MISSION RED PLANET

With ISRO gearing up to launch the MOM project six months from now, here’s your step-by-step guide to the agency’s maiden mission to the fourth planet from the sun.

**LAUNCH VEHICLE**
PSLV-XL with six extended strap-on motors
- MISSION COST: ₹450 crore
- LIFTOFF MASS: 1,350 kg
- DRY MASS: 500 kg
- NUMBER OF PAYLOADS: Five
- POWER SYSTEM: Solar array with three panels
- ON-BOARD PROPULSION: Bi-propellant system for Mars orbit insertion

**STAGE 1**
The satellite circles the earth several times, each time going further away from the earth.

**STAGE 2**
The satellite is put on a trajectory to the Mars.

**STAGE 3**
In the final stage, the satellite begins orbiting Mars.

**MARS ORBITER**
MISSION IS ISRO’S FIRST INTERPLANETARY MISSION TO THE PLANET

**MARS ORBITER**
- Medium Gain Antenna
- Propellant Tank
- Reaction Wheel
- Solar Panels
- High Gain Antenna
- LAP Payload
- MENCA Payload
- TTC Antenna

**DISTANCE**
372 KM
This is the distance the spacecraft has to cover around Mars in an elliptical orbit of 80,000 km.

**INCLINATION**
17.864 degree
This is the inclination at which the PSLV will inject the spacecraft from Sriharikota in the 250 km by 23,000 km orbit.
REQUEST FOR CONTRIBUTING
SCIENCE BASED ARTICLES IN ENGLISH

The Secretary, Odisha Bigyan Academy invites articles in English on Basic and
Applied Sciences from scientists, technologists and professionals to be published in the
English magazine "SCIENCE HORIZON". The articles should be lucid and easily
understood by students of Higher Secondary schools, undergraduate students and common
readers. They should focus on scientific topics and should be presented in a popular style
covering information on scientific discoveries/inventions, biography of scientists,
eradication of superstitions, development of scientific temper, story, features, snippets
etc. The article should ordinarily be of two to three printed pages in one side of A-4 size paper
with attractive headings. The authors are requested to give their E-mail, Contact details,
passport size photograph along with Bank Account No. etc. for transfer of remuneration for
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EDITORIAL
WATER CONSERVATION YEAR - 2013

Water is one of the most essential natural resources for sustaining life, livelihood, food security and development on Earth. The total volume of water in the hydrosphere is estimated to be about 1.36 x 10^9 km^3, of which 97.3% is present as sea water and another 2.1% in polar regions and glaciers. Freshwater constitutes about 0.6% of the total water inventory. A bulk of this fresher water occurs as groundwater. Freshwater in lakes, streams, rivers, ponds, and the atmosphere constitutes less than 0.05% of the total water on earth. India supports more than 18% of the world population, but has only 4% of world's water resources, with 2.4% of world's land area. The surface and groundwater resources of the country play major roles in drinking, agriculture, hydropower generation and industrial uses etc.

With rapid growing, population, increased urbanization, industrialization, expanding economic development and variations in climatic conditions, the pressure on water resources of the country is increasing and the annual per capita availability of water is declining at a fast rate (from 1816 m³ in 2001 to 1545 m³ in 2011 and projected to be reduced to 1341 m³ and 1140 m³ by the years 2025 and 2050 respectively).

The increasing demand of water for various purposes will further increase the possibility of water conflicts among different stakeholders as drinking water need is going to rise by 44%, irrigation need by 10% and industry need by 81% by 2025.

The increasing gap between availability and demand of water highlights the need for its conservation, with optimal usage of the existing resources. A paradigm shift from water resource development to integrated water resource management is the need of the hour. Taking cognizance of the situation, the national water policy (2012) has laid stress on conservation of water and Government of India has declared the year 2013 as water conservation year. The national water mission, has envisaged conservation, minimizing wastage and ensuring more equitable distribution of water resources both across and within states through integrated development and management of water resources.

The important component of water conservation involves minimizing water losses, prevention of water wastage and increasing efficiency in water use. Proper planning and efficient use of water by different sectors like irrigation, domestic and industrial development alongwith mass awareness programme would help in achieving this goal. Various new water conservation techniques are now available in our country. However, for conservation of water, the age-old traditional water conservation methods in addition to the modern conservation technologies are necessary. Therefore, efforts should be made to fully utilize the monsoon run off and store rainwater at all potential storage sites. In addition, creation of new storage sites and renovation of the existing water bodies are essential to conserve the surface water. Similarly, for the enrichment of ground water resources it is necessary to arrest the groundwater outflows by the construction of sub-surface dams, development of watershed projects, treatment of upstream areas for the springs etc. Again to maintain the quality of fresh water it is necessary to protect the existing surface water and groundwater resources from pollution and other contaminations. Further, conservation of fresh water can be made by recycling of waste water. This can be made mandatory for big hotels, industries and similar other establishments. In this context, the 3R strategy of 'reduce, recycle and reuse' as suggested by the Honourable President of India (in his address in the Second India water Forum 2013, New Delhi) for conservation of Water is noteworthy.

Water is life and it has no substitute. To sustain life on earth in all its totality, this precious resource should be managed carefully in all its natural habitats. This is accompanied by managing life (Biodiversity) as life is both a consequence and a cause of water on land. Thus a holistic approach is needed for conservation and management of water resources.

Tarani Charan Kara
WATER ... WATER ... EVERYWHERE ...

Narendra Prasad Das

As a teenager I had read the title lines in Samuel Taylor Coleridge's lyrical ballad - 'Rhyme of the Ancient Mariner'. It was summed up in my memory (must also be the case with all my contemporaries) as 'water, water, everywhere, not (nor in original) a drop to drink'. In fact, now in the 21st century we are experiencing scarcity of water to drink, though the circumstances of ours and those of the 'ancient mariner' are totally different. But how much water does an adult need to drink? One estimate puts it at about two litres per day at the minimum. Thus it may be said, we need about a thousand litres that is one cubic metre of drinking water each, per year. This human need, compared to all the water we have on our planet, is so meagre that one may feel astounded why every day newspapers publish alarming news about non-availability of water.

Distribution of water

It is common knowledge that, three quarters of our earth is occupied by water. To be precise, it is 71% of the earth surface. Total volume of water available to earth has been calculated at 1,386,000,000 cubic kilometres. But unfortunately, more than 99% of it cannot be used by us. About 96.5% of all available water is saline and found in oceans, seas and bays. Some saline water (about 1%) is also found underground. The usable (by humans themselves, their cattle, their crops and by other animals and plants) is a meagre 1% of the total water. However, that one percent is also not easily accessible as may be found from the following Table (given by Gleick, P.H. in 1996).

As may be observed from the above Table, only (about 0.77 percent of the total water

<table>
<thead>
<tr>
<th>Water Source</th>
<th>Water volume in Cu.km</th>
<th>Percentage of Fresh water</th>
<th>Percentage of Total water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oceans, Seas, Bays</td>
<td>1,338,000,000</td>
<td>---</td>
<td>96.5</td>
</tr>
<tr>
<td>Ice-caps, Glaciers</td>
<td>24,064,000</td>
<td>68.7</td>
<td>1.74</td>
</tr>
<tr>
<td>Groundwater-fresh</td>
<td>10,530,000</td>
<td>30.1</td>
<td>0.76</td>
</tr>
<tr>
<td>Groundwater-saline</td>
<td>12,870,000</td>
<td>---</td>
<td>0.94</td>
</tr>
<tr>
<td>Ground-ice &amp; frost</td>
<td>300,000</td>
<td>0.86</td>
<td>0.022</td>
</tr>
<tr>
<td>Soil-moisture</td>
<td>16,500</td>
<td>0.05</td>
<td>0.001</td>
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<tr>
<td>Freshwater lakes</td>
<td>91,000</td>
<td>0.26</td>
<td>0.007</td>
</tr>
<tr>
<td>Saltwater lakes</td>
<td>85,400</td>
<td>---</td>
<td>0.006</td>
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<tr>
<td>Atmosphere</td>
<td>12,900</td>
<td>0.04</td>
<td>0.001</td>
</tr>
<tr>
<td>Swamp water</td>
<td>11,470</td>
<td>0.03</td>
<td>0.0008</td>
</tr>
<tr>
<td>Rivers</td>
<td>2,120</td>
<td>0.006</td>
<td>0.0002</td>
</tr>
<tr>
<td>Biological water</td>
<td>1,120</td>
<td>0.003</td>
<td>0.0001</td>
</tr>
<tr>
<td>Total</td>
<td>1,386,000,000</td>
<td>---</td>
<td>100</td>
</tr>
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available on earth (in rivers, freshwater lakes, and under-ground freshwater) is accessible to human use. But groundwater forming the bulk of water available for our use is not really available to us due to heavy exploitation of the groundwater for human use since 1950.

A close examination has revealed that a mere 0.03 to 0.05 per cent of all water is only drinkable. Besides, a study has also indicated that water is not equitably distributed on the earth surface. Only ten of the countries have about 60% of the world’s available fresh water. These 10 countries are Brazil, Russia, China, Canada, Indonesia, USA, India, Columbia and Congo. It is related to local variations due to climatic changes, seasonal variations and unplanned pattern of human use; that make the situation alarming.

**Pattern of water-use**

According to the report of the World Business Council for Sustainable Development (WBCSD) and the United Nations Environment Programme (UNEP), there is a difference in the pattern of use of fresh water among high-income and low or middle-income groups of countries in the world. High-income group use about 11 percent of water for domestic purposes, while the other group use 8%. Similarly while high-income group of countries use about 59% of water for industrial purposes and 30% for agriculture, the low- and middle-income groups spend only 10 percent on industry and 82 percent on their agriculture.

The lifestyle is also squarely responsible for this difference. Food and Agriculture Organisation of the United Nations in its report in 2003 revealed that there is a huge difference in the per-capita (per person per year) use of water in cubic metre for domestic purposes among countries as shown in the following bar chart for six countries such as Mali (4 cu.m), China (32 cu.m), India (52 cu.m), Egypt (77 cu.m), France (106 cu.m) and USA (215 cu.m) for example. One cubic metre of water measures one thousand litres, that is the required drinking water per year per person. So it is really surprising what an American or French adult would be doing with 215 cubic metres or 105 cubic metres of water respectively. This amounts to some 587 and 187 litres of water every day. Here comes the lifestyle which also includes food habit. USA, Australia, Italy, Japan and Mexico are the known top five countries using largest amount of water daily.

In the recent past there was an uproar over whom to blame, India and China or the West led by US for depletion of resources. One opinion was that in India and China people are taking to western protein-rich food habits because of their new found prosperity and that way they are more responsible for depletion of world-resources and pollution. That was because production of animal protein, say 1
kilogram of industrial beef consumes as much as 16000 litres of water. As against that only one tenth of that amount of water (about 1600 litres) is needed to produce one kilogram of wheat. Beside food habits, very often daily habits also result in wastage of water. Many of us living in urban areas, and using municipal water supply, do not care for conserving water. While brushing our teeth we keep the tap open and so also while washing our vehicles we leave the water flowing out. Even while washing the utensils we leave the tap running. This is particularly true for our country. Most shocking fact is that, when you ask somebody wasting water like this, they think you are a miser even for water. Actually our people are not yet aware of scarcity of water and they do not realise the consequences of their misusing water. Even highly educated men and women waste water.

**Water scarcity today and tomorrow**

Non-availability of water for human needs in varying degrees are differently termed by water-experts. This non-availability is described as water deficit, water stress, water shortage or water crisis. When water supplies fall below 1700 cubic metre per person per year the condition is called a water stress, and when this drops below 1000 cubic metre per person per year it is called water-scarcity. When the availability is more than 1000 cubic metre but less than 1700 cubic metre the situation is termed as water-shortage. A report by the Food And Agriculture Organisation (FAO) of the United Nations has warned that by the year 2025 about two billion people of the world will be living under absolute water scarcity and about two third of the world population will be living under water stress. Climate change will, no doubt, adversely affect the supply sources of water thus accentuating the water stress.

Once open a time we the people had taken availability of water for granted. But with rise in population, urbanisation and industrialisation coupled with better living habits and prosperity, consumption of water has increased manifold. In some parts of the world people drink only contaminated water. That is also the case in some remote parts of our country. Local, regional and even international conflicts arise for possession of enough water-supply. Today's situation is bound to be more acute tomorrow. About 80 million people are born every year which entails finding another 65 billion cubic metre of water every year for the added population. Increased population also is responsible for more pollution, contamination and misuse of water. One estimate shows that about two million tons of wastes are dumped into lakes, streams and rivers. In India we know how much we pollute the rivers, canals and streams with immersion of idols of different deities every year.

**Solution to Water-shortage**

Although the problem is alarming, not that there is no solution to the problem. Perhaps the first and foremost solution is to reduce the population pressure. Once the rate of growth of human population is brought under control,
demand for water will increasingly fall. Pollution will also be reduced progressively. This could be attained with right kind of awareness or education. We must also learn how to reduce consumption of water. In the agricultural sector we shall have to adopt modern technology that restricts use of water, like drip-irrigation, use of slow sprinklers to water, use of organic manure in place of chemical fertilisers, restrict use of phosphate-rich fertilisers. We must learn how to conserve rain water and recycle the water we use for different purposes.

In our households we must prevent misuse of water. In some countries like United Kingdom people are encouraged to put water filled bottles inside the sink so that much water does not flow out when you flush it. People should be properly educated to take notice of our common habits that are responsible for wastage of water. We must regularly check our water taps and plumbing system. One must remember that leaky taps even if it is a drop per second if not repaired immediately it leads to wastage of about 7000 litres of water in a year. Let our awareness today lead to a safer world vibrant with life tomorrow.

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ALLEY CROPPING

Alok Kumar Patra

Alley cropping or hedgerow intercropping is an agroforestry practice in which perennial, preferably leguminous trees or shrubs are grown simultaneously with an annual agricultural or horticultural crop. The trees, managed as hedgerows, are grown in wide rows and the crop is planted in the interspaces or 'alley' between the tree rows. The trees may be grown in single or multiple rows.

The effectiveness of an alley cropping system depends to some extent on the soil type and agroecological zone in which the system is practised. But the success of the system is also very much dependent on management strategies adopted. Factors such as choice of tree species, orientation, layout and manipulation of the hedgerows and crop husbandry practices are all important in determining the outcome of the alley cropping system. Trees are planted as hedgerows in farm fields to maximize the positive and minimize the negative effects of trees on crops. Trees compete with agricultural crops for nutrients, soil moisture and solar energy. However, right kind of tree species planted at right spacing, with proper management practices can reduce competition and actually produce a net increase in yields per unit area.

Benefits from alley cropping
- Alley cropping is a sustainable agricultural practice.
- An important benefit of alley cropping is the addition of large amounts of organic
materials to the soil through pruning i.e. removal of side branches of trees. This has a favourable effect on soil physical and chemical properties, accelerates microbial activity of the soil and increases soil productivity. This ultimately improves crop performance in alleys.

- There is a reduction in the use of chemical fertilizers which decreases environmental pollution and maintains soil health.

- The tree prunings spread over the soil surface of alleys work as mulch. The addition of mulch moderates soil temperature, reduces evaporation and improves activity of soil microorganisms and soil structure. These result in better infiltration, reduced runoff and improved water use efficiency.

- The tree rows on sloping land act as a physical barrier to soil and water movement, resulting in significant reductions in erosion losses. The presence of prunings applied as mulch in the alleys also controls soil erosion.

- Alley cropping provides additional products such as forage, firewood or stakes when a multipurpose tree is used as the hedgerow.

- During the fallow period, shading of the interspaces reduces weed growth, while in the cropping phase, the mulch inhibits germination and growth of weeds.

- Alley cropping improves the economic stability through increased cash flow.

- It improves the biodiversity and aesthetic value of the farm.

### Choice of tree species

The choice of tree species for alley cropping is extremely important and to a large extent determines the success or failure of the system. The desirable characteristics of trees will vary depending on the goals, objectives and priorities of the grower. The first consideration is to make sure that soil is suitable for the tree species chosen. Also, ideally, the tree species should have high commercial or environmental value and the physical characteristics of the trees must create suitable microenvironments for the companion agricultural crops. While selecting a tree species for an ideal alley cropping, the following attributes are to be considered.

- rapid growth rate
- ability to withstand frequent cutting
- good coppicing ability (regrowth after cutting)
- easy to establish from seeds or cuttings
- nitrogen fixing capacity

A fast growing tree species *Acacia mangium* is planted at 8 m x 2 m spacing. Sesame crop can be grown in the tree alleys up to 3 years without any substantial reduction in yield. (Photo source: AICRP on Agroforestry, OUAT, Bhubaneswar)
deep-rooted with a different root distribution to the crop

- multiple uses such as forage and firewood
- ability to withstand environmental stresses such as drought, water logging and extremes of pH
- small leaves or leaflets
- dry season leaf retention
- freedom from pests and diseases

**Tree arrangement**

Alley cropping is unique in comparison to traditional agriculture or traditional forestry because, through the interaction of trees and crops, the economic gain becomes maximum. Alley cropping practices are highly diverse and range from simple to complex. While deciding the best tree arrangement, the following aspects are to be considered carefully:

- The growth characteristics of potential tree species
- Whether single or multiple rows should be planted
- Whether single or mixed species should be used
- Spacing within the rows and between the rows of trees
- Light requirements of companion crops

Having knowledge of the growth characteristics of trees and the companion crops will help determine whether trees should be planted in single or multiple rows, and whether single or mixed species should be used. The position and spacing of hedgerow and crop plants in an alley cropping system depend on plant species, climate, slope, soil condition and the space required for the movement of people and tillage equipments. Ideally, hedgerows should be positioned in an east-west direction so that plants on both sides receive full sunlight. The spacing adopted is usually 2 m to 8 m between rows and 25 cm to 2 m between the trees within rows. The closer spacing is generally used in humid areas and the wider spacing in sub-humid and semiarid regions. On sloping land, hedgerows are
densely planted along the contours to form a barrier against soil erosion. Grass strips planted alongside hedgerows will create a more effective barrier. If the desirable east-west orientation of hedgerows is not maintained on the slopes then regular pruning of tree branches is required to prevent excessive shading of the agricultural crops in alleys.

**Agricultural crop management**

Agricultural production in an alley cropping may take various forms like annual agricultural food crops, agricultural cash crops, vegetable crops, short duration fruit crops, pasture for grazing, forage crops for harvesting, etc. or any combination of these. The selection of compatible crops is as important as the choice of tree species. Certain principles should be followed while choosing agricultural crops to be grown with commercial trees in alley cropping.

- The crops should not produce dense shade before the trees are well established.
- Climbing species such as yam, vanilla and pepper should not be planted while the trees are young.
- Crops that compete for nutrients and water should not be planted during the tree establishment stage.
- Crops such as banana, maize and sugarcane that exhaust soil nutrients can negatively affect the establishment of trees on the site if adequate fertilizers are not applied.
- Root and tuber crops with extensive horizontal root systems should be planted at a sufficient distance from the tree species to avoid competition and damage during root crop harvest.

- Annual legumes should ideally be included during the crop rotation.
- The crop should not act as a host to the common pests and diseases that can affect the trees.
- The crop must be shade tolerant (like ginger, turmeric, arrowroot, pineapple, etc.) when the tree canopy closes.
- Perennial grasses should not be planted before the establishment of tree species.
- The crop should not have allelopathic effects on the trees.

Due to the presence of perennial trees, the nature of system continues to change throughout the rotation of the system. Thus agricultural management practice varies during the development of the tree crops, to minimize damage to the trees and to maximize agricultural production.

Depending upon the climatic and soil characteristics of the location, a wide range of agricultural crops should be taken during the early stages of tree growth. At this stage, trees have a very little effect on availability of solar energy on the agricultural crops. Cereals like: millets, early varieties of rice, maize; pulses like: green gram, black gram, pigeon pea, field peas, chickpea, horse gram, cowpea; oilseeds like: sesame, groundnut, rapeseed, soybean; vegetables like radish, brinjal, pumpkin, etc can be well accommodated with the tree crops.
within the first 2/3 years of tree plantation. But, as the canopy of trees grows, choice of crops becomes limited. However, during that time some shade tolerant crops like turmeric, ginger, arrowroot, mango ginger (Curcuma amda), pineapple, Aloevera, etc. can be grown. The side branches of the trees should be pruned up to one third height of the tree to allow solar energy to reach the underneath annual crops.

**Soil improvement through alley cropping**

Alley cropping provides an opportunity for modifying nutrient cycling through management which results in more efficient use of nutrients in the soil. There are several management options for exploiting the advantages of efficient nutrient cycling in agroforestry systems.

- The deep root systems of trees reach deeper soil horizons, which are not often accessed by roots of common agricultural crops. Thus, there is an enhanced nutrient uptake as a result of rock weathering or percolation past annual crop roots. This process, which is commonly called nutrient pumping, is a significant factor of soil fertility improvement in alley cropping.

- Gains from symbiotic Nitrogen-fixation by trees can be enhanced through selection of tree species.

- Different trees and shrubs used in alley cropping systems vary in quantity, quality and decomposition rate of leaf biomass. The timing of hedge pruning can be regulated in such a way that the nutrient released through decomposition of biomass is synchronized with the peak period of crop's nutrient demand.

- Better management practices which improve organic matter status of the soil in an alley cropping system will also improve nutrient cycling and, thus enhance soil and crop productivity.

- A major management consideration in alley cropping is to reduce nutrient loss through soil conservation.

**Conclusion**

Alley cropping today has been well recognized as a sustainable method to manage forest and agriculture together. It provides productive benefits both to the grower as well as to the society. Wide adoption of alley cropping practices will definitely reduce the pressure on natural forests, while being economically and environmentally viable.

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GREEN BUILDING

Mayadhar Swain

Introduction

Global warming and climate change are two major environmental issues faced by humans today. In fact, both are interrelated. The cause of this issue is release of some greenhouse gases to the atmosphere. These gases are mainly man-made. Out of this, carbon dioxide is the main culprit. This is emitted to the atmosphere from the burning of fossil fuels like coal, petroleum oil and natural gas from thermal power plants and other factories. But contribution of thermal power plant is more. Hence, by reducing use of energy, we can help mitigate the effect of global warming and climate change. This can be done in several ways. One of them is our own house buildings.

We spend 90% of our lives in buildings that protect us from the extremes of nature such as heat, cold, rain, wind, snow etc. However, our buildings use huge amount of energy, water and material throughout their life cycle. They also generate a large amount of waste which affect badly to our surroundings. Now, new technology has been developed to build such a building which consumes less energy and water and also generates less waste. This building is called green building.

What is Green Building?

Green building is a building which optimizes the use of resources like water, energy and materials for its construction and use. With this, it reduces building impacts on human health and environment. This can be achieved through better design, construction, operation and maintenance of the building. In short green building does the followings:

1. Uses energy, water and other resources efficiently.
2. Protects occupant’s health.
3. Reduces waste, pollution and environmental degradation.

Features of Green Building

Several steps are taken for buildings to achieve the "green" tag during its construction and stay. Recycled materials are used for its construction and different conservation measures are taken for use of water and electricity. Some of these are enumerated below.

1. Green Cement

Green cement is a combination incorporating limestone, fly ash from thermal power plant and blast furnace slag from steel plant. By this, wastes from factories are utilized. It is used in the construction of green building.

2. Fly ash brick

Fly ash is fine powder recovered from the gases of burning coal during the production of electricity in thermal power plants. It consists primarily of silica, alumina and iron. Adding fly ash to soil-bricks increases their compressive strength. Green buildings utilize bricks made from fly ash.
3. **Insulated Walls**

In our home and office, a lot of electricity is required to cool the room by using air-conditioners during summer and to warm the room by using room heaters or blowers during winter. We can save this energy by putting insulation inside the wall. The insulation can be air-gap, cotton, mineral wool or plastic fiber.

4. **Natural Light**

The Sun is the ultimate source of sustainable light and we can make use of it as far as possible. Lighting accounts for around 15% of the energy bill in most homes, and around 25% in commercial buildings. Careful architectural design is required to maximize the use of natural light. This can be done by strategic placement of windows, skylights, light shaft and translucent panels.

5. **Green Paints**

The air inside a home is, on an average, two to five times more polluted than the air outside. Paint is a large contributing factor for this. It emits harmful chemicals for years after application. Using paints that are free of volatile organic compounds such as benzene and toluene and free of heavy metals such as lead or cadmium is beneficial both to the occupant and environment.

6. **Eco Wood**

Deforestation is one of the major causes for emission of more carbon dioxide to the atmosphere. Hence, for green buildings, eco wood is used. These are the recycled wood. The wood manufactured from baggage of sugarcane can also be classified in this category.
7. **Conservation of Electricity**

Incandescent lamps consume more energy than compact fluorescent lamps (CFL) for the same amount of light. Use of energy efficient ballast electronic for fluorescent lamps reduces consumption of electricity. Also high pressure mercury vapor lamps consume more electricity than the high pressure sodium vapor lamps. Hence, energy efficient lamps are main components of green buildings.

8. **Solar Electricity**

On the roof top of the green buildings, photo-voltaic modules are installed to generate solar power. Also there are devices available to heat water efficiently from direct sunlight. Further, where adequate wind velocity is available, small wind turbine can be installed on top of the roof to generate electricity.

9. **Rain Water Harvesting**

Rain water harvesting is a process of collecting the rainwater that falls on terraces and roof tops during the monsoons and storing it in tanks, pits, wells etc for future use or directing it so that it percolates into the ground water.

10. **Water Management**

All household waste water, except toilet waste, is called grey water. Grey water from washing dishes, showers, sinks and washing machines comprises the largest part of residential waste water. This water can be filtered and recycled and can be used in the toilets or garden.

11. **Afforestation**

This green technique includes planting of deciduous trees surrounding the building. These trees have special property that they shade their leaves in winter and allow sunlight to enter the house. But during summer, these have maximum number of leaves so that the building gets natural cooling.

**Green Building Certificates**

Whether green buildings are really green is to be decided against the predefined rating systems. There are three rating systems in India. They are GRIHA, IGBC and BEE.

Green Rating for Integrated Habitat Assessment (GRIHA) is India’s own rating system, jointly developed by The Energy Research Institute (TERI) and the Ministry of New and Renewable Energy, Government of India. It consists of 34 criteria, categorized in four different sections such as (1) site selection and site planning, (2) conservation and efficient utilization of resources, (3) building operation and maintenance and (4) innovation.

Indian Green Building Council (IGBC) was formed by Confederation of Indian Industry (CII) in 2001. It has license from the Leadership in Energy and Environment Design (LEED) which is the rating system developed by the U.S. Green Building Council for certifying green building.

Bureau of Energy Efficiency (BEE) has developed its own rating system for the green buildings based on a 1 to 5 star scale. More stars mean more energy efficiency.

**Green Buildings in India**

In India, many green buildings have been constructed and certified by different certifying agencies. There are more than 1980
IGBC certified green buildings in India. World’s first green legislative assembly is in Chennai. The Tamilnadu Legislative Assembly is built incorporating green building principles. It is the largest green building in Government sector in India to have achieved status of Green Building certification (Gold rating under LEED India).

**Example of a Green Building**

As an example, we can see the features of one of the green buildings in India. It is Gujarat Pollution Control Board’s new Paryavaran Bhavan. It has achieved gold rating under LEED (India). Some of the green features of the building are:

- Central courtyard for natural ventilation
- 100% access to daylight and outside view
- Existing greenery and natural topography of site have been retained
- Energy efficient building envelope
- 100% rainwater harvesting
- Low flow water fixtures to save water
- China mosaic tiles on rooftop to reduce heat island effect
- 100% waste water treatment
- 80 kW grid-connected solar power plant

The new Paryavaran Bhavan has generated about 36904 kWh of electricity through its in-situ solar systems since September 2012, while the overall power consumption from the grid was about 39502 kWh. This high performance building is thus able to meet around 94% of its power requirement from on-site renewable energy sources.

**Conclusion**

The most criticized issue on green building is its cost. By accommodating the green features, the cost of the building may have increased up to 5%. But over a period of 20 years, the saving on electricity can compensate the initial additional cost. Simultaneously, it lays the foundation of a healthy lifestyle. For example, the building of GPCB is 100% solar-powered. Total electrical demand comprising of 40 ACs, 600 fans and 1000 CFL tube lights is 80 KW which is met through roof top solar PV panels. Total investment in power system is Rs. 5 crore and it will be recovered in five years though less power consumption bill.

In India, of the 911209 million units of electricity annually consumed (CEA report for the year 2012 - 13), residences use about 20 percent. By adopting green practices, buildings can reduce 90% of their total energy requirement. Every unit of electricity saved, when added with transmission losses, would amount to substantial monetary gain, and would cumulatively reduce investment in energy sector. Now everybody should adopt green building practices and Government should make it mandatory at least to government buildings.

For the last four years, every year the World Green Building Week is being celebrated in the third week of September to highlight the importance of the sustainable buildings for business communities and individuals across the world.

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ABEL PRIZE - 2013

*Sunita Chand
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Known as the 'Nobel Prize' in mathematics, the Abel Prize has completed a decade this year. Instituted in the name of the brilliant Norwegian mathematician Niels Henrik Abel, the Norwegian Academy of Science and Letters, has been giving away the award to outstanding mathematicians since 2003. The prize carries a cash award of 1 million US dollars and a citation. This year the honour has gone to Pierre Deligne of the Institute for Advanced Study, Princeton, New Jersey, USA for "seminal contributions to algebraic geometry and for their transformative impact on number theory, representation theory, and related fields."

Algebraic geometry is a branch of mathematics in which geometric methods are used to study the solution of polynomial equations, and, conversely algebraic techniques are applied to analyse geometric objects. Pierre Deligne played a crucial role in developing the subject, which now has deep connections with almost every area of mathematics. However, his most significant contribution is the spectacular solution of the last and deepest of Weil conjectures, namely the analogue of the Riemann hypothesis for algebraic varieties over a finite field.

The issue of the Weil conjectures is the so-called zeta functions, which are mathematical constructions that keep track of the number of solutions of an equation, in different number systems. Weil said that the conjectural statements are true for curves meaning that they are true for equations in two unknowns. However, varieties which are referred to as higher dimensions, correspond to equations in three or more unknowns.

The Weil conjectures are formulated in four statements. He himself had proved those in case of curves. For more general equations, three of the four statements were proved by other mathematicians. The last statement, analogous to the Riemann hypothesis and considered to be the most difficult one was proved by Pierre Deligne in 1974.

Some new type of mathematical tools were developed in 1920 and 1930s to understand and systematize knowledge about geometric structures and shapes. Those were called as cohomology.

When the conjectures were announced it was clear that those would be proved to be true if one could find a certain type of cohomology called Weil cohomology. Weil had no suggestion on how to define those. However, he knew what type of cohomology should have proved the Weil conjectures. In 1960, Alexander Grothendieck introduced the concept of etale cohomology. He proposed that it should play the role of the mysterious, unknown but essential Weil cohomology. However, Grothendieck could not prove that etale cohomology can satisfy the requirements of Weil cohomology. Pierre Deligne succeeded in this task.
Pierre Deligne was born on 3 October, 1944 in Etterbeek, Brussels, Belgium. When he was around 12 years, he started reading his brother’s mathematics books and asked for explanations. Observing his interest in mathematics, J. Nijs, his high-school teacher lent him several volumes of "Elements of Mathematics" by Nicolas Bourbaki. The books were too hard for a 14 years old like him but he read and understood those, which become a life changing experience for him. As a result, although his father wanted him to be an engineer, he opted for mathematics as his career. Deligne completed his Licence en mathematiques degree in 1966 and Doctorat en mathematiques (Ph.D. Degree) in 1968 from the University of Brussels.

Then, after a year of Ecole Normal Superiure in Paris as auditeur libre, Deligne who was also concurrently serving as a Junior Scientist at the Belgian National Fund for Scientific Research and was a guest at the Institute des Hautes Etudes Scientifique (IHES) from 1968-70, joined as a member and visitor in the School of Mathematics, Institute for Advanced Study, Princeton, New Jersey, USA. There he was appointed as a faculty member in 1984 and now is the Professor Emeritus.

Deligne has earned many laurels for his unique contribution to mathematics. For his proof of the Weil conjectures in 1973, he received the Fields Medal (1978), and the Crafoord Prize (1988) jointly with Alexander Grothendieck. The other prizes he won include Francois Deryuys Prize (1974), A. De Leeuw-Damy-Bourlart Prize (1975), the Balzan Prize in mathematics (2004), and the Wolf Prize (2008) jointly with P. Griffiths and D. Mumford. King Albert II of Belgium honored him by making him a Viscount in 2006 and a postage stamp was issued in his honor. Deligne was elected as a foreign honorary member of the American Academy of Arts and Sciences (1978) and Royal Swedish Academy of Sciences (2009). He has been honorary members of the Moscow Mathematical Society (since 1995), the London Mathematical Society (since 2003) and the American Philosophical Society (2009). The list of his other academic honors is pretty long. As for example, he was an elected member associé étranger, Académie des Sciences, Paris (1978), elected member associé, Académie Royale de Belgique (1994), elected foreign member, Accademia Nazionale dei Lincei (2003), and elected foreign Associate, National Academy of Sciences (2007). He was also conferred Doctor honoris causa of the Vrije Universiteit, Brussel (1989) and that of the Ecole Normale Superieure (1995).

When Deligne entered the University of Brussels to begin his career in mathematics, his teacher was Jacques Tits. He used to say his students "one could earn one’s living by playing, i.e. by doing research in mathematics". The statement had enormous impact on young Deligne and he proved to his teacher that by doing research in mathematics not only could one earn his living but also reach the pinnacle of glory.

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"C. R. Rao would be found in almost any statistician's list of five outstanding workers in the world of Mathematical Statistics today. His book represents a comprehensive account of the main body of results that comprise modern statistical theory."

- William Gemmell Cochran

It is about a bespectacled young man who came to Calcutta to secure a job in 1941. Albeit a first class first in M.A. (Math) from Andhra University (Vizag), he could not find a place offering research facilities. He met a student of the ISI. At that time, as the institute had no exclusive campus, it was running in the 3 rooms (Statistical Lab) of the Presidency college. Rattling calculating machines, sheets full of data, colourful charts fascinated him. He convinced his father to allow him to join the institute for the M.A course in Statistics and completed the same in 1943, winning a gold medal.

The bespectacled man was Dr. Calyampudi Radhakrishna Rao, currently Professor emeritus at Penn state University. The Journal of Quantitative Economics published a special issue in Rao's honour in 1991.

"Dr Rao is a very distinguished scientist and a highly eminent statistician of our time. His contributions to statistical theory and applications are well known, and many of his results, which bear his name, are included in the curriculum of courses in statistics at bachelor's and master's level all over the world. He is an inspiring teacher and has guided the research work of numerous students in all areas of statistics. His early work had greatly influenced the course of statistical research during the last four decades. One of the purposes of this special issue is to recognize Dr Rao's own contributions to econometrics and acknowledge his major role in the development of econometric research in India."

He was born on 10th September 1920 in Huvina Hadagali (Karnataka) to C Daraiswamy Naidu (1879-1940), a police inspector and A Laxmikantamma. As he was 8th male child of his parents' 10 children, his name Radhakrishna comes from the god Krishna. His mother had a major influence upon him:- "in my younger days, she woke me up every day at four in the morning and lit the oil lamp for me to study in the quiet hours of the morning when the mind is fresh."

After the retirement of his father in 1931, family settled down in Vizag. From earliest years, Rao had an interest in mathematics and decided to make career in Math. He studied in schools at Gudur, Nuzvid, Nandigama and Visakhapatnam. He joined intermediate at Mrs. A.V.N. College. He graduated M.A. (Hons) in Mathematics in 1940 and decided to sit the competitive Indian Civil Service examinations but, being only 20 years old, he had to wait 18 months. His family were in some financial difficulties as CR's father had died. CR once told about the influence of his father:-
"When I was 11, I could do complicated arithmetical problems without paper and pencil. My father appreciated my interest in mathematics and my good performance in school, and he thought that I should eventually get a degree in mathematics and proceed to do research to get a doctorate degree. He presented me with a book called 'Problems for Leelavathi', a collection of problems set by a mathematician for his daughter Leelavathi to solve. He asked me to work out 5 to 10 problems in the book every day. I enjoyed solving these problems, which aroused further interest in me to pursue mathematics. Thus, my entry into mathematics resulted from the encouragement I received from my father and my own interest in solving mathematical problems."

A few months after he began training at the ISI, Calcutta University announced a new Master's degree in statistics. He took courses from K Raghavan Nair, Samarendra Nath Roy (1906-1964) and Raj Chandra Bose (1901-1987). He was awarded the degree in 1943 with gold medal. CR was appointed as a Technical Apprentice at the ISI in November 1943 and also worked as a part-time lecturer at Calcutta University in June 1944. He began to look at combinatorial problems with R C Bose and number theory problems with Sarvadaman Chowla (1907-1995).

On 9 September 1948, he married Bhargavi who has 2 master's degrees, one from BHU in History and another from the University of Illinois in Psychology and a Bachelor's degree in Teacher's Training. She worked as a professor of psychology at Jadavpur University. He had known her from childhood and couple had a daughter Tejaswini and a son Veerendra.

In August 1946 he boarded a ship sailing from Calcutta to England to work on a project at the Museum of Anthropology and Archaeology at Cambridge University, which required the statistical methodology developed by ISI founder P.C. Mahalanobis (1893-1972), father of statistics in India. He acquired his Ph.D. (1948) from King's College, Cambridge University with R.A. Fisher (1890-1962), the father of modern statistics, as his thesis advisor. His thesis 'Statistical Problems of Biological Classification' was examined by Scottish mathematician and agricultural statistician John Wishart (1898-1956), was a major piece of work in 4 areas: the design of experiments, linear models, multivariate analysis, and the characterization of probability distributions. The university awarded him the prestigious D.Sc. in 1965 for his research contributions to statistics. He left ISI in 1978 and in 1988, joined the Pittsburgh University then moved to the Pennsylvania State University as Eberly Professor of Statistics, where he continues to work as the Director of the Center for Multivariate Analysis (CMA). He told about his research career-

"I continued my research on combinatorics with reference to design of experiments and wrote a number of papers, some jointly with R C Bose and S D Chowla. I developed a general theory of least squares without any assumptions on the concomitant variables. I found a test for redundancy of a specified set of variables in multivariate analysis."
The most significant result he obtained during this period is now called the Cramer-Rao inequality and gives a bound for the variance of an unbiased estimate of a parameter. While at Cambridge, every evening he used to spend a few hours in Fisher's genetics laboratory mapping the chromosomes of thousands of live mice.


In the 115-year history of Royal Statistical Society, he is the 34th recipient of the award. He is the first Asian, first non-European and first non-American to receive the award. He has been awarded 33 honorary degrees by different universities of 18 countries.

He has been elected to the Royal Society of London (1967), the National Academy of Sciences, USA (1995), the American Academy of Arts and Science, the Indian National Science Academy, the Lithuanian Academy of Sciences and the 3rd World Academy of Sciences. He was made an Honorary Member of the International Statistical Institute (1983), the International Biometric Society (1986), the Royal Statistical Society (1969), the Finnish Statistical Society (1990), the Portuguese Statistical Society, the Institute of Combinatorics and Applications, and the World Innovation Foundation.


The biennial C. R. Rao Award for statistics was instituted in his honour. The Advance Institute of Mathematics, Statistics, and Computer Science in the Osmania University Campus have been named after him. The Times of India on 31 December 1988 declared that C. R. is one of the 10 top Scientist of India.

C R has many hobbies such as gardening, photography, cooking, and Indian classical dance. During his stay in Calcutta he used to play soccer and badminton with staff and students in the evenings.

"C. R. Rao is one of the pioneers who laid the foundations of statistics which grew from ad hoc origins into a firmly grounded mathematical science."

- Bradley Efron (born May 24, 1938), an American statistician.
SMFIR TECHNOLOGY: A BOON FOR URBAN TRANSPORTATION

Bibhuti Narayan Biswal

Introduction

Young Indians are dreaming about migrating to urban centres and our major cities are getting congested day by day. The cities are playing vital roles in generating national income through employment and building the steps of prosperity for the nation. There is widespread migration from rural India to the cities for productive livelihood and quality of life. Thus the urban population has increased significantly from 62 million in 1951 to 285 million in 2001 and is estimated to grow to around 540 million by the year 2021. As percentage of total population, the urban population has gone up from 17% in 1951 to 29% in 2001 and is expected to increase up to around 37% by the year 2021. In recent years many cities in our country have grown at an unprecedented rate. For instance, in 1951 there were only five cities in India with populations in excess of 1 million: Kolkata (4.67 million), Mumbai (2.97 million), Delhi (1.43 million), Chennai (1.54 million), and Hyderabad (1.13 million). However, by 2001, there were 35 cities in India each having more than 1 million population and it is expected that by the end of the year 2021 the number of cities excluding 1 million mark of population size would be at least ninety. The ever growing population in cities have not only caused widespread anthropogenic activity, which is ecologically unsustainable but also catalysed huge demand in creation of new infrastructures, especially public transportation facilities. In fact, successive governments are working on the principle of "Carrot & stick" principle without having vision for a long term sustainable plan. At this juncture an alternate system of public transport named as SMFIR Technology has been proposed which is known to be both environment friendly as well as economically viable.

SMFIR in Nutshell

Scientists from the Korea Advanced Institute of Science and Technology (KAIST) have introduced a new technology called as "Shaped Magnetic Field in Resonance (SMFIR)" technology that enables Online Electric Vehicles (OLEV) to transfer electricity wirelessly from the road surface while moving. The Online Electric Vehicle receives power remotely through the electrical cables buried under the surface of the road, creating magnetic fields. There is a receiving device installed on the underbody of the OLEV that converts these fields into
electricity (Fig. 1). The length of power strips installed under the road is generally 5%-15% of the entire road, requiring only a few sections of the road to be rebuilt with the embedded cables.

OLEV has a small battery (one-third of the size of the battery equipped with a regular electric car). The vehicle complies with the international electromagnetic fields (EMF) standards of 62.5 mG, within the margin of safety level necessary for human health. The road has a smart function as well, to distinguish OLEV buses from regular cars - the segment technology is employed to control the power supply by switching on the power strip when OLEV buses pass along, but switching it off for other vehicles, thereby preventing EMF exposure and standby power consumption. As of now, the SMFIR technology supplies 60 kHz and 180 kW of power remotely to transport vehicles at a stable, constant rate.

**How it Works**

OLEV receives power wirelessly through the application of "SMFIR" technology that enables electric vehicles to transfer electricity wirelessly from the road surface while moving power comes from the electrical cables that are buried around 12 inches (30cm) below the road surface creating magnetic fields. The embedded power cable which essentially runs 100 kilowatts of power through the cables at a very specific frequency (20 kHz in this case), can generate a 20 kHz electromagnetic field as illustrated in Fig. 2 when the cable gets 20 kHz AC electricity from the power inverter, which is controlled under constant current output. The shaped magnetic field concept and the coverage of the magnetic field by pick up devices is considered as a dual type power supply system due to its magnetic fields as shown in figure 3.

![Fig. 2: Cross section of SMFIR cabled road](Image)

![Fig. 3: Schematic diagram of shaped magnetic field](Image)

The power converter takes electricity from the grid with the typical industrial power of 3-phase 380 or 440V. For the bus application, the power capacity of the power inverter has been selected with a 100-200 kW
are not all that lucky in terms of intra-city transportation. Transport in this context has been a victim of ignorance, confusion and neglect - or all these at once. It is perhaps time for us to devise a long term strategy to deal with burgeoning population in years to come which is possible through harnessing science & technology as a growth partner. Thus technology will be the change maker in our effort. Calibrated, well tested technology like SMFIR is a ray of hope for our ever growing problem of urban public transportation in our country. Transportation with electrified vehicles can not only reduce our dependence on fossil fuels but also it can reduce the emission of green house gases that accounts for a major pie of air pollution.

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Conclusion
Urban areas in India, which include a wide range of mega cities, cities, towns etc.
Oral cancer is one of the most common type of cancers in the world. Its incidence is increasing day by day due to the increasing use of tobacco in various forms. Tobacco smoke contains more than 30 different carcinogenic compounds. Tobacco is the worst form of drug abuse in human beings since time immemorial. This not only predisposes a person to oral cancer but also to larynx cancer, lung cancer etc, the risk of which further multiplies if taken along with alcohol.

1) Out of more than one billion smokers worldwide, there are 182 millions in India only.

2) It is estimated that every minute, at least two persons succumb to tobacco addiction and related ailments.

3) Annually, at least 10 lakh people are sacrificed at the altar of tobacco addiction.

4) More than one crore people report sick, courtesy to tobacco addiction.

5) More than 80,000 people fall in love with tobacco every year afresh.

6) In case of a person smoking 20 cigarettes per day, the lifespan is reduced by at least 10 years.

7) The chances of dying due to cancer in smokers is 27 times more than the non-smokers.

8) Out of every 5 deaths, one is related to tobacco consumption.

9) When accidents kill only 58 thousand people annually, tobacco related diseases kill 10 lakhs annually.

10) More than 200 people in India die everyday due to passive smoking.

11) The individual who quits smoking before reaching 50 years, the risk of dying in the next 15 years is reduced by 50% than who continue smoking.

12) The risk of dying from lung cancer after 10 years of quitting smoking is 30-35% of that for regular smoker.

13) The excess risk of dying from CHD is reduced by 50% after one year of quitting smoking.

14) According to the U.S Department of Agriculture, the average cigarette production was about 40 packets for every person in the world.

15) According to the U.S World Watch Institute, some 48 million people, one in eight adults are believed to have died prematurely last year from smoking and related illness.

16) The number of cigarettes actually smoked is thought to be 5,530 trillion, the lowest number in the last 10 years.

17) In India, approximately 90 people are dying every hour due to tobacco related disease.
18) India is the 2nd largest tobacco growing country in the world & more than 400,000 hectares of land are harvested for tobacco industry.

19) India is the 7th country to ratify the WHO framework convention on tobacco control and 31st May is the World Anti-tobacco Day.

20) Smoking during pregnancy, results in low birth weight baby.

21) A British medical research study in 2005 found that not only sperm count was considerably low among smokers but also the quality of sperms got affected.

22) According to a recent Australian study, impotency is 40% more in men between 16 to 59 years of age who smokes more than a packet of cigarette per day.

23) South East Asia has 250 million smokers and almost same number of smokeless tobacco users representing 90% of global Smokeless Tobacco (SLT) users.

24) 100 million people worldwide were killed in the 20th century by tobacco epidemic.

25) Almost six million people would be dying from tobacco use each year by the turn of this century and 70% of these deaths will be in the developing countries.

26) Tobacco smokers have 2-3 fold higher relative risk of coronary heart diseases (CHD).

27) Data from several studies indicate that tobacco smokers have 12-fold risk of lung cancer.

28) One-third of all pregnant women in Odisha have exposure to tobacco (National Institute of Health, USA).

29) India is the third largest user of tobacco in the world (Ministry of Health & Food, New Delhi).

30) SLT is known to contain 4,200 chemicals approximately.

31) 600,000 deaths occur every year done to exposure to second hand smoke (SHS) globally.

32) 84% of the 1.3 billion current smokers reside in developing countries.

33) One of every ten adults dies due to cigarette smoking and other tobacco use currently.

34) It is estimated that by 2030, this proportion will be one in six or 10 million deaths every year, accounting for more than any other single cause of death.

35) One-third of women and two thirds of men in India, use tobacco in some form or other.

36) Nearly two in five (38%) adults in rural areas and one in four (25%) adults in urban areas use tobacco in some form or other. (Global Adult Tobacco Survey-GATS).

37) Overall, the smoking epidemic is spreading from its original focus, among men in high income countries to women in high income countries and men in low income regions.
38) Tobacco use is the single most preventable cause of morbidity and mortality globally with the World Bank prediction that there will be over 450 million tobacco deaths in the next 50 years.

39) Tobacco related mortality in India is among the highest in the world. (Indian Journal of Cancer-2010).

40) Enforcement of smoking ban in medical schools in India is as low as 53% (Global Health Profession student survey-2005-2009).

41) There are 275 million tobacco users aged ≥15 years in India currently (GATS India-2009-10).

42) In India at present, around 200 million people use tobacco (70% beedi, 10% cigarettes and 20% smokeless tobacco).

43) Beedi has nicotine content of 1.7 to 3 mg and 45 to 50 mg of tar. Cigarettes have a nicotine content of 1 to 1.4 mg and 19 to 27 mg of tar.

44) As per WHO, 90% of oral cancer in India is directly attributed to chewing tobacco and smoking.

45) In any given year, more than 1,00,000 individuals suffer from oral cancer.

46) Tobacco burden in South East Asia Region (SEAR) is one of the highest in WHO regions (Indian Journal of Public Health-2011).

47) Exposure to second hand smoke is 50% or more in three SEAR countries (Myanmar, Bangladesh and Indonesia).

48) Children as young as 14 years old have been diagnosed with pre-cancerous lesions resulting from smokeless tobacco (SLT) use in India.

49) According to GATS India report (2009-10) those using SLT only are more than double of those who are exclusive smokers.

50) The SLT use has increased from 28% in men and 12% in women (1998-99) to 33% in male and 18% in female in 2009-10.

From Gautam Buddha to Mahatma Gandhi, every enlightened person has spoken against the use of tobacco which is not only a menace to the addicted individual but also to his family, friends and society at large. Considering the social and economic impact of tobacco consumption, smoking cessation interventions are the most cost effective of all medical intervention. Hence, a supportive environment for tobacco cessation can be created by mass media campaign and clinic-based smoking cessation programmes and health education.
ANTARCTICA - THE LAND OF SCIENTIFIC CURIOSITY

Ashit Kumar Swain

Introduction

Antarctica, known for its iconic penguins as 'Penguin Land', is situated at the southernmost part of the globe. This white continent is the fifth largest continent of the world in area. It has an approximate area of 14.5 crore square kilometre. The geographic area south of 600 south is treated as the part of Antarctica. The ocean surrounding it is known as 'Southern Ocean'. This is the windiest continent of the world and is home to most severe cyclones. This is the continent with maximum ice cover. It is covered by an ice sheet of 1.5 to 4.5 km thick. Only 2-3% of the total area is ice free. Antarctica in its present form came into existence only about 60 crore years ago. Before that, i.e. about 500 to 160 crore years ago, it was a part of the Gondwanaland. That time, it was joined together with Africa, Australia, South America, Arabia and India. Scientists believe that various geological factors like Plate-Tectonics are responsible for the separation of the continents and the living beings associated with it. Gradually, the distance between the continents increased to such an extent to form the present geographical shape. In this way, Antarctica has an important role in the history and evolution of the earth (Fig.1 & Fig2).

Discovery

Antarctica was first discovered in 1820. James Cook became the first person to reach Antarctica. Captain R.F. Scott reached Antarctica in 1901 by its famous 'Discovery' boat. Ronald Amundsen became the first person to reach South Pole in 1911. In due course of time, many expeditions were conducted for science and other geopolitical reasons. The first Indian Antarctic Expedition reached Antarctica in the summer of 1982 and from that day till date, India is engaged in continuous research in different branches of science (Fig. 3).

Scientific importance

The earth rotates round its axis at geographic poles. The speciality of Antarctica is that depending upon the geographic latitudes it has either complete 24 hours days or 24 hours of night, during some period of the year.
Near South Pole, it is four months of continuous light (day) and four months of continuous dark (night) and four months in between these. Near Indian station Maitri, however, there is only two months of complete absence of sunlight in a year.

Because of its location far away from the civilised world and pollution, it has enormous scientific importance that no other location on this earth can have. The heat budget of the world is balanced due to the presence of polar ice caps to a large extent and therefore it governs the world weather. The warm oceanic currents of Indian, Pacific and Atlantic meet the cold currents of Sothern ocean around Antarctica and is known as 'Antarctic convergence'. Due to this mixture, always turbulence is created, better branded as 'roaring fourties', 'furious fifties' and 'screaming sixties'. This water has physical, chemical and biological significance. A lot of parameters of Indian Ocean are governed by that of the adjoining oceans surrounding Antarctica.

From the past to present, the information regarding paleoclimate is stored in its enormous ice sheets like that of a library. The micro-organisms living here have special molecular DNA structure, which enables them to live and reproduce in an entirely different climate and are very important for biotechnological and microbiological research. Because of the cold water of Southern Ocean, there is a limited food chain activity, of which Kryll is an important parameter. Antarctica has several varieties of Penguins, which is the symbol of Antarctica. Emperor, Adelie penguins and Seals, Skuas, Snow Petrels are the only living beings seen in this huge continent apart from human beings. Antarctica and its surroundings have attracted the world attention due to its possibility of organic hydrocarbons in the form of fossil fuels (oil and gas) and economic mineral deposits. Polar Regions are known for spectacular display of auroras or dancing rainbows, which are produced due to the ionisation of charged particles in earth's geomagnetic field. The evidences of coexistence of Antarctica with other parts of the world including India in the geological past are also being explored for finer details. All these factors helped Antarctica to act as a world laboratory for scientific investigations. India is also very active in different fields of scientific research in Antarctica.

**Indian scientific research**

Because of the above scientific curiosity, Indian expedition to Antarctica started in 1981 and uninterruptedly continuing till date. To facilitate year round scientific research, Dakshin Gangotri, the first Indian Antarctic station was built in 1983-84 on ice shelf of Princess Astrid coast. But this station is now buried in ice. The second permanent station, Maitri (Fig. 4), was built in 1988-89 on an ice free area of Schirmacher oasis, 80 km from the coast, where Dakshin Gangotri station was built to provide year long scientific activities. The third permanent station, Bharati, was built recently on Larsemann Hills, about 2000 km
east of Maitri, to expand scientific research in
different parts of the icy continent. Apart
from the station bound research activities,
special expeditions were also undertaken by
Indian scientists from time to time. Wedell
sea expedition took place in 1989-90 to
explore possibility of establishing a permanent
station and conduct the preliminary geological
survey of the area. Very recently, in 2010-11,
the first Indian scientific expedition to South
Pole was successfully carried out in which the
author was a member scientist. In this
expedition, the scientists collected scientific
data on ground penetrating radar (GPR), total
electron count (TEC), shallow ice cores and
gemorphological observation in a record time
travelling from Indian station, Maitri to
dgeographic South Pole and back.

During the relentless research of more
than three decades, Indian scientists have made
significant contributions to the fields of
geology, geophysics, glaciological studies,
geomagnetic studies, paleoclimatology and
climate change science, ice core studies,
meteoro logic and space weather, botany and
paleobotany, Antarctic life sciences,
environmental sciences, human physiology and
medical sciences.

**Conclusion**

Man and Nature have inseparable
relationship and the effect on one is reflected
on the other. Antarctica has unique climate and
weather which plays an important role in
governing local weather patterns. Its pristine
nature is a storehouse of information regarding
the past climate and proper study of it can lead
to understand our future. This windiest, coldest,
driest continent is a natural laboratory for the
scientists. To provide better awareness
regarding this vastness of Antarctica, we need
to create scientific interest among the people
by providing literature and information. To
begin with, if a student builds awareness that
Antarctica, the sun never sets during summer
time that will create some sense of curiosity.
To satisfy the general curiosity, to understand
the formation of Gondwanaland and Plate
Tectonic concept to different stages of ice
ages and reason behind aurora display forms
an integral part of that curiosity. Therefore,
we need to preserve Antarctica for the fruitful
scientific investigation in future, so that the
legacy of scientific curiosity will remain alive
in everybody's mind.
Introduction

When we buy a pack of potato chips or curry powder or mango drink, or any other processed food, we have a normal tendency to look at the information on the packages about the food ingredients or constituents. In most of the cases, we observe that in addition to the main ingredients, some other types of materials are also incorporated into the food. They are mentioned as "permitted food additives or permitted food preservatives". In some packages, we see that some materials with code names as E-308, or E-260 or E-330 have been added. But most of us really do not know what that E-308 or say E-330 stands for, i.e. we do not know what we really eat. And suppose we eat that, how is it going to help our body or even the food. So here we will discuss about some of these added materials to the processed food and the significance of these added materials. We can name them as food additives.

Food additives and their benefits

A food additive can be defined as any natural or synthetic material, other than the basic raw ingredients, used in the production of a food item to enhance the final product or any substance that may affect the quality of any food, including those used in the production, processing, treatment, packaging, transportation or storage of food. In other words, food additives can change the characteristics of food. A common example is that we add colours to the food. The colour added to the food is not to hide the spoilage of food, but to make it more appealing. Similarly the different preservatives come under the category of food additives. When we use salt to preserve fish, spices to improve the flavour of food, sugar to increase the shelf life and taste of fruit pulp, they are all food additives.

It is very important to note that these additives are not used to mask problems (such as spoiling) in the food, but are often used to prevent spoilage or other loss of quality.

The food additives can serve for many purposes, as preservatives, anti-oxidants, stabilizers, emulsifiers, thickening agents, gelling agents, food colours, sweeteners, flavour enhancers, acidity regulators and buffers, anti-caking agents, etc. When we prepare squash or jam or jelly, commonly we add acetic acid (or vinegar) and potassium metabisulphite. The vinegar is a food preservative and potassium metabisulphite is a common antioxidant. Both of them help to increase the shelf life of the prepared food. They are the most common food additives.
E numbers

Food additives are often referred to as E-numbers, as in the European (EU) countries, additives are numbered with a prefix E. The E thus refers to an approved additive. The numbering scheme follows that of the International numbering system (INS) as determined by the Codex Alimentarius Committee. The EU legislation requires most additives used in foods to be labeled clearly in the list of ingredients, either by name or by an E number. This provides us with information about the use of additives in foods and allows us to avoid foods containing specific additives if we wish. Giving an additive an E number means that it has passed safety tests and has been approved for use in the European Union. There is a maximum permissible limit of consumption for the food additives also.

The E numbers are now universally adopted by the food industry worldwide. In some countries like Australia and New Zealand, the prefix E is not used when listing additives in the ingredients. In some packages, the additives are written as INS (e.g. INS 102 or INS 627, etc.). This directly corresponds to the International numbering system (INS). The INS numbers generally correspond to E numbers for the same compound, e.g. INS 102, Tartrazine, is also E-102. INS numbers are not unique and, in fact, one number may be assigned to a group of like compounds. An additive that appears in the INS does not automatically have a corresponding E-number.

The different categories of the additives as placed under different E numbers are given in Table 1. Table 2 gives a list of some such common additives and the type of food in which they are used.

### Table 1. Categorization of E numbers

<table>
<thead>
<tr>
<th>E number range</th>
<th>Type of additive</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>E 100- E199</td>
<td>colours</td>
<td>caramel (E 150a), curcumin (E 100)</td>
</tr>
<tr>
<td>E 200- E 299</td>
<td>preservatives</td>
<td>sulphur dioxide (E 220), acetic acid (E 260)</td>
</tr>
<tr>
<td>E 300- E 399</td>
<td>antioxidants, acidity regulators</td>
<td>ascorbic acid (E300), tocopherols (306)</td>
</tr>
<tr>
<td>E 400- E 499</td>
<td>thickeners, stabilizers, emulsifiers</td>
<td>lecithin (E 322), pectin (E440)</td>
</tr>
<tr>
<td>E 500- E 599</td>
<td>acidity regulators, anti-caking agents</td>
<td>potassium hydroxide (E 525), potassium silicate (E 560)</td>
</tr>
<tr>
<td>E 600- E 699</td>
<td>flavour enhancers</td>
<td>monosodium glutamate (E 621), inosinic acid (E 630)</td>
</tr>
<tr>
<td>E 900- E 999</td>
<td>glazing agents, sweeteners, gases</td>
<td>aspartame (E951), saccharin (E 954), argon (E938), hydrogen (E949)</td>
</tr>
<tr>
<td>E 1000- E1999</td>
<td>Additional chemicals</td>
<td>amylase (E 1100), invertase (E 1103)</td>
</tr>
</tbody>
</table>
Table 2. Some common food additives

<table>
<thead>
<tr>
<th>E-Number</th>
<th>Substance</th>
<th>Some foodstuffs in which they are used</th>
</tr>
</thead>
<tbody>
<tr>
<td>E260</td>
<td>Acetic acid</td>
<td>Butter, margarine, processed cheese, curry powder, cooking oil.</td>
</tr>
<tr>
<td>E263</td>
<td>Calcium acetate</td>
<td>packet desserts, pie fillings</td>
</tr>
<tr>
<td>E270</td>
<td>Lactic acid</td>
<td>cheese, milk, meat and poultry, salads, sauces and beverages</td>
</tr>
<tr>
<td>E296</td>
<td>Malic acid</td>
<td>tinned fruit, vegetables and pulses, jams, jelly, frozen vegetables</td>
</tr>
<tr>
<td>E297</td>
<td>Fumaric acid</td>
<td>bread, fruit drinks, pie fillings, poultry, wine, jams, jelly</td>
</tr>
<tr>
<td>E330</td>
<td>Citric acid</td>
<td>fruits and vegetables (lemons and limes), soft drinks</td>
</tr>
<tr>
<td>E334</td>
<td>Tartaric acid</td>
<td>bakery, candies, jams, juices and wine</td>
</tr>
</tbody>
</table>

Table 3. Sources of some food additives

<table>
<thead>
<tr>
<th>E-number</th>
<th>Name</th>
<th>Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>E120</td>
<td>Carmine, Cochineal</td>
<td>Colour isolated from the insects Coccus cacti or Cochineal insect</td>
</tr>
<tr>
<td>E322</td>
<td>Lecithine</td>
<td>Soy beans and for some purposes from chicken eggs</td>
</tr>
<tr>
<td>E901</td>
<td>Bees wax</td>
<td>Made by bees, but does not contain insects.</td>
</tr>
<tr>
<td>E904</td>
<td>Shellac</td>
<td>Natural polymer/resin derived from lac insects</td>
</tr>
<tr>
<td>E101</td>
<td>Riboflavin (lactoflavin)</td>
<td>Yellow food colour. It can be isolated from milk, but commercially produced from micro-organisms. Isolation from milk is too expensive.</td>
</tr>
<tr>
<td>E306, 307, 308</td>
<td>Tocopherols (vitamin E)</td>
<td>From vegetable oils. Also in animal (fish) oils but these oils are too expensive. Fish oils are, however, used as a source in food supplements, but not in foods, due to the strong flavour.</td>
</tr>
<tr>
<td>375</td>
<td>Nicotinic acid (vitamin B3)</td>
<td>From yeast. Production from liver is too expensive.</td>
</tr>
<tr>
<td>E422</td>
<td>Glycerol</td>
<td>Part of animal and vegetable fat. Commercially made synthetically from petroleum.</td>
</tr>
</tbody>
</table>

The list of food additives is very long. If we want to know about a specific food additive, we can easily access several information sources available on internet. Some such helpful sites have been mentioned in the list of references. The food additives can be prepared from many types of raw materials. The origin of the product may also be either from animal or non-animal sources. This is especially the case for those additives that contain fatty acids. These are normally of plant origin, but animal origin fatty acids are also available. As the
products are chemically identical, the consumers can not differentiate; only the produces can give information on the exact origin. As the fatty acids from animal or plant origins are identical, the origin is of no importance for the function in the food. Producers thus normally choose the cheapest oils to make these fats. Table 3 gives an idea of varieties of raw materials/ sources for some specific food additives.

As people from different religions have different food preferences (and of course restrictions), accordingly they can look at the E numbers or the preservatives added to the food to determine whether or not to accept the additive. In fact, there are certain forbidden food additives by some religious groups also. The list of really prohibited E-numbers is very short; E120 and E904 are prohibited in many places as these are made of/from certain insects. E901 is made by insects, like honey, but does not contain insects. The food manufacturers should also be well aware of the category of food additives, their functions, their maximum permissible limits and their sources.

**Conclusion**

The food additives normally are used to enhance the characteristics of food and in many cases the shelf life of food. Many times the food additives are written as E numbers or INS numbers on the processed food packages. E number states that it is a permitted food additive. The food additives are prepared from both plant as well as animal sources along with many other types of raw materials. The detailed information on the permitted food additives should be considered before adding that in a specific type of food considering the local food habits and preferences.

**Further reading**


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NEW COMET 'ISON' WILL TELL THE TALE OF OUR SOLAR SYSTEM AND THE UNIVERSE

The excitement in the air is palpable. Astronomers across the globe are polishing their telescope lenses, and wiping down their solar filters. Comet ISON is coming to our sky on 28th November 2013, and there it will shine brighter than the moon, providing amazement, awe and inspiration to the world, and heralding forth a new era of peace and serenity across our planet!

The students of Gujarat are now preparing for the Diwali Vacation with lots of new ideas on comet ISON. While one group of students are writing essays on comet and its arts and science, the other groups are collecting the tale of comets from their grandparents and localities. Even a few are in the creative mood to write science fiction on the arrival of ISON closer to the Sun and Earth.

A new Comet, discovered in September of 2012 has been named as ISON in the name of the organization International Scientific Optical Network (ISON) is now on the way to the Sun and passing closely to Earth. The comet has been discovered by Belorussian and Russian astronomers and it starts out this month by making a relatively close flyby of the planet Mars. This particular comet is exciting as it may get very bright later on in the year as it approaches the Sun. The date of closest approach of Comet ISON (known as a sun grazing comet) to the Sun (perihelion) is the 28 November 2013 when it will come within 1.2 million km of the Sun's surface (over 100 times closer to the Sun than Earth!). The nucleus of comet ISON is believed to be 5 km across. There are various possibilities about how bright the comet may become.

Because of ISON's size and brightness at a great distance from the sun, it's given sky-watchers plenty of opportunity to be excited about. It is going to be recognized as the "comet of the century". The following link will give you a virtual look of the ISON: http://www.solarsystemscope.com/ison

These beautiful visitors to the inner solar system probably come from the extreme outer parts of the solar system.

Comets are huge 'snowballs' or 'icy dirt balls' of frozen gases, water ice, rock, and dust created when the solar system was formed. The center, or nucleus, of a comet may range from 100 meters to 40 km. When the comet is heated by solar radiation in the inner solar system, frozen gases in the comet turn to vapor and stream away from the comet nucleus. This creates a thin atmosphere, or coma, around the comet that can make the comet appear as a large glowing object with a tail millions of kilometers long.

There are many types of small bodies in the solar system but none may be as dramatic as comets. The sight of a new, bright 'star' in the night sky -- one with a long tail or "beard" -- was frightening to ancient people. Any change in the heavens were considered messages from the gods, portents of evil or omens of greatness.

Even in 1910 there was widespread panic that the world would end when Earth passed through the tail of Halley's Comet -- even though Halley's Comet was millions of kilometers away from Earth. Astronomers had discovered evidence of cyanogens (cyanide-like molecules) in comets' tails. Newspapers predicted the end of the world. Gas mask vendors made big profits.

In fact, we do pass through the remnants of Halley's Comet dust tail every year. We experience this as a meteor shower called the Orionids, in October. The Perseid meteor shower in mid-August occurs when Earth passes through the orbit of the Swift-Tuttle comet.

Comets and other small bodies have a big impact because they tell us so much about how our solar system formed. Comets tell scientists about conditions early in the formation of the solar system. Many comets come from the Kuiper Belt and the Oort Cloud.

The Kuiper Belt is a large region that begins at Pluto and extends for billions of miles. The Oort Cloud is even further out. Scientists believe that icy and rocky objects in these regions far from the Sun are relatively unchanged since the beginning of the solar system.

ISON has been bringing such mysteries which are going to be explored soon.

Let's involve, engage and experience this spectacular celestial event with one and all in our society for spreading science and enjoying the beauty of our universe...

Courtesy: Gujarat Science City
THE NOBEL PRIZE - 2013:
PHYSIOLOGY OR MEDICINE

Nityananda Swain

The Winners

Americans James E. Rothman and Randy W. Schekman and Germany-born American Thomas C. Sudhof have been awarded the 2013 - Nobel Prize in Physiology or Medicine.

Rothman was born in Massachusetts in the year 1950. He is currently the Professor and Chairman in the Department of Cell Biology of Yale University in Connecticut.

Schekman was born in 1948 in St. Paul, Minnesota. He is presently holding the post of Professor in the Department of Molecular and Cell Biology of the University of California at Berkeley.

Sudhof was born in 1955 in Gottingen, Germany. After receiving MD Degree and a Doctorate in Neurochemistry in 1982, he left for USA. Since 2008, he has been working as the Professor of Molecular and Cellular Physiology at Stanford University.

The Cell Traffic

As you know, each cell in the body has a complex organisation. There are several subcellular particles called organelles. Each cell acts as a chemical factory where a lot of molecules are produced. These molecules need to be transported to different organelles present within the cells. Similarly various molecules are exported outside the cell as well.

But how do the molecules reach their target locations? They are packaged in vesicles. The vesicles traffic inside the cell and deliver the molecular-cargo to the specific intracellular organelles and also to the blood stream through the outer membrane of the cell. The packaging of the molecules inside vesicles, their transport and the delivery at the right locations are regulated very scrupulously with utmost precision.

For instance, the hormone insulin is synthesised in the B-cells of the pancreas, but are released into the blood to participate in glucose metabolism. Similarly, chemical signals called neurotransmitters are transported from one nerve cell to another. The vesicles serve as transport-vehicles.

vesicles are regarded as a major transport system in our cells.

Their research spanned three-and-a-half decades. They had worked independently and solved the riddle of transport of molecules through an internal cellular freight system that is effected by vesicles.

The Discovery

These three scientists have been jointly nominated for this prize for their ground breaking work and discoveries of the machinery regulating vesicle traffic. The
What are vesicles? The vesicles are very small membrane-bound fluid-filled sacs which are engaged in various functions inside our cells. Some of the vesicles help in the transport of different types of molecules, some serve as storage sites for enzymes and others function as chambers for chemical reactions. Rothman, Schekman and Sudhof had studied the mechanism of molecular transport by means of vesicles. They have discovered the molecular principles that govern as to how the intracellular chemical cargo is delivered to the right place at the right time in the cell.

Whereas Randy Schekman had discovered a set of genes that are required for vesicle movement, James Rothman had unravelled protein machinery that allows vesicles to fuse with their targets to permit transfer of cargo. Thomas Sudhof revealed as to how signals instruct vesicles to release their cargo with precision.

Randy Schekman became interested to delve into the problem of molecular transport system in cell. He began his research in 1970 to study if there were any genetic basis in such transport. His work was on yeast cells. He noticed that in some of the yeast cells this transport system was faulty resulting in accumulation of vesicles inside those cells. He discovered that this accumulation was due to some mutated genes in the yeast. He had succeeded in identifying the genes that govern the vesicular transport system.

The transport system in the cell fascinated James Rothman too. He started studying this aspect in the mammalian cells and had discovered a protein - complex that enabled vesicles to correctly fuse with the target membrane. The target membrane may be of any of the organelles inside the cell or of the outer membrane of the cell. The proteins on the vesicles very satisfactorily bind to the target membrane in specific combinations. He described this precision binding with that of the functioning of a zipper fastened to a pant or a bag. When the vesicle binds to its correct locations, the releasing of its contents is effected. Interestingly, some of the genes which Schekman identified in yeast cells are found to code for proteins which Rothman had discovered in mammalian cells.
Thomas Sudhof was enthusiastic to study cell communication between nerve cells in the brain. This communication takes place through release of signal substances called neurotransmitters. The neurotransmitters are transported by vesicles discovered by Rothman and Schekman. The vesicles transporting these molecules fuse with outer membrane of the nerve cells and release their contents. But the release is very precisely regulated by calcium ions. Sudhof had worked on the calcium sensitive proteins in nerve cells. These proteins facilitate vesicle binding and release of the signal substances.

**The Significance**

But how are their discoveries significant?

As you know, if the traffic system in a city is not rightly regulated, the whole city is thrown into chaos. Likewise, if the cellular transport system is not precisely controlled, it would lead to chaos in cellular function resulting in various diseases.

The discoveries of Rothman, Schekman and Sudhof have explained the exquisitely precise control system for the transport and delivery of cellular cargo by vesicles. Disturbances in this system have deleterious effects causing diseases like diabetes, Alzheimer’s and Epilepsy, besides a few immunological disorders as well.

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**THE NOBEL PRIZE - 2013: PHYSICS**

Lambodar P. Singh

The 2003 Physics Nobel Prize has been awarded to Emeritus Professor of Edinburgh University of England, Professor Peter Higgs and Emeritus Professor of Brussels University of Belgium, Professor Francois Englert for their path-breaking theory of how particles acquire mass propounded almost fifty years back in 1964.

We can not think of an object without concurrently thinking about its mass. Even though the great scientists like Galileo, Newton and Einstein have given us understanding about various magical aspects of mass, we have had no understanding about the origin of the mass of an object. One could justifiably argue that the mass of an object originates from the mass of its elementary constituents. But that only shifts the question to origin of mass of elementary constituents like electrons, neutrons, protons etc.

First of all, we should note that the theories which describe elementary particles and the elementary interactions among them
are ingenious mathematical structures combining quantum principle and relativity called Quantum Field Theory (QFT). By 1960 it was not known how to generate mass for particles in such (QFT) theories. The problem was solved almost simultaneously and independently in 1964 by Peter Higgs and F. Englert, R. Brout and G. Guralnik, T. Kibble, C. Hagen. However it was Peter Higgs who stressed that excitations of the all pervading Higgs field as Higgs particles can be accessed through experimental search.

Higgs field pervades the Universe as an invisible background field. It imports mass to elementary particles through interaction, greater the intensity of interaction, greater in the mass that particle acquires.

After intense research for nearly 50 years Higgs particle was discovered in CMS and ATLAS experiments of LHC conducted in CERN, Geneva. The discovery was announced on 4th July 2013.

So, finally one of the great puzzles of Nature - Origin of mass - has been cracked. Nobel prize only celebrates this extraordinary achievements.

Baya Nivas, Shree Vihar, Patia, Bubaneswar-751024

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THE NOBEL PRIZE - 2013: CHEMISTRY

Abhay Kumar Mahanta

1. Introduction

The Royal Swedish Academy of Sciences has announced the prestigious Nobel Prize in Chemistry for the year 2013 on 9th October. This year, the award goes to Martin Karplus (Harvard University, USA), Michael Levitt (Stanford University School of Medicine, USA), and Arieh Warshel (University of Southern California, USA) for Development of Multi-Scale Models For Complex Chemical Systems. So far, the Nobel Prize in Chemistry has been given 105 times to 165 laureates between 1901 and 2013, out of which 63 prizes won by one laureate, 23 prizes shared by two laureates, and this is the 19th time in the history of Nobel Prize in Chemistry that three scientists have shared this prize. Frederick Sanger is the only Nobel laureate who has received this prize twice. Nobel Prize is given in the name of great chemist Alfred Bernard Nobel. He was the inventor of Dynamite. In his entire career, he owned 920000 US dollars. The interest of this amount...
is given as prize money every year in five subjects (Chemistry, Physics, Medicine, Literature, and Peace) according to the will written by Alfred Nobel before his death. The prize amount for 2013 in Chemistry is 8.0 million in Swedish kronor (reduced from 10 million kronor awarded since 2001 because of the economic crisis last year). That means each recipient will receive about 1.24 million US dollars as prize money.

2. Computational Chemistry Won Over Experimental Chemistry

If you look at the history of Nobel Prize in chemistry, you see that a great majority of Nobel Prize winners in chemistry are experimentalists. In Fig. 2, you can see that maximum number of Nobel Prize goes to bio-organic chemists followed by organic and then the physical chemistry.

This year, the trio computer chemists have won the Nobel Prize for their work on multi-scale models for complex chemical systems. Of course, you can call them computer chemists as their work is basically on computational chemistry models which require extensive use of computer to do the complex chemical calculations for studying all kinds of molecular properties. They have developed theoretical models and applied these models to simulate the behaviour of the molecules at different length and time scale. Thus these models are often called as multi-scale models and that can be applied to a wide range of molecules starting from single organic molecule to the complex biological macromolecule.

In fact, this is altogether a different chemistry as compared to the conventional chemistry or experimental chemistry. The experimental chemists usually study chemistry in test tubes by reacting two or more chemical ingredients, isolating, purifying, and finally characterizing the products to see whether the desired product is formed or not. This is what experimental chemists do in the chemical laboratory. This year, the Nobel chemists did the chemistry in computer instead of using test tubes, thus providing a powerful tool for chemists to drug designer/engineers. In layman's language, one can summarize what the Nobel trio did as: they simply listed all the forces that hold the atoms together in a molecule, and then they put these into one big computer program and set it running. The final outcome is that you can see chemical reactions simulated by software in computer just like a Hollywood movie and map the minute details as the reaction proceeds. One can easily get ideas of what role specific atom (the actor) plays at different stages of the chemical reaction. You might wonder how somebody
can do chemistry without experiments. The fact is that you still have to do experiments to confirm the science it. There is no substitute to that but the informations one get from computer simulations are as informative as the experiments, and the predictions that the multi-scale models make are so much powerful that one can almost save 90 % of the experimental work and focus on only 10 % where the important results lies. The advantage is that before starting experiments, you have in hand a rational experimental design which guides and inspires throughout the experiment. Here confidence and chances of success are incredibly high.

3. The Cross-Fertilization of Molecular Mechanics with Quantum Mechanics

The Nobel laureates' work is simply a judicious blending of classical ball and spring models (molecular mechanics) of the molecule with quantum mechanics to simulate the molecular dynamics of the complex chemical system. The main difference between quantum and molecular mechanics is that in quantum mechanics (QM), your particles of interest are the electrons and nuclei, whereas in molecular mechanics (MM), one considers atom or group of atoms as the particles.

Chemical reactions, as you know, occur at lightning speed. In a fraction of a millisecond, electrons jump from one atomic nucleus to the other. The profile of chemical transition is often characterized by a transition state, i.e. a configuration with the lowest possible (free) energy that links the products and the reactants. The transition state is not experimentally accessible. It is virtually impossible to experimentally map every little step involved in a chemical process. To have a greater insight, this is where you need theoretical models to describe such process, and quantum mechanics (QM) gives details about the electronic structure of the molecular system as the reaction proceeds. QM, in fact, was born out of inability of MM to reconcile theory with experiments. The strength of QM is that it is unbiased. The models based on QM are more realistic as here you specify the number of electrons and nuclei for each system. You calculate the electron density and the energy for each different configuration of the nuclei, thus determining the redistribution of electrons among atoms as the reaction proceeds. A QM method provides a rigorous description of molecular system and gives more accurate calculation for structure, electromagnetic spectra, kinetics, and energetics along with dynamics of the chemical reaction.

However, the main draw back with QM calculation is that they are much more expensive and time consuming than the force filed or MM calculations as they require enormous computing power to do so. You have to process, in fact, every single particle, i.e. every single electron and every single atomic nucleus, to map minute details of the chemical reaction. The computational cost grows N4 times (N is the number of atom) with the number of atoms involved in a chemical system. This poses a serious limitation for application of QM in complex molecular system.
Karplus, Levitt, and Warshel's solution to this problem was to use QM only when it is required and let MM does the rest. They have done an outstanding job by merging QM and MM together to create hybrid quantum mechanics/molecular mechanics (QM/MM) methods to study the reaction dynamics. For an enzyme, the small active site, where the reaction actually takes place, is treated by QM and the rest of the protein is modelled by MM. Thus, finally you get a computer model which is accurate enough to describe the minute details as well as the dynamics of the molecular system. They used the hybrid models successfully to study the reactions catalyzed by the enzyme, i.e. lysozyme. Warshel has extensively used these hybrid methods, most importantly his empirical valence bond (EVB) approach, to study a wide range of reactions in solution and in enzymes. It is undoubtedly he who has made the major contribution, both in terms of method development and in applications, to this area. These QM/MM methods are now being widely used to understand and predict how drugs are broken down in the body and to look at the fundamental principles of catalysis. These molecular level insights, they gave into biological processes, are now helping chemists to develop new medicines and will help in emerging areas like the design of novel protein catalysts.

4. The Work of Nobel Laureates

The work of Nobel laureates is an excellent example of passionate research, collaboration, inter-disciplinary thinking, and innovation. Here is how it is: the year was 1967, a young researcher named Levitt, highly motivated by John Kendrew's BBC 1964 television series "The Thread of Life", arrived at the Weizmann Institute of Science (WIS) in Rehovot (Israel) on advice of his research mentor Kendrew to work under the supervision of Shneior Lifson and his Ph.D. student Arieh Warshel as a part of his Ph.D. training programme. At that time, computing at WIS was among the best in the world. In a very short period, he developed a program based on MM called consistent force field (CFF) and applied this program to calculate the energy, forces (energy first derivatives with respect to atomic positions) and curvature (energy second derivatives with respect to atomic positions) of many molecular systems. Warshel used this program to calculate structural, thermodynamic and spectroscopic properties of small organic molecules, whereas Levitt used it for complex micro-molecule like proteins, i.e. myoglobin and lysozyme. Subsequently, Levitt joined at the renowned Medical Research Council (MRC) Laboratory of molecular biology in Cambridge (UK) for his Ph.D. research. The molecule of the year was tRNA, which had been predicted to exist by Francis Crick of the cell biology division, MRC laboratory 10 years before. Levitt immediately set to work for programming the molecule and independently published the model in 1969. Later, he started working on his Ph.D. thesis entitled "conformation analysis
of proteins”, which was entirely devoted to computational biology.

In the mean time, upon finishing his Ph.D. from WIS-Israel, Arieh Warshel joined at Karplus’ Laboratory at Harvard University in Cambridge (USA) in 1970 as a post-doctoral fellow. He worked there with Martin Karplus on computer programs that could simulate chemical reactions with the help of QM. At that time, Karplus was considered as a godfather of this field firmly rooted with QM. He was the Linus Pauling’s (Noble laureate of 1954) last graduate student. The undergraduate chemistry student would know him from the famous Karplus equation which is used in Nuclear Magnetic Resonance (NMR) based on the quantum chemical properties of the molecules. Karplus was interested in retinal (exist in the retina of the eye). Retina contains free electrons. Karplus wanted to understand those free electrons, and along with Warshel, he developed a way of simulating systems which used QM for the free electrons only and resorted to MM for other components of the system. Subsequently, Karplus and Warshel developed a revolutionary computer program with QM on free electrons and applied simple MM for all other electrons and all atomic nuclei. This is the first time they merged the two fields, using the best of QM to study the finer details of a chemical reaction, and MM to explain the rest. The ground-breaking results were published in 1972. The major drawback of the program was that it could apply to the molecules with mirror symmetry only.

In 1973, Michael Levitt armed with greater insight in MM computer programs joined back with Warshel at the WIS in Israel as a post-doctoral research fellow. Soon, Levitt and Warshel started to work together on both protein folding and enzyme reactions. After finishing the post doctoral training, Levitt moved back to MRC in Cambridge in 1974, and Warshel joined them as a visitor. In 1976, they published the first ground breaking computerized model of an enzymatic reaction. Their technique published in 1976 could be applied to other molecules too, regardless of size and truly universal. The results are used in all areas of chemistry from making cars more environmentally friendly to producing medical drugs to cure diseases.

Bibliography


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MARS ORBITER MISSION

Prem Chand Mohanty

Introduction

In our solar system Earth is said to be the sole planet which is habitable and provides all the parameters essential for life. But with the increasing human activities, it is difficult to say about the life span of the planet. Hence, utilising his powerful intellect and wisdom, man has started to explore the possibility to build shelter in any other planet. In this quest Mars is considered to be a good option. Amidst a number of criticisms, hopes and aspirations, India has advanced one step forward in the journey to space. Our country’s tryst with space science dates back to ancient astronomers and mathematicians like Aryabhatta, Bhaskar, Brahmagupta, Pathani Samanta and many others who have striven a lot to understand and explore space. Since 1960 India has taken deep interest in the field of space science. After the successful completion of Chandrayaan-1, India became very enthusiastic to start the Mangalayan mission. This space odyssey is long and complex. Our space agency ISRO is now looking forward to two key dates December-1, 2013 when the Mars Orbiter Mission (MOM) space craft leaves the Earth’s gravitational field and September-24, 2014 when it is captured by the Martian orbit. Till now 51 numbers of such attempts have been made by various countries, out of which only 21 numbers of such mission have succeeded.

Mars is the second smallest planet of our solar system. It is also called Red Planet because of its red appearance. It is a terrestrial planet with a thin atmosphere and possesses some features like volcanoes, valleys, deserts and polar ice caps, similar to that of the Earth. The rotational period and seasonal cycles on Mars are similar to those of Earth. It has two moons named Phobos and Deimos. In 1965 it was speculated after observations by Mariner-4 that the surface of Mars was covered with a lot of water bodies. This fact was supported by the later unmanned missions, whose geological evidence suggested that once Mars had large scale water coverage on its surface. Radar data also proves the presence of large quantities of ice at its poles and mid latitudes. In 2007 some water containing compounds were collected by rover with Spirit.

India’s Mission to Mars

With a view to reveal the unknown facts and to study various aspects of the parameters supporting the existence of life, three countries namely USA, Russia and Europe had undertaken such attempts. India will be the fourth country and first in Asia to keep pace with the mission in the name of Mars Orbiter Mission (MOM).
Objectives

It is India's first interplanetary mission, where an orbiter is carried to Mars on being boarded on PSLV-C25, indigenously built by India. This earlier version of the launch vehicle has been improvised to suit the needs of Mars mission. Primary among these changes being that it would successfully carry out a flight which has twice its usual payload. The focus was to ensure that the mission reaches Mars with the least energy possible. That would be a display of India's ability to conceive, design, develop and execute a complex space mission. On reaching Mars orbit, the focus would shift to the various instruments, that are on board of the orbiter, which would carry out a number of information gathering exercises such as detection of methane, charting of Martian surface, surveying of soil composition, understanding the presence of water and monitoring surface weather phenomenon on the planet. Replying to a question in this context the chairman of ISRO, Dr K. Radhakrishnan told "There is no race with anybody or any country, India has its own direction. We are always on race with ourselves to excel in areas that we have chalked out for ourselves. Being a complex mission of this nature any day you advance is a progress. ISRO is primarily focussing on space application, communication, remote sensing, navigation, space sciences, building satellites for these areas besides indigenous launch vehicle technology. MOM will serve as a technology demonstrator for future space mission. Mangalayaan's journey is a 300 day, 78 crore km journey to orbit Mars and survey its geology and atmosphere. At its closest point it will be 365 kms from the planet surface and at its farthest 80,000 kms. The 1337 kg Mars orbiter satellite will be put into a 250 km X 23,500 km elliptical orbit time from launch to injection of the orbiter into its trajectory in about 44 minutes.

The international designator, that is the NSSDC ID of India's Mars mission is, 2013-060A. It is the international naming convention for satellite comprising the launch year, a three digit incrementing launch number of that year and up to a three letter code representing the sequential identifier of a piece in a launch. The website of MOM is (www.n2yo.com).

Time Line of the Mission

According to ISRO chief Radhakrishnan, India's attempt in this field is an interplanetary mission which would pass through three phases namely Geo centric, Helio centric and Martian. On 5th November 2013 the 44.5 metre PSLV-C25 will launch MOM into an initially elliptical Earth parking orbit of 248 k.m.x23000 k.m. On 1st December when the spacecraft will be injected, it will leave Earth's orbit into outer space in a trajectory where it will be computed for 280 days ahead of positioning it near
Mars. For these days the space craft will float through the inky void towards Mars. During November 5 to November 30, when the orbiter will move around Earth at a position 250kms away from equator (perigee), its apogee will be raised to 192,000kms from 23,500kms on November 16 by firing its motors from ISRO’S telemetry, tracking and command network. On 1st December the motor will be fired at 00:42am (IST), so that the velocity at the orbiter will rise and will start its journey towards Mars. After nine months on September 2014 another firing of motor will reduce the velocity so that the orbiter will precisely capture the martian orbit. The speed of the space craft will be 9.8kms/sec. After launch during 5 orbit raising manoeuvres and trans orbit injection will be given an additional velocity of 1.55 kms/sec. For its nine months journey and reduced to 1.11kms/sec. On 24th September. After reaching Mars orbit, the orbiter will move at that speed for over six months.

Instruments Present on the Orbiter

MOM satellite has carried five instruments of mass 15kg to study martian surface, atmosphere, mineralogy and many other parameters. Its payload comprises, besides the Tri colour; Mars Colour Camera to image the planet and its two moons, Phobos and Diemos, the Lyman Alpha Photometer to measure the abundance of Hydrogen and Deuterium and understand the planet’s water loss process, a Thermal Imaging Spectrometer to map surface composition and mineralogy, the MENCA mass spectrometer to analyse atmospheric composition and the Methane Sensor for Mars to measure traces of potential atmospheric methane down to the ppm level.

Programme so far

Under the name of Mars Orbiter Mission (MOM) India launched its Orbiter from Satish Dhawan Space Centre, Sriharikota on 5th November 2013, exactly at 2.38pm (IST). The rocket on which the orbiter was launched was a polar satellite launching vehicle (PSLV-C25) weighing 320 tonnes and having a height of 44 metres. Rupees 110 crores have been spent in making this. It carried 1340kg Mars Orbiter costing rupees 150 crores. For augmenting the ground support about 90 crore rupees have been invested. In total about 450 crore rupees have been spent in this mission. About forty four minutes after lift off, the solar panels and the main dish shaped antenna of the space craft got successfully deployed. Subsequently, the other intended operations to accurately stabilise the spacecraft were also performed successfully.

The first orbit raising of Mars orbiter was performed in the wee hours on Thursday, two days after its successful launch into orbit around the earth. At 1.17 a.m., the first five liquid apogee motor (low) engine of 440 Newton thrust of the space craft was fired for
416 seconds by commanding it from spacecraft control at ISTRAC. With this the space craft apogee has been raised to 28,825 km while its perigee was at 252km.

The second orbit raising manoeuvre that started at 2.18am on Friday has been successfully completed. The on board motor of orbiter was fired for 570.6 seconds taking it to 40,186km apogee from the Earth level of 28,814km.

In this context, some comments on this Mission are noted below:

C.N.R. Rao:
Mars mission is a very good thing, they could have taken more time and done home work. They have done something and that needs to be appreciated.

K. Radhakrishnan:
MOM is a major step forward in our space programme and a turning point for us, as India will foray into the vast inter-planetary space for the first time with our indigenous capabilities to build satellites and launch vehicles. He admitted that the 450 crore mission was a complex and challenging task in view of the sheer distance, the journey duration and the 5 experiments to be conducted on the Martian orbit. Within 15 months our scientists have proved it. The next mission will be 780 days later in Jan 2016.

It is a precise and perfect launch and is the first major test in inter-planetary mission.

Madhavan Nair:
India’s Mars mission is utter nonsense. With a minuscule methanesensor, even if you want to look at methane can’t be done. It is not value for money. It is more disturbing that somebody is making a claim that they are going to find presence of life on mars. This is really a Moonshine.

Jean, Dreze (Economist):
This project is a part of the Indian elite’s delusional quest for super power status.

Amitabh Ghosh (Scientist - NASA):
ISRO’s priority should have been the development of GSLV rather than this mission.

U. R. Rao (Former ISRO Chief):
India spends around 5000 crores rupees on Diwali purchases and crackers and Rs 450 crores to reach mars is affordable. It is a great day for ISRO and the department of space.

K. Kasturirangan (Former ISRO Chief):
We have always had exciting moments in ISRO and this is an incredible excitement moment. I think first of all, given the 15 months time to take the mission to first level is something unbelievable for space programme of this level. Something we all should be proud of. It will become an important milestone for India when it completes 300 days and enters the Mars orbit.
Conclusion

We are living in an age of science and whatever we have achieved is based upon intensive research work. At times explorations and research works end in complete failure but this does not limit scientific temperaments. Our mars expedition is not outside the boundary of criticism. According to some activists "India is striving under poverty, hunger, illiteracy, sanitations and so many other burning problems. x x x". It may be mentioned that scientific achievements cannot always be achieved on cent percent result-oriented research work. A society is always burdened with problems that does not mean that the other corners of human life will be neglected. We have to utilise our scientific intellect, endurance, desire and provide the scientists with opportunities to keep up our nation's dignity. Hence it is rightly expressed by the chairman of ISSRO, A. Radhakrishnan that our space programme over the past five decades have been application centric and people centric. And we are deeply involved in making India a bright star in the field of astronomy and space science. So friends, let us join our hands to congratulate and appreciate the deeds of our scientists and expect an optimistic result from this mission.

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QUIZ:

COMPUTER SCIENCE

Titaram Nanda Brahmachari

1. VSAT can be described technically as an intelligent earth station connected to the geosynchronous satellite suitable for supporting a variety of two-way telecommunication and information services, such as, voice, data, and video. It stands for______?
   a) Very Small Amplitude Terminal
   b) Very Small Accelerated Terminal
   c) Very Small Aperture Terminal
   d) Value Added Satellite

2. HTTP is a web server. Its function is to send information to the client software using HTTP. It stands for______?
   a) Hypertext Transform Protocol
   b) Hypo text Transfer Protocol
   c) Hypertext Transfer Procedure
   d) Hypertext Transfer Protocol

3. SMPS is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. It stands for______?
   a) Simple mode Power Supply
   b) Switched mode Power Supply
   c) Simple mash Power Supply
   d) Switched Power Supply

4. The BIOS is a computer program embedded on a chip on a computer's motherboard that recognizes and controls various devices. BIOS stand for______?
   a) Basic input/output System
   b) Basic input/output Service
   c) Basic input device only Service
   d) Basic input/output device System
5. UPS is a battery that provides emergency power to a load when the input power source, typically main power, fails. It stands for ______?  
   a) Uninterruptible Power Supply  
   b) United Power Supply  
   c) Uninterruptible Power service  
   d) Uninterruptible Parcel Service

6. WWW is a system of interlinked hypertext documents accessed via internet with web browser. It stands for ______?  
   a) Work with web  
   b) World wide web  
   c) Word wide web  
   d) Worth while web

7. POP is an application layer internet standard used by local email clients to retrieve email from a remote server over an internet connection. It stands for ______?  
   a) Protection of protocol  
   b) Potation of protocol  
   c) Product of protocol  
   d) Post office protocol

8. MIME is widely used internet standard for encoding binary files to send them as e-mail attachments over the internet. It stands for ______?  
   a) Multiple Internet Mail Extension  
   b) Multination Internet Mail Extension  
   c) Multipurpose Internet Mail Extension  
   d) Multipurpose Internet mail Extension

9. PDF is designed by Adobe. This is a file format that captures all the elements of a printed document as an electronic image. It stands for ______?  
   a) Pure Document File  
   b) Part of Document File  
   c) Portable Document File  
   d) Portable Document Format

10. USB port of the Rear panel of a computer is used to connect the mouse, pen drive, printer etc. It stands for ______?  
    a) Universal Serial Bus  
    b) Universal Service Bus  
    c) Unique Serial Bus  
    d) Union Service Bus

11. PPP provides router-to-router and host-to-network connection over synchronous and asynchronous circuit. It stands for ______?  
    a) Pin to Pin Protocol  
    b) Pin point to point protocol  
    c) Peer to peer protocol  
    d) Point to Point Protocol

12. DNS is a hierarchical distributed naming system. It is used for translating domain name into IP addresses. It stands for ______?  
    a) Domain name server  
    b) Domain name system  
    c) Domain name service  
    d) All of these

13. ATM is a network technology, based on transferring data in cells, or, packets of fixed size. It stands for ______?  
    a) Asynchronous Transmission Mode  
    b) AnyTime Money  
    c) Automated Teller Machine  
    d) Automatic Teller Machine

14. FTP is a standard networks protocol. Allows transferring file from one computer to another over the internet. It stands for ______?  
    a) File Tranjection Protocol  
    b) File Transmission Protocol  
    c) File Transfer Protocol  
    d) All of these
15. CPU is a brain of a computer. Its primary function is to execute programs. It stands for ________?
   a) Central Processing Unit  
   b) Control Processing Unit  
   c) Conduct Processing Unit  
   d) Centre Processing Unit

16. PCS consists of power switch, reset button, turbo switch, indicator light, floppy drive etc. It stands for ________?
   a) Programme control system  
   b) Programme computer system  
   c) Personal Calculator system  
   d) Personal computer system

17. ASCII code allows manufactures to standardize computer hardware such as keyboards, printers and video displays. This code stands for ________?
   b) Asian Standard Code for Information Interchange  
   c) Australian Standard Code for Information Interchange  
   d) American Standard Code for Information Interchange

18. VDU is very similar to a television and its size is measured in diagonal length of the screen, such as, 12", 14", 15", 17", 19" and even in 21" size. VDU stands for ________?
   a) Video Display Unit  
   b) Visual Display Unit  
   c) Vocal Display Unit  
   d) Void Display Unit

19. An OS is a software program that controls the internal activities of the computer hardware and provides user interface. OS stands for ________?
   a) Open System  
   b) Organ System  
   c) Optical System  
   d) Operating System

20. URLs are the unique addresses of internet resources. A URL is divided into four parts such as Transfer protocol, Server name, Directory path and file name. It stands for ________?
   a) Unique Resource Locator  
   b) Union Resource Locator  
   c) User Resource Locator  
   d) Uniform Resource Locator

21. Website is a collection of information stored as web pages. The web browser in your computer is a client that requests HTML files from the web server. A web page is an electronic document written in computer language called HTML. It stands for ________?
   a) Hypertext Markup Language  
   b) Hyper text Markup Language  
   c) Hypertext Mark up Language  
   d) Hypertext Mark Language

ANSWERS

1. (c)  2. (d)  3. (d)  4. (a)  
5. (a)  6. (b)  7. (d)  8. (c)  
9. (d)  10. (a)  11. (d)  12. (d)  
13. (a)  14. (c)  15. (a)  16. (d)  
17. (d)  18. (b)  19. (d)  20. (d)  
21. (c)
GUIDELINES FOR CONTRIBUTING ARTICLES FOR THE MAGAZINE

1. "SCIENCE HORIZON" aims at developing the scientific outlook of students as well as the general people and seeks to give them information on scientific developments. It is published as a monthly magazine.

2. The authors desirous of writing and contributing articles to the magazine should first assimilate the ideas of the theme and present it in simple language and popular style.

3. The authors are requested to write clearly on one side of A/4 size paper. The relevant pictures in 4cm X 6 cm size are welcome. Photo copies of manuscripts are not accepted for consideration.

4. Each article will be ordinarily of two to three printed pages in A/4 size papers.

5. The article shall be profusely illustrated with pictures.

6. At the end of the article the author should give the references and suggestions for further reading.

7. The reference of books, journals, sources, ideas and essential points collected by the writer should be mentioned in the bibliography. This will enhance the quality and fidelity of the writing and give the reader an opportunity for making further studies.

8. Matter translated from other languages and illustrations should indicate the original sources otherwise those would not be accepted. The articles which are not selected are not returned to the authors. However, if the author wants, such articles may be collected from our office.

9. As far as practicable the articles should be based on contemporary science and must be easily comprehensible to students at the secondary level.

10. The writers should present difficult concepts of science through stories of everyday life, heart-rendering songs, pictures, satirical cartoons or attractive dramas.

11. All units in the articles should be given in the metric system.

12. The title of the article should be brief and attractive. Moreover, subtitles may be given in long articles. The writings should be coherent and cohesive.

13. There should not be repetition of specific words. While ensuring the contemporary spirit of the writing, it should reflect some valuable lesson for the society. It is also necessary to avoid mistakes in spelling, language use and factual details.

14. The Editor & the Editorial Board of "Science Horizon", Secretary of the Academy or Odisha Bigyan Academy shall not be responsible for the views of the authors.

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