EVERYMAN'S SCIENCE

Vol. XLIV No. 6 (February – March)

COVER PHOTOGRAPHS ***(From the Top)***

Past General Presidents of ISCA

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EDITORIAL

'Stagnation' literally implies a state of no change or no flow, which can be interpreted somewhat liberally as a stationary state. Many institutions or systems can be characterized—at some point in time or during a certain period—in terms of stagnation. And it will not be altogether wrong to argue that—in some situations and in cases of some institutions—stagnation at a particular state (which may correspond to the most desirable state that can be achieved within a given framework) is what is intended. However, a significant and oft-used connotation of the word 'stagnation' is something like showing no signs of improvement or progress. In fact, stagnation leads to retrogression in quite a few situations, unless appropriate remedial steps are initiated in time. In the context of our economy, we now-a-days hear about 'stagflation' implying stagnant inflation, or better, nagging inflation showing no signs of deceleration or decrease.

Many institutions in several sectors of human activity suffer currently from stagnation, after having grown reasonably well over the past. Institutions in academic and professional circles as well as those engaged in Research and Development including those which promote the cause of a particular branch of knowledge or of a particular profession provide ample illustrations of this phenomenon.

A host of factors explain this phenomenon, some are causative while some others are incidental. Some contributions to stagnation are imposed by the environment, while a good amount comes from within. Remembering that the majority of institutions or systems that we are speaking of are manned and led by a group rather than a single individual, the most important contributor to stagnation is the lack of foresight as also of hindsight on the part of these individuals, particularly on the part of those who take decisions and get them executed by others, not always involving them in appreciating the decisions and subsequently in implementing the decisions.

Proponents of progress—as opposed to stagnation—sometimes favour the idea of frequent changes in procedures and protocols, plans and strategies, allocation of responsibilities and authorities (without necessarily checking if these are commensurate with the responsibilities), communication and control mechanisms, and even codes and designations. Sometimes such changes—however drastic these may appear—have to be introduced to ward off stagnation. There are other situations where some of these changes are merely cosmetic and cannot produce any tangibe difference in performance. And in certain other institutions, changes are initiated simply for the sake of 'change' even though such changes are not warranted. We should not forget the unfortunate instances where changes introduced either with hidden agenda or with good intentions not backed up by adequate foresight have eventually led to deterioration.

Change is the only constant we can think of, and yet managing change is a delicate and difficult task. Experimenting with change—as is an accepted practice in many organizations–is not the same as managing change. In fact, changing the levels of some factors to study the impact of such changes on the response or responses which characterize the performance of a system to determine the optimum levels is a commonplace exercise in most industrial situations and also in research and development efforts.

How to assess the performance of a system or institution, what are the controllable factors that affect this performance, and what corresponds to changes in these factors are issues that merit a comprehensive discussion that keeps into account the specific character and even the development

of the concerned system or institution. It may a good idea to delve into such an exercise before we introduce changes which cannot be undone–if these need be–until it is too late.

By way of a digression from the theme of 'stagnation', let me close this swan song with a statement that the outgoing Editorial Board put an honest effort to usher in some changes–in both content and presentation–which were appreciated by some readers. Of course, mere appreciation by a handful of readers cannot speak of an improvement. The outgoing Board is confident that the new set-up will be able to enchance the reputation of Everyman's Science.

S. P. Mukherjee

"Science without religion is lame, religion without science is blind."

—Albert Einstein

PRESIDENTIAL ADDRESS

IMPACT OF SOCIETY ON SCIENCE

PROF. P. PARIJA* M. A., (CANTAB.), D. SC., F. N. I.

I am grateful to the members of the Science Congress Association for the honour done to me by electing me to be their President, although I realise at the same time how undeserving I am of that honour. It is perhaps in recognition of my long association with the Indian Science Congress in one capacity or another, because I am no longer an active worker in any branch of Science, but only an interested observer at close quarters. Such a position has certain advantages of its own. A specialised scientific worker is like a man inside the forest whose vision is often limited to the tree while an interested observer is like a man outside the forest looking at the forest as a whole. He not only sees the beautiful foliage, flowers, fruits and the harmonious blending of colours, but is also likely to notice the spark that may spread the forest fires. He may also speculate on the factors that might have inhibited the growth of the forests in some parts producing undergrown areas.

What little a man like me may say will therefore be based on the musings of an interested observer who had been a humble worker inside the forest. During the few minutes at my disposal, I shall deal with one aspect of the relation between society and scientific progress. Scientific discoveries in various directions have been utilised so extensively for the advancement of social welfare in all its aspects that one is likely to overlook the restraining influence society has on Science. Even today this influence is operating. Unless we guard against this, true scientific advancement may be hindered. It would be useful to know what these restrictions are so that one can guard against them in the interest of Science.

From the time human beings began to take interest in the natural phenomena around them, they have been curious about their causes and have formed tentative hypotheses. The earliest presumption based on human experience has been that every phenomenon is the manifestation of an intelligent being. Hence an individual deity had been presumed for each particular phenomenon. Thus gods of rain, wind, fire and light had been conceived. Later on, these were synthesised into a universal godhaed. When such hypotheses were consolidated into doctrines of faith, they hindered progressive thinking. Any dissent from the accepted doctrines was dubbed as heresy. We all know how free scientific thinking suffered in the West from doctrinaire orthodoxy and how the inhibitory influence has been overcome. As to the East in general, Whitehead in the course of his analytical study of the growth of Science in Europe makes one observation about China, India and Iran which deserves our attention. He says :

"There have been great civilisations in which the peculiar balance of mind required for science has only fitfully appeared and has produced the feeblest result. For example, the more we know of the Chinese art, Chinese literature, and of the Chinese philosophy of life, the more we admire the

* General President, Forty-seventh Indian Science Congress held during January, 1960 at Bombay.

heights to which that civilisation attained. For thousands of years there have been in China acute and learned men patiently devoting their lives to study. Having regard to the span of time, and to the population concerned, China forms the largest volume of civilisation which the world has seen. There is no reason to doubt the intrinsic capacity of individual Chinamen for the pursuit of Science. And yet Chinese Science is practically negligible. There is no reason to believe that China, if left to itself, would have ever produced any progress in Science. The same may be said of India. Furthermore, if the Persians had enslaved the Greeks, there is no definite ground for belief that Science would have flourished in Europe.

Whether the conclusion that these civilisations left to themselves would have produced any progress of Science or not is a debatable question. The assertion that the peculiar balance of mind made only fitful appearance requires scrutiny. Before one can accept such a generalisation, one has to analyse the factors which have exercised influence on human thought in these civilisations. If these influences are eliminated, it is doubtful if the human mind in these countries would be different from that in any other part of the world. It is admitted that scientific thought did appear, so contributions were made by these countries. There is no reason to believe that, given suitable conditions, such thought would not have continued, without any break. The fact, how-ever remains that after a certain stage scientific progress stagnated. In our country we have evidence that in the early centuries of the Christian era, this country attained a leading position in scientific achievements in all directions. Thus, for example during the period when Kalidas, the author of Shakuntala, lived, i.e. the 4th and 5th century A. D., we find mention of many illustrious names. To name only a few, Nagarjuna, the physician, Varahamihira, the astronomer, Vararuchi, the grammarian and Amar Singha, the lexicographer seem to belong to this period. These men were noted in their own branch of learning. Amar Singha in particular records in his lexicon careful observations on plants and animals and each synonym given describes particular character or group of character of plants and animals. There was, also an attempt at classification of living beings according to the habits and mode of reproduction. Our sculpture gives evidence of careful observation of the human and animal body and of the plant world. The period may be called the peak period of scientific thought and it extended over a few centuries, because the Chinese pilgrims, like Fa Hiyan and Houen Tsang speak highly of Indian medicine. It is recorded in the history of the Sui Dynasty that in early seventh century, books on Brahmin Astronomical Manual, Brahmin Mathematics, Brahmin Calendrical method and Brahmin Pharmaceutics were translated into Chinese. Not only that the Hindus, like the Greeks, regrarded Man as a part of the living world though endowed with certain special qualities that they called *Dharma* while Europe still clung to the idea of special creation of man.

"Man", said Anaximander, "was produced in the first instance from animals of a different kind". According to the Hindus—

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eating, sleeping, fear and reproduction, men have in common with animals. Dharma is the only speciality of man. Without "Dharma" man is like a beast.

If these lines of thought had been pursued unhindered, it is imaginable that true scientific progress would have followed. We have now to see why further progress stopped. While progress was being made in advancing knowledge through observation and deductions and reached the height in the early centuries of the Christian era, there

was running concurrently another line of thought, namely that knowledge can be acquired through intuitive perception. This power of intuition is either god-given or developed through prescribed exercises. Naturally such power was supposed to be inborn in a few. Those endowed with intuitive power prescribed certain exercises for the attainment of this superior quality and it was open to any man to follow the prescribed path to gain the intuitive power. This led to the cult of the sage or Preceptor and the disciple. According to this cult the disciple had to follow implicitly the path shown by the Preceptor. The result was that thought was canalised and unrestricted free-thinking which is so necessary for scientific progress, was hindered. Of these two means of acquiring knowledge, the one by developing intuitive power evidently got the upper hand and the other, namely that by observational deductions was superseded. The reason for this is not clear—possibly the exertion might have been the cause. The result was that free-thinking was restricted. Now and then one comes across instances of revolt against such restriction on thought but these did not change the main current.

It is not contended here that this line of thought has not produced anything good. By pure logical deductions, the ancient sages have arrived at conclusions which are similar to the conclusions arrived at by scientific methods. As an example, may be cited the atomic theory of Nyayavaisesika which deduces the existence of atoms from the known divisibility of perceivable material objects—a divisibility which must terminate at some stage. The terminal stage in this process of division gives the atom which is simple and partless. However, one effect of this cult was that men's mind turned inwards and all thought was directed towards self-improvement to gain the highest bliss, namely, to have communion with divinity. The surrounding world was considered unreal. So long as the sage remained the perfect man, no harm was done. Unfortunately nothing human remains stationary. The perfect man did not remain at the highest level and degeneration set in. All thought become self-centered and natural phenomena were observed as omens for divination based on faulty generalisation from insufficient data. Astrology, that pseudo-science based on emprical generalisation comes to one's mind as an example of such divination. When such ideas grip men's minds, all observations are biased and not scientific.

So far, as one can gather a similar line of thought was developed in China in Taoistic philosophy. This line of thought became wide-spread with the help of the preachers belonging to all schools. This is not peculiar to China or India. It is stated that in Greece, Science declined and ethics and metaphysics prospered on account of Sophists and itinerant lecturers and discussions. According to Casson, these lecturers were men without any specialised knowledge and they gravitated towards the kind of philosophy which had no need for any raw material other than the behaviour of men among themselves. This sort of canalisation of thought making it concentric appears to be one of the main factors which stood in the way of scientific advancement.

In addition to this and perhaps as an offshoot of this mode of thinking in our country there were restrictions put by authoritarian injunction on intellectual pursuits of men. As an example, one may cite Manu's classification of men into categories confining each to a particular sphere activity with heavy penalties for transgression. Although Manu lived before the peak period indicated earlier, and the original work did not prescribe rigid demarcation of boundaries between different categories these prescriptions by Manu underwent changes in course of time and by the period we are talking about or even before this period boundaries baked into rigid lines and castes became immutable. These inhibitions naturally stunted the natural propensites of capable men.

There are instances in which severe punishments have been inflicted if a man transgressed from his assigned sphere.

There was another factor which seems to have universal application and that is the absence of a sewse of security. Progressive thought is only possibile when people have a sense of security. At the peak period of intellectual development there seems to have been peace and prosperity in our country. Soon, however, internal strife and foreign invasions, especially by the Huns, destroyed peace in the country and security of the people. Invaders whether they are barbarians or civilised people seldom attach any value or pay any attention to the cultural achievements of the conquered country. The Romans did not pay adequate attention to Greek achievements nor did the foreign rulers of India attach much value in the beginning to our culture. When there is lack of peace and security and no encouragement from the rulers, all intellectual activity is either stopped or goes into hiding, so to speak, and confined to pure literary works as opposed to scientific activity.

Internal strife and foreign invasion seew to have had such effect on scientific advancement in our country after the peak period. The Ionian and Greek Science seems to have met with similar fate after foreign invasion. The "Athenians and most other Greeks", says Casson, "had become introspective and self-analytic. To some extent this might have been due to the incidence of the Pelponesian war which, like all wars, limited possibilities of genuine research and drove men into themselves. Science was, for the time being, overwhelmed". China also must have experienced such difficulties after repeated foreign invasions.

Thus we see that in our country and in other eastern countries so much as one can see, the two main inhibitive factors against free-thinking has been the authoritarian imposition of dogmas and foreign invasions. The former canalised human thought while the latter created a sense of security and subdued the free-play of human curiosity which is the bane of all scientific activity. In the West also these factors were operative a certain period. Up to that point there was not much difference between the West and the East so far as the Scientific thought was concerned. This was not a question of lack of balance of mind. The channel of thought was directed by external forces.

In Europe certain historical events occurred which led to intellectual freedom. The chief of these were the industrial revolution, voyages, discovery and the conquest of Byzantium by the Turks. Behind the industrial revolution was the desire to emulate the quality of imported goods from India and China and to produce them in large quantities so that trade might expand. This attempt at production led to empirical experiments in technology. These empirical experiments led ultimately to scientific experiments. On the other hand, the voyages of discovery were actuated by the motive of discovering the sources of the imported goods thereby promote trade. Incidentally from those voyages were brought back a mass of information and materials which, when studied, tended to shake the faith vested in dogmas. This process was aided by the greater access to Greek literature when on the fall of Constantinople Greek culture with its traditonal free-thinking moved westward into Europe.

Similar events did not occur in our country. The reasons are not far to seek. The social organisation and economic system were such that the incentive for revolutionary change did not exist. Different circumscribed groups or classes were enjoined to stick to the production of the goods assigned to them. Improvement of the process of manufacture was confined to the inventive ability of that group. The products were considered superior to those of other countries. Although contact with the outside world by land and by sea had been long established, and abundant evidence of such contact exists even

today in far-off lands, these voyages do not seem to be as fruitful as those in Europe. Reasons appear to be two-fold. Of the two classes of men who undertook voyages, one class had the mission of spreading spiritual doctrines. Perhaps the majority of this class did not come back to the homeland and their experiences were lost to the country. The other must have belonged to the class which was tradionally and religiously enjoined to follow their particular profession and hence had limited vision. Even then these contacts with the outside world were so disturbing to the orthodox at home that a ban was placed on voyages beyond the seas. Those who undertook voyages were put in the same category as convicts and perjurers and were banned as social outcastes by Manu.

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Even journeys to the eastern parts of India were prohibited except for the purpose of pilgrimage.

Apart from these considerations, people seem to have developed a superiority complex which does not encourage perceiving or receiving anything good in other civilisations. A Chinese pilgrim records that at a farewell gathering at Nalanda, the Indian monks asked him to stay on in India as in his country there was nothing worth going back to. If this was the attitude of those devoted to study, one can imagine what would have been the attitude of the others.

Other peaceful cultural contacts were neither many nor lasting to have any influence on the mental attitude of the people. There was some exchange of thoughts and ideas with Greece but there does not seem to have been any change in the intellectual attitude.

When, however, there was lasting peaceful contact with the free-thinking world, an age of intellectual freedom was ushered in. Those Indians who responded to this liberalising influence have made notable cotributions to scientific advancement. Freed from the restrictive social influences, the Indian mind is equally capable of scientific thought as any Western mind. This can be said of all eastern peoples.

We have so far analysed the inhibitory influence society had imposed an scientific advancement. Now let us examine whether such influences are operative today. Although these influences may not appear in the crude forms of the bygone days, yet it will be seen that they do exist today. Group-consciousness based on race, religion, language and social ideologies has raised it ugly head and has led to various conflicts all the world over. In our country despite efforts to the contrary, there is a recrudescence of narrow group-consciousness. When group-consciousness makes its appearance, it leads to grooved thinking. We have already seen that such canalised thought is not conducive to scientific advancement. On the other hand, it generates hatred and exclusiveness. In such circumstances, the rivalry and fear-complex in the antagonistic groups actuate them to develop means of self-defence against apprehended conflicts. The scientific discoveries already made are utilised to perfect weapons of self-defence. The spectacular utilisation of nuclear energy is an example to the point. During the process of perfection of such weapons, an astounding quantity of scientific data and information has been gathered as a by-product. No doubt these data and information are valuable for fundamental Science, but it is permissible to envisage that if there had been cooperation between the various groups engaged in such activities and if they had been actuated with the motive of elucidating the ultimate foundation of natural phenomena, greater success would have resulted. In place of fear and rivalry the knowldge obtained would have been shared by the whole human races and would have been applied for the welfare of the whole mankind. It will not be out of place to quote what Bertrand Russell says on this subject. He says.

"The creation of satellites has given pleasure to schoolboys and statesmen, marred only, for the West, by the fact that the first satellite was Russian. As yet, satellites are small ; but it is not to be supposed that they will remain so. They do not at present carry weapons of offence, but militarists everywhere hope that they will carry such weapons before long. By means of electronic computers, they can be timed to rain death upon enemy regions, while suspending this useful activity during their passage over friendly territory. Such weapons will be enormously expensive, but on each side it will be argued, 'if the enemy may have them, we must see about having them too."

He goes on to say, "But I am afraid that it is from baser motives that people are willing to spend enormous sums involved in making space-travel possible".

We have seen earlier that a sense of insecurity and invasions were responsible for making people self-analytic and hence scientific thought was hindered. The same feeling in another form is operative today. Some of the ablest minds are being diverted to channels not leading to fundamental scientific advance.

There is another undesirable effect of confining one's thought to the narrow limits of a group. Science and literature require encouragement and patronage. Group-consciouseness leads to limit such patronage to talents inside the group. Such talent may be of the highest quality judged by any standard but it may also be of a mediocre quality. Confining patronage to the latter type of talent means that we are satisfied with the minimum while a broader outlook can secure the best available type as the object of patronage.

We have so far seen that one of the limiting factors, namely, the one generated by a sense of insecurity and desire for self-defence, is operating today though not in the same crude form as in the past. Let us see the second one, namely, imposition of doctrinal dogmas on men's mind is also operative today. In some parts of the world social revolution has led to the reorganisation of society. One of main arguments for such reorganisation is that, given the same nurtural environment, every human being can attain the same intellectual height irrespective of hereditary limitations. In other words, qualities acquired under environmental influences during short exposure to such influences become permanent and heritable. On the other hand, the results of prolonged biological investigations suggest the nurture can only bring about the development of hereditary potentialities. No one denies the possibility of the hereditary composition of the individual being altered by environment provided the environmental conditions are so prowerful that they affect the nature and composition of the carrier of hereditary characters. But to say that short exposure of the individual to altered environment during the lifetime would produce heritable changes is to discredit all experimental evidence on heredity. In order to emphasise the overall importance of inheritance of acquired characters, some scientists have made attempts by uncritical experiments to produce evidence to the effect. According to Julian Huxley, "it is less a branch of Science comprising a basis of facts than a branch of ideology, a doctrine which it is sought to impose upon facts". Whether such attempts are designed to secure the good will of the powers that be or they are the result of directives from above, the influence of doctrinal imposition on scientific investigation is clearly indicated. What is happening in one part of the world may happen in any other part.

Man is naturally prone to impose his ideas on others. If such attitude is supported by age-old tradition as in our country, it may become a common custom. In our country and possibly in

the eastern countries in general, the danger of the revival of authoritarian tendency is real. Rude awakening to the reality of this danger comes when a sooth-sayer or miracle man attracts to his door even men with scientific training. Recent political happenings might give an impetus to such revival as a reaction against western political domination. One already sees signs of such harking back to the past. This in itself is not condemnable but if it revives authoritarian domination, scientific thought is in danger.

In this brief account the inhibiting influences of society on Science are indicated as one sees them. Men of Science all the world over should guard against such obstacles if probing into the mysteries of nature in search of truth, is to continue unhindered. Only by cooperation and not by unhealthy competition can the mysteries of nature be unravelled by the men of Science and through the application of their discoveries the welfare of mankind will be assured.

FOOD HAZARDS AND FOOD SECURITY

Sanhita Majumdar*

Every sensible human being is very much conscious about his/her food intake and food habits. Keeping this in mind, nowadays food security is a hot topic of discussion and everybody has a concerned interest in it. In this article, some very common food related problems are discussed and their probable solutions are indicated.

INTRODUCTION

Food is one of the basic requirements of life. Organisms derive material and energy from food. However, we'll concentrate on food for humans only. Although we depend on nature for our food, we do not always consume food in their natural forms. We often cook or process them to improve upon both nutritionally and aesthetically. During processing, it is common to add ingredients to make food tasty, get flavor and look colourful. Processing also involves heating, cooling, thawing, etc. which are also responsible for physical and/or chemical changes. From the point of view of health, food materials available naturally may not always be free from components or contaminants that are not safe for ingestion. The physical and chemical treatments involved in processing food may also generate or introduce substances that are not good for human health. Such contaminations of food with undersirable substances–natural or artificial–may be called *foods hazards*. By taking such foods we often invite, knowingly or unknowingly, many different types of health-hazards or ailments.

Food-security is much wider in scope. Humans feel secured in respect of food when, firstly, there is an uninterrupted supply and secondly, the available food-materials are of sufficiently good quality, not posing any threat to health. Supply of food at a given time to a specific community of populations is controlled by production, distribution, economics and politics. I shall not discuss them. But the availability and maintenance of quality-food are very much dependent on our attitude, culture, habits and on the type and extent of our processing, etc. This falls within the scope of *environmental public health* which is one of our major concerns.

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NATURAL TOXICANTS IN FOOD

The food that we take daily may not always be safe. Sometimes, besides being nutritionally poor our food may contain undesirable, even harmful substances. With a view to avoid eating them, or getting rid of such food before eating, the following discussions would prove useful :

Edible Oils

Oils, mostly vegetable oils, are widely used as cooking medium. We in India, and particularly in West Bengal, are in the habit of consuming mustard oil. But unrefined mustard oil (and rapeseed oil) contains a lot of erusic acid (Fig. 1) that gets deposited in tissues of heart and causes it to swell. Sometimes mustard seeds get mixed with argemone

seeds (or intentionally adulterated) which yields argemone oil, a toxic and it functions as co-carcinogen. But mustard oil is preferred due to its particular flavour, hence its amount may be restricted or reduced. Nowadays varieties of vegetable oils such as sunflower oil, soyabean oil, groundnut oil, corn oil, etc. are available. All the oils have their characteristic mono-and poly-unsaturated fatty acid (MUFA & PUFA) and saturated fatty acid compositions. They differ nutritionally.

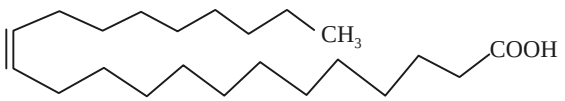

Fig.1: Erusic Acid [Δ^{13}-cis dicosenoic acid] ($C_{22}H_{42}O_2$)

Experts suggest that it is better to use a mixed or blended vegetable oil for best nutritional results. Rice bran oil, now available in the market, contains some typical antioxidants that are not found in other edible oils and thus may be partly used in our kitchen.

Solanine in Potato

Potato which is one of our important vegetables, may sometimes contain natural glycoalkaloid toxins of the solanine group. Six solanine alkaloids are well known : α, β, γ solanine and α, β, γ chaconine. They get concentrated particularly in damaged or green portions (exposed to sunlight) of potatoes. We should avoid eating these affected parts.

Fungal Infections

Foodstuff spoiled by growth of *fungus* is quite common. Corn, wheat, bazra, rye, etc. are sometimes–especially on long storage, infected by fungi of the ergot group. They liberate toxins known as *ergotoxins.* Although some of them have medicinal value, human consumption of such materials-whole or powdered may cause vomiting, stomach-ache, diarrhoea, etc. Ergotoxins comprise of at least ten ergot peptide alkaloids and lysergic acid, lysergic acid amides resemble the notorious psychotropic drugs, LSD. The fungi and their toxins can be easily removed by washing the affected cereals with 20% saline water. Fig.2 shows the growth of mold on loaf; however, such things can be treated with vinegar to get rid of the hazards of such fungal infections. Diseases caused by fungi in man are called *mycoses* and are more common in temperate climates. Majority of diseases are caused by bacteria and virus, a limited number of diseases are due to fungi.

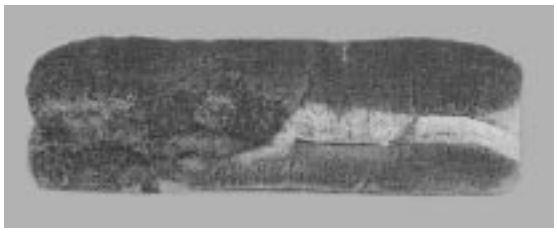

Fig.2 : Mold growth on loaf; right half was treated with vinegar

Oxalic Acid and Oxalates in Tuber Vegetables

Arums, Corms (oal) and such other vegetables which grow underground as tubers, contain excessive amounts of oxalic acid and oxalates which help to precipitate out calcium, magnesium, iron, copper, etc. as insoluble oxalates and deprive the body from the mineral nutrients. Prolonged consumption of such tuber-vegetables may cause 'stones' in Kidney and bladder. In India poor people in the hilly regions of Tripura, Rajasthan etc. are compelled to consume tubers as their main food. Incidence of 'stones' in their kidneys are quite high. The problem is aggravated by scarcity of water in those regions.

BOAA in Khesari dal

Khesari dail is a cheap source of nutrition amongst the poor people in India. But it contains a biotoxin called Beta-N-Oxalyl Amino Alanine (BOAA) (Fig. 3) that affects the nerve system and

makes people cripple. This was first noticed in some of M.P. villages. Lot of research has been done on it and it is now possible to get rid of the toxin by boiling the pulse in water and rejecting the washing before cooking.

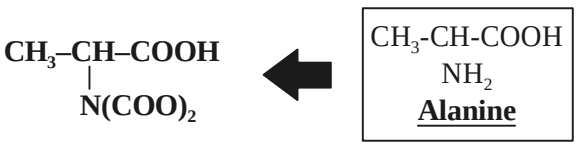

Fig. 3: (BOAA) Beta-N-Oxalyl Amino Alanine

Being cheaper, powdered khesari dail is often used for adulteration in powdered pea or chana (choola) known as besan and potentially threatening for human health.

Antivitamin

Some kind of food materials, e.g., certain vegetables and uncooked fish contain materials which destroy vitamins. For example, soyabean contains antivitamin D, which destroys vitamin D.

Goitrogens

Green cabbage, uncooked soyabean, red cover of groundnut and some others are responsible for non-assimilation of iodine in our body and prolonged consumption of such materials may cause goiter (iodine deficiency disease).

Deadly Mushrooms

Mushrooms are of high protein content and are popular. Though not all mushrooms are edible (some varieties that release toxins). Only the safe varieties are available in the market. The worst is *Amanita phalloides* (Fig. 4) which is literally deadly. The toxin released by this mushroom is alpha-amanitin which hinders RNA synthesis in our body. We must however be careful to avoid these toxin-generating mushrooms.

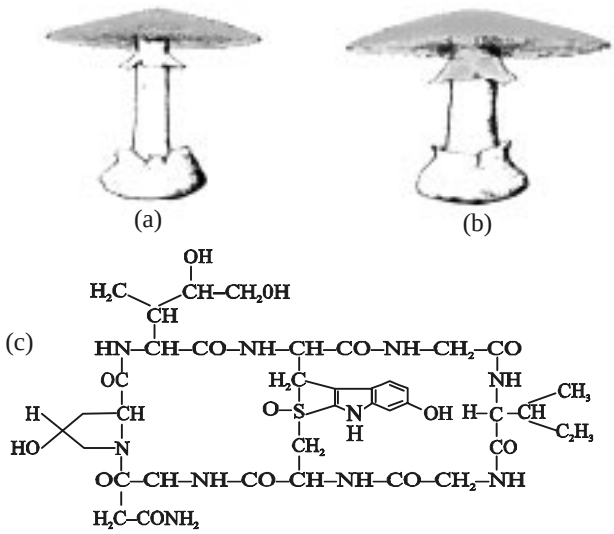

Fig. 4 : Some deadly mushrooms (a) *Amanita virosa* (commonly known as 'death angel') (b) *Amanita phalloides* (commonly known as 'death cap') (c) *Alpha amanitin.*

Aflatoxin

In the fungi, grown on long-stored cereals, red covers of groundnut, containers of milk-products, the fungus *Aspergillus flavus* is common. It releases a toxin which is called aflatoxin. This group of

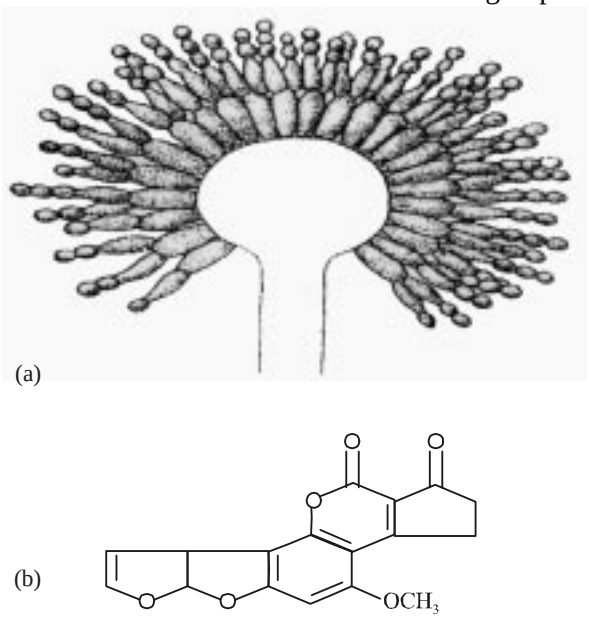

Fig. 5 : (a) *Aspergillus flavus* (microscopic view) (b) Aflatoxin

mycotoxins are coumarin type organic compounds and are highly toxic and known carcinogen. It affects the red blood cells (RBC) and the brain. Fig. 5 shows the microscopic view of *A. flavus* and the chemical structure of the most toxic aflatoxin B. In 1960 about 100,000 Turkey birds died within a few months in England because of aflatoxin coming from contaminated peanut meal feed.

MICROBIAL CONTAMINATION OF FOOD

During processing and storing food, pathogenic organisms may be contaminated. A large number of people fall victim to contaminated food.

Many of our foods are excellent growing media for microbes. *Clostridium botulinum* is a dreaded microorganism that releases a deadly nerve-toxin called *botulin.* Botulins are neurotoxins-there are seven serelogically distinct types designated as botulin A, B, C, D, E, F and G. They prevent the release of acetylcholine from presynaptic nerve terminals at the neuromuscular junction. Among other toxin-releasing microbes, *Clostridium perfringens, staphylococcus, salmonella, Bacillus cereus* etc. may be specially mentioned. Although toxins generated by them are not as dangerous as *botulin,* but they are also potentially very serious threats to human lives. Salmonellosis' origin can be traced to eggs and chicken meats. The ailment is expressed through headache, abdominal pain, nausea, diarrhoea, shivering and fever. Normally starts within 12-48 hours of infection and lasts for 2-3 days, which we commonly express as 'food poisoning'. *Listerisis* is another common ailment resulting from infection of *listeria*. Most common sources are unpasteurised milk products, improperly cooked meats and cooked chilled foods. Manifestations are like common flu-aches and pains accompanied occasionally with fever. Expectant mothers should be specially cautious as miscarriages and stillbirths have been linked to listerisis. *Taxoplasmosis* is yet another disease caused by infection coming from improperly washed raw vegetables grown particularly on soils often visited by cats. Infection may also come from undercooked meat and pork. Fig. 6 Shows Oidium group of fungus most commonly found in milk and milk-products.

In many cases, the water used for the preparation of food materials is the source of contamination. Milk and milk-products like curd (doi) is a very good substrate for growth of these pathogenic microbes. A little care may help us to avoid many of such hazards. The foods must be cooked properly, preserved scientifically, must not be left open and unattended for long durations. Unpasteurised drinks-milk and fruit-juices, cooking before complete defrosting, refreezing after cooked food has been defrosted once, use of raw meats and eggs should be avoided as far as possible. Water used should be free from organisms and of good quality suitable for drinking.

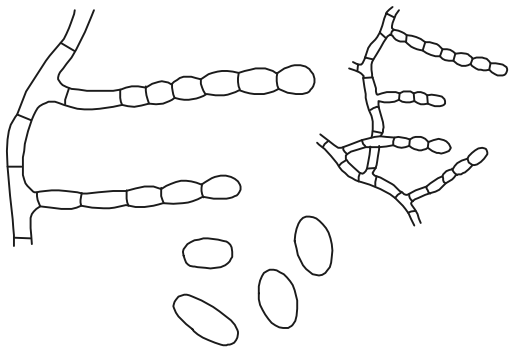

Fig.6 : *Oidium lactis*, an imperfect fungus, one of the fungi most commonly found in milk and cream.

FOOD ADDITIVES

We often use chemicals and other additives to food and food-source materials to 'improve' them for better marketability and acceptability. The estimated total number of food-additive chemicals is more than 20,000, which may be classified into about a dozen different groups, such as preservatives, antioxidants, emulsifiers, stabilizers and thickeners, buffering and sequestering agents, colourants, flavouring agents, bleaching and

maturing agents, nutrient supplements, non-nutritive sweeteners and anticaking agents. But even this practice is not without hazards. The additives must be assessed for their potential effects of toxicity-acute or chronic, mutagenicity or carcinogenicity and teratogenicity (embryo-toxicity). Though not comprehensive, yet a few important areas are discussed below :

Colour Additives : Stale and discoloured vegetables are often artificially coloured to make them appear fresh and brighter to fetch a good price. Some green vegetables are coloured by using solution of *malachite green* (Fig. 7a) in water. Malachite green is a synthetic dye. Chilli powder, tea etc. are coloured red usually by *congo red* (Fig. 7b), turmeric is coloured bright yellow with *metanil yellow* (Fig. 7c). Sometimes powdered turmeric has been found to contain yellow and heavy lead chromate. All these additives are dangerous to human health.

Prepared sweetners are sometimes coloured yellow with *metanil yellow*, a synthetic organic dye which is carcinogenic. Other synthetic dyes are also used to impart colour to sweets.

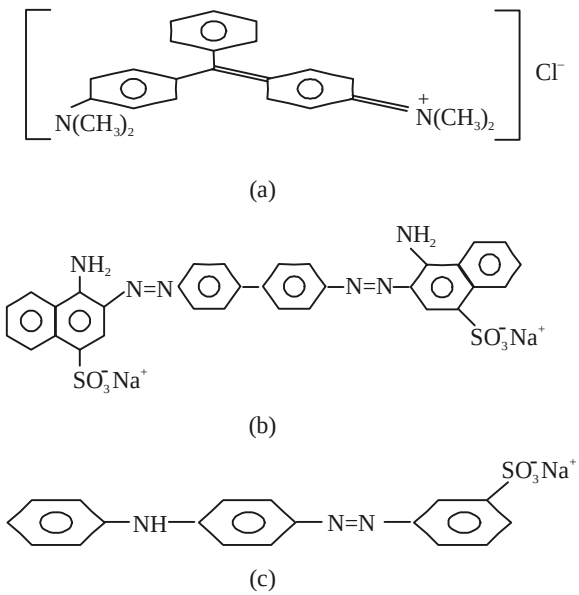

Fig. 7: (a) Malachite green, (b) Congo red and (c) Metanil yellow

In india, these synthetic dyes and colours are prohibited by law. The permitted colours are either natural or derived from natural things. Rules pertaining to Prevention of Food Adulteration Act usually specify the names of the colouring agents permitted along with their Acceptable Daily Intake (ADI) quantities and their Maximum Permissible Levels (MPL). **Table** below summarises them.

Table : Colours permitted in India under the PFA Act

Natural : Turmeric, Annate, Caramel, Carotenoids, Chlorophyll, Riboflavin, Saffron.

Synthetic :

Colouring		ADI (mg)	MPL (mg/kg body wt)
Red	Ponseau 4R	0.75	30-300 (diff.Foods)
	Carmoisine	0.50	
	Amaranth	0.75	30-200
	Erythrosin	1.25	30-300
Yellow	Tartrazine	7.5	30-200
	Sunset Yellow FCE	5.0	30-200
Blue	Indigo Carmine (Indigotine)	2.5	200
	Brilliant Blue FCF	12.5	100-200
Green	Green S	5.0	100-200
	Fast Green FCF	12.5	200

Taste Enhancers and Other Additives in Food

A common taste-enhancer, especially used in Chinese foods, is agino moto or monosodium glutamate. Many surveys have indicated that prolonged consumption of food containing agino moto and other additives common in Chinese resturants, may adversely affect the nerve-system and causes depression and other disorders. They have been branded collectively as Chinese Restaurant Syndrome.

Nitrites and metabisulphites are widely used as *preservatives*. They too are not friendly to human health and care should be taken to remove them before preparation of foods to be served on the table. In fact, nitrite type preservatives are

responsible for the formation of carcinogenic chemicals like *nitrosamines* such as *N-nitroso dimethyl amine, N-methyl N-nitroso methanamine.*

Soft Drinks and Others

According to a survey report in 1997, 'soft drinks' worth 42 billion dollars were sold throughout the world. India too is a big market of soft drinks. *Pepsi, Coke* and other soft drinks are very popular. These are alcohol free and are flavoured aqueous drinks and enjoy popularity amongst all ages, as it is believed that they are made from harmless ingredients. But the belief may not be well founded. Soft drinks usually contain cocoa-extracts which contain alkaloids, use of phosphoric acid is known to harm bone and teeth; along with the use other unspecified chemicals and water of uncertain quality. Recently, Center for Science and Environment (CSE), New Delhi had reported alarming concentrations of residual pesticides in samples of *Pepsi* and *Coke* collected from markets in Delhi and around. The Govt. of India has appointed a Joint Parliamentary Committee (JPC) to look into the matter. Waste discharges and sludges from brand soft drink factories in Kerala and West Bengal have been found to contain large concentration of cadmium and other heavy metals. All these, it is hoped, will be looked into by the JPC. CSE, New Delhi, in the mean time, has pointed out that the laws and standards in our country are inadequate to deal with the situation - there is no appropriate legal tools to ensure quality of marketed soft drinks in India. This is a serious public health issue and requires immediate attention. JPC, in its report, has also upheld that the Governments should be more vigilant in the activities of the brand soft drink producers, they should also refrain from indiscriminate use of underground water. But the people at large must have their say. We can largely avoid drinking beverages of questionable quality.

Not only soft drinks, other ready for-use fashionables like icecream, jam, jelly etc. also are generously coloured, flavoured and sweetened. There is no procedure to check their quality and we must be on the alert. The so-called 'mineral water' sold in bottles are not above question. Consumer Education and Research Society of Ahmedabad found that 5 out of 6 samples of bottled water fell short of standard quality. Here also, the governmental control is inadequate.

Food Hazards Due to Residuals and Others

Pesticides and varieties of other agrichemicals are now-a-days widely used in agriculture, plantations, etc. Careful analysis have shown that cerals, fruits, vegetables, tea etc. occasionally contain alarming concentrations of pesticides and other chemicals, some of them are straightaway toxic, some are bioaccumulated in specific organs of humans and other living species. Some even reach to the humans biomagnifiedly through the food chain.

Dioxine (Fig. 8a) is a typical representative of derivatives of *dioxan* (TCDD) and remains as a by-product in popular weedicides such as 2,4-D or 2,4,5-T (Fig. 8b and 8C).

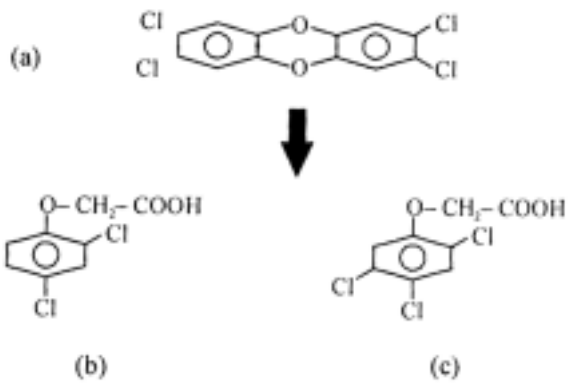

Fig. 8 : (a) Dioxin or TCDD (2,3,7,8 tetrachloro dibenzo (b,e) 1,4 dioxan) (b) 2,4 D (2,4 Dichlorophenoxy acetic acid) (c) 2,4,5 T (2,4,5, Trichlorophenoxy acetic acid)

Dioxin is historically infamous. It was a component of *Agent Orange*– a devastating defoliant used by the US army in Vietnam in the

1960's. The tragic incident responsible for large-scale devastation and death in Seveso, Italy in 1976 was due to an industrial explosion that took place during synthesizing trichlorophenol when accidentally dioxin was formed and accumulated in the reaction vessel.

Very recently, the whole of the Asian continent has come under the threat of *Bird Flue.* Billions of poultry-birds are being destroyed to check the endemic spread of the deadly virus, H 5 N 1 (H-Haemaglutinin, N-Neuraminaides) that is capable of being transmitted to man through the infected poultry and products causing type A influenza. Not only are our security and availability of eggs and chicken in great danger, the whole economy of the country might be devastated.

GENETICALLY MODIFIED (GM) FOOD

Genetically Modified (GM) food has added a new dimension to anything related to our food. Genetic manipulation and modification using recombinant DNA technology and other developments are now-a-days a reality and influencing our lives in many ways. On the one hand biotechnology has brightened the prospects of increased food production and improving qualities in many ways, but on the other hand, it has also raised serious questions about food security. The controversy is already strong. Proponents claim GM food to be the panacea for any kind of food problem, while the antagonists apprehend unforeseen dangers in GM food. Scientists have been studying the potential dangers related to GM food.

To impart certain qualities to crops, Bt-gene (*Bacillus Thuringensis)* is incorporated into tobacco, cotton and paddy. It was established that this gene-manipulation results in deposition of a toxin (Bt-toxin) and renders paddy unsuitable as paddy. In UK, GM potato has been studied at length and was found that such potatoes weaken the immunity of experimental rats towards certain diseases. GM crops-cereals, oilseeds etc. require specific uses of pesticides, herbicides and other chemicals that are produced and marketed by giant multinational companies only. The seeds are developed and marketed by the same group of MNC's and the farmers in different countries will lose their control on seeds and production technology – this is one of the important allegations of the opponents. This, they uphold, will severely affect food security of highly populated countries like India.

Evidences are also accumulating that GM foods may be strong allergens and cause other problems in the long run. In an experiment in Europe, conducted over five years, it has been observed that in and near the fields cultivated with GM crops (oilseeds like soyabean etc.), severe distortion and loss of biodiversity occur. Weeds of uncontrolled growth, pests resistant to any pesticide, reduction in biodiversity etc. have been observed. Long-term effects on genetic make-up of humans consuming GM food are other matters of concern to many scientists.

In the West, in Europe and in US, people are highly sceptic in consuming GM food. The Governments, have imposed strong restrictions in production and selling of such food materials. It is mandatory to declare whether the food-item marketed is genetically modified or not. Recently Monsanto Corporation, one of the leaders in GM crops, is reported to have dropped their programme for GM wheat, fearing insufficient market.

Faced with such situations GM foods are being exported to other countries with food-shortage such as to the developing countries. In those countries, legislations are weak and the GM-declarations are not mandatory. The total picture is potentially much threatening and confusing. Science and good sense of people associated with GM food, can only be hoped, to solve the problem and mankind will not be pushed towards a dangerous insecurity.

EPILOGUE

Few years ago, in February 2004, a *National Food Security Summit* was held in New Delhi organized jointly by *M S Swaminathan Foundation* (Chennai) and *World Food Programme,* (a UN agency) for tackling global hunger. On the auspices of this summit, *An Atlas for Sustainability of Food Security* (for India) has been brought out. Although this report has not *directly* taken into consideration the question of *quality* of food but it has *indirectly* incorporated it through the consideration of the aspect of *absorption* of food that takes into account the major environmental factors making up *environmental public health.* The *atlas* is a welcome beginning in the right direction and with more application of science and tehcnology in production and processing of food, a comprehensive assessment of *sustainability of food security* may be arrived at to help move towards *sustainable development*.

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DO YOU KNOW ?

Q1. Why the people in the northern latitudes are of lighter, white skin ?

Q2. What is the full form of A.M ?

Q3. How accurately horizontal is the base in case of the pyramid.

MODERN CULTIVATION TECHNOLOGY OF AONLA

P.K.Gupta* and M.C.Singh**

Aonla, the indigenous fruit has highly nutritous and medicinal value. This article deals with the modern cultivation technology of Aonla.

INTRODUCTION

Aonla or Indian gooseberry is an indigenous fruit to Indian subcontinent. Owing to hardy nature, suitability to various wastelands, nutritive and therepeutic values, aonla have become an important fruit. It is grown in tropical Asia and is widely grown in tropical India, where it is endemic to the state of U.P., Bihar, M.P., Gujarat, J&K, Karnataka and Tamilnadu. Owing to its high nutritive and medicinal value and higher productive potential even in wasteland, its cultivation is increasing in every part of the country. The crop is now being explored for its value added products, which has bright future prospects for export particularly to European countries.

TAXONOMY

Aonla (*Phyllanthus emblica*) a euphorbiaceous, medium height tree and possesses the (2n) = 28 chromosomes. It is referred as evergreen in tropical countries but exhibits deciduous nature in subtropics. The bark is smooth and comes off in thin strips. Leaves are simple, flowers are same in leaf exiles and starts flowering in spring.

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USE AND NUTRITIVE VALUE

Aonla is regarded as sacred tree and has mythological significance as "Amrit Pani" in old literature. Ayurveda has recommended this fruit for balanced diet and sound health and it is an important ingredient of triphala and chyavanprash. Dried fruits are used in diarrhea, dysentery, jaundice, dyspepsia and cold. It is used either in fresh form or as preserve like murabba, chutney, pickle, jam, jelly, sharbats, etc. It is also used in the preparation of hair oils, hair dyes and different kinds of body lotions. It is highly medicinal and nutritive as it is one of the richest source of vitamin C(500 – 1500mg/100 g pulp). Fruits are also rich in pectin content and minerals like iron, calcium and phosphrus.

CLIMATE AND SOIL

Aonla is subtropical plant and prefers to grow well in dry subtropical climate. A mature aonla tree can tolerate freezing as well as high temperature of 46ºC. Ample humidity is essential for initiation of fruit growth of dormant fruitless trees during July-Aug. Dry spells result in heavy dropping and delay in initiation of fruit growth.

Since Aonla is a hardy plant, it can successfully be grown in variable soil conditions and has deep root system. Thereby, it reduced foliage, fruits flourish. Aonla can be cultivated in marginal soils,

slightly acidic to saline/sodic (pH 6.5-9.5) soil conditions. However, the heavy soil or high water table is not suited for its cultivation.

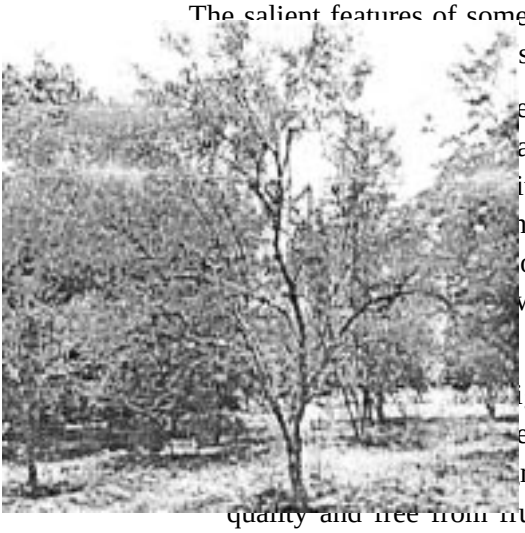

Fig. 1. Aonla Tree

CULTIVARS AND THEIR FEATURES

The salient features of some of the commercial
scribed as follows :

ect, semi tall with
aturities obtained in
it is large (48 gm),
nd thin whitish green
ource of vitamin C
ws the poor keeping

ight growth, fruit
er to mid January.
reen, good keeping
quality and free from fruit necrosis.

3. **Francis :** Tree of this variety is tall erect with drooping branches. Fruit matures in mid November. Fruits are large, flatted, light green and smooth. The skin of fruit is fresh white green and yield is moderate.
4. **Kanshan (NA-4) :** This variety is tall and of spreading growth habit. It bears more of female flowers/branchlet, matures in mid-November. Fruits are small (30 gm), flattened and oblong. The skin of the fruit is thin and keeping quality is good. It bears profusely (74 kg fruit from an eight year old tree).
5. **Krishna (NA-5) :** Trees are semi-tall and of spreading habit. Fruits get mature in mid-October. Fruits are of medium to large size (45 g). The colour of the fruit is fresh pinkish to yellow. It bears moderately (41 kg/plant of eight year old).
6. **Amrit (NA-6) :** Trees are tall with upright growth and have mid season maturity. Fruits are medium (35g) in size, bearing is heavy (56 kg/eight year old tree).
7. **NA-7 :** A seedling selection from Francis. It is precious, prolific and regular bearer (9.7 flower/branch let). This is ideal variety for preparation of food and medicinal products of great promise.

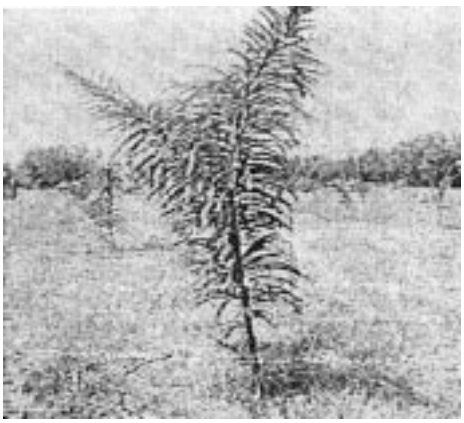

Fig. 2 : NA-7 in early establishment phase

8. **NA-9 :** Trees are tall, semi spreading and early maturing with average fruit weight of about 50 gm, moderate bearer.
9. **NA-10 :** Trees are semi tall with semi spreading habit. Fruits mature early and have large fruits (41 gm). Variety is highly productive and ideal for commercial cultivation.

PROPAGATION

Aonla is propagated by seed as well as by vegetative methods. Aonla plants raised from seeds do not ensure true to type plants and bears fruits of inferior quality. To overcome this variability, vegetative propagation should be adopted. Seedlings are required to raise through seeds. Seeds are soaked in water for 12 hours before sowing. The seedlings of 10 cm height when transplanted after holding three days under shade give better establishment.

ESTABLISHMENT OF ORCHARD

Planting

Grafted or budded Aonla plants are planted 8-10 meter apart during June-August or February in the pits of size 1×1×1 meter dug 1-2 months prior to planting. In each pit 25 kg well rotten farm yard manure (FYM) or 4-5 kg "Multiplex Annapurna" organic manure mixed with 1 kg neem cake and 500g bone meal with soil and filled much before the time of planting. However in the sodic soils, 5 kg gypsum along with 20 kg sand is incorporated. Planting density can be kept optimal i.e. 156 plants/ acre by planting them at the distance of 8 meter in a row from plant to plant.

Intercropping

Aonla being a deep rooted, deciduous tree with sparse foliage is an ideal and amicable plant for 2 or 3 cropping system. Fruits, vegetables, flowers and a few medicinal and aromatic plants are well suited for intercropping in aonla orchards. Some models are Aonla + Ber (2tier), Aonla + Guava (2tier), Aonla + Ber + Phalsa (3tier), Aonla + Dhaincha + Wheat or Barley (3tier), Aonla + Dhaincha + Onion/Garlic/Fenugreek or Brinjal and Aonla + Dhaincha + German Chamomile (3tier).

Fertilizers And Manure

The dose of fertilizers depends upon soil fertility, age of plant and cultivars. A dose of 8 Kg F.Y.M. or 2-3 Kg Multiplex Annapurna organic manure, 100g nitrogen, 50g phosphorus, 100g potassium and 50g Multiplex Zinc High Should be given to one year old plants of Aonla as per the given Table. Full dose of F.Y.M and Phosphorus and half of Nitrogen and potassium should be given in tree basin during January–February. However, the remaining half dose should be applied in August.

Table : Recommended fertilizers and manures of Aonla.

Year of Planting	N (g)	P (g)	K (g)	Multiplex Zinc High(g)	F.Y.M (kg)	Annapurna (kg)
1	100	50	100	50	8	3.0
2	200	100	200	75	12	3.5
3	300	150	300	100	15	4.0
4	400	200	400	125	20	4.5
5	500	250	500	150	25	5.0
6	600	300	600	175	30	5.5
7	700	350	700	200	35	6.0
8	800	400	800	225	40	6.5
9	900	450	900	250	45	7.0
10	1000	500	1000	300	50	8
11	1000	500	1000	300	50	9

Spray of multiplex Prokissan (1g/litre of water) on aonla crop since 3 years at monthly intervals helps in better growth of the trees in early stage of establishment. At the time of flowering use of Multiplex Mahaphal (2ml/lit of water)+Allbore (1g/ litre) have been proven beneficial for improving the fruits set and also check the fruit drop.

Irrigation

Establishment of the aonla orchards in general do not require irrigation in normal soils. In the beginning of plantation, first irrigation should be given just after manuring and fertilizers application (January-February). Irrigation should be avoided during flowering (mid March–mid April) period. Irrigation in normal soil at 15-20 days invervals

during summer or early established state or in the salt affected soils. Although the basin system of irrigation is well suited for aonla but drip irrigation with 16:2:20 drip lateral with 6 M^3 water per acre water discharge has been excellent to grow the healthy trees with a concrete water saving of 40-45%.

Mulching

Mulching with organic wastes (garden leaves, paddy and wheat straw, sugarcane trash) over a number of year shall be helpful in improving the organic matter content and infiltration of excess moisture to produce a healthy crop.

Training and Pruning

The unwanted branches are pinched off during March-April. In the subsequent year, 4-6 branches should be allowed to develop. Although the regular pruning of a bearing aonla tree is not required, but as per growth habit, shedding of all determinate shoots, the new growth in coming season is encouraged. However, dead, infested, broken, weak or overlapping branches should be removed regularly.

PLANT PROTECTION MEASURES

Harvesting And Yield

Changes in seed colour from creamy–white to brown are indication of fruits maturity. Fully developed fruits are harvested. Delay in harvesting may sometimes result in heavy drooping of fruits and thereby may affect the following years bearing.

A budded/grafted aonla tree starts bearing from third year onwards after planting, whereas, a shedding tree May take 6-8 years. Vegetative propagated plant attain full bearing within 10-12 years and may continue to be in bearing for 60-75 years of age under well managed conditions. An aonla tree may bear 1-3 quintal per tree, giving 70-90 quintal fruits per ha.

Post Harvest Management

An Anola tree may bear 1-3 quintals/tree giving 15-20 tones/hac., Anola fruits are graded in 3 parts. Large sized, sound fruits and mostly utilized for preservation and in candy making; small size for *Chavanprash*, *Trifalla* and blemished fruits for powder and shampoo making. Aonla fruits can be stored for 6-9 days at ambient temperature. However, with a salt solution it can be stored up to 75 days.

DO YOU KNOW ?

Q4. What is the meaning of Hallux.

Q5. Why is koko the gorilla so famous ?

Q6. How long can a bird fly continuously without Landing ?

MUSHROOMS : THE MAGIC STORE OF HEALTH BENEFITS

Susanta Banik*

The Mother Nature has provided man with beautiful variety of mushrooms to be used as food as well as medicine. They were highly valued in the history and culture of ancient people in various civilizations. Mushrooms being low in calories, fat content with no cholesterol and being rich in various minerals are the ideal choice of food for health conscious people. These days researches are looking up to mushroom in search of novel drugs to cure diabetes, heart ailments and even cancer of various types.

ABOUT MUSHROOM

Mushrooms are nothing but macroscopic fruiting bodies produced by microscopic fungi of certain fungal groups[1]. They are often classified as a vegetable or a herb. There are more than 14,000 types of mushrooms of which only about 3,000 are edible, about 700 have known medicinal properties. There are many species of mushrooms which are poisonous. The world over, only about 20 mushrooms are commercially cultivated[2] (Table 1). For rest of the mushrooms, either appropriate technologies for cultivation have not been developed yet or they have not been tried to cultivate.

Table 1 : Major Mushrooms of Today's Importance

Sl No.	Common name	Scientific name	Remarks
1.	Button mushroom, portobello, crimini, champignon	*Agaricus brunnescens* (= *Agaricus bisporus*)	40% of world production
2.	Oyster mushroom, king trumpet mushroom	*Pleurotus sajor-kaju, P. ostreatus*	25% of world production
3.	Paddy straw mushroom	*Volvariella volvacea*	16% of world production
4.	Shiitake mushroom	*Lentinus edodes*	10% of world production
5.	Enoki take	*Flammulina velutipes*	–

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Sl No.	Common name	Scientific name	Remarks
6.	Truffles	*Tuber aestivum*	Constitute costliest food of the world
7.	Maitake	*Grifola frondosa*	Stimulate immune system, called as king of medicinal mushrooms
8.	Shimeji, Beech mushroom	*Hypsizygus tessulatus*	–
9.	Matsutake	*Tricholoma matsutake*	Lower cholesterol and help prevent strokes and heart attacks
10.	Cordyceps	*Cordyceps sinensis*	—
11.	Chaga	*Inonotus obliquus*	Have anti-tumor, anti-bacterial, anti-allergic, anti-inflammatory and anti-oxidant activities.
12.	Turkey tail	*Trametes versicolor*	Restore immune health
13.	Micraculous mushroom	*Agaricus blazei*	–
14.	Reishi, Lingzhi	*Ganoderma lucidum*	–

TRADITIONAL BELIEF AROUND MUSHROOM

Since ancient times, mushrooms have been thought to have special powers. The Pharaohs of Egypt prized mushrooms as a delicacy. The Egyptians thought mushrooms gave immortality and only Pharaohs are worth of this. Common people were not even allowed to touch mushrooms. The Greeks believed that mushrooms provided strength for warriors in battle. The Romans regarded mushrooms as a gift from God and mushrooms were served only in festival times. The Romans often offered mushrooms as food for gods. The Roman Caesars used to have a food taster to taste the mushrooms before the Caesar to make sure they were safe. The Chinese took mushrooms as a health food[3]. The folklore of many cultures, including Russia, China and Mexico held that eating mushrooms could give someone superhuman strength.

BEGINNING OF MUSHROOM CULTIVATION AND INDIA'S POSITION

The mushroom cultivation for food is thought to have began as early as 600 A.D. in China[4]. In Europe it appears to have begun first in France in the 1650s. From there it spread to other European countries and probably entered the United States from England by the 1870s. Mushrooms are cultivated in at least 60 countries with China, the United States, Netherlands, France and Poland being the top producers. Though the conditions for mushroom cultivation between India and China were similar, China topped in mushroom production, while India did not even find a place among the 100 mushroom producing countries in the world. The Indian production scenario was negligible at 50,000 tonnes per annum as against the world's production of 55 lakh tonnes.

NUTRITIONAL BENEFIT FROM MUSHROOM

These days the health conscious people prefer food containing low energy (low calorie) and low fat. For them mushrooms are valuable health food as they are low in calories, high in vegetable proteins (Table-2), chitin, iron, zinc, fiber (8-10% of dry weight), essential amino acids, vitamins, & minerals[5]. They have very little sodium and fat and no cholesterol (Table-3). The Nutritional Index that indicates the content of essential amino acids in foods is higher for *A. brunnescens* than all vegetables except spinach and soybeans. Mushrooms help our body strengthen itself and fight off illness by restoring our bodies balance and natural resistance to disease.

Table 2 : Nutritional Comparison of Mushroom with Vegetables (*per 100g*)

Name	Calories	Moisture	Fat	Carbohydrate (%)	Protein (dry wt. basis)
Mushroom	16	91.1	0.3	4.4	26.9
Beet root	42	87.6	0.1	9.6	12.9
Brinjal	24	92.7	0.2	5.5	15.1
Cabbage	24	92.4	0.2	5.3	18.4
Cauliflower	25	91.7	0.2	4.9	28.8
Celery	18	93.7	0.2	3.7	20.6
Green beans	35	88.9	0.2	7.7	21.6
Green peas	98	74.3	0.4	17.7	26.1
Lima beans	128	66.5	0.8	23.5	22.2
Potato	83	73.8	0.1	19.1	7.6

Source : National Research Centre for Mushroom, Solan, (available online)[10]

Table 3 : Comparison of Calorie and Fat Content in Meat, Milk and Mushroom (*per 100g*)

Name	Goat	Chicken	Beef	Pork	Lamb	Whole Milk	Mushroom
Calorie	143	190	210	212	205	110	28.0
Fat (g)	3.0	7.4	9.3	9.6	9.5	6.0	0.5
Saturated fat (g)	0.9	2.0	3.5	3.4	3.4	3.7	0.1
Cholesterol (mg)	75.0	89.4	86.0	86.0	92.0	24.2	0

Source : www.nutritiondata.com[7]*, www.chestnutmeat.co.uk*[8].

In a study with six mushroom varieties viz. white button, crimini and portabella (*Agaricus bisporus*, harvested at different maturity levels), and maitake (*Grifola frondosa*), shiitake (*Lentinus edodes*) and enoki (*Flammulina velutipes*) they were found to be rich in total dietary fibers, including chitin and beta-glucan. Chitin present in the cell wall of the mushroom lowers cholesterol and beta-glucan keeps our heart healthy. It was already known that mushrooms offer high-quality

protein, vitamins and unsaturated fatty acids[6]. Raw, mature portabellas also had the highest level of beta-glucan (0.2 percent), while most of the other mushrooms had 0.1 percent.

The inexpensive white button mushrooms (*Agaricus bisporus*), commonly found in grocery shops in dried form, although not held with high regard in relation to exotic, expensive varieties like maitake and matsutake mushrooms (preferred in Japan), provide as much or even more anti-oxidant activity as the costly ones. This was the finding of the research done at the Institute National de la Recherche Agrinomique in France. This antioxidant activity prevents cell damage and ageing in out body.

Fibre

Fibres in our diet prevents constipation. We rarely think of mushrooms when we need to add fibre to our diet. But they are a very good source of fibre. Fresh harvested mushrooms are comprised mostly of water (about 90%), but about 10% is natural fibre, and this helps keep the digestive system running smooth. Eating four to five medium-size mushrooms each day fulfils our fibre requirement.

Potassium

A mineral that helps lower elevated blood pressure and reduces the risk of stroke. One medium portabella mushroom has even more potassium than a banana or a glass of orange juice.

Selenium

Selenium is a powerful antioxidant that in association with vitamin E protect cells from the damaging effects of free radicals. Selenium also helps in preventing prostate cancer, colon cancer, arthritis, asthma and heart disease. Besides, selenium is involved in repairing of damaged DNA (occur at low frequency during DNA replication in our cells). These damaged DNA if left as such may cause cancer. Mushroom being an excellent source of selenium (11.9 mg per 100g) reduces the risk of cancer.

Copper

Copper is a trace mineral helpful in reducing the symptoms of rheumatoid arthritis. Copper, along with manganese (a trace mineral for which crimini mushrooms is a very good source), helps in disarming free radicals. Copper is also necessary for providing the flexibility in blood vessels, bones and joints. Copper keeps cardiovascular system in check.

Iron

Iron is a part of hemoglobin, the molecule responsible for transporting and releasing oxygen throughout the body. But hemoglobin synthesis also requires copper. Fortunately, both the minerals are present in mushrooms.

Zinc

Zinc is critical to immune function, wound healing and normal cell division. Zinc also helps stabilize blood sugar levels and the body's metabolic rate. A strong immune system depends on adequate zinc levels. Zinc prevents even some of the serious infections seen in patients with advanced or long-standing diabetes. Crimini mushrooms are a very good source of zinc.

Vitamin B complex

The mushrooms contain a variety of B complex vitamins. Crimini mushrooms qualified as an excellent source of riboflavin, pantothenic acid and niacin, as well as a very good source of thiamin, and vitamin B_6, and a good source of folate. Riboflavin protects the energy production system from oxidative damage. **Riboflavin** been shown to be able to reduce the frequency of migraine headaches in people who suffer from them. The B vitamin, **pantothenic acid** also plays an important role in the prevention of fatigue since it supports the function of the adrenal glands, particularly in times of stress. **Niacin** (vitamin B_3), is helpful in reducing cholesterol levels and in preventing osteoarthritis. The production of estrogen, testosterone, and progesterone rely on niacin.

Mushrooms, which contain niacin, also help the body produce energy from blood sugar, and they help give the skin a healthy texture and brilliant glow. **Vitamin B_6** is involved in decreasing risk for heart attack and stroke.

L-ergothioneine-an Antioxidant

L-ergothioneine, a powerful antioxidant, has been discovered in mushrooms. We know the health benefits of antioxidants which inactive the free radicals produced in our body during energy production process. An American research team revealed that mushrooms contain higher concentrations of L-ergothioneine than either of the two dietary sources previously believed to contain the most : chicken liver and wheat germ. The team found that shiitake, oyster, king oyster and maitake mushrooms contain the highest amounts of ergothioneine, about forty times as much as is found in wheat germ. Of the most commonly consumed mushrooms, portabellas and criminis have the most L-ergothioneine, followed by white buttons. The good news is that L-ergothioneine is not destroyed when mushrooms are cooked.

MEDICINAL BENEFITS

Mushrooms are the magic store of medicinal benefits[11]. In ancient Egypt and Asia, mushrooms were a sacred longevity tonic ; in Europe, the mummified 5,000-year-old "Ice Man" was found with a medicine kit of dried mushrooms.

Cancer Fighting Properties

Many of the foods provided by nature contain cancer fighting ingredients, and mushrooms are no exception. According to recent studies, consuming just $3^1/_2$ ounces of the white button variety each day, can decrease the risk of developing prostate cancer and breast cancer[12]. In Japan, Russia, China, and the U.S.A., several different antitumor agents have been developed from various medicinal mushrooms (*Lentinus edodes, Ganoderma lucidum, Schizophyllum commune, Trametes versicolor, Inonotus obliquus,* and *Flammulina velutipes*).

Protection Against Alzheimer's Disease and Age-related Cognitive Decline

Research published in the *Journal of Neurology, Neurosurgery and Psychiatry* suggests that regular consumption of niacin-rich foods like crimini mushrooms also provides protection against Alzheimer's disease and age-related cognitive decline.

The "king of medicinal mushrooms", now being researched extensively is the maitake, a large fan-shaped tree fungus. It is said to give super immunity[13]. "Maitake is one of nature's richest sources of beta-glucans, which are among, or even may be, the most potent natural immune forces ever discovered". Recently, the Food and Drug Administration (USA) approved testing a compound called maitake D-fraction in treating advanced breast and prostate cancers.

A black, rubbery Chinese mushroom called moer, or tree ear, is a potent blood thinner. Tests at George Washington University identified the mushroom's blood-thinning chemical as a adenosine, described as "similar to aspirin." Adenosine also accounts for blood-thinning properties of onions and garlic.

***Ganoderma lucidum* (Reishi mushroom)**

Reishi mushroom grows in densely wooded mountain of high humidity and dim lighting. Reishi has been used in Traditional Chinese Medicine for at least two millennia, and archaeological evidence indicates people may have been eating it for almost 7000 years. It is known as 'elixir of life" to Chinese due to its tremendous reputation for increasing longevity and it helps to avoid problems of senility. It stimulates immune system, promotes good blood circulation, protects liver from toxic chemicals, helps against insomnia by having calming effect to the muscle. Reishi is effective in the treatment of high blood pressure.

***Lentinus edodes* (Shiitake)**

Shiitake mushrooms have been used for centuries by the Chinese and Japanese to treat colds and flu.

An extract Lentinan (a beta-glucan) from Shiitake has been licensed as an anti-cancer drug by the Japanese FDA. Lentinan stimulates the production of T lymphocytes and natural killer cells and can potentiate the effect of AZT in the anti-viral treatment of A.I.D.S. Shiitake stimulates the production of Interferon which has anti-viral effects.

***Cordyceps sinensis* :** It helps in strengthening our immune system's ability to fight against bacterial and viral infection. Human clinical studies indicate that *Cordyceps* can be effective for treatment of high cholesterol, poor libido/impotence, arrhythmia, lung cancer, and chronic kidney failure. It is also reported that *Cordyceps* causes smooth muscle relaxation. This can make it especially helpful for treating chronic coughs, asthma, and other bronchial conditions.

***Agaricus blaxei*-the miraculous mushroom**

A Japanese living in Brazil visited Piedade located some 200 km from Sao Paulo, capital of Brazil about 44 years ago, and found that the people there ate a special kind of mushroom not found anywhere in Brazil or the rest of the world. These people enjoy long lives and great health and rarely suffer from the common illnesses and degenerative diseases such as cancer, heart disease, stroke, diabetes, arthritis, allergies, asthma, eczema, ulcers, etc. Coincidentally, two American scientists had also visited Piedade at about this time. The mushroom was identified to be *Agaricus blazei*.

Ronald Reagan, ex-President of the USA, was publicized to be taking these mushrooms in his successful fight against skin cancer. And then the special mushroom caught the attention of the world. It is the best cancer fighter among known medicinal mushrooms with a cancer cure rate of 90% and inhibition rate of 99.4%.

Today, everyone in the world can enjoy the wonderful health benefits of the *Agaricus blazei* Murill as it is now available in capsule form in medical stores.

Conclusion

Health is wealth. But these days health problems are numerous due to unbalanced nutrition. From the ongoing discussion it is obvious that mushrooms can help to keep us healthy and free from many life-threatening diseases. Being mushroom literate, why not to eat and popularise mushrooms? India, having diverse climatic conditions suitable for cultivation of several types of mushrooms holds the potential of several-fold increase in production. Though present production is low, popularizing mushroom as food will remain a greater challenge. In the context of prevalence of malnutrition and various health problems in India, mushroom can help in a great way. Now it is high time to make and reserve some room (space) in your dish for mushroom.

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GREENHOUSE TECHNOLOGY

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There is great potential for greenhouse technology in the country for increasing the yield and productivity of horticultural crops, vegetables, flowers and ornamental plants by controlling the environment. The plastics greenhouse is economically more favourable compared to glass. This article discusses various aspects of Greenhouse Technology as well as various systems which were being used inside the greenhouse for controlling the environment.

INTRODUCTION

In the last 20 years there has been a growing interest throughout the world in controlled environmental agriculture. People have come to realize that in this time of world population growth, we need to improve the systems of intensive agriculture to meet our needs and, at the same time, conserve resources that are non-renewable. Greenhouse agriculture permits production of food crops out of season, at yields often far greater than that achievable under conventional conditions. Greenhouses are framed or inflated strucutures covered with transient material, large enough to grow crops under partial or fully controlled environment conditions to get optimum growth and productivity. The enclosure provides an opportunity to control the environment and other factors like soil moisture, nutrition, pH and carbon dioxide etc. The purpose of a greenhouse is to provide a good growing climate for plants in all seasons of the year. For most plants the favourable conditions are at a temperature of 20-30ºC and relative humidity of 50-80%. The environmental requirements for some horticultural and floricultural crops are given in Table-1.

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A very wide range of agroclimatic conditions spans India. It is simultaneously hot, cold. humid and dry. As various are its crops, inputs and cultural practices. As the pressure on agriculture mounts, every square metre of land must deliver more.

Surface covered cultivation, particularly the all season greenhouse, would be very relevant to the search of alternate technologies both for research and practice of farming in India. At present area under floriculture in open field conditions is 80,000 ha out of which in Maharashtra 9,000 ha is under floriculture and yields are recorded as 49722 metric tonnes. Maharashtra is a leading state in long stem variety production of flowers. However, area under polyhouse for floriculture is increasing in Maharashtra quite steadily. The major flowers grown under polyhouse are roses, chrysanthemum, carnations, gerbera and ornamental plants. Besides tomato, capsicum, cucumber are also grown under greenhouse in the state. The yield of greenhouse crops in Abu Dhabi is given in Table-2.

In Maharashtra, the maximum area under control condition are in Western sector which has favourable microclimate. However, Marathwada and Vidarbha comes under hot and dry region and summer temperature goes upto 45ºC and humidity 10-15% therefore, the adoption of control cultivation has not taken a good shape for production of high value low volume crops. The commonly grown greenhouse crops are illustrated in Table-3.

Table 1. Environmental Requirements for Some Horticultural and Floricultural Crops.

Sr. No.	Crop	Season	Temperature	Relative Humidity (%)	Light (Klux)	Remark
1.	Potato	Sprouting and initial growth Growth and tuberation	20-24 18-20	– –	– –	Above 30ºC no tuber formation
2.	Tomato	Fruit setting Colour development (red and yellow)	21-13 10-13	– –	– –	CO_2, 200 ppm –
3.	Bell pepper		21-23	–	–	–
4.	Onion	Bulb formation	20-22	–	–	–
5.	Carrot	Root development Colour development	15-21 15-22	– –	– –	– –
6.	Cauliflower	Curd formation	17	–	–	–
7.	Garlic Brinjil	–	–	–	–	Cool temp.
8.	Mango	–	24-27	>80	–	–
9.	Citrus	–	25	–	–	–
10.	Banana	–	20-35	–	–	–
11.	Passion fruits	–	20-30	–	–	–
12.	Rose	–	13.3–21	–	64.6 to 86.1	CO_2, 1200 to 2000 ppm
13.	Orchids	Day Night	15.5–21 10-15.5	>30 >80	25.8 to 38.7	CO_2, 500 ppm
14.	Gladiolus	–	15–25	15	–	–
15.	Carnation	–	15.5–20	60–70	–	–
16.	Chrysanthemum	–	8-12	–	–	–

Table-2. Yields of Greenhouses Crops in Abu Dhabi

Crop	Yield of Single Crop t/ha	Crop/year Number	Annual yield t/ha
Tomato	135	2	270
Cucumber	180	3	540
Beans	10	4	40
Cabbage	52	3 to 4	156 to 208
Chinese cabbage	45	4	180
Radish	20	9	180

This paper presents some general design criteria, environmental control systems, construction and management of polyhouse for production and propagation of horticultural crops grown in Maharashtra.

ADVANTAGES OF GREENHOUSE

The general advantages are as follows :

- Crops can be grown all through the year.
- The yield and quality of produce impoves.

Table-3. Commonly Grown Greenhouse Crops

Vegetables			Fruits	Ornamental Crops	Others
Tomato	Beans	Squash	Strawberries	Rosses	Tobacco
Cucumber	Peas	Chillies	Grapes	Poinsettias	Nurseries
Lettuce	Spinach	Okra	Citrus fruits	Chrysanthemums	–
Onion	Egg plant	Turnip	Melons	Potted plants	–
Cabbage	Peppers	Radish			

- Plant moisture requirement is optimized.
- Good control on pests and diseases is achieved.
- There is less requirement of intercultivation practices.

However, greenhouse cultivation requires a complete chain of management practices, in order to prevent failures – which can prove very costly. Well managed greenhouses can provide excellent means of living for small holdings resulting in unusually high income per unit area, much higher than open field cultivation.

In India, a country with diverse and extreme of agro-climatic conditions, greenhouse technology can be exploited for :

1. Production of high value, low volume horticulture crops.
2. Production of planting material – both for agriculture and horticulture.
3. Hardening of tissue cultured plants.
4. Cultivation in extreme climatic areas.
5. Production of hybrid seeds, ornamental plants and tissue cultured plants.
6. Cultivation and preservation of rare species of plants including medicinal, aromatic and ornamental species.

The choice of crops to be raised in a greenhouse depends on the physical site of the structure and the economics of crop production.

TYPES OF GREENHOUSES AND THEIR CLASSIFICATION

Greenhouses can be broadly classified into fully environmental controlled, partially environmental controlled and naturally ventilated structures depending upon the size, area and cropping intensity. To check the suitability of a region for protected cultivation the climatic data should be compared with those of other regions and with the main requirements of the plants to be grown in the greenhouse. Vegetables and flowers have different climatic requirements.

1. Based on shape

(a) Lean type greenhouse, (b) Even span type of greenhouse, (c) Uneven span type of greenhouse, (d) Ridge and furrow type greenhouse, (e) Saw tooth type of greenhouse and (f) Quonset type of greenhouse.

2. Based on utility

(a) Greenhouse for active heating, (b) Greenhouse for active colling : (i) Fan-pad colling system, (ii) Fog cooling system.

3. Based on construction

(a) Wooden framed structures, (b) Pipe framed strucures and (c) Truss framed strucutres.

4. Based on covering materials

(a) Glass greenhouses, (b) Plastic film greenhouses and c) Rigid panel greenhouses.

5. On the basis of utility

(a) Retail (upto 500 m^2) and (b) Wholesale (upto 1000 m^2)

6. On the basis of control technology

(a) Temperature based control system, (b) Humidity based control system, (c) Pressure based control system, (d) Timer based control system and (e) Light based control system.

GLAZING MATERIAL

Greenhouse can be convered with any of the cladding material such as glass, plastics, film plastics includes polyethylene, polyvinyl, fluoride, polyster rigid panels viz. fiberglass reinforced panels, acrylic panels, polycarbonate panels. etc.

As regards the cladding material, one can use 200 micron (800 guage) UV stablizied LDPE film manufactured by Indian Petrochemicals Corporation Ltd., (IPCL) or M/s. Siltap Industries Ltd., Bombay which has the desirable characteristics for the purpose as per ISI standards. This will reduce cost. These films give a service life of 2 to 3 years and

approximate cost is Rs.30-35/m^2 as against Rs. 300 to 500/m^2 in case of fiber glass sheets/or poly-carbonate sheets. The technical information on several glazing materials are given in Table-4 and the light transmission properties are given in Table-5.

Table 4. Technical Information on Several Glazing Materials

Material	Thickness (Micron)	Weight Kg/m^2	Heat Transfer (U) W/m2/°C	Line Expansion CU/cm/°C	Life Expectancy (Year)
Glass	3,000	5.9	6.5	—	30+
Double Polythyelene	2×150	0.3	4.0	17×10^{-5}	1–1.5
Acrylic SDP	16,000	4.9	3.3	7.5×10^{-5}	15+
Polycarbonate SDP	16,000	4.9	3.3	6.5×10^{-5}	20+
Polycarbonate qualex	6,000	1.2	3.5	4.1×10^{-5}	5+
Fibreglass GRP filon SP-15	1,000	1.5	5.7	–	15 (only on strength)

Table 5. Lights Transmission of Different Glazing Materials Light Transmission (%)

Material	Single layer Source I	Double layer Source I
Glass (3mm)	88	78
Polythelene (100 micron)	89	79
Acrylic (SDP) (16mm)	–	–
Polycarbonate (16 mm) (SDP)	84	73
Polycarbonate (6mm) (Qualex)	84	73
Polyvinyl Fluoride	91	84
Polyester (Mylar)	86	78
Fibreglass (1000 micron) Corrugated	79	62

In a naturally ventilated greenhouse where no gadgets are provided, to reduce the temperature, sufficient ventilation (60-70%) with 40-60 mesh net all round the sides should be provided with a provision to cover with the rollable film whenever required.

However, in a medium cost greenhouse which is to be used for propagation of plant material besides natural ventilation, misting/fogging system has to be provided.

GREENHOUSE ENVIRONMENT CONTROL

Greenhouse plants live in an artificially created and controlled miniature environment or climate. The most important factors in the greenhouse environment are air, light, water and heat. One should regulate the amounts of each to suit the particular needs of the plants being grown.

Light : During the summer it is possible to shade greenhouse plants to protect them from scorching strong sunlight, and to prevent the temperature in the house from rising too high. The aim should be to provide just enough shading-not too little or too much. One can provide shade by using black or green PVC-woven covers of different densities to achieve different efficiencies of shading. The more usual methods of protecting greenhouse plants are to use blinds or shading plants.

Depending on the requirement of the crop, photo-period control can be provided, using overhead lighting of the requisite itensity, connected to automatic timers.

For specialty crops like potted chrysanthemums, specially designed benches with provision for total blackout using LDPE film can be provided.

Water : For most vegetable and fruit crops, two methods of automatic watering are particularly useful in greenhouses.

Drip Irrigation : Drip irrigation is specially suitable for crops grown in rows, whether they are grown directly in the soil or in pots. The water is distributed to the plants through a pipeline fitted with nozzles or outlets at intervals and preferably designed to deliver the water to the immediate vicinity of each plant. Various methods can be used to send the water through the pipelines automatically as required.

Capillary Watering : This is based on the property of water, which causes it to move upward against gravity through porous or finely divided particles. Originally, sand was extensively used as a capillary material spread on polyethylene or plastic sheeting on the greenhouse floor.

Overhead Misting : This is done by HDPE pipes fitted with nozzles running along the length of the greenhouse. These are attached to a pressurising pump through an automatic timer.

During periods of bright sunlight, air temperature in a greenhouse will rise above outdoor ambient due to the non-heat influx and the reduced air movement. Plant temperature and that of greenhouse air must be lowered ; this is accomplished by both transpiration and mechanical means. Under optional conditions the plant temperature can be regulated by the rate of transpiration.

Ventilation : The conventional method of lowering the temperature is accomplished by drawing cooler outside air into the greenhouse. Different methods of ventilation are available and they vary primarily in the cooling capacity. When considering cooling for a greenhouse range it it important to appraise the requirements of different seasons. Ventilation must be considered a year round process ; of course, during the winter a reduced capacity is needed to avoid excessive chilling. Winter ventilation is often used to reduce the relative humidity.

Forced Cooling System Using Electrical Exhaust Fans and Inlet Vents : This is used primarily for cooling during periods of high temperature. Ventilation is provided by electrical exhaust fans which are set in the side or the wall, drawing fresh air into the house from open ventilators on the opposite side of the wall. With certain crops, notably those requiring cooler temperature during the summer, it is advisable to have an evaporative cooling system installed at the vent opening. The air is drawn through continuously wet fibrous pads. This sytem is referred to as fan and pad cooling. High-pressure misting systems are very popular in Europe. These are activated by time clocks and produce an extremely fine mist. The evaporation of fine water particles cools the surrounding air but should not create a condensation layer on the foliage.

Relative Humidity : One of the most neglected factors in controlling the greenhouse environment is the regulation of relative humidity. Several reasons may account for this, but the intricate combination of many factors affecting the relative humidity and difficulty in accurately measuring the relative humidity are considered the most important problems.

During the process of photosynthesis plants absorb carbon dioxide from the air to produce carbohydrates necessary for plant growth. This process takes place only during the time that sufficient visible radiation is received by the plant. As a consequence of plant uptake carbon dioxide levels in the greenhouse could drop below ambient levels, especially during periods when there is little air exchange with the outside. Hence carbon dioxide levels can be changed in the greenhouse.

Heating : From the engineering viewpoint, greenhouses are usually poorly insultated buildings. Large amounts of heat are required, especially during the winter to maintain temperatures optimal for plant growth. To provide a uniform temperature distribution throughout the greenhouse, the heating system needs to be carefully planned and designed. The type of heating system required depends on crops to be grown and the glazing material used.

Heat is provided in the form of steam or hot water from a centrally located boiler. Water is the heat-transfer medium and it is circulated through heating lines either as hot water or steam. In places where potted plants are grown on the ground, or where a crop requires a higher root temperature compared to the air temperature, heating lines are buried in the ground. In most greenhouse, heating lines are located near roof trusses where they are close to the area of greatest heat loss and not interfering with the cultural operation.

PLANNING AND DESIGNING FOR A GREENHOUSE

Any technology cannot be made profitable until it is planned and designed to meet the requirements of the users. The size and shape of the greenhouse to be erected is the important consideration. It is believed that a 500m^2 greenhouse unit for a single person retail business is sufficient. However, about 1000 m^2 unit is required for a whole-sale business.

Following points are considered for Planning of Greenhouse construction to run a horticulture project.

- Site selection–size and future expansion.
- Water supply-source-well, tank, pipeline, river etc.
- Electric supply – 1f 3f
- Fencing—Type, gate, cattle trap etc.
- Greenhouse—Design, plan, layout and working drawing.
- Plant system—Soil, pot, bags, platform or soil less media.
- Irrigation—Drip, sprinkler and Ridge-furrow.
- Cooling system—Fan-pad, Humidifier, foggers and misters.
- Ventilation—Natural, Forced or openings
- Water circulation—General use, cooling, irrigation and humidifier.
- Water filtration plant.
- Environmental factors—Temperature, Relative humidity, CO_2 and light.
- Root media—Natural or artificial.
- Cost Economics.

GENERAL DESIGN CONSIDERATIONS FOR GREENHOUSE

- Labour requirements—8-10 persons per hectare for greenhouse as against 1 person in traditional farming.
- Light—Generally 21500 to 86100 lux for 8-14 hrs duration.
- Orientation—E-W for single span to receive more sunlight in winter and N-S for multispan.
- Ventilation—20 to 30% of the floor area and wind breaks on windward sides. Generally the air flow rate should be 0.034 m^3/m^2 of floor area.
- Life—25 years for semi-permanent and 10 years for temporary construction.
- Load—Should be designed for 150 kg/m^2 with wind velocity of 100 to 150 kmph.
- Coverings—U.V. films (2.5-3 years) of 150-200 micron, Rs.25-30/m^2. Shade net (4-5 years) with 25 to 80 per cent solar cut intensity. Poly carbonate sheet (25 years), FRP sheet–Rs.300-500m^2.
- Cooling system—
  (1) Natural (air vents)
  (2) 50% shade net (6ºC drop)
  (3) Water film on root
  (4) Fan-pad system (3-12ºC drop)
  (5) High pressure mist 2-4 lit/hr discharge at 60-70 kg/cm^2 pressure gives temperature drop of 5-14ºC. Basic flow rate should be 2.44 m^3/m^2/minute.
- CO_2 Enrichment—General level 300–350 ppm, at 1200-1500 ppm plant gives good response. Above 5000 ppm in hazards to human being.

- Irrigation—In general the water requirement for soil based substrates is at a rate of 20 L/ m^2 of bench, 0.3 to 0.35 lit per 16.5 cm diameter pot. Generally, 200 L/day for 100 m^2 is required. The pump capacity should be 10 times of water evaporation and tank capacity 4-5 times of pump capacity.
- Environmental conditions

  Temperature range – 28ºC to 31ºC during day time.
  – 15ºC to 18ºC during night time.

  Relative humidity – 60 to 70%

  Light intensity – 21500 – 86199 lux
- Cost range

  Lost cow – Rs.400-500/m^2

  Medium – Rs.600-1500/m^2

  High cost – Rs.1600–3200/m^2.

CONSTRUCTION EQUIPMENT AND MATERIAL

There is a wide range of construction material and equipment needed for a modern farm and material available in India under two categories : (i) facility equipments and (ii) progress equipments.

The former comprises of : 1. insultated soil sterilizing rooms, 2. propagating beds, 3. special ventilation system, 4. greenhouse cooling, heating and humidifying system, 5. control panels for environmental control system, 6. watchodog weather station, 7. diesel generator set, and 8. controlled nutrition system.

The latter comprises of : 1. misting system, 2. soil pasteurization equipment, 3. compost turners, 4. plant support systems, 5. irrigation systems and 6. fumigation equipment.

Crops can be generated, propagated and grown under protected cultivation for advantage in quantity, quality and off-seasons production. These can be divided under five heads; vegetables, fruits, flowers, foliage plants and seeds.

Generally speaking, plants require heat more in the juvenile stage than in the adult stage. The protection offered by plastic materials is, therefore, particularly valuable in the production of seedlings and for giving a good start to young crops. Climate-controlled greenhouses have helped in producing hand-pollinated hybrid seeds of many varieties of flowers and vegetables. These seeds are high-yielding and disease-resistant. In all countries fresh vegetables and fruits occupy an important place in the daily diet. The market for flowers has benefited both by the rise in the standard of living and concentration of housing. The common vegetables grown all over the world, under cover are : cucumbers, egg plants, red pepper, tomatoes, french beans, asparagus and strawberries. Flowers such as roses, carnations and foliage plants also grow very well under cover.

PROBLEMS IN LARGE-SCALE COMMERCIALIZATION

The major problems which are visualized in the commercialization on a large scale of greenhouses in India are the following :

Plastics : The quality of plastics, specially in relation to its ability to withstand UV radiation is very much below the required standard and therefore is the major cause of breakdown and probably the single main reason of the concept not becoming popular.

Lack of Knowledge : Inadequate training facilities on the use of greenhouses is another hurdle. Because of this lack of research done with particular emphasis on India and the corresponding lack of knowledge, specialized products like shading, irrigation and structure have not been developed, keeping in mind our special situation of having cheap labour and high light intensities.

Facilities : Adequate transportation and storage facilities for produce are not presently available.

Strategies : Greenhouse projects are capital intensive and therefore, adequate insurance cover for both the facility and the plant material should be made available.

Efficient management of polyhouse in a hot and dry climate requires the following consideration :

- Uncontrolled or lowcost polyhouses do not maintain the microclimate in summer, whereas in rainy and winter season when the temperature and relative humidity is relatively higher than ambient, it may be used for nursery management, propagation of some horticultural crops and raising of seed bed nursery.
- Semicontrolled type polyhouse with fan-pad system can effectively work in hot and dry climate. After standardization of operation of fan-pad system, it is possible to maintain the desired level of temperature and relative humidity inside the polyhouse.
- To provide the confortable microclimate to the plants inside the polyhouse during hot summer, it is recommended that the polyhouse system should be equipped with
  (a) Fan-Pad cooling system
  (b) Fogging or Misting cooling system
  (c) 50% shednet at gutter height.
  (d) Covering about 50-80% rooftop depending on solar intensity with 20 to 50% shednets.
  (e) 15 to 25% natural ventilation on both sides.
  (f) Ridge ventilation at leeward side ranging from 0.5 to 1.0m width (high).

DO YOU KNOW ?

Q7. Where was oil discovered first in India for commercial exploitation ?

Q8. What circles the globe on the log of the Messionaries of Charity ?

Q9. Tauromachy refers to which sport ?

THE FLAP OF A BUTTERFLY'S WINGS IN BRAZIL SETS OFF A TORNADO IN TEXAS

Sumita Singh*, Asutosh Kumar** and Swetamber Das**

The study of chaos has provided us with new conceptual and theoretical tools enabling to categorize and understand complex behavior and propound new theories. Chaotic behavior shows qualitative and quantitative universal features which are independent of the details of the particular system. Nonlinearity plays a central role in the evolution of chaos. This article introduces some basic concepts of chaos.

INTRODUCTION

We live in a nonlinear world. We can say that the effect of stimulus is not directly or linearly related to its cause. The evolution of all real-life systems is inherently nonlinear. Therefore a linear system is an ideal concept.

The lack of periodicity and certainty are common in natural phenomena. They are often unpredictable despite their simplicity. Thus the analysis of nonlinear systems is an uphill task. These systems can be called disordered. They may exhibit chaotic behavior.

But what is this 'chaos'? How does it arise ? The dictionary meaning of word chaos is a 'a state of complete confusion and disorder'[2]. It is primarily associated with motion or dynamics. By chaos we mean an irregular, seemingly random change in motion which is too complex to predict in detail or rather compute with any given precision in the long run. We say 'seemingly' random because the physical laws and the forces that govern the motion are all perfectly deterministic and given. Chaos is the transient state between the regular or periodic solutions and complete randomness of a dynamical system.

The phenomenon of chaos was known to physicist **Henry J. Poincare**, a French mathematician, in late 19th century. Poincare extended Newton's two-body problem and worked on the three-body problem in classical mechanics[3]. But the development of modern chaos can be attributed to **Edward N. Lorenz**, a meteorologist at Massachusetts Institute of Technology (MIT), USA in 1960's. Lorenz was working on the problem of weather prediction. He had a computer program with a set of equations to model the weather. One day, in order to save time, he started in the middle of the sequence instead of the beginning. Those days computers ran slow so he fed the number of his earlier printout and left it to run. After some time, he found that the sequence had evolved differently. Thus a system evolves differently with slightly different initial conditions of the system. This hypersensitivity to initial conditions came to be known as the **Butterfly's effect**. Conceiving this idea, Lorenz stated that it is impossible to predict the weather accurately.[1] Many new aspects have been discovered in chaos thereafter and it is an active area of research today. Chaos is an

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interdisciplinary phenomenon, pervading almost all the disciplines of scientific study, viz., basic science, medical science, mathematics, engineering and environment.

A few examples of chaos from daily life are erratic weather, the rising column of cigarette smoke, leaking faucet, turbulence, convection in fluids, shedding of leaves of trees etc. Modestly speaking, chaos describes nature and unravels its mystery.

There is a tremendous interest today with chaos and fractals[4]. A fractal is a geometrical object self-similar at different scales, with usually a fractional or non-integral dimension. By self-similarity we mean that if we magnify a tiny part of the fractal, we will see features reminiscent of the whole. They are a great interest because of their exquisite combination of beauty, complexity, endless structure and strange propeties. For example, the ***von Koch curve*** has an infinite length in a small area. Natural objects like mountains, clouds, coastlines/seashores, cracks in earth, surface of *kadamb* fruit, leaves of thorny plants, structure of lizard and chameleon, blood vessel networks, etc. are manifestations of the fractals. Picture books like 'The Beauty of Fractals' by Peitgen and Richter (1986) can be found on coffee tables in living rooms everywhere.

It seems that even nonmathematical people are captivated by the infinite patterns found in fractals. One can turn on a home computer and create complex mathematical images that appeal to the eyes.

NONLINEAR DYNAMICS AND CHAOS

A study of nonlinear dynamics has revealed that ***determinism***, ***nonlinearity*** and ***sensitivity*** are three essential elements of chaos[5]. Any system having these conditions will behave in chaotic manner for given initial conditions at certain threshold values of control parameter. It is to be noted that all complex, nonlinear systems are not chaotic but all chaotic systems are, indeed, complex and nonlinear. The Kolmogorov-Arnold-Moser (KAM) theorem provides the condition of breakdown of regularity[6]. This theorem states that 'If the bounded motion of an integrable Hamiltonian H_0 is disturbed by a small perturbation, δH, that makes the total Hamiltonian, $H = H_0 + \delta H$, nonintegrable and if the following two conditions are satisfied :

(i) the perturbation δH is small, and

(ii) the frequencies w_i of H_0 are incommensurate, then the motion remains confined to an N-torus, except for a negligible set of initial conditions that result in a meandering trajectory on the energy surface'. Chaos can occur when KAM theorem does not hold.

Nonlinear equations describing chaotic systems, in general, do not have analytic or closed form solutions, that is, we do not obtain a formula in which we substitute values of different parameters and variables and get the result. Also it is much more confusing and cumbersome to interpret the formulae physically, even if we could find them. Should we abandon the study of chaos ? No, there is an alternative ! We do graphical analysis. We are able to extract all the important qualitative features of a given system without invoking any difficult formula. After all, we are more interested in knowing its nature—how does a system evolve in time. This is really welcome news for non-mathematical people. It is said that all living systems live at the 'edge of chaos'.

Systems having bounded (or constrained), non-periodic solutions are ordinarily unstable with small modifications, so that slightly differing initial states can evolve into considerably different states. They are said to be sensitive to the initial conditions of the system. Solutions of these systems can be best visualized with trajectories in phase space (phase space is the hypothetical mathematical space defined by the variables needed to specify dynamical states of a system. The phase space for a single particle

is six-dimensional ; three coordinates are needed to specify its location and another three to specify its velocity or momentum). Though the phase space is filled with trajectories, they do not intersect one another.

FINDING ORDER IN DISORDER

By now, a person might have conceived a mental picture of chaos that it is all about disorder and unpredictability or uncertainty. Well, to be sure, CHAOS is not an acronym for *"Can't Have An Orderly System"*. The study of chaos aims at finding order in the disordered systems and finding its applications to the real world. Chaotic systems, indeed, have some amount of order. The physicist **Feigenbaum** discovered that there are certain universal laws governing the transition from regular to chaotic behavior, roughly speaking, completely different states can go chaotic in the same way. His work established a link between chaos and phase transitions. The **Lyapunov exponent** λ, which is a measure of the rate of divergence of nearby trajectories, is a useful coefficient which quantifies chaos. Mathematically, it is the average of the natural logarithm of the absolute value of the derivatives of the map function evaluated at the trajectory points. If λ for a given system for a particular parameter value is positive, the system evolves chaotically in time and the nearby trajectories diverge exponentially.

IMPORTANCE OF CHAOS

- Chaos exists in nature

  It is a rule rather than the exception. In fact, all motions in physics and reactions in chemistry turn chaotic for some initial conditions when driven hard enough, far from equilibrium, to the non-linear regime when more becomes different.

- Chaos provides novel, non-Newtonian world view where chance emerges out of the very necessity of the deterministic laws. It provides an insight to think meaningfully about many old as well as new phenomena such as turbulence.

- While chaos is all about complexity, it itself is rather easy to get acquainted with. And what is more encouraging is that here one can go a long way without much formal training. Also, some of the most important and powerful methods developed for the study of chaos are mostly qualitative in nature and are best visualized through graphs—a kind of visual mathematics. Also, availability of a programmable calculator and PC greatly simplifies the study of chaos.

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FAILURES ARE THE FEELERS OF SUCCESS

(An Innovator's Perception)

Subrata Ghosh*

Innovation is the key to success of any organization specially in this world of competition. All innovations cannot be successful. Failure is inherently intermingled with the game of innovation. In fact many a time failure acts as a great teacher. The role failure plays has been explained with examples. Without worshipping failure, it has been emphasized that organization and leadership can create ambience for individuals to be innovative.

Do you not repent for not being aware of the following advice in your college days when you had to receive severe scolding from your father for miserable performances in your semesters? If you were aware, you could conveniently take refuge under them.

1. *If you want to succeed, double your failure rates* (IBM's Tom Watson).[1]
2. *Fail often to succeed sooner*. (mantra of IDEO–the world-renowned consultancy firm for innovation).[2]
3. *A successful innovator fails early* (S.C.Lundin–coauthor of bestselling book FISH.)

These are the utterances of a few stalwarts who have guided some of the most successful organizations of the world with their innovative capability.

Yes. Our topic of discussion is innovation–the term which quite often we use rather indiscriminately. We start by first defining the terms which are often used in any discussion on innovation.

Idea : A concept or notion that has its origin in the human brain.

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Novel idea : An original or unusual concept or notion.

Creativity : The act of generating a novel idea.

Prototype : A mock-up of an idea.

Invention : A new idea that is often turned into a tangible outcome, such as a product or a system.

Innovation : Fashioning something new and of potential value from a novel idea. It does not have to be new to the world. Schumpeter (1928) defined successful innovation as "a task *sui generis*," a feat not of intellect but of will.[3]

Someone writes Innovation = Invention X Enterprise.[4]

Jeff Immelt CEO, General Electric was curt in saying "Innovation without a customer is nonsense; it's not even innovation". An idea that looks great in the lab and fails in the market is not an innovation; it is at best a curiosity.

If we agree with the above, we should not feel shy to accept the following :

a) invention is needed for innovation to take place–but invention is not innovation.

b) an organization cannot be called "innovative" just because it has an appreciable number of patents in its kitty.

c) there is no correlation between the number of corporate patents and financial success.

There are several pleasing truths about innovation that may inject enthusiasm among the readers. A few are listed.

1. all human beings have the capacity to innovate. It comes with our membership in the human race.
2. we all commit acts of innovation. We may not think much about them because they happen naturally.
3. the human brain is an associative mechanism that constantly builds associative networks. The strong networks are called *routines*, *habits*, and *paradigms*.
4. innovation brings vitality, meaning, and novelty into our lives.
5. an organization does not innovate – its people do.
6. all innovation is personal–personal innovation produces the natural energy of life.

The following myths about innovation are equally educative.

(i) it is all about new products

(ii) innovation is for geniuses.

(iii) innovation can be effected only in large firms.

A natural derivative is that a company which waits for "eureka" moments sees the doomsday very soon.

ABOUT HABITS, ROUTINES AND BEING NORMAL

In order to lead a healthy, social life we all follow certain norms, we develop a few habits. These are nothing but normal. Innovation needs getting outside the norms which is really very difficult and a challenge to an innovator. The intensity of the challenge can be gauged from the convictions expressed by quite a few who have otherwise proved themselves to be the real game changers. Some selected statements given here illustrate how sometimes even the best of innovators were unable to see the future.

"640K ought to be enough for anybody"— Bill Gates, Founder of Microsoft, 1981.

"I think there is a world market for may be five computers"—Thomas Watson, Jr., Chairman, IBM, 1943.

"There is no need for any individual to have a computer in his home"—Ken Olson, President, Digital Equipment, 1977.

".... and I can assure you that data processing is a fad that won't last out this year"—Editor-in-charge, Business Books for Prentice-Hall, 1957.

"Who the hell wants to hear actors talk?"—H.M. Warner, Warner Brothers, 1927.

"Everything that can be invented has been invented"—Charles H. Duell, Commissioner of the US Office of Patents. 1899.

IS INNOVATION A RISKY GAME?

Of course it is – which is why many people try to avoid the game. It is safe for them to buy or borrow innovation which has the proven record of success in its true definition. Financial risk is better understood. Currency and commodity risk can be hedged. No such advantage is available with innovation. This risky nature keeps innovation away from venturing into it, not to speak of, accepting it as a carrier. It is in the core of any risk-ridden activity that those who dare and succeed reap rich harvest. If we see innovation as a venture then knowing when to stop or terminate a venture may be as important as knowing when to start.[5]

A FAILURE IS A FAILURE

The above statement holds water in every walk of life-whether it is in a college semester or in

design of Nano car. However, we need to understand the value of a failure.

In our day-to-day life we dislike to taste failure– whatever is our activity. We exhaust our store of vocabulary and use words like flubs, flops, glitches, stumbles, guffaws, fumbles, snags, screw-ups, dropped balls, mess-ups, nicks etc. Why do we prefer to resort to such tongue-twisting jugglery? Simply because we earnestly try to avoid even uttering the word 'failure'.

To know what a failure is we should know what a success is. Success is defined as the achievement of something desired, planned, or attempted. If we revert back to our definition of innovation-which is the product of invention and enterprise, the multiplication sign demands that for an innovation to be successful there has to be success both in invention and as well as financial or $S=s_1 \times s_2$. If invention (s_1) is for a product or process the success we stress upon is for the product or process. Generally by s_2 most experts mean either marketing or financial return.

Financial return is the most important quantifiable yardstick of success in industry. But it is not the only one. On the other hand a technology award winning product (for technological excellence) may fail to bring smile in the face of the CEO – if customers betray him fair and square. The history of product and process innovations is littered with examples of apprarently good ideas which failed – in some cases with spectacular consequences.[6]

A FAILURE IS NOT A FAILURE

It is hard to check the temptation of restating Tony Buzan, originator of "Mind Map", author of 82 books published in 100 countries and in 30 languages.

a kid in trying to stand and walk falls on the ground how many times even his mummy does not know. Mummy might be knowing how many times the kid had cuts, swelling or bleeding in the attempts to stand and walk. But has the baby even after so many falls ever took a decision that he would spend the whole life lying on the floor?

Now let us read the following two stories.[7]

Story 1 : For several years Marine Technology (MT) developed and marketed a commercial and military navigation system with reasonable success. With the appearance of microprocessors in 1970, MT, in order to design a compact, light-weight, small system, embarked upon with a well-knit team and came out with flying colours resulting in MT-1. Over 7,000 units were sold at a price of $25,000 per unit and the margin exceeded 50%. This remarkable success of MT-1 encouraged the company to take up the development of MT-2. It was a marvelous technical success–reducing the size to one sixth of MT-1. But three and half years of R&D & $3.5 million went to drain. MT-2 was a total market flop.

This failure was followed by another attempt to bring out MT-3 targetting consumer market. It took two years to launch the new product. Immediately after its launching it repeated the performance of MT-1-over 1500 was sold and a backlog of 600 orders.

Story 2 : International Instruments, a large electronics firm floated a new product (diode arrays) without having much past experience both in its use and the market. Few were sold and obviously it was a failure. But diode array technology helped them developing other product families which struck the market with booming success.

Moral of the above two (and many other) stories are :

(i) *Success/failure should not be measured by the sale of a product. The product family is a far superior unit of analysis.*

(ii) New product 'failures' can result in other important by-products : organizational, technological and market development.

(iii) full measure of a product's impact can be determined by viewing it in the context of both the products that preceded it and those that followed.

Story 1 of Marine Technology reveals a general character of new product development – recurrent cycle of success and failure (Fig.1). This does not necessarily mean that a success is always followed by a failure. But the unsavory truth was told by the general manager of 'Automatrix', a test equipment manufacturer – "It's hard, very hard to learn from your successes". In the simplest terms, failure is the ultimate teacher.

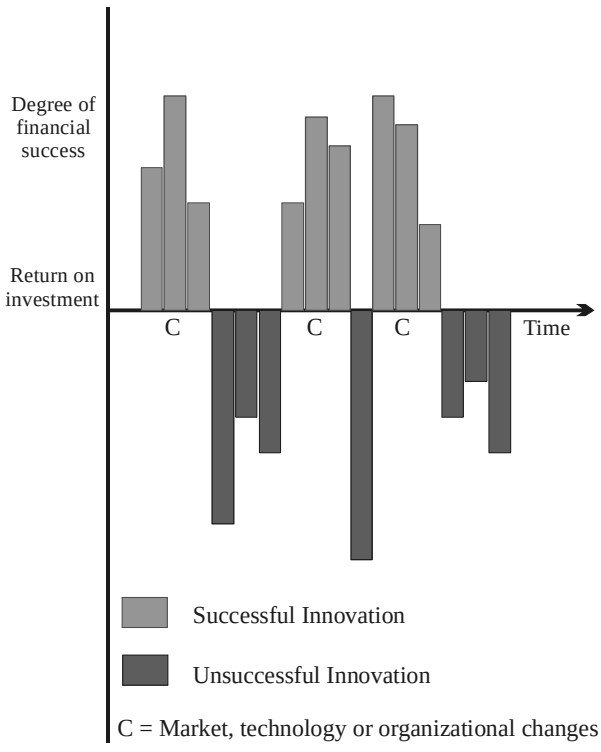

Fig.1 : A New Product Development Evolution Pattern[7]

As innovation is risky, success in new product launching is never assured and its behaviour is stochastic. Even statistics of countries who have strong technological and market research base reveal this stochastic nature. About 40-50 percent of new venture-capital backed ventures bring reasonable returns of which 10-15 are outstanding. However, when we take stock of results of combined investments, we find a return of 25-30 percent.

Failure being the ultimate teacher, innovators, in attempts to glorify failure, add various adjectives and call 'smart failure', 'glaring failure', 'failure that works', 'failing well', 'favourite mistake' etc. It is realized that 'productive failure' is better than 'unproductive success'. Productive failure enriches the fund of knowledge as it adds to the 'know-why' part. And unproductive success can at best highlights 'know-how'.

LEARNING TO LEARN

Rycroft and Kash[8] while discussing network learning have spoken of six types (i) learning by doing, (ii) learning by using, (iii) learning from advances in S&T, (iv) learning from spillovers (v) learning by interaction and (vi) learning from formalized inquiry.

As in network learning, the game of innovation also embodies *learning by doing* which is associated with manufacturing. Some branding it as *learning from experience* brings into its fold improvement in production process, management system, distribution, sales, advertisement, worker training, and motivation. While *learning by doing* results in lower labour cost, the later reduces full cost. This enhanced learning process can best be understood by what is known as 'experience curve'. In the ultimate analysis these are all *learning by doing.*

Whatever nomenclature we use, while the whole process (*learning by doing*) is internal with reference to the production process, *learning by using* is external. And the latter is gained after a product is used for a prolonged period. External learning may be **embodied** which leads to design

modification resulting in improved usability and reliability or may be **disembodied** causing improved operation of the original or the modified product.

A different type viz. *learning by failure* is of special importance for our present discussion. This leads to development of **new** market approaches, **new** product concepts and **new** technological alternatives.

Another dimension of this type of learning relates to organizational development.

Its difference with former two types is quite obvious and which is why its importance in innovation is so over-riding. Fig.2 below is self-explicit.

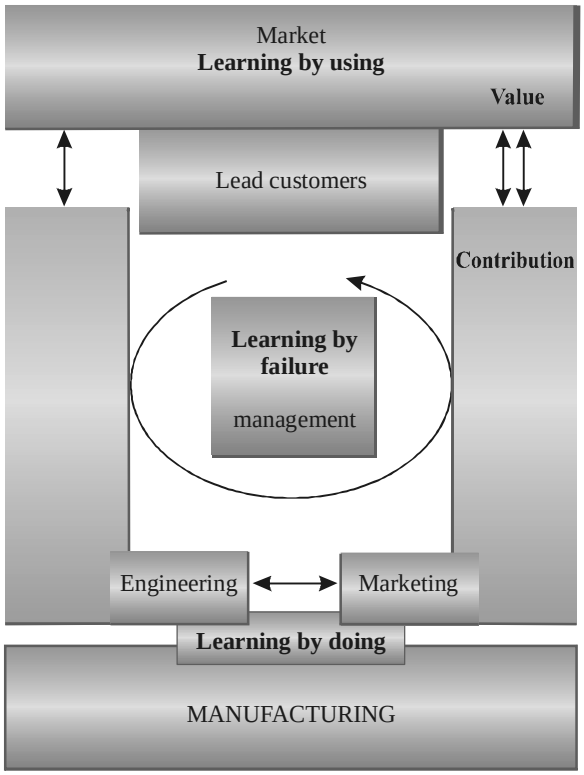

Fig.2 : A Model of External and Internal Learning[7]

It sounds unbelievable that there exists a Museum in Ithaca, New York for failed products. Its curator Robert McMath has a collection of thirty five thousand such failed products (failed in markets) from peanut butter to deodorants collected through forty years.

NO FAILURE-WORSHIPPING

No one, however, innovates to fail. We neither pray for failure to occur nor extend a red-carpet reception to it. We do not begin our day with a plan to commit a certain number of mistakes.

The submission is that a low-tolerance organization is not the propitious ground for fructification of innovations. A successful organization will not go for hanging the staff who has failed in his/her attempt to innovate. A true leader never calls his staff and says—"I want a 30% increase in your creativity in next three months. Otherwise I will ask you to put in your papers." A successful leader is who can balance IQ and EQ. A great leader of innovation is able to talk openly about an innovation failure.

Starbucks is a famous brand in publishing. In an endeavour to extend the brand, *Joe* magazine was published and it failed–failed miserably. Starbuck's founder and CEO, Howard Schultz keeps a copy of the ill-fated *Joe* in his office for display.

Jeff Immelt, published 'My Favourite Mistake' in 'Business Week'–the mistake which cost his company $20 million.

A.G.Lafley, CEO of Procter & Gamble also published his 11 'Biggest Innovation Failures' which is reproduced in the next page :

INVENTING THE WHEEL

We end this article by mentioning a successful invention which is Indian. Time is not yet ripe to call it an innovation as we are glued to our definition of innovation stated in early part of the article.

The story is of 27-year old Myshkin Ingawale, an electrical engineer, a NITan (Bhopal) and now a Ph.D scholar at IIMC. He invented what is already named as **Copenhagen Wheel** as this was

A.G.LAFLEY'S 11 BIGGEST INNOVATION FAILURES

Brand	In-Market Experience	Key Learning
1. Frit Fruit and Vegetable Wash	Still in market, owned by another company.	Required significant consumer habit change
2. Dryel At-Home Dry-cleaning Kit	Still in market, owned by another company (for niche audience)	Required significant consumer habit change.
3. Oxydol Laundry Detergent	Still in market, owned by another company.	Bad/small idea
4. Lemon Dash Laundry Detergent	$75 + million in retail sales for P&G, discontinued	Good idea. No difference vs. other detergents
5. Bold 3 Laundry Detergent	Discontinued.	Small idea
6. Solo Laundry Detergents	Discontinued	Small idea
7. Olay Cosmetics	$100 million in retail sales, discontinued.	Didn't do the right consumer testing before launch
8. Physique Hair Care	$100 million in Year 1 retail sales, discontinued.	Didn't sustain brand differentiation vs. competition
9. Vidal Sassoon Hair Care	$50+ million in retail sales, discontinued in US, business still strong in Asia.	Didn't do the right consumer testing before launch.
10. Torengo's Salted Snacks	Discontinued	Competitive walled city
11. Tempo Tissues	Discontinued	Small idea

unveiled during the recent (December 2009) climate conference in Copenhagen.[8]

Ingawale while studying in NIT felt the urge to bring out a viable, economical, eco-friendly and comfortable option to make Indian cities remain navigable and livable. He had originally thought of an electric bike.

But ultimately he landed with a modified bicycle. A smart disc can be retrofitted on any bicycle that can boost the cycle's power and can keep track of friends, fitness, smog and traffic. If anybody tries to steal the bicycle in its owner's absence the device sends an alert message. For those who cannot cycle there is an electric motor to the **Copenhagen Wheel**. Working with MIT's (USA) SENEable City Laboratory acted as a booster to Ingawale's idea. Claus Johl, CEO of Copenhagen has already assured to place the first order for this green 'wheel'. It is a coincidence that Copenhagen is set to get the laurel of being the first carbon-neutral capital by 2025. Ingawale is already in dialogue with a few Indian industries for commercialization.

We have to wait a little for **Copenhagen Wheel** to satisfy our definition of innovation.

We conclude with two sayings that truly set the tune of any disccussion on innovation :

- ✓ ***an organization does not innovate–its people do.***
- ✓ ***to innovate we must understand and at times even embrace failure. After all failure is not the opposite of success in all circumstances.***

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DRUGS FROM PLANTS : GLOBAL RESURGENCE OPENS NEW OPPORTUNITIES

S. P. Singh*

Plants and plant products find extensive application for their therapeutic properties and for providing lead molecules for the development of new and better drugs. Global resurgence requires exploration of traditional Indian medicinal plants using modern scientific tools. Also, rapid steps are to be taken to save them from piracy.

Discovery of a new drug is a time consuming and very expensive business. It has been estimated that it takes 8-10 years of sustained efforts of chemists, pharmacologists and physicians to bring a new product into the market as a drug. Broadly, the process consists of (a) synthesis (or isolation from a natural product) (b) efficacy in biological systems (c) animal toxicology and (d) human clinical testing consisting of phase 1,2 and 3 trials. Each step takes about two years and the cost involved in these steps may be about a billion US$(Rs.5000 crores). This exhorbitant cost is primarily due to the failure rate of the candidate molecules. Only one out of 5000 compounds may have a chance to be placed on the shelf of a chemist. Despite the high cost, efforts are being continuously made to develop new drugs as the annual global sale of drugs crosses US $500 billion. In USA alone, there is sale of drugs worth US $250 billion followed by European Union with its share of US $120 billion. Rest of the countries consume drugs worth US $130 billion.

The potential compound to be tested as a drug molecule is often synthesized following a lead which is often a natural product or obtained through molecular modeling. However, plants continue to remain a primary source for providing a drug or a lead molecule for further development.

The reason for greater acceptability of plant products in human body can be traced to the 'biological friendliness' between the animal and plant kingdoms. A synthetic compound, on the other hand, is a 'foreign body' in the human system which may cause toxic side effects. It is therefore not surprising that out of about 1000 new drugs introduced in the last 25 years, more than half are natural products or derived from them or are mimics. Nearly one third sale of anticancer drugs is from taxenes and camptothecin which are derived from plants. The use of pure plant products as drugs began with the isolation of morphine from opium in the early 10^{th} century. Subsequently many drugs such as cocaine, codeine, digitoxin and quinine were isolated from different plants.

How do we proceed with a plant which is being used in folk medicine or in traditional system of medicine? The particular portion (root, bark, leaves, flowers or fruits) is powdered and dried, preferably in shade. The powder is normally extracted with aqueous ethanol and the extract evaluated for bioactivity. In case the extract has bioactivity, it is

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subjected to further bioactivity-guided fractionation. Only the fractions that retain activity are further subfractionated. The active subfractions are further purified, using traditional and chromatographic methods to the stage of pure compounds. The compound(s) that has bioactivity is then used as a prototype to develop new drugs having more activity and less toxicity. In many cases, during fractionation process, the activity gets distributed in several fractions. In such a situation, the extract itself is considered for development in herbal mode. It is also desirable that in cases, extract of bark or root is found to be active, evaluation of leaves, twigs, flowers and fruits must be done in order to ensure sustainable utilization of the plant. A case in point is that of taxol, a widely used anticancer drug, which was isolated from the bark of *Taxus* trees which are 50-100 years old thus creating danger for the survival as bark of three trees is required to cure a single patient. With great efforts, it could be established that leaves or twigs of the plant provide substances which could be transformed into taxol in the laboratory with relatively simple chemical manipulations.

Obtaining drugs from plants has been a traditional way in the Indian system of medicine. It is rightly said that ancient wisdom has been and will remain the basis of modern medicine. The Ayurvedic system which is very well documented in ancient scriptures such as Atherveda (1200 BC), Charak Samhita and Sushruta Samhita (1000 BC) is being still practices in India. Ayurvedic system is of great significance due to the rich biodiversity obained in our country. There is wide variation in climatic conditions when one travels from Kanyakumari to Kashmir and from the deserts of Rajasthan to the rain forests of Assam. This rich biodiversity has placed India among the 16 megadiverse countries, where 70% of the world's species occur collectively. Eastern Himalayas and Western Ghats are among the 18 hotspots of plant biodiversity in world. Such a great biodiversity had allowed Ayurvedic practitioners to do experimentation with plants which were thought to possess therapeutic properties. Ayurvedic system should not be confused with folk medicines as it is based on sound scientific principles developed over hundreds of years of experimentation, careful observation of medicinal properties and the side effects associated with their use. Many compounds including reserpine (Sarpgandha, *Rauwolfia serpentina*) and psoralene (Babchi, *Psorylia corylifolia*) have indeed been isolated using modern methodology of isolation and have been shown in display the same medicinal properties as described for the plant extract thousands of years before.

Recognizing the need to revalidate the traditional system of medicine, many National Laboratories have joined hands together to collect, extract and fractionate Indian medicinal plants and evaluate their biological activity. Council of Scientific and Industrial Research (CSIR) has undertaken an extensive programme where public and private sectors are working together to revalidate some of the traditional medicines which are commonly used to manage chronic disorders like diabetes, asthma, arthritis, ulcers and fatigue. In addition to the CSIR, Department of Science and Technology (DST), Department of Biotechnology (DBT) and Indian Council of Medical Reserach (ICMR) are also generously funding the R&D programmes related to traditional medicinals and bioactives from natural resources. Department of Ocean Development (DoD) has been liberally supporting an all India coordinated R&D programme on 'Drugs from Ocean'. As a result of these sustained efforts, a few leads developed in India are : bacoside (memory enhancer) from *Bacopa monnieri*, picroliv (hepatoprotective) from *Picrorhiza kurrora*, curcumin (anti-inflammatory) from *Curcuma domestica* and contraceptive cream from *Sapindus mukorossi*.

India's traditional system of medicines, primarily based on Ayurveda, has been exploited by companies in the West by filling patents. It was found that a majority of the patents granted by the US Patent and Trademark Office (US PTO) on medicinal plants were plants of Indian origin. European Patent Office (EPO) has also granted patents on the use of many Indian medicinal plants such as methi, amla, jira, kali tulsi, papaya and pudina. It is estimated that till now, India has lost over 15,000 patents of medicinal plants to the West. Some recent examples include granting a patent on the wound healing properties of haldi (turmeric) by US PTO and the anti-fungal properties of neem by EPO even though the plants were being used for centuries in India for such benefits. India contested these patents and they were revoked in 1997 and 2005, respectively.

Since contesting and revoking the patents is a time-consuming and expensive process, the CSIR has recently prepared the world's first Traditional Knowledge Digital Library (TKDL). TKDL documents over two lakh medical formulations of Ayurveda, Siddha and Unani systems to save them from piracy. This library which is available in five languages English, French, German, Japanese and Spanish has millions of pages of information about the application of plant products (and other traditional sources) being used for medicinal purposes.

Like India, Chinese system of traditional medicines is also very much developed. The first compound obtained from traditional Chinese system was ephedrine from *Ephedra sinica*. It is still used as a decongestant and for treatment of bronchial asthma. The Chinese system came into global focus in 1970s when artemisinin was isolated from *Artemisia annua,* a plant which was traditionally used in China for curing fever. Artemisinin is the first effective anti-malarial drug which was discovered after chloroquin in 1940s. It has been found to be very effective for the treatment of drug resistant malaria and a lot of work is being done throughout the world to modify the structure of artemisinin. Some of its effective derivatives are : dihydroartemisinin, artemether and arteether.

Recently, the Chinese have developed another compound, Kanglaite, derived from a herbal medicine traditionally used for the treatment of cancer. The compound has been found to possess unique anticancer properties with very less toxic effect and has been approved by United States Food and Drug Administration (US FDA) for clinical trials. Chinese have also obtained a process patent and use patent for Kanglaite injections rectifying their mistake in not obtaining such patents for artemisinin. Policy makers in China believe that screening herbal remedies is a way for them to catch up with Western countries in developing new drugs. China, Hong Kong and Taiwan are spending huge amount of money in R&D for getting drug leads from herbal remedies.

Apart from India and China, there has been recent worldwide interest in finding new drugs or leads from plants. As a result of these efforts, many new drugs such as galantamine (reminyl), a drug for Alzheimer's disease obtained from *Galanthus wornowii ;* nitisinone (orfadin), a drug for tyrosinaemia obtained by the structural modification of mesotrione, a constituent of *Callistemon citrinvs ;* and tiotropium (spiriva), a drug for pulmonary disease, obtained by strucutral modification of ipartropium, a constituent of *Atropa belladona* could be developed.

A major breakthrough in the chemotherapy of cancer was the introduction of taxol (taxanes) in 1990s which was obtained from the bark of *Taxus brevifolia*. Camptothecin, isolated from *Camptotheca acuminata,* is also a very effective anti-cancer compound. Taxanes and campothecin account for nearly one third of the global anticancer market in 2006. Vinca alkaloids-vimblastin and

vincristin, isolated from *Cantharanthus rosevus* (formerly vinca rosea) and epipodophyllotoxin, obtained from the resin of *Podophyllum peltatum* are other compounds widely used in the chemotherapy of cancer. It has been estimated that 40% of the current anticancer drugs are plant products with another 8% considered natural product mimics.

It has recently been found that many plant products are effective in cancer chemoprevention. Broadly speaking, chemoprevention is a strategy of cancer control by administration of synthetic or natural products to reverse or suppress the process of carcinogenesis. It has been established that transformation of a normal cell into a cancerous cell invloves : initiation (DNA damaging agents), promotion (cell proliferation is increased) and progression (additional genetic alteration). Chemoprevention strategies target each of these steps : anti-initiation (DNA repair), anti-promotion/ anti-progression (free radical scavenging, proliferation suppression and immunity enhancement).

Researches have indicated that many herbal medicines, edible plants and plant products play significant role in cancer chemoprevention due to their long history of human consumption. Many such products and the compounds isolated from plants which are currently under chemical traials are : curcumin (phase 1, colon cancer), genistein (phase 1, breast cancer), green tea (phase 2, breast cancer), resveratrol (phase 2, cancer of the bladder), soya isoflavanones (phase 2, prostate cancer) and indole-3-carbinal (phase 1, breast cancer).

Use of drugs-whether synthetic or from natural sources-has played pivotal role in fighting diseases and improving the quality and span of human life. However, there is a downside and that is the side effects associated with their use, particularly of the prolonged use. It has been estimated that about a hundred thousand people die every year in US alone due to the side effects of the drugs. Alarmed with such a situation, US Congress passed Dietary Supplement Health and Education Act (DSHEA) in 1994 allowing the sale of herbal preparations without the expensive and time-intensive clinical trials, thereby getting products to the store shelf more quickly and cheaply. It was also stipulated in DSHEA that such products (dietary supplements) can only claim to prevent disease's symptom and not cure the disease! DSHEA puts the onus of the FDA to prove that a supplement pose risk or harm rather than on the manufacturer to prove the supplement's safety.

European Parliament has passed adequate legislature in 2003 making easy marketing of traditional medicines with a rider that the marketing companies will have to demonstrate safe use of herbal products for 15 years within Europe and at least 30 years in its country of origin. Canada also allowed entry of herbal products if traditional references like translated Sanskrit texts or anthropologically validated tranditions can prove that it has been safely used for at least 50 years. *Thus we are witnessing an era of world-wide interest in plant products being used as drugs.*

Increasing popularity of herbal preparation in management of chronic disorders at global level may be attributed to lesser side effects. Herbal preparations are particularly used for the management of chronic disorders at a global level. It has been estimated that some of diseases where these products have found wide application are : breast cancer (12%), liver diseases (21%), HIV (22%), asthma (24%) and rheumatological disorders (26%). The preparation commonly consist of leaves, stems, flowers, roots and seeds. They may contain a simple herb or several herbs. The chemical constituents commonly include fatty acids, sterols alkaloids, flavonoids, glycosides, saponins, terpenes and tannins. It may be noted that heating or boiling of these products (extracts) may alter the pharmacological activity of the organic constituents.

Standardization of herbal preparations constitutes a signicicant step to maintain their efficacy. It is well established that chemical composition of plant products largely depends upon soil, altitude and seasonal variation in temperature, humidity, rainfall, dew and frost conditions. This simply means that herbal preparations collected from different places, seasons, altitudes and periods may not have similar pharmacological properties needed for providing relief for a particular disease. For example, analysis of Ginseng products (a Chinese herbal preparation used as energy booster) found a 15 to 200 fold variation in the concentration of two important biological ingredients. Gineosides and Elevthreosides!

Standardization process of herbal preparations usually involves identifying the biologically active compound(s) termed as the Marker. Uniformity in the concentration of the Marker is then obtained by blending several batches of the preparations collected from different places in different seasons, at different altitudes and from different soil conditions. In certain cases, purified Marker may be added to an extract, but the final product will not have original balance of organic ingredients found in the extract.

Efficacy of herbal preparation in providing cure for a disease has been widely investigated. In many cases therapeutic properties of such substances have been established beyond doubt. A few typical examples are : garlic has been found to decrease total cholesterol level by 4-6% as allicin, a component of garlic, inhibits cholesterol synthesis; extract of Ginko biloba is equally effective as the drug Tacrine for the treatment of Alzheimer's disease; extract of saw palmetto has been shown to improve urinary track symptoms and flow rates and extract of St. John's wart has been shown to be more potent than the drug Imiprimine in the treatment of depression with fewer side effects.

In addition to higher plants, micro-organisms continue to remain a rich source of getting new antibiotics even since the discovery of penicillins. Many antibacterial agents including cephalosporins, aminoglycosides, tetracyclins and polypeptides have been obtained from micro-organisms. These organisms have also been traditional source for immunosuppressive agents (cyclospoins and rapamycine), cholesterol lowering agents (lovastatin and mevastatin) and anticancer agents (peplomycin and epirubicin).

It thus emerges that in order to provide strong scientific base, Indian traditional medicinal plants need to be explored using modern scientific tools. Also, rapid steps are to be taken for the export of herbal medicines to a global market of US $60 billion.

SOMETHING TO THINK ABOUT

IN HUMAN EVOLUTION WHAT WAS MORE IMPORTANT– THE HEAT FROM FIRE OR THE LIGHT ?

Hem Shanker Ray

This interesting question and possible answers have been discussed by Andreas Koller in a recent article in Science (24 July, 2009, p. 204) which is a review of the following recent books published on the subject.

(a) Catching fire, By Richard Rangham, Basic Books, New York 2009 (ISBN 9780465013623).

(b) Fire : The spark that ignited human civilization, By Frances D Burton, University of New Mexico Press, Alburquerque, 2009 (ISBN 9780826346469).

The present write up is mainly based on the views summarized by Koller.

We generally give more importance to the heat of fire because that made humans 'cooking apes', the word used by Koller. Yet, light must have played on equally important role.

It is well accepted that biological and cultural changes that helped early men to leave other apes behind in evolution were largely driver by opposable thumbs that gave dexterity, walking upright on land that freed the hands, language for communication and trade that created social units. Yet all these were possible because of safety, security and comfort provided by fire.

The knowledge to light a fire, control it and use it accelerated genetic changes and cultural accomplishments by, as Koller says, reshaping selective forces. He emphasizes the argument that learning to ignite and control fire a few million years ago ignited human civilization as well. Consider the following arguments.

- Light from campfires extended the day for our ancestors and provided a sense of security in surrounding darkness. More light meant decrease in melatonin levels and positive effect on cognitive abilities, reproduction and other physiological processes. Lengthening of the day thus had beneficial genetic effects.

- Light from fire helped create a sense of togetherness and safety from wild animals. The togetherness helped in cultural progress and language for communication.

  Koller says that there is a positive feedback between genes that propel cognitive abilities and behaviour and cultural progress.

- Heat was important because it allowed cooking which is a kind of outsourcing of chewing and digestion. Since less angry was required in eating cooked food, the energy saved shifted to the brain to make the brain bigger and superior.

- It is well known that dietary changes bring anatomical changes. Darwin had noted that flinches of different Galapogas islands had different shapes of beaks due to differences in the available diets.

Koller says that the celebrated female gorilla named Koko, who has learned some 300 English words and can write a poem or two, likes her vegetables cooked. Even cows are said to produce more milk when given cooked food to eat.

No doubt cooking destroys vitamins and some other food values but on the whole cooked food provides more energy. One would certainly lose weight if one ate only fruits, nuts, milk and raw vegetables. With loss of carries eating raw flesh was no longer a better option.

- The heat of fire provided additional protection from predators. Sleeping on ground around campfire facilitated anatomical changes.
- If men and women ate cooked food gathering around a campfire talking, singing and dancing then evolutionary progress was bound to come. And then with light and warmth in the cave dwellings some went for artistic pursuits by painting the cave walls, fashioning tools, artifacts and clothing. Settlements allowed domistication of animals and agriculture too.

  We need not chose between light of fire and the heat because they come together anyway.

KNOW THY INSTITUTIONS

INTERNATIONAL ADVANCED RESEARCH CENTRE FOR POWDER METALLURGY AND NEW MATERIALS, HYDERABAD

International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI <http://www.arci.res.in/>) is a state-of-the-art facility for research & development in advanced materials and associated processing technologies. Having its origin in the Integrated Long Term Programme on Cooperation in Science & Technology (ILTP) signed by the erstwhile USSR and India in the late 1980s, ARCI became operational in April 1995. Today, ARCI functions as a grants-in-aid institution of the Government of India's Department of Science & Technology.

Translating Research to Technology has been ARCI's motto and the Centre has set for itself the task of striving to bridge the gap between conventional research institutes & laboratories and the high-technology industries. Consistent with this overall goal, ARCI has dedicated its efforts toward achieving the following objectives:

- Development of high performance materials and processes for niche market.
- Demonstration of technologies at prototype scale.
- Transfer of technologies to the Indian industry.

In order to achieve the above, ARCI has been taking up technologies while they are in their embryonic stages from laboratories/institutions of CIS countries or Indian laboratories, and jointly developing them to the levels of pilot plants/ demonstration centers. The pilot plants/ demonstration centers are then primarily utilized to sensitize the Indian industry to the advantages and

cost-effectiveness of the technology under Indian conditions and thereby aid in the smooth transfer of such technologies to the industries. Such conscious efforts to direct research to fuel growth and evolution has resulted in development of technologies, which are ready for adoption by the Indian industries. The Center's efforts to effect technology transfers have been fortified by the attractive schemes set up by the Indian Government under which the Indian industry can obtain very soft loans for implementing technologies developed by the Indian laboratories and R&D institutions. This has enormously increased the 'salability' of technologies developed by institutions like ARCI.

Surface Engineering, Ceramics, Powder Metallurgy and Laser Processing of materials constitute the four major thrust areas at ARCI. The Powder Metallurgy programmes are largely aimed at developing value-added products and exotic materials for the Indian industry. There is also significant focus on transformation of the otherwise mine burden to useful P/M products, energy conservation and development of permeable materials for varied applications. The activities in the field of Ceramics have been initiated to create new and advanced materials for high-tech applications. The programmes are primarily oriented towards developing alternative materials for better performance, substituting the import market for high temperature materials and recycling of scrap to produce engineering ceramic powders. In Surface Engineering, ARCI has been judiciously building up facilities to complement and enhance existing national capabilities in the field. The Centre has been continuously striving to provide most cost-effective solutions to combat surface degradation problems in the industry. This is being achieved through indigenization of coating equipment as well as by offering some of the institute's unique coating facilities for jobbing activities to permit the industry access to technologies not available elsewhere in the country.

ARCI Advanced Technology Incubator (AAMTI) is being established adjacent to ARCI R&D Campus. Three companies , all technology received from ARCI, have already set up their production facilities in the incubator.

Objectives of establishing AAMTI are

- to minimise the risks involved in commercialisation of ARCI technologies.
- to promote and support small scale entrepreneurs in their effort to innovate and commercially exploit ARCI technologies.
- to deliver the benefits of ARCI networking to members.

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Conferences / Meetings / Symposia / Seminars

Fourth International Conference on Plants & Environmental Pollution (ICPEP-4), 8-11 December 2010, NBRI, Lucknow, India.

Areas/disciplines of the Conference :

1. Bio-indication & Bioremediation
2. Environmental biotechnology
3. Environmental education, Mass awareness and Legislation
4. Environmental Impact Assessment and Eco-auditing
5. Environment and Biodiversity
6. Plant Responses to Environmental Pollution
7. Climate change
   - Impacts on Forest Health and Ecosystems-in collaboration with International Union of Forest Research Organizations, (IUFRO) Vienna, Austria.
   - Agriculture & Food Production.
   - Aquatic Ecosystems.
   - Human health.
   - Role of botanic gardens in climate change research
8. Contemporary environmental issues
   - Palaeo-Environment
   - Environmental impact on cultural heritage
   - Environmental systems and Disaster management
   - Bio-pollutants
   - Indoor pollutants
   - Bio-pollutants
   - Bio-energy
   - Sustainable agriculture
   - Human settlements
   - Alien Plant Invasion
9. Biotechnology, GM Food & Environmental Safety (Special Session)

Last date for submission of abstract is 31st July 2010.

Contact : Dr. K.J. Ahmad / Dr. R.D. Tripath, Organizing Secretaries, ICPEP-4, National Botanical Research Institute, Rana Pratap Marg, Lucknow 226001, India. **Tel :** +91-522-2297821 (Direct) / +91-522-2205831 to 2205835(PBX) Extn. 821 **Fax :** +91-522-2205836/2205839, **E-mail :** isebnbrilko@sify.com/ isebmail@gmail.com **Website :** http://isebindia.com.

1st National Conference on Animal, Microbial, Plant Toxins & Snakebite Management, December 11-12, Kolkata, West Bengal.

This conference aims to provide a common platform for all researchers (clinicians and non clinicians) working on different aspects of natural toxins from animal, microbial and plant, snakebite management and environmental issues related to natural toxins, to discuss their research findings. The conference will consist of plenary sessions, orations, invited lectures, oral and poster presentations.

OBJECTIVES : To create awarness and understanding of issues related to natural toxins (animal, microbial, plant) and snakebite management.

- To identify scientists working on natural toxins
- To establish state-of-the-art research on natural toxins
- Snakebite management - current status, problems and future
- Application of toxins in medicine and biotechnology
- Environmental issues related to natural toxins

SCIENTIFIC AREAS TO BE COVERED

- Animal Toxins
- Microbial Toxins
- Plant Toxins
- Toxin Miscellaneous
- Snakebite Management
- Antivenom/Antidotes
- Environmental Issues & Natural Toxins

Contact : Dr. Aparna Gomes, Organising Secretary AMPTOX2010, Drug Development Diagnostics and Biotechnology Division, Indian Institute of Chemical Biology 4, Raja S.C.Mullick Road, Kolkata-700032, India. Contact e-mail : amptox2010@gmail.com, Phone : +91-98311 85589 & +91-94331 39031

S & T ACROSS THE WORLD

FORMULATING TECHNOLOGY ROADMAP

The Technology Information Forecasting and Assessment Council (TIFAC), along with the Indian Chemical Council (ICC), are planning to commission a study for formulating a technology roadmap for the invited proposals from competent consultancies for undertaking the study, titled "Indian chemical industry : Technology imperatives and business opportunities." Based on the findings of the study, TIFAC will prepare a report. The objectives of the study include :

(i) Identification of technology gaps and recommendation of methodologies for catching up with global benchmarks.

(ii) Determination of roles of the national laboratories, along with academia, towards strengthening of the Indian chemical industry.

(iii) Identification of the opportunities for making India a global chemical hub.

(iv) Recommendation of ways to promote India as a global research and development destination.

(v) Identification of the obsolete environmentally polluting technologies in the country vis-à-vis the prevailing global environmentally friendly technologies.

(vi) Fostering new entrepreneurs to undertake new start-up ventures.

(vii) Formulation of a technology roadmap for the country with short as well as along-term perspectives.

(TIFAC, Sep 2009)

PREVENTING OF BLOOD CLOTH

Scientists at the Banaras Hindu University (BHU) claim to have discovered a new potential alternative to aspirin and other anti-platelet agents used widely to prevent blood clots in coronary artery disease and stroke. The scientists said that the lab testing of silver noanoparticles seemed to keep platelets in an inactive state. Nanosilver is already know to have antibacterial property. Research showed that noanoparticles of silver strongly inhibit formation of platelet aggregates and keep the silver noanoparticles in an inactive state.

The scientists through their research have also highlighated that the silver nanoparticles are more effective than traditional ways to treat clot. Traditional drugs used to prevent platelet aggregate formation in case of stroke and heart attack individually block the specific pathways of platelet aggregation. None of these drugs completely prevent platelet activation, as an element of redundancy in their functions always remains. In contrast, nanosilver prevents platelet aggregate formation at the final common point. Thus nanosilver, it is believed, is more effective technically than any of these drugs in preventing platelet aggregation. The researchers further point out that nanoparticles also hold immense potential in managing heart disease.

(BHU, Jul 2009)

UNMANNED SURVEILLANCE PLANE

US company Aurora Flight Sciences have developed the unmanned aircraft under a programme called 'Vulture' with the support of BAE Systems, CS Draper Laboratory, and the Sierra Nevada Corporation. It has a Z-wing configuration that spans almost 500 ft (150 metres) so that the aircraft's shape can be adjusted when in sunlight to absorb as much solar power as possible. When it is in darkness, it flies flat in a straight line for aerodynamic efficiency with the energy collected stored in onboard batteries used to drive the aircraft's electric motors.

The aircraft is designed to fly at altitudes of 60,000-90,000ft so that it could be used for

surveillance, communications and environmental monitoring such as climate change research.

It is a solar-powered aircraft that aims to be able to stay in the air for over five years continuously. Design of the aircraft has now been revealed. Full-scale prototype is expected to be ready within the next five years.

(Mail Online, Aug 2009)

MICROORGANISMS REVOLUTIONISE PRODUCTION

In many industrial sectors, biotechnological processes have become an inherent part in the repertoire of production processes. Biotechnological processes can keep up with "conventional" processes in many cases : in pharmaceutical production, food manufacturing, in the chemical industry or in the production of energy sources. Besides the classical fields of application like specialty and fine chemicals, new application, e.g. in the use of renewable resources, are emerging. Worldwide production volumes of biomaterials and bioenergy are expected to be in the range of Euro 300 bn by 2030, accounting for around a third of total industrial production.

Examples of biotech products include ethanol, organic acids, amino acids, biopolymers, specialty and fine chemicals and enzymes which play a major role in biocatalyst synthesis. Intensive development work continues on other industrial biotechnology products which can be used as catalysts, process materials and additives in a number of different industries.

(Chemical Weekly, Jun 9, 2009)

E-WASTE MEDICINE

University of York's Green Chemistry of Excellence has found highly innovative potential use for e-waste. They have found a way to recover a chemical that is widely used in LCD displays and put it to use in medicine. Polyvinyl alcohol (PVA), when recovered from displays that would otherwise be landfilled or incinerated, can be transformed into a substance that doctors use to make "tissue scaffolds" that help parts of the body regenerate. Researchers also say the chemical could be used in pills and dressings to deliver drugs to specific parts of the body.

Because PVA does not provoke a response from the human immune system, it is a suitable chemical for these types of internal medicine uses. And with untold millions of tons of electronic waste disposed of very year, there is no shortage of supply of the chemical.

(Greener Computing, Jul 14, 2009)

OPTICAL TRANSISTOR

ETH Zurich researchers have successfully created an optical transistor from a single molecule. This has brought them one step closer to an optical computer. Scientists have been trying for some time to fine ways to produce integrated circuits that operate on the basis of photons instead of electrons. The reason is that photons do not only generate much less heat than electrons, but they also enable considerably higher data transfer rates. They have now achieved a decisive breakthrough by successfully creating an optical transistor with a single molecule. For this, they have made use of the fact that a molecule's energy is quantized : when laser light strikes a molecule, that is in its ground state, the light is absorbed. As a result, the laser beam is quenched. Conversely, it is possible to release the absorbed energy again in a targeted way with a second light beam. This occurs because the beam changes the molecule's quantum state, with the result that the light beam is amplified. New single molecule transistor may ultimately pave the way for a quantum computer.

(Science Daily, Jul 3, 2009)

WIRELESS POWER SYSTEM

A system based on the work by physicist Marin Soljacic the Massachusetts Institute of Technology

(MIT), can deliver power to devices without the need for wires. The technique exploits simple physics and can be used to charge a range of electronic devices over many metres. It could thus replace the miles of expensive power cables and billions of disposable batteries. It exploits 'resonance' whereby energy transfer is markedly more efficient when a certain frequency is applied. When two objects have the same resonant frequency, they exchange energy strongly without having an effect on other surrounding objects. The system uses two coils, one plugged into the mains and the other bedded or attached to the gadget. Devices using the system would automatically begin to charge as soon as they are within the range.

(BBC News, Jul 23, 2009)

REDUCING CO_2 EMISSIONS

Security of supply and climate change are high on the global energy agenda, and the transport sector is no exception as virtually every means of transport by land, air and sea uses fossil fuels and thus emits CO_2. Energy consumption for transport purposes represents 20% of the world's total energy consumption. The most important thing is to introduce renewable energy in the transport sector and have the sector integrate in the energy system. By land, air and sea there are plenty of opportunities to reduce CO_2 emissions.

In short term it is possible to make the cars far more fuel efficient. In the longer term electric cars charged by wind turbines seem to be a fine solution for the global energy system. A good alternative for vans and trucks could be gas instead of diesel. To reduce CO_2 emissions in international shipping, ships can be constructed with better propellers and hulls with less water resistance. Wind and solar power can also be used together with better engine technology. Passenger air transport could also become much more fuel efficient by using lighter construction materials, reduction of air drag from planes, replacing hydraulics with electric engines and also by using solar energy.

(Chemical Weekly, Aug 18, 2009)

ANSWERS TO "DO YOU KNOW ?"

A1. The colour of the skin depends on availability of ultra violet ray. The western people are exposed to less UV ray which results in white skin. Near the equator and in the south, people are darker because of more melanin present to block UV rays. UV B rays produce vitamin D in the skin and this helps to fight many diseases if not present in excessive amounts.

A2. Ante Meridien.

A3. The level from one edge to the alter has only a difference of $^1/_2$".

A4. Hallux – Big toe in the hind foot of vertebrates.

A5. This gorilla female has command over 2000 words in English. When she had a toothache. She simple asked for a dentist and indicated the level of pain by pointing to 9 in the pain chart with maximum 10.12 Specialists rushed to her enclosure and extracted a tooth after a check up ; koko sat through everything patienly.

A6. A variety of swift has been known to go upto 3 years in sky.

A7. Digboi, Assam.

A8. A Rosary.

A9. Bull Fighting.

Cth;eg ÂJÒttl fÙtdm mô:t

14, ztO ÂchN dnt ôxex, fÙtj fÙt;t - 700 017, Cth;

THE INDIAN SCIENCE CONGRESS ASSOCIATION

14, Dr. Biresh Guha Street, Kolkata-700 017, INDIA

;th/Telegram : SCICONG : CALCUTTA
=hCtM/Telephone : (033) 2287-4530, 2281-5323
JcmtRx/Website : http://sciencecongress.nic.in
V¢m/Fax : 91-33-2287-2551
R-bj/E-mail : iscacal@vsnl.net
iscacal_2004@yahoo.com

m=ôg;t fle N; yth m=ôgt fle ÂJNMtÂ"fÙth/Terms of Membership and Privileges of Members :

mô:t fle m=ôg;t Wl mCe jtdt fÙ ÂjY Fj n st ôlt;fÙ gt Wmf mbtl ô;h vh NGÂKfÙ gtÉg;t ysl fÙh af n yth Âsàn Cth; ÂfÙ ÂJÒttl fÙ ;h¢fle b ÁÂa n›

Membership of the Association is open to person with *Graduate or equivalent academic qualification* and interested in the advancement of science in India.

1. **JtÂMfÙ m=ôg** & st ôgÂÿÙ lg Áv m JtÂMfÙ m=ôg;t dnK fÙhlt atn;t n Wm JtÂMfÙ m=ôg;t NÖf Á 200/- fÙ mt: C;e NÖf Á 50/-* (ÂJ=ÂNgt fÙ ÂjY** U.S.$ 70) btºt =l vzd› JtÂMfÙ m=ôg;t NÖf ŒÀgfÙ JM fÙ 01 yŒj fÙt =g nt stYdt› st Ce 15 sjtR fÙ Ce;h yvle m=ôg;t NÖf lne y=t fÙh vtYdt Jn Wm mtj fÙ ÂjY yvle Jtx =l fle Gb;t m JÂa; nt stYdt yth/gt Jn Wm JM fÙ ÂjY mô:t fÙ fÙtgtjg fÙt Ce ÂlgºtK lné fÙh vtYdt› YfÙ m=ôg st JtÂMfÙ m=ôg NÖf ydj mtj fÙ bta fÙ y; ;fÙ lné = vtYdt Wmfle m=ôg;t mbtË; nt stYde›

   m=ôgdK yvlt vvh fÙtdm mºt fÙ mbg vN fÙh mfÙ; n› Wàn JtÂMfÙ ÂJÒttl fÙtdm mºt fle fÙtgÂJJhK fle YfÙ ŒÂ; ÂcltbÖg b ŒtË; nt mfÙ;e n› RmfÙ mt: J mô:t fÙ htsltbat llYJhebl m mtRm00 Ce ÂcltbÖg Wvjç" fÙh mfÙ; n›

1. **Annual Member :** A person willing to be enrolled as new Annual Member has to pay an annual subscription of Rs. 200/- along with an admission fee of Rs. 50/-* (for foreign** U.S.$ 70) only. The annual subscription of a Member shall become due on the 1st April of each year. Anyone who fails to pay the subcription on or before the *15th July* in any year shall lose the right of voting and/ or holding any office of the Association for that year. A member failing to pay the annual subscription by the end of March of the following year shall cease to be a Member.

   Members may contribute papers for presentation at the Science Congress. They will receive, free of cost, reprints of the Proceedings of the Session of any one section of their interest and also the bi-monthly journal of the Association "Everyman's Science".

2. **mºt m=ôg** & gÂ= f‖A f‖thKt m JtÂMf‖ m=ôg yvle m=ôg;t Wm JM f‖ 15 sjtR f‖ y=h =tnhtlt Cj stY ;t Wlf‖e m=ôg;t mºt m=ôg;t f‖ Áv b Âclt Jtx ztjl f‖e Gb;t b meÂb; f‖h Â=gt stYdt› JtÂMf‖ m=ôg yvle m=ôg;t =tctht ydj mtj Âclt C;e NÖf Â=Y yvle m=ôg;t NÖf f‖t Xef‖ mbg vh =f‖ vl& ŒtË; f‖h mf‖;t n›

2. **Sessional Member :** If for some reasons, Annual Members fail to renew their Membership by remitting subscription prior to 15th July each year, their Membership for the year would be restricted to Sessional Membership without voting right. Annual members can renew their Membership without paying the admission fee in the next year by remitting subscriptions in time.

3. **Atºt m=ôg** & st ôgÂÿ‖ ôlt;f‖ ô;h f‖ lea vZtR f‖h hnt n Jn JtÂMf‖ m=ôg;t NÖf Á 100/- btºt =l vzd› yvlt ltb Atºt m=ôg f‖ Áv b ÂjFJt mf‖;t n cN; Wmf‖ ytJ=l vºt vh Wmf‖ Œtatg/ ÂJCtdtÉgG/mô:tl f‖ Œ"tl f‖ nô;tGh nt› Yf‖ Atºt m=ôg f‖t gn yÂ"f‖th Â=gt stYdt Âf‖ Jn yvlt vvh f‖tdm mºt f‖ mbg vN f‖h mf‖ cN; Jn vvh Jn Âf‖me JtÂMf‖ m=ôg gt mô:t f‖ f‖tR yJ;Âlf‖ m=ôg f‖ mt: vN f‖h› Wm Jtx f‖hl f‖t gt f‖tgtjg f‖t ÂlgºtK f‖hl f‖t yÂ"f‖th ŒtË; lné ntdt› Atºt m=ôg f‖t ÂJCtdt f‖ ôgJmtg cXf‖t yth mt"thK cXf‖t b Ctd jl f‖e gtÉg;t ŒtË; lné n›

3. **Student Member :** A person studying at the under-graduate level may be enrolled as a Student Member by paying an annual subscription of Rs. 100/- only provided his/her application duly certified by the Principal/Head of the Institution/Department. A student member shall have the right to submit papers for presentation at the Session of the Congress of which he/she is a member, provided such papers be communicated through a Member, or an Honorary Member of the Association. He/she shall not have the right to vote or to hold any office. A student member shall not be eligible to participate in the Business meetings of the Sections and the General Body.

4. **ytseJl m=ôg** & Yf‖ m=ôg yvl CÂJíg f‖e mthe ctÂMf‖ m=ôg;t NÖf Yf‖ cth b Áv 2000/- (ÂJ=ÂNgt f‖ ÂjY U.S.$ 500) btºt y=t f‖hf‖ vt mf‖;t n› Yf‖ ôgÂÿ‖ st 10 mtj gt Wmm yÂ"f‖ ÂlgÂb; Áv m m=ôg;t ŒtË; f‖h af‖t n, Wm Wmf‖e mgÿ‖ m=ôg;t NÖf f‖ Wvh ŒÂ;JM Á 50/- f‖e Ax =e stYde, cN; Âf‖ Wmf‖e mgÿ‖ NÖf Á 1,200/- m lea l nt (ÂJ=ÂNgt f‖ ÂjY U.S.$ 12.50 yth U.S.$ 300 f‖bN&)› Yf‖ ytseJl m=ôg f‖t Wmf‖ vh seJl f‖tj b m=ôg;t f‖e mthe ÂJNMtÂ"f‖th ŒtË; ntd›

4. **Life Member :** A Member may compound all future annual subscriptions by paying a single sum of Rs. 2000/- (for foreign** U.S.$ 500) only. Any person who has been continuously a member for 10 years or more, shall be allowed a reduction in the compounding fee of Rs. 50/- for every year of such membership, provided that the compounding fee shall not be less than Rs. 1,200/- (for foreign** U.S.$ 12.50 and U.S.$. 300 respectively). A life Member shall have all the privileges of a member during his/her lifetime.

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* C;e NÖf Á 50/- ÂmV‖ Yf‖ lg JtÂMf‖ m=ôg f‖ ÂjY sÁhe n› gn mºt m=ôg/ytseJl m=ôg/ mô:tl m=ôg/Atºt m=ôg/=t;t f‖ ÂjY sÁhe lné n›

* Admission fee of Rs. 50/- is needed only for becoming a new Annual Member and not for Sessional Member/Life Member/Institutional Member/Student Member/Donor.

** (Yf ÂJ=Ne m=ôg f t y: n st Cth;JM f ctnh f t ltdÂhf nt)›

** (A Foreign Member means one who is normally resident outside India).

5. **mô:tl m=ôg** & Yf mô:tl st Á 5,000/- m=ôg;t NÖf f Áv b = Jne mô:t f mô:tl m=ôg cl mf;t n (ÂJ=ÂNgt f Âj Y U.S.$ 2,500)› Rmb Jn Âcòttl f tdm f JtÂMf mºt b yvl Yf ôgÂÿ f t ltb ltbtÂf; f h mf;t n st Wlf t ŒÂ;ÂlÂ" nt› Yf mô:tl m=ôg f t JtÂMf ÂJòttl f tdm mºt f e f tgÂJJhK f e Yf vK ŒÂ; Âcltbög b ŒtË; nt mf;e n› Rmf mt: J mô:t f htsltbat llYJhebl m mtRm00 Ce Âcltbög Wvjç" f h mf; n›

5. **Institutional Member :** An Institution paying a subscription of Rs. 5,000/- (for foreign** U.S.$2,500) only, can become an Institutional Member of the Association. It shall be eligible to nominate one person as its representative to attend Annual Session of the Science Congress. An Institutional Member shall be eligible to receive, free of cost, a copy of the complete set of Proceedings of the Annual Science Congress Session as also a copy each of the Association's journal "Everyman's Science".

6. **=t;t** & f tR Ce ôgÂÿ st Yf mt: Á 10,000/- (ÂJ=ÂNgt f Âj Y U.S.$ 5000) btºt = Jn mô:t f =t;t cl mf; n› Yf ôgÂÿd; =t;t f t Jn mthe yÂ"f th yth ÂJNMtÂ"f th Âbjd st Yf m=ôg f t Wmf vK seJl f tj b ŒtË; nt; n› Yf mô:tl st Yf mt: Á 50,000/- (ÂJ=ÂNgt f Âj Y U.S.$ 25,000) btºt = Jn mô:t f mô:tl =t;t cl mf;t n, Âsm Yf ôgÂÿ f t ltbtÂf; f hf Wm yvl mô:tl f ŒÂ;ÂlÂ" f Áv b ÂJòttl f tdm f JtÂMf mºt b Cs mf; n› Yf mô:tl/ôgÂÿd; =t;t JtÂMf ÂJòttl f tdm f f tgÂJJhK yth mô:t f htsltbat llYJhebl m mtRm00 Ce Âcltbög Wvjç" f h mf; n›

6. **Donor :** Any person paying a lump sum of Rs. 10,000/- (for foreign **U.S. $5000) only, can become a Donor of the Association. An ***INDIVIDUAL DONOR*** shall have all the rights and privileges of a member during his/her lifetime. An Institution paying a lump of Rs. 50,000/- (for foreign U.S. $25,000) only, can become an ***INSTITUTIONAL DONOR*** of the Association, which shall have the right to nominate one person as its representative to attend Annual Session of the Science Congress. An Institutional/Individual Donor shall be eligible to receive, free of cost, a copy of the complete set of Proceedings of the Annual Science Congress Session as also the Association's journal "Everyman's Science".

(y) **vvh vN f hlt** & Yf vK vvh f e ŒÂ; Wmf mt: ;el mthtN f e ŒÂ; st 100 Nç=t m ßgt=t l nt yth Âsmb f tR ythF gt Vlbjt l nt, Jn ŒÀgf JM 15 Âm;öch f y=h bntmÂaJ (bÏgtjg) ;f vna stlt atÂnY›

(A) **Presentation of Papers :** A copy of complete paper accompanied by an abstract in triplicate not exceeding one hundred words and not containing any diagram or formula, must reach the General Secretary (Hqrs) latest by September 15, each year.

(c) mCe Jdt f\ m=ôg st ÂJÒttl f\tdm mºt b Ctd j l f\ vëat; jtx; mbg f\ Âxf\x b Âhgty; ŒtË; f\h mf\;t n cN; Âf\ Wlfle gtºtt f\ Fa f\t :tzt Ce Ctd mhf\th (f\Šeg gt htßg), f\tR f\tl\le mútt gt f\tR ÂJëJÂJ'tjg gt f\tR ldhvtÂjf\t l WXtY›

(B) Members of all categories are entitled to railway Concession of return ticket by the same route with such conditions as may be laid down by the Railway Board for travel to attend the Science Congress Session provided that their travelling expenses are not borne, even partly, by the Government (Central or State), Statutory Authority or an University or a City Corporation.

(m) mô:t f\ vô;f\tjg b mCe Jdt f\ m=ôg f\t vZl f\e mÂJ"t mcn 10,00 cs m Ntb f\t 5.30 cs ;f\ mCe f\tb f\ Â=lt b (NÂlJth yth hÂJJth) f\t Atzf\h ŒtË; ntde›

(C) Members of all categories are entitled to reading facilities between 10.00 a.m. to 5.30 p.m. on all weekdays (except Saturdays & Sundays) in the library of the Association.

(z) mbg mbg vh mô:t Ãtht ;g f\e dR bÖg vh ÂJ¶tbdn, mCtdth ytÂ= mÂJ"tyt f\e ŒtÂË; Ce mCe Jdt f\ m=ôg vt mf\; n ›

(D) Members of all categories may use Guest House facilities, Lecture Hall hiring at the rates fixed by the Association from time to time.

(R) CÂJíg b Cth;eg ÂJÒttl f\tdm mô:t Ãtht ytgtÂs; vÂhmJt=, möbj l yth JtÂMf\ f\tdm b mCe Jdt f\ m=ôgt Ãtht Ctd j l f\ ÂjY yvle-yvle m=ôg;t vºt f\t jtlt sÁhe n›

(E) Members of all categories should bring the Membership Card always for attending any Seminar, Conference and Annual Congress organized by ISCA in future.

Agtl = & mCe cf\ ztÜx "Treasurer, The Indian Science Congress Association" f\ ltb m ne ÂjFt stY yth f\tjf\t;t f\ Âf\me Ce NtFt b =g nt› m=ôgt m gn ÂlJ=l Âf\gt st hnt n Âf\ J yvle m=ôg;t mÏgt f\t W¨F Cth;eg ÂJÒttl f\tdm mô:t f\ f\tgtjg f\ mt: vºttath f\ ôgÿ\ yJëg f\h›

Note : All Bank Drafts should be drawn in favour of "Treasurer, The Indian Science Congress Association" Payable at any branch in Kolkata. Members are requested to mention their Membership No. while making any correspondence to ISCA office.

Cth;eg ÂJÒttl f\tdm mô:t

14, ztO ÂchN dnt ôxex, f\tjf\t;t - 700 017, Cth;

THE INDIAN SCIENCE CONGRESS ASSOCIATION

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JcmtRx/Website : http://sciencecongress.nic.in
iscacal_2004@yahoo.com

m=ôg;t f\ ÂjY ytJ=l - v°t/ Application Form For Membership :

mJt b/To
bntmÂaJ (bÏgtjg)/ The General Secretary
Cth;eg ÂJÒttl f\tdm mô:t/The Indian Science Congress Association
14, ztO ÂchN dnt ôxex/14, Dr. Biresh Guha Street,
f\tjf\t;t - 700 017/Kolkata - 700 017

bnt=g/Dear Sir,

b Cth;eg ÂJÒttl f\tdm mô:t f\t ytseJl m=ôg/JtÂMf\ m=ôg/m°t m=ôg/At°t m=ôg/mô:tl m=ôg/ =t;t/ yvlt ltb ÂjFJtlt atn;t / atn;t n›

I like to be enrolled as a Life Member/Annual Member/Sessional Member/Student Member/Institutional Member/Donor/of The Indian Science Congress Association.

b Rmf\ mt: Á _____ m=ôg;t NÖf f\ Áv b lf\=/cf\ ztÜx mÏgt _____ Â=ltÂf\; _____ Œatjf\ cf\ _____ 01 yŒj —— m 31 bta —— ;f\ Cs hnt/hne n›

I am sending herewith an amount of Rs. ———— in payment of my subscription by Cash/Bank Draft No. ———— dated ———— issuing bank from the year 1st April —— to 31st March ——.

b ÂlölÂjÂF; ÂJCtd b ÁÂa hF;t/hF;e n (Âf\me Yf\ b f\vgt ÂlNtl jdtY)/ I am interested in the following section (Please tick any one).

ÂJCtd/Section

1. f\ÂM yth JlÂJ't ÂJÒttl/Agriculture and Forestry Sciences
2. vN, vNÂaÂf\Àmt yth bÀôg ÂJÒttl/Animal, Veterinary and Fishery Sciences
3. btlJNtô°teg yth ytahK ÂJÒttl (Âsmb mÂöbÂj; n vht;ÀJ-ÂJÒttl yth bltÂJÒttl yth NÂGf\ ÂJÔttl yth mlt ÂJÒttl/Anthropological and Behavioural Sciences (including Archaeology and Psychology & Educational Sciences & Military Science)
4. hmtgl ÂJÒttl/Chemical Sciences

5. C-võÂ; ÂJÒttl/Earth System Sciences
6. yÂCgà;t ÂJÒttl/Engineering Sciences
7. Jt;tJhK ÂJÒttl/Environmental Sciences
8. malt yth mathK ÂJÒttl yth Œt'tÂdfle (flövxh ÂJÒttl mÂöbÂj;)/Information and Communication Science & Technology (including Computer Sciences)
9. CtÂ;fl ÂJÒttl/Materials Science
10. dÂK; ÂJÒttl (mtÂÏgfleg mÂöbÂj;)/Mathematical Science (including Statistics)
11. ÂaÂflÀmt Ntô°t (Nheh ÂJÒttl mÂöbÂj;)/Medical Sciences (including Physiology)
12. lgt seJÂJÒttl (seJ hmtgl, seJ CtÂ;fle yth ytKÂJfl seJÂJÒttl yth seJ-Œt'tÂdfle mÂöbÂj;)/ New Biology (including Bio-Chemistry, Biophysics & Molecular Biology and Biotechnology)
13. CtÂ;fleg ÂJÒttl/Physical Sciences
14. JlôvÂ; ÂJÒttl/Plant Sciences

(flvgt xÂfl; flh gt çjtfl yGht b Ch/Please type or fill up in Block Letters)

ltb/Name (çjtfl yGht b/in block letters) : _____ _____

flj ltb/Surname Œ:b ltb/First Name

_____

bÆg ltb/Middle Name

NtGÂKfl gtÉg;t/Academic Qualifications :
(ŒbtK sbt flhlt n/Evidence to be submitted)

v=ltb/Designation :

mövfl flt v;t/Address of communication :
(htßg, Nnh/ldh yth Âvl fltz mÂn;/including state, city/town and pin code)

=hCtM mÏgt yth R-bj/Phone No. & E-mail :
(ydh fltR/if any)

ô:tge v;t/Permanent Address :

ÂxËvKe (ydh fltR)/Comments (if any)

CJ=eg/Yours Faithfully

Â=ltfl/Date : nô;tGh/Signature

Agtl =& (i) mCe cf ztÜx "Treasurer, The Indian Science Congress Association" f ltb m ne Âj Ft stY yth fltj flt;t f Âflme Ce NtFt b =g nt›

Note : (i) All Bank Drafts should be drawn in favour of "Treasurer, The Indian Science Congress Association" Payable at any branch in Kolkata.

(ii) *10 yÿch, 2004 f fltgtÂhKe mÂbÂ; f Œô;tJ f yl mth Cth;eg ÂJÒttl fltdm mô:t fle m=ôg;t f Âj Y ytJ=l b Âflme yàg ôgÂÿ f lbtV;0 flt mtbtàg;& n;tÀmtÂn; Âflgt dgt n› vh; ÂVlh Ce gÂ= ytJ=lv°t b lbtV;0 flt v;t Â=gt hndt ;t Wmb Âsm ôgÂÿ flt ltb Â=gt hndt Wmf nô;tGh Ce sÁhe n›

(ii) *As per resolution of Executive Committee in its meeting held on October 10, 2004 application for membership of ISCA in 'Care of' of some other person is generally discouraged. However, if in the application from "care of" address is given then there should be also signature of the person in whose name "care of" is given.

(iii) *C;e NÖf Á 50/- ÂmV Yf lg JtÂMf m=ôg f Âj Y sÁhe n› gn m°t m=ôg/ytseJl m=ôg/mô:tl m=ôg/At°t m=ôg/=t;t f Âj Y sh¥he lné n›

(iii) *Admission fee of Rs. 50/- is needed only for becoming a new annual member and not for Sessional Member/Life Member/Institutional Member/Student Member/Donor.

(iv) m=ôgt m gn Âl J=l Âflgt st hnt n Âf J yvle m=ôg;t mÏgt flt W¨F Cth;eg ÂJÒttl fltdm mô:t f flt gtj g f mt: v°ttath f ôgÿ yJëg flh›

(iv) Members are requested to mention their Membership No. while making any correspondence to ISCA office.