox branch of Greek tradition with the eternal 'truths' and 'fixed species' of Plato and Aristotle returning to the heretical branch of Democritus with his emphasis on rational developement and change.

It is deplorable that the scientific concept of "survival of the fittest" was distorted to support extermination of the so-called 'inferior' races. The ideological abuse led not only to Nietzschean concept of 'superman' and blatant white racism, but even to the fascist war.

Darwin Day

Many examples are available to help us, understand and interprete Darwin's theory. You can organise small groups of 3 to 5 persons each; find out as many such examples as you can, and organize a competition. Invite a geneticist or a biologist or an anthropologist who will acquaint the audience with the shortcomings in Darwin's formulation of his theory; the objections raised regarding the validity of this theory, defence of Darwin's theory in face of these objections, and the present status of the theory of Evolution.

Science Days: April

Mikhail Vasilieuich Lomonosov, Russian encyclopaedist, thinker of immense versatality,

b. November 8, 1711, d. April 4, 1765.

Great contribution to the development of physics and chemistry, propounded wave theory of light, anti-phlogiston theory of combustion, Law of conservation of matter and motion. Founder of Moscow University.

17. Benjamin Franklin, American Statesman, Scientist and Inventor,

b. January 17, 1706, d. April 17, 1790.

Invented Franklin stove, lightning rod, bifocal spectacles.

18Justus Van Liebig, German Chemist,

b. May 12, 1803, d. April 18, 1873.

Perfected Liebig-Dumas method of quantitative organic analysis. Explained physiology of nutrition of plants and animals. Applied chemistry to agriculture. Developed chemical education and research, and popularisation of science.

26. Srinivasa Ramanujan, Indian Mathematician,

b. December 22, 1887, d. April 26, 1920.

Known for Hardy - Ramanujan - Littlewood circle method in number theory, Roger - Ramanujan indentities in partition of integers and work on the Number Theory and the algebra of inequalities.

NICOLAUS COPERNICUS

Polish Astronomer

b. Torun, February 14, 1473.

d. Frombork, May 24, 1543.

With the publication of "De Revolutionibus Orbium Coelestium (On Revolutions of the Celestial Bodies)" in 1543 by Copernicus, began the revolution that was to dethrone the widely accepted and revered Greek Astronomy and set humankind on a new path. Till that time, Ptolemy's (Greek astronomer, 1st Century A. D.) model in which all heavenly bodies were considered rotating around the earth was the accepted model. The model was very complex and had to be made more and more complex for predicting the position of the planets over long periods. Copernicus - a Polish astronomer, mathematician, physician, priest and statesman - considered, as early as 1507 that the tables of planetary positions could be calculated more easily if it were assumed that the sun rather than the earth was the centre of the universe. This was not a new idea. Aristarchus, a Greek Astronomer, 320 B. C., had suggested this notion. But Copernicus started in 1532 to work out the system in full mathematical detail in order to demonstrate how planetary positions could be calculated on this new basis. The new theory was elegant and simple and it explained some of the hithertofore puzzing motions of planets very neatly; whereas in Ptolemaic theory vast complications were introduced to account for them.

The postulates of the new theory were: Earth is not the centre of the universe. Earth has a threefold motion- a daily revolution around its axis, a yearly motion around the sun, and a precessional motion that produces a slow change of direction of the earth's axis. The sun is the centre of the system, the planets revolve around the sun. The orbits of the planets are circular. Moon is the only body that orbits around the earth. To these basic assumptions, he added some new ideas about a common property of all celestial bodies that keeps them in their spherical volumes and about enormous distances of stars in comparison to the dimensions of planetary system. He compared the theoretical predictions with observed motion and found substantial agreement.

Copernicus gave detailed account of the motions of the earth, the moon and the planets. He provided diagrams showing the course of each planet and deduced tables that predicted the motion and position of the planets relative to the earth. His predictions were sufficiently accurate to enable a new, more precise calendar, the Gregorian Calendar to be devised.

The Copernican theory, a typical product of Renaissance speculation, demonstrated how, being prepared to throw out preconceived ideas and accepted doctrines, it was possible to come to a new synthesis, to formulate a totally new view of Nature. Copernicus's reorientation, changed man's view of himself and the way he was to pursue science. Authority was no longer set above observation. Science progressed, testing each new hypothesis against the touchstone of experiment. Copernicus thus made not only an epochal theoretical break-through but also presented a model of scientific method- an idea, a working hypothesis, to be proved by means of mathematical deductions; the hypothesis leads to consequences which are to be confronted with observations or experiments. In the present age, when science is drowning in accumulated facts, there is a need of Copernicus 'spirit' to reorder data and provide a new perspective, a new synthesis.

Copernicus's theory is truly revolutionary. It removed a subjectivist view of the universe with the room it offered for obscurantist, theological view of the universe and introduced objectivity. However, in the pursuit of "Objectivity" humankind is overlooking its collective subjectivity as consistent and united. "Scienticism" is leading to fragmented vision of 'humankind'. We need the Copernican holistic world view, humane orientation in pursuit of science and in the application of the achievements of science.

Copernicus Day

The true significance of the Copernican Revolution will be more easily appreciable if the Copernican conception of the universe is contrasted in detail with the one put forward by Ptolemy. A comparative evaluation of the two conceptions should also help to clarify the basic issues involved. A number of books on science and history of science contain the diagrams, charts drawn by these two. For the Copernicus day, reproduce them on big posters or prepare three-dimentional models to bring out the differences between the two conceptions. The three dimentional model will also help you explain the concept of the structure of the universe to the lay people.

Science Days: May

2. Leonardo da Vinci, Italian Artist And Inventor,

b. April 15, 1452, d. May 2, 1519.

Famous for range of his genius; excelled as a painter, sculptor, architect, engineer and was centuries ahead of his time in mechanical innovation and scientific enquiry into the workings of human body and physical and natural laws.

8. Antoine Laurent Lavoisier, French Chemist,

b. August 26. 1743, d. May 8, 1794.

Overthrew phlogiston theory and propounded theory of combustion as the combination of burning substance with oxygen. Converted chemistry from a set of independent recipes to general theory. Introduced scientific classification and nomenclature for chemical substances.

16. Frederick Gowland Hopkins, English Biochemist,

b. June 30, 1861, d. May 16, 1947.

Nobel Prize in 1927 for discovery of essential nutrient factors viz., vitamins, needed in animal diets to maintain health.

27. Robert Koch, German Bacteriolosist,

b. December 11, 1843, d. May 27, 1910.

Isolated bacillus causing tuberculosis (1882). Nobel Prize in 1905.

WILLIAM HARVEY

English Physiologist

b. Folkestone, Kent, April 1, 1578.

d. London, June 3, 1657.

Harvey is one more instance in the history of science wherein a new scientific theory came into being not primarily by a pathbreaking observation or experiment, but by a pathbreaking of the science of argument which explained in a self consistent manner, all the major facts already discovered. Till that time, Galen (130 A. D. to 200 A. D.), a Greek physician was the authority in the field of anatomy in Europe. Galen held that one kind of blood ran from the liver through veins to all parts of body to perform nutrifying function while a different kind of blood mixed with vital spirit flowed out through the arteries to perform a more vivifying kind of work. The venous blood was drawn initially into the right side of the heart but some of it seeped through a thick dividing wall called septum into left ventricle and here it was purified and mixed with vital spirits, the mixture passing finally into arteries on its own motion. However, it was discovered by different predecessors of Harvey that the septum of the heart is impervious, that the blood flows from veins towards the heart, that veins have valves, etc. These findings could not be consistently reconciled within the framework given by Galen; but there was no better framework either. Harvey's great achievement was to see the whole problem in a new frame work of circular movement of blood in the body with the heart acting as a central pump.

Harvey's experimental work in comparative anatomy was distinctive and important. He learnt anatomy 'not from books but from dissections.' By various classes of experiments including the exposure of the heart by cutting away ribs and also severance of vessels, Harvey obtained direct proof that the blood flows in a continuous circuit. He combined the results of such ingenious experiments with clinical observations. The new view of circulatory system, made way for fresh look at respiration, digestion and other functions. Both as regards methods and results, Harvey's work was indeed revolutionary!

Harvey Day

In Science colleges, students are taught the dissection of frogs, mice to understand the process of blood circulation and functioning of the heart. Request the teachers and the students in a science-college to perform a dissection for your group and to explain the differences in the structure and function of heart in these animals on the Harvey Day.

Science Days : June

16. P.C. Ray, Indian Chemist,

b. August 2, 1861, d. June 16, 1944.

Known as master of Nitrates. Laid foundation of chemical industry and research in India. Wrote' History of Chemistry in India.'

29. Damodar Dharmanand Kosambi, Indian Scientist

b. July 31, 1907, d. June 29, 1966.

Scientist of renaissance versatality with outstanding contribution in Indology, Archaeology, statistics, Numismatics, Mathematics. Broke new ground in research in Indian History, by applying method of historical materialism. Kosambi's formula for chromosome distance is well-know in genetics. Ardently devoted to Peace Movement and compaign against nuclear weapons.

WORLD ENVIRONMENT DAY

This beautiful earth of ours is a harmonious system of inter-dependent life forms. Man too, is an inseparable part of this panorama of life and has emerged as the most developed species. By virtue of his innate intelligence, man has intervened in the processes of nature and developed civilizations. However the insatiable greed for profit has jeopardised the harmony of life on earth. This has led to enormous destruction of nature and as a consequence even human life is threatened. Before this disastrous damage becomes irreparable, let us intervene as true human beings to restore the harmony of life.

As the environmental problems grew more and more serious, the concern about it grew from all quarters and the UNO convened a conference on the issue at Stockholm in 1972. The opening day of this conference - 5th June, is observed as World Environment Day.

The environmental problem has reached serious proportions in the 20th century, because

The environmental problem has reached serious proportions in the 20th century, because of two main reasons: (1) There is a phenomenal increase (a) in air and water pollution due to uncontrolled growth of mines, factories, automobiles, indisciminate use of chemical products, and (b) in radiation hazards as a result of pilling up of nuclear waste due to wide spread use of nuclear power; and the testing of atomic weapons. (2) Excessive exploitation of non-renewable natural resources due to reckless industrial growth in Europe and America especially during last fifty years, which is maintained at the cost of the non-renewable, natural wealth (minerals, raw materials and food stuffs) of the countries in Africa, Asia and Latin America.

India, is ofcourse, no exception. In its unplanned, profit-oriented industrial development, in which hardly any money is spared for prevention of pollution, a growing number of workers and citizens are exposed to toxic substances and gases in chemical and metal industries. The air in the cities is being polluted by such a growth of factories, automobiles and power-stations that are releasing toxic gases like sulphur dioxide, carbon dioxide, and nitrogen oxide. Five million auto-vehicles in Delhi alone are poisoning the atmosphere with a daily release of 400 tons of pollutants. All this pollution causes respiratory disorders. Inadequate arrangements for sewage disposal is leading to pollution of rivers and canals. The pollution hazards are not limited to the urban areas alone. Sugar and paper factories are polluting water resources. Chemical fertilizers and pesticides are adding to land and water pollution.

To deal with these destructive forces, we, the citizens, have to first establish our right to detailed information regarding all these issues. We must know: (1) While releasing sewage into rivers and streams, are the municipal bodies abiding by the stipulated rules of scientifically treating the refuse? (2) What are the substitutes for chemcial pesticides? (3) Can the air pollution be reduced by minimizing the extensivce use of private auto-vehicles by strengthening the public transport system? (4) What measures can we take to reduce sound pollution?... and so on.

The present ecological crisis is the result of profiteering and consumerism with little consideration for preservation of nature, and for human misery. If we continue to pursue this unscientific, suicidal path, our natural resources would soon get exhausted and poisoned. We have therefore to seek an alternative path where extravangance by the asset-rich is controlled to make room for the provision of food and basic amenities to all the Indian citizens. Only if the developmental targets are set right, then alone can we ensure an environmental balance.

Environment Day

Organize a few small groups to collect information regarding the factors responsible for air, water and noise pollution in your area; and also regarding the legislation passed to prevent or check such pollution. A discussion can be arranged on the Environment Day about how to check this pollution. This can be followed up with collective efforts to pressurize and to help factory-inspectors, Governmental authorities to enforce pollution-prevention-measures.

MARIE CURIE

Polish- French Chemist.

- b. Warsaw, Poland, November 7, 1867.
- d. Haute Savoie, France, July 4, 1934.

In a memorial statement following the death of Marie Curie, Albert Einstein said, "Her strength, her purity of will, her austerity towards herself, her objectivity, her incorruptible judgement - all these were of a kind seldom found joined in a single individual... The greatest scientific deed of her life - proving the existence of radioactive elements and isolating themowes its accomplishment not merely to bold intuition but a devotion and tenacity in execution under the most extreme hardships imaginable, such as the history of experimental science has not often witnessed".

Marie Curie, fascinated by the riddle of the mysterious radiation of uranium and its compounds discovered by Becquerel plunged into scientific quest in that field. With the help of an instrument designed by Pierre Curie, Marie studied thousands of specimen working with primitive equipment under extremely hard conditions. In July, 1898 Curies isolated a new element which they named 'polonium' and in December, the intensely radioactive element, 'radium' was discovered. They worked further for four years purifying and repurifying tons of ore to secure a tenth of a gram of pure radium chloride.

The discovery and isolation of radium- a substance that emits eternal rays, was thus preceded by years of hard work, of series upon series of experiments; it was a result of the self-less work of two remarkable scientists for the benefit of science in the service of humanity. In 1903 the Curies were awarded the Nobel Prize (together with Becquerel). Marie was the first woman in history to become a Nobel Laureate. Eight years later she was awarded the Nobel Prize for a Second time for her work in Chemistry, as she succeeded in isolating radium in a pure state.

Further study of radium led to the discovery of its curative properties. Radium destroyed malignant cells and cured skin cancer. The curative properties of radium attracted the attention of industries. When the Curies were approached, they freely gave the information in the spirit of true scientists. Marie- a humane scientist could not remain shut in a quiet laboratory when the First World War broke. She built the first mobile radiological investigation laboratory and travelled over the battlefield examining the wounded day and night.

The radium known for its healing properties can also kill. Marie died of leukaemia caused by over exposure to radiation during her long years of research.

Marie Curie Day

Madame Marie Curie succumbed to cancer which she contracted while working with radioactive elements. Our sensory organs cannot alert us against the hazards of radiation from a radioactive substance. A lecture /symposium can be organized on the radiation risks of Nuclear Power Plants and test explosions of nuclear weapons with reference to India and other countries.

Science Days: July

27. John Dalton, English Chemist,

b. September 6, 1766, d. July 27, 1844.

Advanced quantitative Atomatic theory based on experimentation. In 1831 helped found British Association for Advancement of Science.

29. Ronald Aylmar Fisher, British Biologist,

b. February 17, 1890, d. July 29, 1962.

Pioneer of biometry, extensive contribution to genetics and the design of experiments by introducing the concept of randomisation and the statistical procedure of analysis of variance.

MICHAEL FARADAY

English Physicist and Chemist

b. Newington, Surrey, September 22, 1795.

d. Hampton Court, Near London, August 25, 1867.

Michael Faraday, son of a blacksmith, was born into a world of poverty and hardship; yet he rose to scientific eminence. While working as an apprentice at a book-binder's shop, a world of scientific marvel and invention opened up before him. The young Michael got the rare opportunity of access to Encyclopaedia and other scientific works and developed a deep interest in science. He attended the lectures of Sir Humphry Davy, and attempted to enter the 'amiable and liberal' company of scientists by the bold step of writing to Davy. Along with this, he sent his 'notebook' on Davy's lectures. Davy was impressed and took him as a laboratory assistant. Thus began his career in scientific research. By the age of 34, he became the Director of the laboratory and 8 years later Professor of Chemistry at the Royal Institute, London. With his passion for scientific research, independence and originality of mind and painstaking experimental work, he made epochal contributions in many fields, both in physics and chemistry.

Faraday holds a foremost place among experimental scientists; his crowning achievement came when he was able to show how to convert magnetism into electricity (1831). He is the father of the electric motor and the electric generator. The heavy electrical industry owes its success and growth to him. He was a forerunner of 'field theory.'

In 1826, Faraday initiated the famous Friday evening lectures for the members of the Royal Institute. He also started annual Christmas lectures for the children. His lectures on the chemical history of a candle where he integrated scientific knowledge into the experience of ordinary human life were popular. A humanist and a responsible scientist, he refused to have anything to do with a project of preparing poisonous gas for use in the battlefield, when approached by the British Government.

Faraday Day

- Organise an exhibition of simple gadgets and toys using coils and magnets, dynamoes, battery-cells etc.
- 2) Arrange a visit to a nearby hydroelectric or thermal power plant.
- 3) You can hold lectures and seminars on topics such as: (a) Wastage involved in the transmission of electric power from one place to another; factors responsible for the wastage and the possible preventive measures recent advances to avoid the wastage (for instance the super-conductors) (b) The efficiency level of various household gadgets which run on electric power-how efficiently they utilize the electric power; efficiency-wise coparison between such gadgets and the gadgets that run on alternate energy sources (such as liquid petroleum gas or solar heaters); ways and means of increasing the efficiency of these gadgets.

Science Days: August

2. Alexander Graham Bell, Scottish-American Inventor,

b. March 3, 1847, d. August 2, 1922.

Inventor of Telephone (patented in 1876), founded in 1883 American Journal, "Science".

14. Frederic Joliot Curie, French Chemist,

b. March 19, 1900, d. August 14, 1958

Nobel Prize with Irene Curie in 1935 for chemistry. One of the discoverer of nuclear fission. Founder of world Peace Movement (1949) and initiated Stolkholm Appeal (1950).

19. James Watt, Scottish Engineer,

b. 19 January 19, 1736, d. August 19, 1819.

Introduced major improvements in the steam engine and manufactured models workable in factories and mines.

26. Anton van Leeuwenhoek, Dutch Microscopist and Biologist,

b. Octomber 24, 1632, d. August 26, 1723.

Perfected microscopic lens and studied protozoa, life cycle of flea, parasites on flea, etc.

NO MORE HIROSHIMA

August 6, 1945! The darkest day in the history of man and science. This was the day, on which the U. S. dropped the first Atom bomb (named the 'Little Boy') on Hiroshima. Fifty thousand people perished instantly due to the explosion, heat and nuclear radiation. Thousands joined their ranks later and in one year a total of 1,40,000 Hiroshima inhabitants died due to the effects of the Atom bomb. Over the last 40 years, the long term effects of radiation made hundreds of Hiroshima residents suffer the horrors of lung and blood cancer before they succumbed. Many children born to the women who were pregnant at the time of the explosion developed birth-defects. Experiments on mice demonstrate that exposure to radiation will induce various types of deformities in the generations to come.

The use of the Atom bombs against Japan was totally uncalled for. Hitler's Germany had surrendered on 8th May 1945. Japan had extremely low reserves of food and fuel. A total cessation of hostilities through negotiations was very much on the cards. Several American scientists who were a part of the Manhattan project had made an appeal that, in view of the super-destructive potential of the nuclear weapons, Japan should be given the opportunity to surrender after a specially arranged atomic explosion demonstration on an uninhabited island. However, the scientists' appeal fell on deaf ears. The U. S. Government decided to drop atom bomb and that too on two cities, to impress the world with its destructive power and thus maintain the U.S. hegemony through this demonstration.

Following the atomic bombardment of Hiroshima, the anguished scientists like Einstein, Sziland, Robinovich formed an organization of Atomic Scientists and made an appeal to but. S. government to discuss the nuclear question with the Soviet Union with a view to controlling the use of nuclear weapons at the international level. However, as the U.S. had the monopoly, the government rejected this proposal. In 1946, in the first meeting of Atomic Energy Commission of the UNO, the Soviet Union made a proposal that production and stock piling of nuclear weapons be banned, all the then existing weapons be destroyed and any action violating this norm be treated a crime against humanity. However, the U.S. government was not in a mood to let go the chance to ride the world roughshod. As a result, the Soviet Union made its Atomic Bomb in 1949. Over the last 32 years, the world has witnessed the making of thousands of atomic devices of increasing destructive power. To day, the world carries the burden of 50 thousand nuclear weapons with a lethal power exceeding 10 thousand megatonnes. These weapons contain enough power to kill the entire world human populatin, 12 times over. The ballistics has also been getting increasingly sophisticated. The speed of the missiles has climbed to such levels that it has become difficult to get enough time to withdraw a missile wrongly released due to mistakes of computers or other mishaps. The chances of annihilation of the world have soared to such a level that a concerted movement by all scientists, technologists and the man in the street alone can save the spaceship earth from the nuclear holocaust.

The Peace Movement

Emerging gradually from the nuclear devastation, Hiroshima-Nagasaki citizens cried for peacel Total, permanent peacel in December 1945, the Chugoku cultural League was formed in Hiroshima and it brought out a periodical, the first special number of which was devoted to the subject of nuclear devastation. The Hiroshima Peace Committee, the Youth Cultural Forum, cultural wings of labour unions, the Women's Committee etc., started work on the issue of peace. Scientists and thinkers had already started working for a nuclear ban at the international level. In May 1950, the World Peace Committee published the famous 'Stockholm Appeal'. It was signed by 50 million people. During the Korean conflict in June 1950 the Japanese government put restrictions on the peace movement. Despite this, the signature campaign continued with undiminished vigour. Peace meetings were organized on 6th and 9th August. Finlad, West Germany, Austria and France also had peace rallies and meetings. Fifteen thousand New Yorkers took out a peace rally. President Truman indicated on 30th November the possibility of using the A. bomb against Korea; this did not materialize as the world peace movement was very active to prevent the catastrophe. Since 1950, Europe, America and Japan have witnessed an increase in the intensity of anti-nuclear movement. Under the pressure of these movements, some international treaties for atomic arms control have materialized. The force of vox populi prevented the U. S. from the use of nuclear weapons in the Vietnam war.

World peace movements have been fighting with great determination for elimination of atomic weapons. Soviet Union is taking initiative for such bans while the U. S. government is going ahead with their star wars programme! Only the people's Movements can successfully oppose such dangerous designs. We must strengthen the anti-nuclear movement with a resolve that we will not let this beautiful earth, which took 4 billion long years to evolve, to disintegrate into dust

Hiroshima Day

Observe 6th August as 'Hiroshima-Day' and 1st 'World peace day' September as part of global efforts to make our world free of nuclear weapons. A Peace-March can be organized through the main streets of your town. Contact the regional unit of the All India Peace and Solidarity Organization or Lokvidnyan Sanghtana, Pune to get songs and slogans to go with the message of the day. Schools, colleges and other institutions can organize on quite a modest budget, anti-war film shows or a slide show on the horrors of 'HIROSHIMA.'

There are no less than 36 wars being fought at present. Some of them are minor skirmishes

There are no less than 36 wars being fought at present. Some of them are minor skirmishes while others are capable of blowing up into major conflagrations. Thousands of people get killed in these wars. The horror of such wars, the aweful wastage of natural resources, wanton destruction, both of human lives and nature and the environmental pollution caused by such wars can be brought home to the people through effective use of posters and display of statistical information. At the same time you can also organize lectures and discussion on these issues, and also on the way manufacturers of arms and weapons instigate and promote wars for their own profits. Skits, mock-trials, can be used to convey these issues.

LOUIS PASTEUR

French Chemist - Microbiologist.

b. Dole, December 27, 1822.

d. Near Paris, September 28, 1895.

Pasteur, the father of Microbiology was initially a professor of Chemistry. While looking at the problem of why beer turned sour after fermentation, he found that this was due to the presence of different micro-organisms which he called vibrios. He observed that fermentation was a biological phenomenon and not a chemical one as was then widely believed. He proved, that by excluding the invisible microbes, animal and vegetable substances can be kept without putrification. On this basis, he invented the ingenious process of Pasteurization.

Picking up this clue he went ahead to propound his famous 'Germ Theory of Disease'. He began his research on anthrax—a disease of sheep and cattle. He proved that the disease was transmitted from an infected cow to another. He also successfully isolated and cultured these bacteria in the laboratory. He demonstrated that they produce anthrax when injected into healthy cattle. This was the first historic step for producing vaccines against infectious diseases. Taking a clue from Jenner's work on small pox, Pasteur developed the method of culturing bacteria which had lost their ability to produce disease and produced a vaccine. Pasteur was always thorough in his experimentation and left no loop-holes and would never take anything for granted. It was his painstaking and careful experimentation, critical open mind and his devotion to the human welfare that made for the revolutionary contribution.

In the later years of his life, Pasteur developed a vaccine against the deadly killer disease-rabies. These achievements made doctors, who initially scoffed at the germ theory of the disease to accept it ultimately. Once the foundation for vaccine production was laid, vaccines against diptheria and tetanus were also produced. The mystery of how wounds become septic was also solved which helped further developments in safe, aseptic surgery. Though the 'germ-theory of diseases' was important for clinicians for diagnosis, its role in the improvement in the health-status of European population has, however, been overrated. The 'Sanitary Movement' in Europe and the improvement in living standards of the workers in the later half of 19th century were responsible for the control of several communicable diseases, even before vaccines were widely available. Eventhough vaccination did play a great role in eradication of smallpox, to control other communicable diseases, vaccination needs to be coupled with public health measures and socio-economic development.

Pasteur Day

More than a hundred years have passed since Louis Pasteur invented vaccines. However, till today, a large section of the poor in India remain outside the pale of vaccination. Carry out a systematic survey of a slum-area or an area where the poor live; and (a) note how many children are not immunized (b) take up community education on immunisation, (c) make liason with Primary Health Centre and initiate immunisation.

SAVE OUR FORESTS

The latest satellite data indicate that India is losing 1.3 million hectare of forest a year. By 1980-82 only about 14 per cent of the land in the country had some forest cover as compared to the recommended 33 per cent. Forests are being cut for paper industry, rayon industry, sport-goods, building construction and also because of mining, dam construction, industrial complexes, roads and other development. The rate of regeneration is negligible. As a result the country is fast losing its forest wealth. The destruction of forests have serious adverse ecological consequences. As the tree cover is cut, soil erosion increases manyfold leading to an accentuated cycle of floods and droughts. Depletion of forest resources leads to shortage of fuelwood; consequently cattle dung and crop wastes get burnt as fuel instead of being used as organic manure to enrich the soil. Once denuded, the high solar energy and temperature begin to bring high desication, destruction and ecological poverty. The denudation of hill slopes is particularly disastrous, it results in heavy erosion and run-off which not only reduces land fertility but also increases the rate of siltation of natural and artificial water reservoirs. Due to erosion, water retention rate also goes down, adversely affecting the ground water balance and crop production. The hardship of nomads and tribals is increasing with the destruction of grazing lands and forests.

The solution that the World Bank and other funding agencies and the forest department advocate is to plant eucalyptus trees that the cattle will not graze upon. They do not consider forest as a living biological community with diverse flora and fauna that thrives on different soil nutrients and returns nutrients to soil in the form of leaf litter, draws water from different strata and helps moisture retention. Consequently natural forests are being cut down and replaced by teak or eucalyptus plantation; such plantations do not help arrest the adverse ecological effects and do not help the people who depend on forests for food, fuel, timber and fodder. The approach is basically commercial. Eventhough the Social Forestry programmes aim to have community woodlots to meet the fuel and fodder needs of the local population, the scheme that has mainly succeeded under the programme is commercial plantation of Eucalyptus by private farmers. This has meant reduction in the area under Nagli, the staple cereal in Karnataka or cotton in Punjab, with the result that the labourers are losing their free fuel source - cotton stalk. There is also a considerable reduction in employment when farm lands get converted to tree- plantations.

The floods and landslides due to the denudation of Himalayan slopes, the scarcity of fuel and fodder due to deforestation have led the women in Tehri Gadhwal to protest against felling of forests on hill slopes. The Chipko movement tried both, stop clearfelling, and replantation of forest to make up for the lost forest cover. And that is the need of the day.

Forest day usually ends in plantation of some seedlings with considerable fanfare but the survival is quite poor due to lack of after-care. Secondly there is no holistic approach to the problem of utilization and redevelopment of forest resources. We have to have an integrated plan of forest conservation and regeneration under which clear felling is banned; commercial tree felling through private contractors is stopped; systematic afforestation plans are drawn wherein the labouring families are assured of steady income for working on regeneration of vegetative cover on waste lands, hill slopes etc; and villge lands not fit for cultivation are put to tree plantation to meet the fuel and fodder needs of the village population.

Forest Day

(1) Eucalyptus, Subabhul, Teak trees are being planted over vast stretches of land under the pretext that such mono-culture plantations will restore the forests. But this is a deceptive move. A natural forest is a symbolitic co-existence of a biomass consisting of trees as well as shrubs, bushes, grasses and creepers, and animal life. Variety is the very soul of a natural forest. You can organize a debate to point out why it is imperative to preserve and encourage the growth of natural forests to achieve an ecologocal balance and also to meet the needs of the people living in and near such forests. The same occasion can be used to point out, also, why we must actively resist the efforts to clear the existing natural forests and replace them by commercially profitable plantations.

(2)... A forest guard launches a case against an Adivasi for illegal felling of trees and destruction of forest. The trial begins and during the course of the cross-examination, the Adivasi brings forth, how the contractor, the owner of a paper/rayon mill and the forest Officer are the real culprits. On the Forest-Day — stage a mock-trial along these or similar lines to show various aspects of and the reasons behind deforestation.

ALBERT EINSTEIN

German-American Physicist.

b. Ulm, Germany, March 14, 1879.

d. Princeton, U. S. A., April 18, 1955.

Albert Einstein has been the legendary scientist of the 20th century. He revolutionized our understanding of the Universe. His theories of Relativity, Equivalence of mass and energy, his work on the Photo-electric effect, Brownian Motion, his work on developing a unified field theory which sought to encompass the four basic forces of gravitation, electro-magnetism, the strong and the weak nuclear interactions into a single mathematical formula- all together constitute a qualitative, epochal change in our understanding of the physical world.

His famous equation $E=mc^2$ was to have a tremendous social significance. He proved that energy obtainable from a tiny particle of matter equals its mass multiplied by the square of the velocity of light. Here was an explanation for the ability of the sun to give off heat and light for millions of years. When Joliot Curie, Fermi and others discovered how to release and control that power from the Uranium atom, atomic energy and the atomic bomb were born. The significance of this discovery was overwhelmingly shown when the conversion of mass to energy on a large scale made possible the devastation by atomic bomb, a denouement to which Einstein was to contribute and which he was to find horryfying.

The special theory of relativity put forward by Einstein in 1905 had shown that as only relative motion was possible, space and time were interdependent, depending on the movement of the observer. In 1915 Einstein completed the 'General Theory of Relativity'. Einstein was able to bring the hitherto arbitratory force of gravitation into the generalized picture of spacetime, but to do this he had to break away not only from the mechanics of Newton, but also from the geometry of Euclid.

The importance of Relativity in science is because of two closely linked relationships: (a) the equivalence of mass and energy $E = mc^2$ and (b) the special limiting character of the velocity of light. By showing that all velocities are relative, Einstein was able to explain that spite of continuos acceleration, no particle could travel faster than the critical velocity of light, for as it approached that velocity its energy and its mass increased simultaneously so that it becomes harder and harder to make it go faster. Einstein had shown that the new method gave results that are in better agreement with experiment. He was able to explain the apparent shift of the position of stars near the sun by the bending of their rays by curved space and to explain the irregularities in the motion of the planet Mercury.

Einstein was a humanist to the core. His famous letter to President Roosevelt (urging him to decide to make an atomic bomb since Nazi Germany might make one,) was prompted by anti-fascist, humanist considerations. These same considerations led him to oppose the use of the first atomic bomb, once Nazi Germany was defeated. He played a leading role in the foundation of the Peace Movement. He was a strong advocate of the social responsibility of scientists and his work and writings on this issue and on peace have been inspiring and influential amongst scientists the world-over.

U.N.O. Day / Einstein Day

The UNO was founded on the 24th October, 1945. One of the important aims of the UNO is to promote international peace. Einstein had, in his later years, dedicted himself to the same cause. It would, therefore, be most be

You can organize several competitions such as essay, poetry, elocution, street-play, posters, photos... etc. for school -college going-students and also for adults. An exhibition of a few selected posters, photographs, from the competitors can be organized on 24th October. A pictorial exhibition depicting the terrible consequences of a.nuclear-war and the activities of the Peace-movement can be organized. Some suggested topics for competitions: (i) the fervent plea of Mother-Earth threatened by the shadow of a nuclear-war; (ii) Atomic warfare, role of scientists and human progress (iii) what can a lay-person do to make the world free from nuclear holocaust. (iv) Problems of the underdeveloped countries and arms-race. (v) Role of Peace movement in nuclear disarmament.

Science Days: September

27. First Railway. George Stevenson, British Technician,

b. June 9, 1781, d. August 12, 1848.

Developed railworthy locomotive. First steam-engine drawn train travelled on a ten mile rail tract on September 27, 1825.

Science Days: October

4. Sputnik in Orbit: On 4th October 1957, the first manmade earth satellite was launched by the Soviet Union heralding the era of new scientific explorations of other planets and outer space; this opened up the prospect of harnessing the economic potential of space; it also made possible the misuse of space through programmes like Star Wars.

18. Thomas Alva Edison, American Inventor,

b. February 11, 1847, d. October 18, 1931.

Invented phonograph, electric bulb with filament (1879), electric generating system etc. Patented 1300 inventions.

19. Ernest Rutherford, British Physicist,

b. August 30, 1871, d. October 19, 1937.

Demonstrated first man-made nuclear reaction. Pioneering research in radioactivity.

27. Lise Meitner, Austrian-Swedish Physicist,

b. November 7, 1878, d. October 27, 1968.

Published report on uranium fission jointly with Otto Hahn in January 1939. Nobel Prize in chemistry in 1944.

CHANDRASEKHARA VENKATA RAMAN

Indian Physicist.

Tiruchirapally, November 7, 1888.

Bangalore, November 21, 1970.

In 1930 Dr. Raman received the Nobel Prize in physics. This was in recognition of his discovery of the "Raman Effect". The Raman effect is the phenomenon of a change in the wavelentgth of light when it passes through a transparent medium, whether solid, liquid or gaseous. The phenomenon takes place when molecules of the medium scatter the light particles, photons. From the minute chages observed in the energy of the photons (or the wavelength of light) the internal molecular structure of the medium can be deduced.

A study of the Raman effect thus makes it possible to map out the levels of possible energy

gains of the molecules and atoms of a substance. Such exploration was possible before Raman's discovery. However, the alternative Raman spectroscopy provides a superbly easy experimental technique. Because of the ease of the technique, internal structures of tens of thousands of compounds have been investigated. One consequence of the use of such molecular and atomic probing machines such as the Raman spectroscope, the electron microscope and the ultra-centrifuge, is that the knowledge thus acquired has shown the way to synthesise more and more artificial molecules - many of them vital to industry and science. A whole crop of new industries such as plastics and synthetic rubber have developed from our deeper understanding of the interior structure of molecules and atoms.

Raman inspired and guided a number of students who have later distinguished themselves in the fields of Physics, Meteorology and Acoustics, He stressed the overwhelming need for original scientific research in India. He warned, "you must remember that knowledge at the present day is not a dead knowledge enshrined in books but a living and growing knowledge. - We live in an age of research, a period of intense striving to create new realms of thought, to penetrate the mystery of nature by the use of all intellectual and material forces. ... We in India as a people cannot afford merely to stand aside and be merely passive spectators to this remarkable outburst of human activity. To stand aside would be to confess ourselves as effete and worn out people, fit only to be laid on the shelf and suffer economic and political extinc-

Raman Day

Scientific research in India is beset with many problems. One of the important ones is the tendency to imitate the West and to do research not relevant to Indian conditions. A public meeting on this topic with the help of scientists, entrepreneurs, social-scientists can bring forward concretely as to why this happens. Since Raman opposed this tendency, such a meeting would be befitting on Raman-Day.

JAGDISH CHANDRA BOSE

Indian Biophysicist

b. Mymensingh (now in Bangala Desh), November 30, 1858.

d. Giridih, Bengal, November 23, 1937 .

Jagdish Chandra Bose had an intense love for animals from his childhood but had to study physics. Brilliant experimentalist as he was, he excelled in this field and has to his credit the invention of wireless telegraphy. In 1895, a year before Marconi patented his invention, Bose demonstrated in public, in Calcutta, how electric waves could travel from his radiatior in the lectureroom to another 75 feet away, where his receiver managed to pick up enough energy to ring a bell and fire on a pistol.

After years of research in Physics, he was destined to return to his old love, animal-life, because he noticed what appeared to him a parallel between the behaviour of inert matter and the living matter. For example, he noticed that his electric-wave receiver or 'Coherer' seemed to show signs of 'fatigue' after continuous use, and would be 'revived' to its original sensitivity after some 'rest.' Through a series of experients he tried to imitate some of the characteristic features of animal behaviour in plants and even metals, in the hope that illuminating analogies would emerge. But his wide sweep of application of the analogy idea was premature. Science has still not evolved the means to implement it to the scale of his contemplation. As a result, the verdict on his biophysical work remains even today as much in reserve as in 1945. Eight years after his death. The Encyclopaedia Britanica biographical note fairly summed it up as 'so much in advance of his time that its precise evaluation was not possible'.

What, however, is beyond dispute is Bose's importation into biophysics of the quantitative precision of a physicist. He did so by introducing new experimental methods and inventing many delicate and sensitive instruments for demonstrating the effects of sleep, air, light, food, durgs, fatigue, irritation....etc. in plants. For example, he invented the crescograph, a supersensitive instrument for recording plant growth by magnifying a small movement as much as ten million-fold.

Bose will always be remembered as a brilliant experimentalist and thinker, who sought to blaze a new path in scientific research; the final evaluation of which, however, is still an open question

Bose Day

Jagdish Chandra Bose's research showed that plants also have 'feelings', they are 'sensitive' to the surroundings as we, human beings, are. To remind ourselves of the relevance of his findings, you can prepare a mock-trial depicting representatives from the plant-kingdom pleading against the rapacious, greedy policy of grabbing, denuding the nature and against using chemical fertilizers, poisonous insecticides and pesticides. Mock-trial could also point out that the destructive use of chemical fertilizers, insecticides and pesticides is motivated by a handful of vested interests for their short-term gains. It would be quite befitting to stage this trial on the Jagdish Chandra Bose Day.

Science Days : November

15. Johann Kepler, German Astronomer,

b. December 27, 1571, d. November 15, 1630.

Advanced Kepler's Laws of planetary motion, established elliptical orbits, destroyed the 'sacred' circular motions. Founded science of modern optics.

18. Niels Bohr, Danish Physicist,

b. October 7, 1885, d. November 18, 1962.

Major contributor to development of quantum physics. Advanced Bohr theory of atom. Nobel Prize in 1922. Laboured for peaceful use of atom, organized first peace conference in Geneva in 1955

Science Days : December

1. John Burdon Sanderson Haldane, British-Indian geneticist,

biometrician, physiologist, popularizer of science,

b. November 5, 1892, d. December 1, 1964.

Opened new paths of research in population genetics and evolution.

17 First Flight:

Orville and Wilbur Wright, American Inventors, successful flight of a small aeroplane on 17 December 1903. Ushered era of air-travel.

30. Robert Boyle, British Physicist and Chemist,

b. January 25, 1627, d. December 30, 1691,

Transformed alchemy into chemistry. Forerunner of modern theory of chemical elements

BHOPAL DAY

On the midnight of 2nd December, 1984, tonnes of deadly toxic gases including Methyl Isocyanate (MIC) escaped from the Bhopal pesticide factory of the American multi-national 'Union Carbide'. This gas leak, according to official estimate, killed over 2850 people in surrounding bastis; (according to reliable non-governmental sources more than 5000 people perished) thus making it the worst ever industrial disaster in human history. There are some more aspects to this tragedy which bring into sharp focus the problems of industrial hazards in India, and this adds to the tragically memorable event. Firstly the disastrous gas leak was not an accident in the true sense i.e. an unforeseen deviation beyond human control; but was due to the gross, callous, neglect of the various safety mechanisms in the plant by the Union Carbide. There were four safety mechanisms to prevent or to cope up with an emergency- the refrigerator to cool MIC, the scrubber and the water spray to neutralize MIC, and the burner to burn out the gas instead of allowing it to escape. All these four mechanisms were either already shut down to cut costs or were non-furtctioning due to gross negligence. Two of these mechanisms were inadequately designed. The skilled workers had been replaced by unskilled ones, and safety maintenance was the casualty. Clearcut warnings due to some earlier incidences of leak, given by the workers' Union and by a journalist were ignored.

The relief and rehabilitation has been illplanned and grossly inadequate with no statutory responsibility on the Union Carbide. Months after the disaster, around one lac people living near the factory continued to suffer from cough, breathlessness and fatigue on exertion, lack of appetite, different symptoms of depression etc. Women sufer from excessive white discharge, menstrual disturbances, a condition called Pelvic Inflammatory Disease (PID) which amongst other things, renders the women infertile/leads to quadrupling of the incidence of abortions/increases congenital defects in the foetuses. Some of the health damages would be permanent; disabling lung damage has caused permanent reduction in breathing capacity and hence in work-capacity. The medical care has been given primarily to those who come to the clinic, with an inappropriate, sterile, 'drug and hospital oriented' approach. Very little effort is made to reach out to the community. Even simple health educational advice, which is so important in this situation, is singularly tacking.

So many mini-Bhopals: The Bhopal disaster is the extreme expression of a general picture that pervades the health scenario in the Indian industry. A number of preventible, industrial accidents kill hundreds of workers in so many mini Bhopals every year. The factors responsible for Bhopal tragedy are ever present in all the industries in India i.e. neglect of safety mechanisms to cut down costs and increase profits. As a result annually about 1400 workers get killed (four a day!) and 1200 get seriously injured in organized industry, mines, railways and docks. No reliable estimate exists for unorganized industries which employ 80 per cent of the industrial work-force and where working conditions are worse. So is the case with the agricultural sector. Over 10,000 agricultural workers in Punjab alone, have sustained grièvous injuries; many of whom have become permanently disabled.
Occupational diseases also take a heavy toll. About 37,000 textile workers suffer from Bys-

sinosis-an incurable disease of the lungs, caused by the inhalation of cotton dust. The mining of coal, gold, sliver, manganese, silica, etc., leads to a similar incurable disease of the lungs-Silicosis. As many as one third of the workers in Silica mines and asbestos industry suffer from Silicosis, because the employers do not go in even for simple safety measures like installing exhaust fans. Not only the workers in chemical and pharmaceutical industries are exposed to toxic fumes, but also the residents of the neighbouring areas, are subjected to slow poinsoning. Only major accidents like the Oleum leak from the Shree Ram Mills in Delhi get publicity. But the small accidents and daily slow poisoning go unnoticed.

Third December is observed by many science, environmental, health and other groups, in the memory of the ghastly disaster in Bhopal. While committing ourselves to "No more Bhopal" on this day, we should also resolve to build public pressure to prevent mini Bhopalsthe hundreds of deaths and injuries that take place every year in the industrial field.

Bhopal Day
Workers working in different units ranging from cane-sugar-juice-stalls, hotels, printing presses and other industrial units, to the agricultural farms using pesticides and farm-machinery can be requested to narrate on the 'Bhopal-day' in a meeting, the nature of their work, the possibilities and incidences of accidents and occupational diseases, and their views on how they could be prevented.

Lokvidnyan Day

We are daily facing 'modern' forms of trickery and deceit. Advertisements bombard us with misleading claims about medicines, tonics, baby-foods, cosmetics and what not. Different groups can divide amongst themselves the task of systematically collecting the claims made in advertisements in different media. A symposion can be arranged on Lokvidnyan day, with the help of experts in health, environment... etc. to critically discuss these claims; and also the effect of these products on health and environemt. This information can be organized in the form of a pictorial exhibition or a slide-show to be shown in different localities

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