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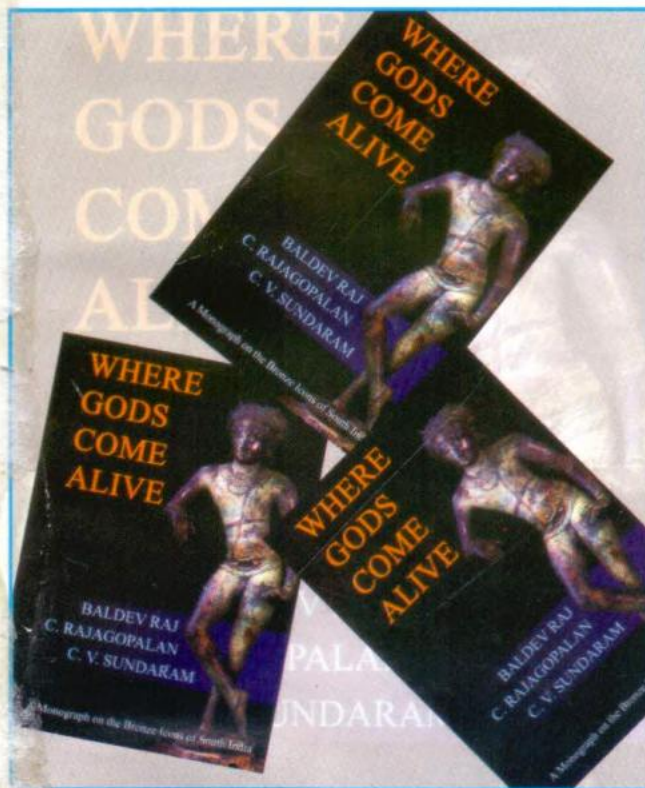
No. 4

VP News

Inside

NEW PUBLICATION

The monograph* is the second under this series 'India's Scientific Heritage'. The first monograph was on the Iron Pillar at New Delhi. The Bronze Icons of South India, particularly those from the Chola dynasty, cast by the *cire per due* process, are known worldwide for their antiquarian value, aesthetic beauty,



*Where Gods Come Alive : A Monograph of the Bronze Icons of South India, By : Baldevraj, C.Rajagopalan & C.V. Sundaram, New Delhi, Vigyan Prasar, 2000, pp: 155+xxiv, ISBN:81-7480-033-6, Rs. 350/-

iconography and perfection in casting. However, to the discerning observers of these bronzes, the most striking feature is the methodology the ancient artisans developed, probably over a period of several centuries, to arrive at the right combination of the metals to form the requisite alloy, the procedure for casting, and the repair and finishing technology.

The Monograph looks at these celebrated bronze icons from both scientific and technological standpoints, also laying special emphasis on the artistic accomplishments. The major challenge before scientists is to preserve these unique artefacts of ancient Indian heritage for the future generation. The authors have discussed in detail about that characteristics and conservation. They have also discussed their own investigations on some icons cast in the 11th and 16th centuries, in an attempt to establish procedures for fingerprinting these icons necessary for conservation. The monographs would be useful to historians, artists, art lovers, scientists who study and analyse ancient objects, besides common readers.

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

EDITORIAL

Edmond Halley
(1656-1742)



Science Club
Activities

MAKING SCIENCE MORE ACCESSIBLE AND LESS FRIGHTENING

DREAM-2047 wishes its readers a very happy and a prosperous new year. The year 2001, incidentally marks the beginning of the new millennium – the true millennium!

When we look back, especially at the last fifty years of the millennium gone by, we cannot help but feel a sense of pride and achievement. Our food production has more than matched the three-fold increase in the population. More than fifty per cent of our population can read and write (it could be much higher in the next census!). Availability of power has considerably gone up. There are more schools and colleges and hence better opportunities for education. Further, there also has been a general improvement in the quality of life – cooking gas and telephone connections are much easier to obtain, rail travel has become more comfortable, and so on and on.

New technologies are fast replacing the “what-were-once-new” technologies as they become obsolete. Just think, how fast the “latest” model of a computer purchased by you becomes obsolete, or how fast compact fluorescent lamps are replacing the good old tube lights. Well, this is how it should be. In the field of medicine, terms like ultrasonography, magnetic resonance imaging (MRI), organ transplant, and in-vitro fertilization (IVF) have almost become a part of everyday life. Consider the advances in the field of biotechnology. Genetically modified food products, transgenic crops, cloning, gene replacement therapy, stem cell harvesting and similar jargon is fast becoming a part of our everyday vocabulary.

Let us look at the other side of the coin. Undoubtedly, the new technologies have helped improve the quality of life, thereby significantly changing our lifestyles. However, it is also equally true that breakthroughs in the fields like biotechnology have instilled a sense of awe and fear – fear of the unknown - in our minds. Consider the question – are genetically modified food products safe to consume? Will transgenic plants with

built-in pesticides give rise to a new breed of pests which are resistant to these built-in pesticides? How shall we tackle the problem then? What is the guarantee that gene replacement therapy would be used only for the human good? Would it not be misused to produce new Frankensteins? Indeed, most of us are totally ignorant of what the new science holds in store for us. Such doubts and questions make the task of realizing our dream – even in a small part - of every citizen with a scientific outlook a distant dream indeed! Under the circumstances, how shall we make the developments in science less frightening and more accessible to the people?

Indeed, people do possess a keen desire to know and understand the new science and new technologies as they become part of their lives. The innate curiosity and the thirst for knowledge always co-exist. Otherwise, over a century ago, people in Punjab would not have thronged to listen to Ruchiram Sahni's lectures by paying a fee of two annas, or the Albermarle street in London to listen to the discourses of Michael Faraday at the Royal Institution of Great Britain. A recent example is the overflowing Siri Fort auditorium in Delhi where people turned up in thousands to hear Stephen Hawking unravel the mysteries of the Universe and the black-holes. True, there can only be one Faraday, Sahni or Hawking. But, there certainly are thousands of mini-Sahnis, mini-Faradays or mini-Hawkings amongst us, in our labs, colleges, university departments, schools and Government / non-Government organizations who could take people into confidence and engage them in discussions and free debates. This is how developments in science would become more accessible to people, and at the same time less frightening. For scientists and science communicators, this is both a challenge and a social responsibility. How shall we take the bull by the horns? Please do write to us.

□ V. B. Kamble

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EDMOND HALLEY

(1656-1742)

□ Subodh Mahanti

The period during which he (Halley) held the post of Astronomer Royal, compared with those of his predecessor Flamsteed, and his successor Bradley, is hardly entitled, if we look at its effect upon the progress of science, to be called more than strong twilight night between two bright summer days.

Augustus De Morgan (1806-71), the first President of the London Mathematical Society.

Under this marble, together with his beloved wife, rest Edmund Halley, LL.D. unquestionably the greatest astronomer of his age.

The inscription on to Halley's tombstone at the churchyard of St. Margaret, Lee near London.

The above two assessments about Edmond Halley's contributions to science are two extremes. (Though Halley's first name is often given as Edmund, he always wrote it as Edmond.) A large number of people perhaps know Halley because of the Halley's comet (the best-known periodic comet, returning to perihelion at average intervals of 76 years—the time between returns ranges from 74 to 79 years) and for his role in the publication of Newton's *Philosophiæ Naturalis Principia Mathematica* (popularly known as *Principia*).

Halley was fortunate to live through a period of scientific revolution that strengthened the foundation of modern science. When England's monarchy was restored under Charles II (1630-85) in 1660, Halley was four years old. Two years later Charles II granted a charter to the informal organisation of natural philosophers under the aegis of 'invisible college' which later became the Royal Society of London with the motto, *Nullis in Verba* - take nobody's word; see for yourself — set the stage for the centuries to come. Halley's scientific work and his life covered a vast range. He made enormous contribution in almost every branch of physics and astronomy. Halley published his first scientific paper when he was 20. It was on the theory of planetary orbits and was published in *Philosophical Transaction of the Royal Society*. In 1679 Halley published his *Catalogue of the Southern Stars* (*Catalogus stellarum*



Edmond Halley

australium). It was the first catalogue of telescopically determined star positions in the southern hemisphere. It not only established Halley's reputation as an astronomer but was also partly responsible for his being awarded a Master of Arts degree by the Oxford University without going through the usual examinations. Halley's catalogue of stars was useful for navigation at sea.

Halley's masterpiece on comets, *A Synopsis of the Astronomy of Comets* (*Astronomiæ cometicae*) published in 1705 laid the foundation of modern cometary study. Halley predicted with considerable accuracy the path of totality of the solar eclipse visible over England in 1715. After a long and careful study he was the first to realise in 1693 that the Moon's mean motion had a secular acceleration. An apparent gradual acceleration of the Moon's motion in its orbit, as measured relative to mean solar time. He was the first to predict extraterrestrial nature of the precursors of meteors. He was the first to suggest that observations of transits of Venus could be used to measure the distance of the Sun. However, this was first done long after his death. He offered the first proof of motion of stars by showing that they had moved since Ptolemy's time. In 1721 he raised the problem of what has come to be called Olbers' paradox—the apparent contradiction between the simple observation that the night sky is dark and the theoretical expectation that an infinite,

static Universe, consisting of stars and galaxies more or less uniformly distributed, should be as bright as a star.

It was Halley who published the first meteorological chart in 1686. He extensively studied the distribution of the prevailing winds, magnetic variations and tides over the oceans. In map making Halley was the first to use an isometric representation. (Isometric projection is a method of drawing figures and maps so that these dimensions are shown not in perspective but foreshortened equally). The sea voyages undertaken by Halley are considered as the first sea voyages undertaken for purely scientific purposes. It can be said that Halley practically founded the sciences

of geomagnetism and physical oceanography. He is considered the founder of geophysics, especially for his paper on trade winds and his work on tides. In 1686 he formulated the mathematical law concerning barometric heights and pressure above the sea levels. He also made many advances in barometric designs. By studying extensively the evaporation and salinity of lakes during the period 1687-94 he drew conclusions about the age of the Earth. He was constantly concerned with the magnetism of the Earth and developed a general theory about this. He was also concerned with weather and published on the relation of barometric pressure to the weather. He improved the design of the diving bells. In 1693 he published the mortality tables for the city of Breslau. This was the first attempt to relate the mortality and age in a population. It influenced the future development of actuarial tables in life insurance.

Halley published innumerable articles on natural history and classical studies. Halley published important editions of Apollonius of Myndus (fl. 4th century BC) and works of other ancient astronomers. He also published papers in pure mathematics. Many would like to call Halley an 'idea man'. His intellect was so lively for him to concentrate on a single problem for long. However, by any standard he made remarkable contributions.

One may be really bewildered to know the type of appointments Halley held. During 1696-98 Halley was deputy controller of the mint at Chester. Between 1698-1700

Halley was commissioned as a naval captain and he actually commanded a Royal Navy man-of-war, the *Paramour*, making prolonged and eventful ocean voyages. At the instance of the Queen Anne he made two diplomatic missions (1702 & 1703) to Vienna (Austria). As he completed his first Austrian mission, the Holy Roman Emperor presented him with a valuable diamond ring. His first mission to Vienna was to advise on the fortification of a port on the Adriatic and on his second mission he oversaw the actual building of the fortifications. In 1703 Halley was elected to the Savillian Chair of Geometry at Oxford. In 1720 he succeeded Flamsteed as astronomer royal at

Greenwich. (Following the realisation that knowledge of the stars and their position was the key to navigation the British government created the post of astronomer royal. Flamsteed was the first incumbent). Halley served as the first corresponding secretary to the Royal Society of London and published the scientific works of its members.

Halley was born on November 8, 1656. His father, also Edmond Halley, was a wealthy London merchant, a soapmaker and salter. After studying at St. Paul's School at London he entered the Queen's College, Oxford, which he left in 1676 without a degree. While still a student Halley published a little book

on Kepler's laws. John Flamsteed (1646-1719) who became Britain's first astronomer royal took note of this book and he was impressed by Halley's work. Flamsteed encouraged Halley to take up the study of astronomy seriously. On the lines of Flamsteed, who compiled an accurate catalogue of northern stars, Halley wanted to prepare a catalogue of the stars of the southern hemisphere. With this view he sailed in a ship of the East India Company in November 1676 for the Island of St. Helena, the southernmost territory under British rule in the South Atlantic. This was possible due to the financial assistance from his father and a letter of introduction from the king. Halley spent one and a half year (1676-78) at this bleak island. The weather of the Island was harsh and inhospitable and particularly it was extremely hostile for astronomical observation. Without being frustrated by this adverse condition, Halley spent hour after hour gazing at the sky with his telescope. He was successful in listing



John Flamsteed
(1646-1719)

the positions of no fewer than 341 previously uncharted stars. He became an immediate celebrity among scientific elite. Flamsteed heralded him as the "The Southern Tycho", thereby linking Halley's name to the great Danish astronomer, Tycho Brahe (1546-1601). Halley was made a fellow of the Royal Society. Suddenly he found himself in the company of great intellects like Newton, Flamsteed, Robert Hooke (1635-1702), the inventor and microscopist, and Christopher Wren (1632-1723), the famous architect.

During his long voyage to St. Helena, Halley had noticed that unlike the commonly held belief the ship's compass did not point exactly to the north pole. Though the difference was not very significant but it showed that the magnetic pole and the north pole were not the same. In any case this observation was of commercial significance as the worldwide explosion of commercial trade in the second half of the 17th century had opened up many new ocean route. There was a fierce competition to take advantage of the situation. So alongwith the maps of the skies there was demand for better marine charts for efficient navigation. In 1698 Halley undertook a voyage which lasted for two years. Under his command was the world's first ship ever commissioned solely for the scientific purpose. Halley thus measured magnetic declinations around the world. He prepared new navigation charts. He also tried to determine the correct altitudes and longitudes for the major ports.

What is the distance of the Sun from the Earth? Astronomers asked this question from almost the beginning of time. Today every high school student knows the answer. But at the beginning this question was one of the most difficult questions to answer. There was no direct method for measurement. In

any case Aristarchus and Hipparchus of SAMOS (fl.3rd century BC), the two ancient Greek astronomers,

attempted to answer it. Aristarchus placed the distance between 18 and 20 times more distant than the Moon. This was exceedingly far from the reality as the actual distance is more like 340 times as far. Though Hipparchus fared little better than Aristarchus, but he was also still very far off. Better method was developed only after Johannes Kepler (1571-1630) made some key discoveries about planetary orbits. Kepler found that the planets orbit the Sun in ellipses. Further, according to Kepler the average distance of a planet from the Sun and the time it takes to complete an orbit are mathematically related. This implies that from the distance of a planet from the Earth and how long it takes to orbit the Sun the distance between the Sun, and the Earth can be determined. So finally

there was a method for accurately determining the distance between the Sun and the Earth as following the

trigonometrical method known as triangulation it was theoretically possible to measure the distance between the Earth and a nearby planet. Such an attempt was made by Giovanni Domenico Cassini (1625-1712) in 1672. He used Mars for the calculation. It may be noted here that Cassini was brought to France by Louis XIV (1638-1715), whose reign encompassed a flourishing French culture. Though he came up with a much closer figure than ever before—86 million miles against the actual distance of 93 million miles—but the problem remained far from being solved. It was Halley who pointed out that instead of Mars one should try to use Venus as the latter approaches closer to Earth than the former. But then it is rarely possible to see Venus during its closest approach to the Earth. This is because Venus



Giovanni Domenico Cassini (1625-1712)



Isaac Newton in his sixty fourth year, portrait by William Gandy, 1706

appears to be too close to the Sun. The Venus in its closest approach to the Earth can be observed only on those rare occasions when it crosses the Sun's disk. Such a period of crossing is called transit in astronomy. In 1691 Halley suggested that such a transit of Venus would be ideal situation to make measurements from all locations of the Earth. Halley in his lifetime did not witness a transit of Venus because they only occur in pairs separated by eight years at intervals of more than 100 years. After the suggestion made by Halley the nearest transit was to occur in 1761. Though Halley did not live to see the transit, in 1716 he had presented a paper to the Royal Society of London calling for coordinated world wide preparation to utilise the forthcoming rare opportunity. He also devised a method for observing transits of Venus across the disk of the Sun for correctly determining the distance of the Sun from the Earth by solar parallax.

Halley's appeal to the scientific community did not go unheeded. Perhaps the transit of Venus in 1761 was the first great international scientific event. Scientists from all over the world joined together to make use of the opportunity. The planet was sighted by 122 observers from 62 different locations, including Newfoundland, Siberia, Beijing (then Peking), Calcutta, Rome, the Indian Ocean and St. Helena. The popular press recorded the enthusiasm generated. However, the results were not conclusive. So a greater effort was mounted again in 1769. This time planet was sighted by 151 observers from 77 sites. Captain James Cook (1728-79) sailed to then newly founded island of Tahiti in the South Pacific to observe the planet. After analysing the measurements (which took nearly 60 years to complete) made in 1769 the average value achieved turned out to be 96 million miles. This measurement expanded the solar system nearly 100 times the size that Ptolemy estimated the entire universe to be. It may be noted that no transit of Venus took place in 20th century. The only

transits of 21st century will occur in 2004 and 2012.

The *Synopsis of the Astronomy of Comets*, Halley's celebrated treatise, which laid the foundation of modern cometary science was rather brief. It was first published in Latin in 1705 as a six page folio pamphlet. An English version was also brought out in the same year. A longer and slightly

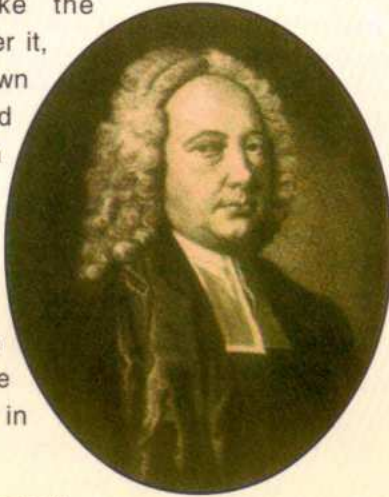
modified Latin version also appeared in the *Philosophical Transaction of the Royal Society*. In this treatise Halley presented the orbital features of 24 comets seen from 1337 through 1698. This information was presented in tabular form. Though Halley noted in this treatise that all the 24 comets had parabolic paths he himself believed that the true paths of comets were very eccentric ellipses. The most important observation put forward in this treatise was that the comets observed in 1531, 1607 and 1682 were the same object. Halley noted that their orbital features were identical except that the historic periods between their perihelion (the point nearest the Sun in the orbit of a planet, comet or man-made satellite) passages were different over 76 years between 1531 and 1607 and just under 75 years between 1607 and 1682. According to Halley the difference was due to the effect of Jupiter on the comet's orbital period. In his treatise of 1705 Halley also predicted the 1758 return of his comet. Later he revised his prediction to late 1758 or early 1759. To support his prediction of the comet's periodic returns Halley gathered an impressive amount of data. On the return of the comet Halley wrote: "Wherefore if according to what we have already said it should return again about the year

1758, candid posterity will not refuse to acknowledge that this was first discovered by an Englishman." It may be noted that as time passed Halley's confidence in his own prediction gradually decreased. This was because of his increasing awareness of the problem's complexity and in particular, the role of planetary perturbations.



Hooke memorial window St. Helen's, Bishopgate, City of London.

Halley played a very important role in the publication of *Principia*, one of the greatest master pieces of science. He persuaded Newton to work for it. When the Royal Society could not afford to finance its publication it decided that "Mr. Halley undertake the business of looking after it, and printing it at his own charges." Halley provided the necessary funds from his own pocket. He edited the text, corrected the proofs, and saw it through the press in 1687. He even contributed some laudatory Latin verses in honour of the author.



James Bradley
(1693-1762)

Halley's interest was not confined to pure science alone. He was equally interested in technological pursuits. In 1731 he published a method to measure longitude via lunar position. He drew up a map of

magnetic declination as a possible means for longitude measurement. He produced a world map with trade winds shown. Besides mapping magnetic declination, his expedition in the Atlantic was also concerned with determining the exact location of islands and ports. He was deeply involved in instrumentation. He developed a thermometer, a device for measuring the speed of ship through the water, and an improved version of the back staff for measuring the height of the Sun and his much talked about diving bell. He also helped Harrison to build his clock.



Comet Halley as it appeared
on March 8, 1986



German Festival in India

The Governments of India and Federal Republic of Germany reached an agreement in 1989 to hold Festivals in each other's country to create greater awareness among the people for each other's rich cultural heritage and contemporary developments in various spheres of Performing and Plastic Arts. The Festival of India was held in Germany in 1991 - 1992. The Festival of Germany in India, which started in October 2000 will continue till March 2001.

As part of the festival, Vigyan Prasar was entrusted to develop an Internet quiz on India. The quiz is meant for German citizens. The quiz is hosted on "quizonindia.com". The purpose of this quiz is to stimulate young people in both countries to find more about each other's country. The two quizzes may differ in nature and character as they are developed independently. The Quiz on India is being developed by the National Council for Science and Technology Communication (NCSTC) and Vigyan Prasar.

A similar Quiz on Germany has been developed by their festival directorate. This quiz is meant exclusively for Indians and is accessible on Internet at the following address:

["http://www.german-festival-in-india.de"](http://www.german-festival-in-india.de)



German Festival in India 2000-2001
Online Quiz

The questions cover a wide panorama of the historical & cultural aspects of Germany, its people & traditions, geography, science & technology, sports and music, etc. Lucrative prizes are on offer for the winners of this quiz contest including free trip for a week to Germany and exciting holiday offers within India.

SCIENCE CLUB ACTIVITIES

□ V.B. KAMBLE

To nurture and retain the scientific temper among children, it is necessary to impart encouragement, guidance and a bare minimum of facilities so that they can satisfy their curiosity and pursue their individual interests and hobbies. It is for this purpose that science club activities assume even a greater importance than the class room activities. Further, the science clubs possess the potential of triggering an interest in science even amongst the grown-ups, who could in turn constructively contribute to consolidate the activities of the clubs. Eventually, a science club could become a nodal point or a hub of dissemination of scientific information on a variety of subjects in the local area. An exchange of information on various scientific activities undertaken with science clubs in other parts of the state/country would then give rise to a science club movement which could play a key-role in transforming our country into a nation of scientifically thinking people. It was with such considerations that Vigyan Prasar Network of Science Clubs (VIPNET) was born.

However, we are often flooded with requests for the types of activities which could be taken up. Occasionally, we receive requests to provide guidance and outline the way in which certain activities could be conducted. Surely, there cannot be a unique way in which the clubs could function or activities conducted, since every club may have its own set of typical problems and difficulties and hence may need to be tackled accordingly. In this article, we shall briefly discuss the possible science club activities and how a science club should, by and large, function.

Getting Started

Quite often, the only science activity in a school is that of a science club - and quite often the science clubs exist only on paper! Attempts to set up a science club in a school often meet with only a limited success, perhaps due to the fact that the teachers may not be able to devote time for the club activities after school hours or on holidays or there may not be any space available, or due to financial constraints. But, most important factors for the science clubs not functioning well, or not functioning at all, are the lack of initiative and ideas. It is, of course, desirable that some space is made available, preferably at the school premises itself, to conduct the club activities even after the school hours or on holidays. The space could be used for discussions,

storing materials and as activity areas for children. However, when the space is not available, either at school or at some other place, it is always possible to conduct several outdoor activities like sky-viewing, Model Rocketry and activities related to environment and those utilising folk media like science skits, street plays etc.

Contrary to the belief, the requirement of funds is really not high. In fact many of the activities could be conducted at a very low cost or even at no cost. Most schools do have some funds, may be small, for extra curricular activities. Unless activities involved require purchase of kits, apparatus, equipment etc., the total fund requirement may not ordinarily exceed Rs. 5/- to Rs. 10/- per month per child. A nominal fee of Rs. 5/- per month, wherever possible, could cover the cost of materials partially. Needless to say, it is expected that teachers/volunteers work with a spirit of voluntariness and make their time available free of cost!

Availability of Teachers/Volunteers

The science teachers of the school could offer to conduct the science club activities. Further, it is always possible to locate resource persons who would be willing to conduct activities in specific areas free of cost. Quite often, the senior members of the club, say, students of secondary/higher secondary classes could assist, even conduct activities they have gained proficiency in with their juniors. It may be stated that they enjoy doing so and that they do it with interest and the utmost sense of responsibility as our experience suggests. The very feeling that they are facilitating the learning process of their juniors is a reward in itself. Further, this imparts an opportunity to them to develop their presentation skills and leadership qualities.

Suitability of Time

That the activity time for the science clubs should be suitable to the members needs no overemphasis. But, it needs to be ensured that the club remains open during that period. (We have assumed that some space has been made available for the science club activities!). If the teacher-in-charge of the club cannot remain present, the responsibility could be shouldered by the volunteers or the senior students. For this purpose, it is necessary to trust them and also make them feel responsible. Incidentally, this strategy almost always works!

Accessibility

It is not only desirable, but also essential that the club facilities are also extended to children from other schools, or even to those who are drop-outs. If encouraged to participate in the club activities, it is likely that their interest in science in particular and education in general may be rejuvenated. It may even inspire them to come back to the school once again. No rigid rules need to be framed which only hamper the access to the club.

General Activities

It needs to be borne in mind that teachers/resource persons are also active participants in the club activities. They further shoulder the responsibility of devising and conducting activities suited to various age groups, say, at primary, secondary and community levels. We shall briefly discuss the types of activities which could be taken up. Surely, it may not be possible to conduct all the activities discussed here at every club due to want of suitable resource persons, materials or space. It may, however, be stated that information to initiate these (and many other activities not discussed here) is readily available - in the form of resource/activity books or kits. It may even be possible for Vigyan prasar to supply the names and addresses of resource persons/organisations specialising in various areas. True, some of the activities mentioned here may need extra support either from the school or other sources.

General activities of common interest and awareness type could be conducted at community level as well. Popular science lectures/ demonstrations, slide shows, video/film shows, exhibitions could be taken up by the members of the club under the guidance of teachers and resource persons. It is even possible to organise activities/competitions with specific scientific themes from time to time, on say posters, essays, quiz, stories, fiction, elocution competition etc. It is advisable that the organisational responsibilities of these activities — to the extent possible — be assigned to the members of the club.

Specific Activities

Here, we have described a few specific activities for the school science clubs. Many of these in fact could develop into hobbies:

Science Wall Paper

A Science Wall paper - a fortnightly or a monthly - brought out entirely by children themselves is an activity that could go a long way in stimulating an interest in science alongwith sharpening reading, reporting and

writing skills of the children. Children may contribute science news items or short topical articles collected from various sources. With necessary editing by the science teacher/resource person, the same could be reported in the wall paper. The Art teacher/resource person may help the children prepare the lay-out. Various teams could be formed to take care of different departments of the wall paper such as news item/article collection, editing, lay-out, writing etc. This activity initiated by the author at several urban/rural schools has caught the imagination of children and teachers alike and has continued on its own over the years.

Astronomy

This is an activity suited to all the age groups including general community. It could range from familiarity with stars and constellations to projects at various levels. If a small telescope or a pair of binoculars is already available at school, it could be effectively used for the purpose. In case a portable planetarium is available in the vicinity, it could add a further dimension to the Astronomy activities.

Special awareness programmes/activities could be organised on events like solar/lunar eclipses, transits of Mercury and Venus across the solar disc, appearance of comets, meteor showers which occur on certain days of the year from specific directions in the sky and so on. Several unscientific beliefs and superstitions are associated with astronomical phenomena. This activity hence could effectively be utilised to disseminate scientific information on various astronomical phenomena and help overcome unscientific beliefs and superstitions. The club members could be engaged in making simple astronomical/terrestrial telescopes. It is a great experience and a matter of joy to look through a self-made telescope (incidentally, this is author's own experience!).

Nature Ecology, Environment

This is yet another activity suited to all age groups. Activities could range from awareness programmes and simple projects to even surveys, say on water/air pollution, the flora and fauna of the region, types of soil, agricultural practices, types of fuels used etc. It would even be possible to consider activities on issues with social relevance like a survey of unscientific practices, traditions and beliefs, superstitions etc. existing in the area.

Health and Nutrition

It is possible to involve children in several interesting activities related to health, nutrition, hygiene and

sanitation. For example, with a small plastic microscope (costing about Rs. 100/- that magnifies the image by a factor of 60 to 100), the children may be encouraged to test water samples from different areas or observe small organisms and record their observations. It may be interesting to note that a few years ago young school girls in a remote village in Madhya Pradesh traced the white lines on the green leaves due to a tiny insect of size only 1 mm and not due to the curse of the snake God as was widely believed by the local people! Children could also be engaged in surveys such as the type and quality of food being consumed in various households, common diseases and collecting information/suggesting ways to take preventive measures and so on.

Electronics

With the advent of radio, TV, computers, satellites, and Internet, Electronics has caught the imagination of a number of children. Further, this activity/hobby could be pursued at any level. It may be necessary to store some common components like resistors, capacitors, transistors etc. The club could provide facilities like soldering iron, solder, multimeter etc. and some technical guidance at times. When a child has made a device, quite often, he/she may like to possess it! In such an event, he/she could be asked to replace the components. The experience shows that this strategy works! Several books on simple projects/activities in Electronics are available in the market. Even Vigyan Prasara could offer necessary information in this regard.

Model Rocketry

In this activity, children prepare working models of rockets with paper. For the "engine", (i.e. the fuel) they use the fuel part of a Diwali Rocket. Single, Double and triple stage rockets and rockets with a recovery mechanism (parachute) could also be made. They also learn how to find height attained by their model rocket using a tracking mechanism— also to be fabricated by them. This activity imparts immense possibilities and scope in learning basic concepts of mechanics,

aerodynamics, application of mathematics, and most important, the children develop team-spirit, working as an integral part of the group. Most of the materials required are available locally.

Photography

This activity may require equipments like camera, enlarger, a few chemicals, a dark room; and a cheap box camera. Besides, becoming familiar with concepts of optics, it is possible to develop several professional skills. Photographic films are a bit expensive, but this is a great learning environment for the children. Unfortunately, because of relatively high costs of materials, it may be possible to introduce this activity only in a small number of schools/clubs.

Amateur Radio

Amateur Radio, or ham radio as it is often called, is truly an exciting

and a thrilling hobby, though it may require some investment. It is possible to set up a radio station and communicate on specified bands of radio frequencies - the amateur or ham bands - if one has a licence, i.e.,

Activities suited at different levels

Primary level	Secondary level	Higher secondary/ College level	General Community level
Simple experiments	Model Rocketry Electronics Amateur radio	Fabricating devices	Audio/Video programmes
Sky viewing	Astronomy Use of telescope	Courses for Amateur Radio	Slide shows
Model making	Telescope making	Demonstrations Popular lectures	Lectures/ Demonstrations at popular level
Demonstrations	Simple projects and analysis of data	Developing Computer Software	Astronomy/sky viewing
Quiz	Demonstrations	Essay competitions	Conducting ham radio courses/ demonstrations
Classification -say, types of trees, leaves etc.	Use of camera	Quiz	Demonstration of Computer simulations
Field trips	Science well paper by students	photography	Exhibitions on various aspects of S&T
Exhibition of models made by students	Debates	Field trips	Use of folk media street plays, skits, drama, songs, puppetry etc.
Skits/Plays	Field trips Quiz Workshops Exhibitions Skits, drama, songs, Street-plays, puppetry	Writing articles Investigative projects Workshops Exhibitions Debates Skits, drama	

the Amateur Station Operator's Licence issued by Ministry of Communication. To obtain the licence, it is necessary to pass Amateur Station Operator's Certificate examination consisting of basic radio theory, rules and regulations and communication on Morse code. The sheer thrill of talking to ham operators spread throughout the world is an experience by itself. You literally have the whole world in your room! It is possible to set up an individual ham radio station at one's own home or a club station. Those who are technically oriented, can fabricate their equipment and antennae. Vigyan Prasar has initiated a programme to develop less expensive amateur equipment. This hobby could be effectively used when the normal channels of communication fail, say for relief operations following floods, earthquake etc., but cannot be used as a replacement to conventional modes of communication, say telephone! A network of monitoring stations throughout the country monitors the entire radio frequency spectrum to check any possible clandestine use of this activity. You might remember the supercyclone that devastated Orissa in October 1999, and that Orissa was cut off from the rest of the world for several days. Had it not been for the radio amateurs (or the "hams" as they are called) who rushed from different parts of the country and set-up emergency communication network from various locations in Orissa, and helped in co-ordinating the relief operations, the situation would have been far worse. Vigyan Prasar maintains the club station VU2NCT and strives to promote this activity. It would be possible for Vigyan Prasar to organise Amateur Radio awareness programmes for a cluster of science clubs, and depending on the resources available with them, help them establish club stations.

Activities Employing Folk-Media

Activities involving folk media, say production of street-plays on scientific topics, plays, science songs, puppetry etc. encourage creativity and bring to life the dormant talents of the children. Through activities related to folk media, it is possible to mix a message/information with entertainment. Vigyan Prasar can supply the names of resource persons/organisations who could organise workshops/training programmes to initiate these activities at the school science clubs.

Celebrating Special Days

Observing National Science Day, National Technology Day, World Environment Day, birth anniversaries of great scientists and the discoveries they made could be a very important and educative activity

of science clubs. Talks, lectures/demonstrations, science quiz/essay competitions, rallies and other interesting activities could be organised on these days. The club members could be encouraged to collect information about scientists and the discoveries they made and present the same before the club members and invited audience. What is important is that celebrating such events introduces an element of festival and fun and gradually makes the children and the grown-ups alike interested in science and scientific method.

Get Going, Then!

The activities of the type discussed here not only generate an interest in Science and Technology, but also train the children to approach a problem in a scientific way. Besides, they learn to work in a group where a good deal of co-operation, co-ordination and discipline are required. These are some of the qualities that lie at the heart of all scientific endeavours.

In this article, we have outlined the formation of science clubs and a few possible activities. Of course, a host of other activities are possible, say Origami, scientific explanation of miracles, aeromodelling, activities related to space science & technology, computers and software development etc. The club activities suited to different age groups are indicated in the box. The list is by no means complete, but only indicative of the variety of activities that could be undertaken at the school science clubs. Many of these activities could form the basis for undertaking some investigative project in science by the club members related to specific problems and issues in the local area on, say, quality of drinking water, diseases prevalent in the area and efforts required to eradicate the same, study of unscientific beliefs in the local population and so on.

Vigyan Prasar would be happy to help you with the necessary information on initiating a particular activity at your science club, on availability of books, materials and resource persons including technical aspects. It may even be possible at times to partially support an activity. However, it may not be possible to extend financial support for establishment of a science club. Please do write to us about your ideas and suggestions.

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Note : This article is a somewhat enlarged version of an article published in NCSTC Communications (1994), the monthly newsletter of National Council for Science & Technology Communication, New Delhi. The necessary changes have been made to update the information and suit the needs of VIPNET Clubs, in particular.

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