EVERYMAN'S SCIENCE

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COVER PHOTOGRAPHS

Past General Presidents of ISCA

1. Dr. Atma Ram	**(1968)**
2. Dr. A. C. Joshi	**(1969)**
2. Prof. A. C. Banerjee (died pre-maturely)	**(1969)**
3. Prof. L. C. Verman	**(1970)**
4. Prof. B. P. Pal	**(1971)**
5. Prof. W. D. West	**(1972)**
6. Dr. S. Bhagavantam	**(1973)**

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EDITORIAL

SMALL PROMISES BIG IN AGRICULTURE AND HEALTH !

Sometimes it happens in science that unanswered questions accumulate or critical observations remain unexplained. Such a challenge often entails a breakthrough which opens a new area of investigation and analysis. It happened recently in 1998, when Andrew Fire and Craig Melio, Nobel Laureates in Physiology or Medicine for 2006, discovered RNA interference (RNAi) — a fundamental mechanism of gene regulation (Fire *et. al*. 1998). RNAi allows small double stranded RNA molecules to silence a gene activity by degrading its messenger RNA (mRNA) and has been found to occur in diverse organisms including plants and humans.

Several thousand genes present in the genome make mRNAs which translate into proteins. Messenger RNAs, representing the sense strand equivalent of DNA, have been shown to pair with antisense RNAs leading to inactivation of the gene or gene silencing. Such an approach with customized antisense RNA has been tested to silence a gene, which in an inactive state can confer advantage to the organism. Studies in plants provided unexpected observations on gene silencing. For example, an effort to make petunia flowers with more red coloured petals by gene overexpression resulted, sometimes, in loss of colour. In this background, a nematode *(Caenorhabditis elegans)* was used by Fire, Mello and their colleagues to assess the effect of sense, antisense and a mixture of both (double stranded) RNAs against a gene associated with nematode movement. Surprisingly, double stranded RNA caused twitching movement and mRNA of target gene disappeared. Since only few double-stranded RNAs could elicit the effect, sequence specificity and involvement of an amplification (enzymatic!) step were suggested. Interestingly, the effect could spread to other cells and progeny as well as interfere with expression of the gene by a process called RNA interference (RNAi). It turned out that long double stranded RNA binds to Dicer (a protein complex) which changes it into double stranded small RNAs. These bind to the RNA Induced Silencing Complex (RISC), the sense strand is removed and the antisense strand in RISC helps binding to target mRNA, which is ultimately degraded. Thus, a new mechanism of gene regulation was unraveled. Subsequently, various forms of 21-24 nucleotide small RNAs associated with RNAi, including naturally occurring microRNAs, were discovered and findings were used to explain some unexpected as well as wide-spread natural processes.

Improvement in our understanding about biogenesis of such small RNA has uncovered not only a panoply of proteins performing multifarious steps but also mechanistic variations on central themes among eukaryotes like animals and plants. One of the major forms is 20-24 nucleotides long siRNAs (small interfering RNAs) which are generated from longer double stranded (ds) RNAs. Their characteristic features include 3' dinucleotide overhangs and 3' hydroxyl and 5' phosphate groups. One of the strands called passenger siRNA strand is cleaved by Argonaute protein in pre-RISC complex. The guide siRNA strand in mature RISC complex binds to target messenger RNA. The cleavage generally occurs 10-12 nucleotides away from 5' end of the binding site. Other forms like frans-acting siRNAs (tasiRNAs) and

heterochromatic siRNAs have been found to have novel functions as reflected by their name. The precursors of microRNAs are generated from native genes as primary microRNAs and processed into pre-microRNAs of about 70 bases with a stem-and-loop like structure. They are exported to cytosol and processed, more or less by a similar pathway as mentioned above, first into 21 nucleotide microRNA-microRNA* duplexes and subsequently into single stranded RNA complex to degrade the target mRNA or repress translation initiation. Mitrons are a form of microRNAs generated from spliced introns (Chen 2010, Davidson and McCray Jr 2011). All such small RNAs either control various cellular functions, guard the genome from transposons having RNA as an intermediate replicative form or serve as a defense barrier against viruses in organisms the discovery leaves little room to imagine the utility of the RNAi regulatory process and related small RNAs in agriculture and health. In principle, it is possible to construct vectors capable of producing RNAi related small RNAs or synthesize such small RNAs *per se* against any gene. The product development, however, entails knowledge about the specificity of the functions of gene in the organism and RNAi activity as well as delivery to the target. The chemical make-up of these RNAs also needs to be adjusted to avoid immune response in humans. Sometimes, it is preferable to deliver precursor and use native mechanism to generate RNAi trigger. The carriers of small RNAs include lipid-based systems, nano-particles, viral vectors and bacterial species. The target specificity, as in case of certain carriers, can be provided by incorporation of ligands or by using natural affinities of viral vectors. The potential of RNAi technology has been successful in attracting attention of a wide spectrum of researchers and clinical trials have been undertaken for control of gene activity related to ocular, lipid, kidney and retinal disorders, viral infection, and cancer. Phase II clinical trials are going on or completed for genes like VEGFR1 involved in age-related macular degeneration and choroidal neovascularization, (32 adrenergic receptor involved in glaucoma, BCL-2 involved in chronic myeloid leukemia, p53 involved in delayed graft function kidney transplant, and rniR-122/nucleocapsid against Hepatitis C virus/RSV infections. It should, however, be kept in view that other issues like dose determination and long-term therapeutic strategies also need to be addressed along with limitations being overcome by innovative approaches.

Perhaps the first observation to exemplify the present day RNAi was made by S.A. Wingard in 1928. In a tobacco plant infected by ringspot virus, initially infected leaves showed symptoms but upper leaves remained healthy, possibly due to activated viral RNA silencing. Subsequently, Post-Transcriptional Gene Silencing (PTGS) and Virus-Induced Gene Silencing (VIGS) were discovered in eighties and found to have elements similar to RNAi. Today, control of viruses, transposon movement in genome and gene activity in plants have been related to siRNAs and microRNAs. Much information has been gained about the mechanism of cell to cell and long distance movement but the nature of mobile signal in plants remains enigmatic. It seems that plants incorporated RNAi in their war against viruses for protection, but some viruses evolved to overcome RNAi as certain viral proteins have been identified as suppressors of RNAi. Several crucial developmental processes in plants like leaf surface identity, flowering, meristem identity and determinacy, and sex determination, as also response to stress have been found to be regulated by microRNA. Also, vectors based on viral or microRNA backbone have been designed to trigger RNAi against specific genes in plants, thereby determining their biological function. The use of such vectors along with

transgenic technology provides a way for long-term and stable deployment of RNAi technology (Chen 2010). Investigations are also underway to generate siRNAs against essential genes of pathogens and pests in plant cells and help control their attack as they come in contact with plant.

RNAi emerges as a fundamental mechanism of gene regulation in diverse organisms and controls important biological functions. It holds great promise to be harnessed as a tool to explore gene function and for application in agriculture and health. Notwithstanding the hurdles to overcome, it seems to be an exciting option in the basket of the imminent gene revolution!

Akhilesh K. Tyagi

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Scientific people know very well that time is only a kind of space. We move forward and backward in time just as we can move forward and backward in space ? ***—H. G. Wells***

PRESIDENTIAL ADDRESS

A BREATHING SPELL : PLANT SCIENCES IN THE SERVICE OF MAN

A. C. JOSHI, D.SC., F.N.I.

I am thankful to the Indian Science Congress Association for the honour they have done me by electing me as their President for the 56th annual session. I express my gratefulness in all sincerity and in no way because it is customary to do so on such formal occasions.

My thoughts next turn to the fact that just a year ago I was elected President of the Association for 1969-70 and I was to preside at the 57th meeting in January 1970. The President elected for this year was Professor A. C. Banerji, well-known for his contributions to Astrophysics. This is a field much in the news now-a-days for very rapid advances, particularly in relation to space exploration. We naturally looked forward to a very thoughtful address on the subject. His unexpected demise has deprived us of his wise leadership. All of us mourn deeply his passing away.

The city of Bombay is the commercial capital of our country. It is the leading financial and industrial centre of India. It is also noted for its progressive outlook and cosmopolitan culture. It has for these reasons much attraction for the scientists and it is for the fifth time that the Indian Science Congress is meeting here to discuss the advances in different Sciences and their impact on our national life. The present occasion is, however, significant in that it is for the first time that the Congress is meeting under the auspices of an Indian Institute of Technology. Although young in years, these institutes have already given ample evidence of their excellence in the sphere of technical and scientific education. They are carrying on studies in an atmosphere of orderly devotion when there is a disruption of academic life in many universities due to recurring agitations. Our attention is naturally drawn to their constitution, their governance, their admission procedure, their examination system, etc. It is obvious that even old universities have much to learn from the new institutes of technology.

In the world of today, it is not necessary to dwell upon the importance of Science in the life of a nation. Even the most primitive societies have started thinking about improving Science education and the training of scientists. The very survival of developing countries today depends on an adequate acquisition of scientific and technical knowledge and its full utilization in agriculture, industry, defence and other spheres. This has been brought out very clearly in the Science Policy Resolution of the Government of India adopted in 1958.

Around the beginning of the 17th century, when Science was just entering opon its modern phase of active growth, Bacon listed what could be expected form Science. His important expectations from Science were the prolongation of life, the restitution of youth in some degree, the curing of diseases counted incurable, the mitigation of pain, the increasing of strength, the altering of constitution

* General President, Fifty-Six Indian Science Congress held at Bombay January, 1969.

such as fatness, leanness and stature, making of new species, making better instruments of destruction for war, exhilaration of the spirits and putting them in good disposition, increasing the force of the imagination either upon another body or upon the body itself, acceleration of putrefaction and germination, making rich composts for the earth, making of new foods out of substances not then in use, making new threads for apparel, etc.

While some of Bacon's notions are not shared by modern Science and a few of his expectations are still not realised, it is obvious that we have achieved today almost everything that he desired and many things more. Bacon, for example, never imagined utilization of mechanical power, electricity, nuclear energy, acceleration of transport and communications, television, space travel, etc., which are common things at present. His major interest was in problems of health, freedom from common ailments and prolongation of life. The realisation of all these expectations, nearly 30 years old, has not, however, solved the problems of mankind. The progress of Science in a one field has created new problems in another. Thus the advances in Medical Sciences have greatly increased the expectation of life. In advanced countries a newly born child expects to live now to the age of 75 to 80 years. Even in India, the application of simple health measures in two decades since Independence has resulted in nearly doubling the longevity from 27 to 53 years and the average male in Punjab expects to live for 60 years. The result has been a population explosion unprecedented in history and mankind is faced with the grim possibility of dying from famine and starvation instead of disease.

The condition of many-developed Asian countries, India, Pakistan, Indonesia, Philippines, China, etc., where civilization developed earlier that in other parts of the globe and which are already over-populated, is particularly precarious. Feeding their poor and malnourished millions had become a source of much anxiety to their governments. Food grains and hay had to be imported from outside in large quantities. Many experts forecast the occurrence of widespread famine in the early seventies.

During the last five years, however, a silent revolution has taken place in these countries through what has become known as the modern agricultural technology. This implies the use of high yielding dwarf varieties (wheat and rice), hybrid vigour (maize, jowar and bajra), dependable irrigation, fertilizers, pesticides and fungicides, better machinery and electric power. In 1967, world agricultural production set a new record and the underdeveloped countries accounted for most of that increase. The agricultural output in these countries rose by 7 to 8 percent over 1966. Per capita food production increased by 6 percent.

In Indian economic history also, 1967-68 is one of the most significant years. 95 million tons of food grains were harvested. More than 15 million tons of wheat alone was harvested. This is more than double the production of 1951. In a few years, India aspires to be self-sufficient in food grains and even hopes to export some high quality rice. The Philippines, which has been importing food in large quantities for many years, harvested a record rice crop in 1967 with only 14 percent of its rice fields planted with the new "miracle variety" I.R.-8. It even exported some rice. Similarly, Pakistan harvested 5.5 million tons of wheat and it has good chances of achieving self-sufficiency in food grains in another year and is looking forward to an export potential in the Fourth Five Year Plan beginning from 1970. The first sprouting of the "green revolution" have naturally generated all-round hope. We can say positively that many countries which

were faced just a few years ago with the prospects of a large-scale famine are today on the brink of an unprecedented opportunity. The critical food problem of the next 20 years can be solved with known agricultural techniques.

If the present pattern of consumption continues, the food grain requirements of India by 1975-76 are expected to be 150 million tons. These will rise to 200 million tons by 1985. Both of these targets are within reach by extending the cultivation of high yielding varieties already available in the country or likely to be produced at the plant-breeding stations in the near future and by providing the requisite inputs of water, fertilizers etc. The task before the plant scientists now is to explore the means of meeting the food requirements after 1985 and at the end of the century, as even with the full application of the known agricultural technology, people could outstrip even an expanded food supply.

The food problem could be solved if the world were to achieve a stable population in 20 or even 30 years. This is, however, not likely to happen. The average rate of population growth at present is about 2.5 percent. In large areas of the underdeveloped world the population growth is likely to shoot up to 3.5 percent as soon as essential health services are organised. Despite the fact that very determined efforts are being made in many countries to limit the size of families, the population is going to touch the six billion mark much before the end of the century. Whether it shall be stabilised by the end of the century is an open question. It will be hazardous to base plans of food production on such an assumption. We should be only too well aware of the fact that the extinction of many dominant species in the past has followed the explosion of population. Man by his skill has survived a series of such population explosions in the past following pastoral, agricultural and industrial phases of his cultural evolution. He can survive the present crisis of scientific revolution due to the progress in Medicine by control of his environment and the proper planning of food production well ahead of his requirements. If the world is in a position to feed its population today, it is due to the basic discoveries made in Plant Sciences, that underlie agriculture, during the last 40 years. Planned scientific studies to feed a population of 6 or more billion at the end of the century must begin now.

While it may become possible to manufacture carbohydrates and other simple food materials in due course with the help of atomic energy or other sources of power without the aid of plants, one cannot hope much from such sources to feed the millions. Mankind will continue to depend for a long time for food largely on solar energy captured by the green plants.

Further, our efforts to utilise unconventional food, from *Chlorella* to wild tree leaves, though possible, pose formidable technological problems. Recent work has shown that the seas and the oceans are not so productive as they were once considered since the holding of large proteinaceous biomass is no guarantee for sustained high rate of production. Indeed, they have been compared with deserts in the matter of rate of production among the terrestrial ecosystems.

Technically it is possible to argue that land may be better utilised if we were to obtain our food resources largely from selected trees than from cereals. It is also sometimes said that the climate of tropical countries is better suited for "tree culture" rather than for "grass culture". The argument runs

like this: All materials used for food by man ultimately come from green plants which grow by utilising the energy of the sunlight. Even the best farmlands use annually only a fraction of the solar energy that falls on them. Assuming the average annual input of solar energy for India as about 200 kcal/cm^2 and allowing for reflection from and transmittance through the leaf of about 25 percent of the only 50 percent as photosynthesisable light energy we get a figure of 12 percent of energy fixation on the basis of 10 quanta being used per CO_2 molecule. Roughly 25 percent of the fixed energy is used up in respiration, leaving only 9 percent of the fixed energy for growth or just 18 kcal of the input of 200 kcal/cm^2 for the whole year provided the land is covered with leaf all the time. However, in actual practice the average yield of paddy and wheat in India is 1 ton per hectare or roughly 0.01 g/cm^2 which corresponds to about 0.04 kcal of fixed energy per cm^2 (1 g plant tissue being equivalent to 4 kcal of energy). Trebling this figure to 0.12 kcal/cm^2 may give us a rough estimate of the total energy fixed during the growth of the whole plant during a season. If we raise two crops in a year, the annual yield can be 0.24 kcal of fixed energy per cm^2 against the potential of 18 kcal. The gap between the potential and realised values is staggering. The difference is mainly on account of light saturation of the photosynthetic apparatus so that most of the bright light during the day is not used. The rate of organic production in our forests has been shown to be of a higher order than achieved so far by any cereal, and possibly in trees the critical light saturation intensity is of a higher order. Further, the wild vegetation does not need manuring, irrigation and labour input necessary for raising a crop. This is possible on account of the dynamic equilibrium of flow of energy and cycling of minerals in the natural ecosystem. It is said that man has only to learn the technology of extracting food from the wild vegetation in order to be free from the tedium of agriculture.

In spite of the higher productivity of the forests, it is not likely that men will change their food habits so drastically as to obtain the greater part of their energy requirements from trees. Conventional agriculture would continue to be the mainstay of food requirements of the people and the problem before our country as well as before other parts of the world is how to augment food production through conventional agriculture on a decreasing area of farmland.[1]

In the ECAFE region during the period of 1960-66, the average food grain output increased at the rate of 1.1% against 2.5% increase in the population. In India agricultural production increased at the rate of 3.1% against a rise in demand of 3.36% during the same period. The gap between food requirements and food output has been met by large-scale imports from outside. The heavy imports during the past years have affected very adversely our plans of economic development. Further, we are not sure whether food grains will be available for us from other countries in the future. The food surpluses in U.S.A. are rapidly dwindling. All the production there may be required to meet its own growing population. Every country, unless it is heavily industrialised like Japan or Great Britain, would have to meet its food

1. We have no exact data for our country but it has been estimated that in the United States about one million acres of land are consumed every year by growing cities, suburbs, factories, roads, airports, etc. It is estimated that nearly one-tenth of the farmland will be used up in this manner in the next 40 years during which period the population will double itself. A similar situation may arise in India as we take to large-scale industrialisation, housing of the ill-housed people, provision of roads, etc.

requirements largely by increasing production from its own fields.

Thus in most countries, two curves, one for decreasing farmland and the other of rising population, are on a collision course. The security of man can be assured only if new advances in Plant Sciences result in sufficient increase in productivity as to stave of this collision.

Fortunately very rapid progress is being made in different branches of Biology since world war II. Many thoughtful people have even begun to regard the second half of the 20th century as the commencement of the "Age of Biology". We are better aware now about the nature and diversities of life. The discoveries in Botany are opening up entirely new vistas in our understanding of plants. Some of these findings are as important as the great discoveries in Physics that have led to the tapping of nuclear energy.

When one attempts to classify these developments, it is seen that some of them are at present of a purely theoretical interest and have no direct bearing on agriculture. They greatly broaden, however, our knowledge of plant life. In this category can be placed the discovery of algae-like and bacteria-like fossils from pre-Cambrian rocks, which put back the origin of living organisms on the earth to about 3 billion years, that is almost a billion years earlier than we considered likely only a decade before. Another such example of great interest is the development of new biochemical techniques for characterising and making visible the finest structures of the cells down to individual large molecules.

Other recent discoveries are of immediate practical value and hold out promise of revolutionary applications to agriculture and food technology. The most important among them are concerned with the understanding of the precise nature and the subtleties of heredity. As a result, the long-cherished goal of producing varieties of crops to exact specifications is now coming into view. This is making possible the production of many greatly improved strains.

A good example is the recent development of high yielding varieties of dwarf wheats. Scientific improvement of this cereal in India was started some 50 years ago at the Indian (then Imperial) Agricultural Research Institute. Eight years ago a critical study of factors responsible for the yield stagnation as well as instability in the production of this crop was made. It was concluded that the morphology and the developmental rhythm of the tall varieties cultivated in the country until then were not conducive to the production of wheat under conditions of high soil fertility and irrigation. The tall straw made the crop liable to lodging when 3-4 months old. Further, many of the common varieties were susceptible to rust and smuts. Whenever the farmers gave more irrigation and fertilizers, the intensity of attacks of rust and smuts increased. In addition, in Northern India, rains and hails-storms, which are frequent in late March and early April, caused the lodging of the crop even under conditions of poor fertility. The analysis of this kind led the workers at the Indian Agricultural Research Institute in 1962 to the conclusion that dwarf wheat varieties were essential for breaking barriers to high yields in irrigated fields. A request was made to the Rockefeller Foundation for the seeds of the dwarf wheats already developed in Mexico. In 1963, after visiting the wheat-growing regions of the country, Dr. N. E. Borlaug sent 100 kg each of 4 dwarf and semi-dwarf wheat varieties and small samples of 613 promising selections.

The seeds were grown and the crops studied at Delhi, Ludhiana, Pusa, Kanpur, Pant Nagar, etc. In 1964, it was found that the Mexican varieties Lerma Rojo and Sonora 64 yielded over 4 tonnes per hectare at several places. Seeds were multiplied during summer months in the Nilgiri Hills in South India. During the *rabi* season, the dwarf wheats were tested at 155 locations and subjected to detailed pathological, physiological, agronomic and quality evaluation. In 1965, the results from yield trails conducted all over the country led to the release of Lerma Rojo and Sonora 64 for general cultivation. The yields obtained by farmers were so encouraging that it was decided in 1966 to import 18 thousand tonnes of seeds of Lerma Rojo and a few other varieties from Mexico. These were sown in 400,000 hectares during *rabi* season, along with the recommended doses of inputs, under the High Yielding Varieties Programme. In 1967, these dwarf wheats were cultivated in nearly 2 million hectares and thus started the great agricultural revolution in the country. Such rapid spread of new varieties has not been paralleled anywhere in the world. In the summer of 1968 nearly 17 million tonnes of wheat was harvested in the country as against the previous best of 12 million tonnes.

An amber-seeded mutant developed at the I.A.R.I. by treating Sonora 64 with gamma rays and released under the name of Sharbati Sonora deserves special mention of its high protein content. Its yields have touched more than 6 tonnes per hectare. It possesses on an average 16.5 per cent of protein in contrast to about 14 per cent in Sonora 64. Further, this variety has about 3 g of lysine in 100 g protein in contrast to about 2.4 g in Sonora 64. The mutant has helped to establish that protein quantity and quality in wheat can also be improved simultaneously with increasing yields. As the Indian diet is generally deficient in proteins, this discovery is of great significance in improving the nutrition of the masses. It also holds much promise for the future in developing high-yielding as well as high quality crops.

The wheat revolution has helped to bring about a great change in the outlook and agronomic practices of farmers because new varieties can assist in doubling the yield and income. The farmers have become aware of the need for several fundamental changes with regard to the time and method of sowing and in the timing of irrigation and harvesting.

The recent developments in plant physiology are as revolutionary as those in the field of genetics. The investigations on the different types of plant hormones — auxin, gibberellin and kinetin — are giving us new ideas about growth and development. The basic studies on the auxins have led to the development of chemical weedkillers. The discovery will save not only a good deal of back-breaking labour, but it will also greatly augment the yields of crops.

Rapid advances are being made with regard to the understanding of influence of both internal and external environment on flowering. This has led, among other things, to the discovery of a new light-detecting pigment in plants, the phytochrome. These studies make it possible to have a precise control of the time of flowering of crops by chemical sprays or by exactly timed artificial illumination. This opens up the possibility of industrialisation of agriculture, particularly of green house crops.

Then there are discoveries about the occurrence and functions of the trace elements in soil — zinc, copper, boron, manganese, cobalt and molybdenum.

These findings have helped to explain many problems of plant nutrition and hold out the possibility of bringing large areas of wasteland under fruitful cultivation.

The cultivation of isolated fragments and even single cells of plants marks a new advance on the very old problems of plant differentiation and organogenesis, namely, how different tissues and organs can be formed from cells with the same heredity. The growth of whole plants from single cells has also many practical applications and holds out revolutionary possibilities in plant propagation.

There is a growing understanding of the master role of the nucleic acids in controlling growth, differentiation, pigment formation, etc. Then we have now a much clearer picture of photosynthesis, the ascent of sap and the translocation of nutritive elements, the chemistry of synthesis and breakdown of many of the major metabolites, the different kinds of enzymes etc. These advances are enabling us to understand more fully many of the mysteries of plant life. While this knowledge is of fundamental importance for its own sake, it will in due course have practical applications in agriculture.

The mysteries of the biochemical reactions which lead to the fixation of nitrogen from the air have been gradually unravelled. These discoveries may open the way to ; vast new nitrogen fertilizer resources.

There are still many questions about the nature of the plant world about which we 41 still know very little. How is it, for example, that the green plants can manufacture from 16 elements an enormously complex series of organic compounds, including besides carbohydrates, fats and proteins, a variety of vitamins, many toxins, stimulants, drugs, scents, pigments, fibres, etc.? What determines the sequence of germination, growth, maturity, fruiting and aging of plants? How is it that the sea water kills most ; land plants if used for irrigation, whereas thousands of species of plants, including some flowering plants live in the sea? Why different species grow in specific habitats? Why certain plants cannot stand even slight frost, while others can live in subarctic conditions? It will take a long time before answers are found to these questions, but what has been learnt already in recent years holds out great promise for the future.

The application of the recent discoveries in different fields of Plant Science opens up vast possibilities of obtaining higher yields from the cereals as well as other crops several times the present level of production. In order to derive full advantage from this knowledge very sustained efforts to improve biological and agricultural education, research and extension are essential. The great increase in productivity in the United States during the last 40 years is mainly due to a highly developed biology and productive agricultural practices. In a country like ours, where agriculture is much less productive, the need to improve the study of and research in Biological Sciences is urgent. There has also to be created a climate of Science in the country. Adjustments have to be made in land use and cropping patterns. Irrigation facilities and rural electrification on a large scale have to be provided. Fertilizer production has to be greatly stepped up. Pesticides and fungicides have to be made easily available. Machines for quick harvesting, scientific storage and roads to villages have to be provided. Animal husbandry has to be greatly improved, keeping in view the fact that the cattle directly compete with man for food, that they are inefficient converters of energy and increase in their population is likely to

deplete the primary production, but they have the capacity to digest the fibrous constituents of plants which otherwise are useless to man. Finally, all out efforts are required to activate the vast population to the problems that it is facing, their possible solution, and to improving the farmers ability. All this must be done without delay. We should not imagine that the food problem has been solved. It is going to be continuously with us and will need our earnest attention all the time.

Fortunately, man's position in the biosphere is unique. He has the capacity to manipulate the physical and biological environment to his advantage. His cultural revolution holds great promise provided he is conscious of his limitations, and plans to overcome them in good time. The remaining part of the century places him in a precarious position. Food production is undoubtedly increasing, but the population is growing as fast if not faster. Hence special efforts are required in developing countries to boost up agriculture in the hope that both food and population growth shall become stabilised by the turn of the century. This brief period may be regarded as a breathing spell in the race for man's survival. If he utilizes the opportunity wisely to his full advantage, making use of the scientific method and the technology that Science has given him, he would overcome the present crisis of exploding population as he had overcome several other catastrophes in the past.

PHARMACOGENOMICS : APPLICATIONS IN ANTICANCER DRUG DEVELOPMENT

Rahul Dutta[1], Dhruba Malakar[1]. Dipak Sinha[2], Keviletsu Khate[3] and Sweta Garg[1]

Pharmacogenomics is likely to play a crucial role in changing the picture of anticancer therapy. Presently available traditional anticancer therapeutics is less efficacious and is associated with adverse side effects. Pharmacogenomics is ushering in a new era of therapeutics by helping in discovering newer drugs, newer diagnostic tests and by reducing chemotherapy induced toxicity.

INTRODUCTION

The study of how an individual's genetic inheritance affects the body's response to drugs is known as pharmacogenomics. The term comes from the words pharmacology and genomics and is thus the intersection of pharmaceuticals and genetics. Pharmacogenomics intends to develop rational means of optimizing drug therapy, with respect to patient genotype, to maximize efficacy with minimal adverse drug reaction.

Probable role of pharmacogenomics in anticancer drug development :

1. Discovering new drugs
2. Making existing drug more efficacious.
3. Reducing chemotherapy induced toxicity.
4. To get a treatment regimen that can be helpful to individual need.

Pharmacogenomics allows identification of genes with the highest likelihood of predicting efficacy for novel therapeutics.

1-Animal Biotechnology Centre, National Dairy Research Institute, Karnal, 2-Dairy Cattle Nutrition Division, National Dairy Research Institute, Karnal, 3-National Bureau of Animal Genetic Resources, Email : dhrubamalakar@gmail.com,

The classic way in which an anti-cancer drug is developed is split into three phases, in phase I the Maximally Tolerable Dose (MTD) of a drug is determined, from this the workable dose of a drug that a patient can tolerate is determined, in phase II studies the effect of the drug on the cancer patient is measured by X-rays or other means. This allows determining the response rate of the drug. Phase III is the last and the longest phase. Here, patients are randomized to receive either the new drug or the best available treatment and their long term survival is determined. However, the entire process is extremely time consuming and an expensive one.

''Drug development currently takes too long and is highly expensive bringing a new drug to the market currently costs approximately $1.2 billion, which makes it economically impossible to target small patient populations." Steven Paul, Executive Vice President, Eli Lilly & Co.

Genomic technology has brought a newer approach in this regard. Genechip allow us to examine the expression of thousand of genes simultaneously before and after administration of the drug. For, example if a second biopsy of a particular tumour can be obtained, then we can compare gene expression patterns in both tumour

and normal cells in same patient after exposure to a new drug. This enables scientists to get the drug to work in the most effective way in the shortest possible time.

Cancer therapeutics and adverse drug reactions are like the sides of the same coin. More than 2 million serious adverse drug reaction a year in United States, has been reported to cause as many as 137,000 deaths. Pharmacogenomics here can play a pivotal role and can save many lives in the following manner:

I. A personalized medical approach of a patient with disease will mean that the genetic profile of the patient will improve the diagnosis of the underlying cause of the disease and allow the selection of a specific drug treatment, which yields fewer serious adverse drug reactions . The FDA has approved a molecular assay called "Invader UGT 1A1" for use in identifying patients that may be at increased risk of adverse reaction to the drug, Irinotecan HCl used in the treatment of colorectal cancer. Invader assay detects variations in a gene called UGT1A1 which codes for enzyme UDP glucoronosyltransferase, responsible for metabolism of the drug Irinotecan hydrochloride.

The diagnostic test detects the UGT1A1*1 (normal) and the UGT1A1*28 (variant) alleles. It helps to determine appropriate dosing for patients homozygous for UGTlAl*28 allele. (fig. 1)

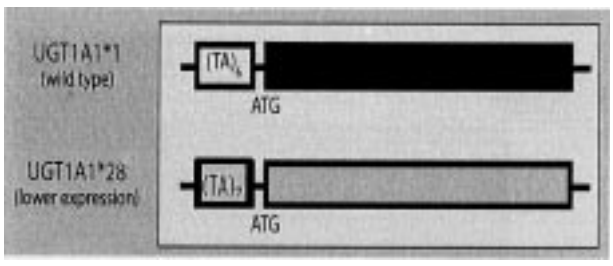

Fig. 1. *UGT1A1 *28 allele is associated with lower expression of UDP glucoronosyltransferase.*

II. Pharmacogenomics will help in aiding the right dose of the right drug to the right patients at the right time by predicting the probability of drug response based on the genetic make up of the patient. Difference in the sequence of a gene can lead the individual to be a slow metabolizer or quicker metabolizer for certain drug. Someone with too slow metabolism has an increased risk to be overdosed when given a typical dose, possibly resulting in serious toxicity. The typical dose may be ineffective for someone with quick metabolism, and thus a higher dose may be needed.

The FDA approved the AmpliChip is the world's first pharmacogenetic microarray based test approved for clinical use. It aims to find the specific gene types (a genotype) of the patient that will determine how he or she metabolizes certain medicines. The AmpliChip CYP450 test provides comprehensive coverage of genetic variations for the CYP2D6 and CYP2C19 genes. These genes account for the metabolism of an estimated 25% of all prescription drugs. The AmpliChip guides the doctors to prescribe medicine for best efficacy and least side effects.

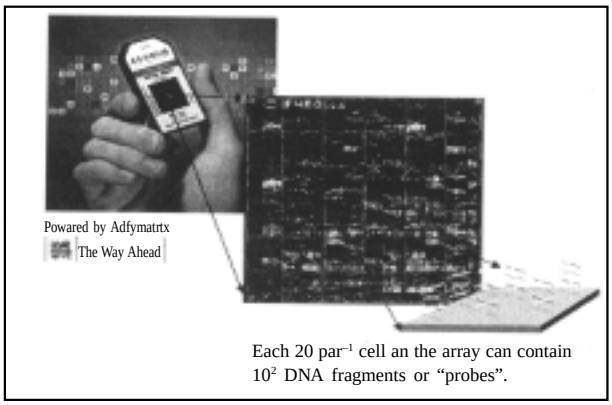

Fig. 2. *AmpliChip CYP450*

How Ampli Chip works :

1. PCR amplification of the gene.
2. Fragmentation and labeling of PCR product.

3. Hybridization and staining on the AmpliChip DNA microarray.
4. Scanning the chip.
5. Data analysis.

III. Pharmacogenomics is used to target therapy to a subset of a disease. Genomic tests have enabled the identification of molecular targets specific to cancer cells resulting in therapies that are likely to respond with enhanced therapeutic efficacy and less toxicity. Numerous cancer patients are benefiting from targeted drugs such as Erbitux (Cetuximab) for colorectal cancer patients with the presence of the biomarker EGFR, Herceptin (Trastuzmab) for breast cancer patients with overexpression of the biomarker HER2 protein.

Theragnostics

Theragnostics is a combination of diagnostics and therapeutics that tailors treatments for individual patients based on their genetic profiles. Theragnostics will identify the subpopulation in which the therapy will be effective, and /or will yield serious adverse drug reactions through the detection of biological markers. This will drastically change the conduct of clinical trials, which will be performed in well-defined subpopulations of patient. Theragnostics will provide more effective care to patients and the possibility of avoiding ineffective treatment that might have serious side effects. (Table : 1)

Drug Name	Test Name	Details
Herceptin (Trastuzmab)	Hercep Test	Immunohistochemical test is designed to identify metastatic breast cancer patients with overexpression of HER2 protein.
Camptosar (Irinotecan)	UTG1A1 UTG1A1	Molecular Assay used to select colon cancer patients who may benefit from treatment with Camptosar.
Erbitux (Cetuximab)	EGFR Pharma Dx kit	EGFR kit helps the detection of colorectal cancer patients who may benefit from the treatment with Erbitux,
Gleevec (Imatinib)	c-kit	C-kit helps to detect the presence of the c-kit protein in GastroIntestinal Stromal Tumor (GIST).
Purinethol (mercatopurine)	TPMT	Patients with inherited little or no ThioPurine S-MethylTransferase (TPMT) activity are at increased risk for severe purinethol toxicity.

Table 1 : *Combination of therapeutic and diagnostic devices.*

TARGETED THERAPY

A type of medication which blocks the growth of cancer cells by interfering with specific targeted molecules needed for carcinogenesis and tumor growth, rather than by simply interfering with rapidly dividing cells.

Advantages of targeted therapy :

I. Molecularly targeted agents are not designed to demonstrate tumor shrinkage but tumor growth inhibition.
II. Most molecularly targeted agents are less toxic than conventional cytotoxic agents.

The first-generation target- based anticancer drugs such as Gleevec, Herceptin and Iressa are now regarded as established drugs.

HERCEPTIN

Herceptin is the first combination pharmacogenomics product. It is considered as a bench mark in the category of targeted drug. Herceptin (Trastuzumab) is used for the treatment of patients with metastatic breast cancer.

Herceptin is a monoclonal antibody directed at the Human Epidermal growth factor Receptor 2 (HER2). Patients that overexpress HER2 in their tumors can be effectively treated using this antibody.

HERCEP TEST

Hercep Test is the first FDA-approved diagnostic system which quickly and consistently identifies

the most appropriate candidates for Herceptin therapy.

Pharmacogenomics has the potential to revolutionize the way cancer treatment is provided. But, it is still in the stage of infancy. There are many challenging issues to be overcome to implement pharmacogenomics vision in clinical practice.

1. Biological responses are complex disease and drug response and can involve more than hundreds of genes. Environmental factors such as lifestyle, nutrition, and age can influence disease and efficacy of the drug.
2. Rapid and reliable automated methods must be developed to efficiently conduct whole genome sequencing.
3. Accessibility of genetic information and databases is an ethical and privacy issue.
4. Cost for whole genome sequencing, SNP analysis and expression profiling are still expensive.
5. Insurance companies may not want to pay for extra diagnostic test.
6. The development of complex systems for computer assisted prescription will be required to actually use the genomic data.
7. Management of data for individual patient will be required for personalized medical care.
8. Value of pharmacogenomic study may not be known until the study is completed.

Pharmacogenomics has the potentials to be used for the entire drug discovery and development. Eventually pharmacogenomics test could be used at clinician's office as a way to get the right dose of the right drug to the right patient at the right time. It receives increasing attention and is becoming an integral part of drug discovery and development. At the end it could be concluded that Pharmacogenomics is a young field that holds considerable promise for drug discovery and development.

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HIGHER EDUCATION IN PURE SCIENCE : CHALLENGES FOR INDIA IN 21ST CENTURY

Kathan Shukla

In order to sustain and to strengthen its economical growth, India needs robust development in the areas of science and research. This can be done by strengthening the pillars of higher education in pure-science. This article explores existing problems in pure-science departments. and suggestions are provided for improvements.

Indisputably, India is one of the leaders of the developing world today. According to the International Monetary Fund (IMF), Indian economy will grow by 8.4% in the year 2011. But, if India wants to grow rich and get into the league of developed nations and to lead the world, it has to strengthen the pillars of scientific research. An example given by the Chinese premier to the CNN news channel, Wen Jiabao, will make my point clear:

"China, the manufacturer country of the Apple I-Pod, gets only about $4 out of the sales price of $299. And the rest of the amount goes to the I-Pod creator country, USA" (CNN, 2010).

If India wants to become a developed nation, if India wants to challenge China and the United States, it has to develop global brands. And the first step in this direction is scientific research.

The development in the field of science and research is rooted in university pure science courses (i.e., Physics, Mathematics, Chemistry and Biology). Unfortunately, the educational practices in an average Indian university can be described as follows :

- This is the syllabus, and these many theories are to be memorized. Please refer the test papers of last five years.
- Reading material can be obtained from the seniors (however, some 'helpful' faculty members dictate notes to the students).
- Drill and practice are the keys for success, so practice writing theories ones, twice, thrice and so on. Once you are able to reproduce theories as in the "reading material", your first class in confirmed (possibly with a gold medal).
- If you perform below expectations, consider that you failed to put sufficient laborious efforts, or wrongly played "the option" card.

This method may efficiently produce trainers (who identify themselves as "teachers"), who can pass on their memorization techniques to the younger generation, but how can it produce scientists and researchers? (The reason of a few exceptions that can be seen in the society can be either student's deep love for the subject or a presence of a dedicated faculty member). As a consequence of such educational practice, India has not yet participated in the global competition in the field of science and research. According to Science Report 2010 of UNESCO, India's contribution to the world research publication is only 3.7%, whereas China's contribution is 10.6% and the United States' contribution is whooping 27.7%. In the category of global patents, India's share is merely 0.5% (USPTO patents) and 0.2% (Triadic patents), whereas China's share is 4.7%

Plot 20, Near Anand Duplex, Bhaikakanagar Thaltej, Ahmedabad, 380 059, Gujarat Email : kathan.shukla@ gmail. com

(USPTO) and 0.5% (Triadic) and the US' share is massive 52.2% (USPTO) and 41.8% (Triadic). Though India has almost doubled its research publications between 2002 and 2008, this progress is over shadowed by glittering Chinese advancement.

Scientific Publications		
	2002	2008
India	18,911	36,261
China	38,206	1,04,968

Resource : UNESCO Science Report (2010)

Almost 16% of the world's population resides in India. However, only 2.2% of scientific researchers of the world hold Indian citizenship. In addition, for every one million of population, India has only 137 scientific researchers; this is outnumbered by many times by all of the developed countries and many of the developing nations (for e.g., China -1070, US -4663 and Japan 5573).

We ought to finalize the aims of pure science education at the university level. If we want our students to get absorbed into the research centres on completion of their post graduate studies and to add value to research projects by their creative inputs, then during post graduation programme the students must have had enough opportunities to develop knowledge and skills required at the research centres. The way scientists and researchers approach to a problem, and their thinking pattern, should be grasped by the pure science student during the university education.

Usually, a researcher follows the following steps :

1. Identify and define a problem
2. Literature review
3. Form hypothesis
4. Develop method, perform experiment and data collection
5. Analyze data and produce results
6. Explain results and draw conclusions
7. Provide directions for further research

During M.Sc., if a student has practice of only writing (and rewriting) already obtained solutions of given problems and theories, how will s/he come up with a newer research problem? and without training, what literature review will she/he pursue and what sort of hypothesis will she/he develop? and of course, in such a scenario the expectation of methodology development is out of question. This is a grim picture of our pure science pass-outs. May be, the business and engineering programmes are aligned with their professional-aims, but the pure science programmes are not designed with such vision, and this could be the reason why increasing number of research centres are compelled to offer M.Sc. and Ph.D. level courses. An obvious question arises- if research centres have to educate masses, what is the requirement of university pure science departments?

According to National Council of Applied Economic Research (2005), out of total unemployed graduates, 22.3% are pure science graduates. The proportion of pure science pass outs is 62.8% among total unemployed post graduates. This represents a disheartening reality of our pure science education. It may be a major reason why students avoid pure science programmes after passing 12th science (NCAER, 2005). As per UNESCO's Science Report 2010, one of the biggest challenges for India in the coming years will be to revolutionarily improve both quantity and quality of scientists and researchers. This gigantic task cannot be done without structural reforms in university education. In order to directly link pure science departments with research work, I am providing certain suggestions based on my observations of research universities in the USA.

¿ Every university should have at least one world class library with a strong e-database having e-books and subscriptions of e-articles of national and international research journals. All of the students and faculty members should

have access of this e-database through internet (e-network), irrespective of their physical location. E-copies of all of the master's and doctoral thesis/dissertations should be included in this e-database. In addition, various universities can be networked throughout India in order to create a large e-database. Throughout the country, such e-networking will facilitate a free flow of knowledge, which is a precondition for research.

- All of the research centres can be linked with such e-network. And experimental data/results and research articles/reports can be made available to each and every university student and faculty member.
- At post graduate level a student must be educated for the following :
  - Critical analyses of research articles
  - Identifying and defining research problems and development of hypothesis
  - Understanding technical limitations
  - Preparing research proposals and contacting funding agencies
  - Working closely with a faculty member on a research project and writing thesis
  - Publishing research articles/papers/thesis

In addition to the written examination, the above points should have significant weightage, while assessing a student.

- India has multiple organizations/interest groups/ associations corresponding to various subjects. It is better to combine various associations and to have one national association/organization/ group for each subject of pure science (i.e., one group for mathematics, physics, chemistry, biology each). Universities should encourage students to become members of such national associations, so that they can get in touch with various national/international scholars as well as other enthusiastic students of different universities.
- All of the universities must strive to minimize the distance between their pure science departments and scientific research centres/ laboratories. In addition, like the students of business and engineering programmes, the pure science students should be interviewed on-campus by public/private research labs/centres. The universities should also approach to the companies that hire pure science graduates.

In the recently organized World Economic Forum 2011 at Davos, all of the eminent economists and financial experts appeared to be agreeing on one particular point: a country with knowledge-based economy will take global leadership in the coming times. The heart of "Knowledge Economy" is progress in science and research. The USA, China and Japan are firmly marching forward in the field of scientific research. Will India participate in the global competition and give a tough challenge?

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MYCORRHIZAL ASSOCIATION : A TRUE FRIENDSHIP ON EARTH

Manab Das and Alok Adholeya

The article is written to describe briefly the association between plant and mycorrhiza and its beneficial effect to agriculture and environment.

INTRODUCTION

Mycorrhiza is a special type of fungus which form a mutialistic relationship (co-operation) with the roots of most plant species (and while only a small proportion of all species has been examined, 95% of these plant families have associated mycorrhiza). Such relationship (symbioses) first evolved ~400 million years ago, possibly helping the earliest terrestrial plants to take up nutrients in the absence of complex vascular root systems. Through this co-operation mycorrhiza access carbohydrates such as glucose and sucrose from the plant roots, in return, it enhances plant's nutrient absorbtion capacity from soil environment. In contacts with plant root, the fungi enhance its vegitative growth through formation of mycelia, a mass of thread like branching, known as hyphae in around the root resulting in increase in total surface area of plant root. Plants need phosphorus (P) in relatively large quantities and it can be found in soil in both organic and inorganic form. Inorganic form of P contributes a little to the available (to plants) fraction in soil, as it forms insoluble crystals with calcium, iron and aluminium. Another factor that limits the availibilty of P in soil are the clay particles, as they bind the P within it. Organic P is the dominant form of available P in soil. However, the mycelia of the mycorrhiza fungus can easily access both these organic and inorganic phosphorus source in soil and make them available to plant, otherwise plant roots alone are capable of taking up P but only the available fraction. This plant-fungi association exists maintans a prolonged and healthy relationship between the plant and the fungus. This relationship leads to a nutrient exchange favourable to both partners. Plants with mycorrhizal fungi are therefore able to occupy habitats they otherwise could not colonize alone. It is essential for many seedlings to have mycorrhizal association at an early stage of growth for their successful establishment in alien habitat[9]. Understanding of this co-opeartive relationship between plant root and mycorrhiza, plant scientists oriented their work towards its use is agriculture (for more yield), growing plants in marginal lands (difficult to cultivate and with little yield), and creation of a green cover on environmentally stressed sites such as contaminated (polluted) soil, industrial waste dump sites.

Centre for Mycorrhizal Research, The Energy and Resources Institute, Darbari Seth Block, Lodhi Road, New Delhi. Email: mdas@teri.res.in, aloka@teri.res.in

CLASSIFICATION OF MYCORRHIZA

The mycorrhizal associations are classified into seven types. The two most predominant ones are ectomycorrhiza and endomycorrhiza.

In ectomycorrhizal association (EM), the fungal hyphae penetrate the intracellular spaces of the epidermis (the outer skin) and of the cortical region of the root but do not enter the living cells. The root morphology is altered, forming shorter, dichotomously (divided into two parts) branched clusters with reduced meristematic regions (where

cell division occurs). Many EM also have a sheath, or mantle, of fungal tissue that may completely cover the absorbing root (usually the fine feeder roots). The mantle can vary widely in thickness, color, and texture depending on the particular plant-fungus combination. Ectomycorrhizae are found on woody plants ranging from shrubs to forest trees. Many of the host plants belong to the families Pinaceae, Fagaceae, Betulaceae and Myrtaceae. Over 4,000 fungal species, belonging primarily to the Basidiomycotina, and fewer to the Ascomycotina, are known to form ectomycorrhizal association. Many of these fungi produce mushrooms and puffballs on the forest floor.

The endomycorrhiza, on the otherhand, enter into the living cells of roots, which become filled with mycelial clusters. Among the various microorganisms colonizing the active root surface, mycorrhizal fungi occupy the unique ecological position of being partly inside and partly outside the host. The part of the fungus within the root does not encounter competetion with other soil microorganisms, hence growing without being hindered by the storage of resources. The endomycorrhizal symbiosis is very common as the fungi involved can colonize a vast taxonomic range of both herbaceous and woody plants, indicating a general lack of host specificity among this type. Mycorrhizal fungi have a unique role in the life cycle of plants in the Orchidaceae. Orchids have orchidaceous type of mycorrhizal associations. Orchids typically have very small seeds with little nutrient reserve. The plant becomes colonized shortly after germination, and the mycorrhizal fungus supplies carbon and vitamins to the developing embryo. For achlorophyllous species, the plant depends on the fungal partner to supply carbon throughout its life. The fungus grows into the plant cell, invaginating the cell membrane and forming hyphal coils within the cell. These coils are active for only a few days, after which they lose turgor and degenerate and the nutrient contents are absorbed by the developing orchid. The fungi participating in the symbiosis are basidiomycetes similar to those involved in decaying. In mature orchids, mycorrhizae also have roles in nutrient uptake and translocation

In some instances both ecto and endo mycorrhiza may be combined and are referred as ectendomycorrhiza. Salix (willows), Populus (poplars), and Eucalyuptus can have both AM and EM associations on the same plant. Structurelly, ectendomycorrhizas are characterized by a thin mantle (some times absent), Hartig net (a hyphal network responsible for nutrient exchange) and various degree of intracellular hyphal penetration into epidermal and cortical cells.

MYCORRHIZA AND OTHER SOIL MICROORGANISMS

Mycorrhiza are found to alter the microbial community around them. The interaction between rhizobia (bacteria that fix nitogen to soil) and mycorrhizal fungi has received considerable attention because of the relatively high phosphorus demand of N_2 fixation. The two symbioses typically act synergistically, resulting in greater nitrogen and phosphorus content in combination than when each is inoculated onto the legume alone. Legumes are typically coarse-rooted and therefore inefficient in extracting phosphorus from the soil. The mycorrhizal fungi associated with legumes are an essential link for adequate phosphorus nutrition, leading to enhanced nitrogen fixing activity that in turn promotes root and mycorrhizal growth. Mycorrhizal fungi often secrete organic compounds, like oxalate or proteins, which may feed oxalotrophic (which are capable of using oxalate as a sole carbon and energy source for survival) and proteolytic (which fed on protein) bacteria. Such phenomenon may affect mycorrhizal fungi either negatively or positively. Roesti[1] showed a possitive correlation between the presence of mycorrhizal fungi and of phosphate solubilizing bacteria : the solubilizing capability of bacteria, combined with the translocating properties of the

fungus, greatly improve phosphate transportation to host plant. Bacteria may also help mycorrhizal fungi by the production of cell wall softening enzymes or plant hormones. Hyphal growth may be stimulated by bacterial production of growth factors or carbon-dioxide. As mycorrhizal fungi colonize feeder roots and thereby interact with root pathogens that parasitize the same tissue. In a natural ecosystem where the uptake of phosphorus is low, a major role of mycorrhizal fungi may be protection of the root system from endemic pathogens such as *Fusarium* spp. Mycorrhizae may stimulate root colonization by selected biocontrol agents, but till date understanding of these interactions is meager. Much more research has been conducted on the potential effects of mycorrhizal colonization on root pathogens. Mycorrhizal fungi may also reduce the incidence and severity of root diseases.

MYCORRHIZA IN AGRICULTURE

There are lots of evidences that depict mycorrhizal symbiosis can increases crop yields. A survey of 78 published field trials revealed that increased mycorrhizal colonization resulted in up to 37% percent increase in average yield[8]. Another study of 290 published field and greenhouse studies reported that increased colonization resulted in a 23% increase in crop yield[10]. Early season phosphorus supply is known to be critical for obtaining optimum crop yields. An inadequate phosphorus supply during early plant growth limits crop growth which cannot be recovered later in the season. Crops such as corn and flax are found highly dependent on mycorrhiza to meet their early phosphorus requirement. Thompson[5] found that mycorrhizal flax had higher seed yield than the un-inoculated control and dry weight of flax seed was linearly dependent on the degree of early mycorrhizal colonization. Legumes, beans and potatoes also benefit significantly from mycorrhizae. Wheat, oat and barley benefit from mycorrhizal symbiosis but are not as dependent under conditions of high soil fertility. The degree to which mycorrhiza increases yields is also dependent on the soil type, nutrient status, and crop management. The Energy and Resources Institute (TERI) is also involved in various national and international project works that specially takes care off application of mycorrhiza in various crops and monitoring the effect of mycorrhizal association on yield and vegetative growth.

MYCORRHIZA AND ENVIRONMENTAL STRESS

Mycorrhiza not only provide the plants with water and mineral compounds and help to improve the structure of soil, but have also been shown to act as filters, blocking xenobiotics (a chemical which is found in an organism but which is not normally produced or expected to be present in it) within their mycelium resulting into reduced toxicity to the plants. They influence the physiology of their host plants making them less vulnerable to pathogens, soil pollution, salinity, drought and a number of other environmental stress factors. Furthermore, mycorrhiza also directly helps the plant to escape from the build-up of phytotoxic (poisonous to plants) concentrations of certain pollutants by secreting specific detoxifying compounds (organic acids). Such mycorrhizal asociation is also supported by secreting plant exudates, e.g. short chain organic acids, phenolics, and small concentrations of high molecular weight compounds (enzymes and proteins) to stimulate bacterial transformations (enzyme induction); by building up of organic carbon to increase microbial mineralization rates (substrate enhancement) or by providing habitat for increased microbial populations and activity. Mycorrhiza have been reported for dissipation of organic contaminants such as atrazine (agricultural herbicide)[3], Polycyclic Aromatic Hydrocarbons (PAHs)[2], DDT[6] and p, p-DDE in soils[4]. Different mechanisms have been proposed to explain the effect of the plant rhizosphere on dissipation of organic pollutants

such as an increase in microbial numbers, an improvement in the physical and chemical soil conditions, increased humification and adsorption of pollutant in rhizosphere. However, the relative contribution of each process has not been clearly explained. In some cases mycorrhizal plants can show enhanced heavy metal uptake and root-to-shoot transport when grown on metal contaminated soil. While in other cases mycorrhizal fungi contribute to heavy metal immobilization within the soil. Protection by mycorrhiza that colonize plant roots and considerably reduce the uptake of heavy metals into plant cells may be one of the means that allow metallophytes (a plant that can tolerate high levels of heavy metals) to thrive on heavy metal polluted sites[9]. Even, it was reported that the mycorrhiza consistently conferred heavy metal tolerance on a variety of plants like tomato, maize or *Medicago truncatula*, in diverse heavy metal contaminated soil under optimum fertilization. Although little research has been carried out on the effect of mycorrhiza on plant uptake of radionuclides, plants with mycorrhizal associations are often found more effective than non-mycorrhizal plants at the uptake of radionuclides. Applying this plant-mycorrhizal fungi association TERI has also done reclamation of various waste contaminated/ waste dump sites including distillery effluent laden soil at Associated Alcohols and Breweries Ltd, Barwaha, Madhya Pradesh; fly ash ponds at National Thermal Power Plant (NTPC), Korba, Chhattisgarh; and chlor-alkali sludge at Tata Chemicals, Mithapur, Gujrat.

CONCLUSION

It was our intention with this article to make aware people about one of the best friendships in nature that is in between plant and mycorrhizal fungi and its beneficial effect on agricultural production as well as management of stressed environment. However, more and more exploration and understanding on this relationship is required to gain maximum benefit from it.

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We acknowledge the many workers we were unable to cite owing to space constraints, particularly those who have made important contributions to the fundamental understanding of mycorrhizal symbiosis.

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ALTERNATIVE RICE CULTIVATION : A COLLATERAL OPTION FOR MITIGATION OF ARSENIC CONTAMINATION

Hirak Banerjee[1], and Kallol Bhattacharyya[2]

Arsenic contamination in groundwater, and the influence thereof on soil-plant-animal and human continuum have been reported from various parts of the country including West Bengal at different point of time. In this context, excessive use of groundwater particularly in the paddy cultivation is a major cause of concern. Therefore, modern paddy cultivation techniques which require less water to produce more rice grain need to be popularize to mitigate arsenic contamination.

INTRODUCTION

Rice being an irreplaceable source of major food supply to people of Asia as a whole and Indian subcontinent to be precise, is predominantly cultivated through wetland production system (75 % of total Asian production turns up from 79 million hectare wetland cultivation). About 92% of the world rice is produced and consumed in Asia which shares more than 50% of the total irrigation water employed for rice production. Irrigated rice has very low water-use-efficiency and consumes 3,000-5,000 liters of water to produce 1 kg of rice. The available amount of water for irrigation is, however, increasingly getting scarce worldwide. In many Asian countries, per capita water availability is expected to decline by 15-54% by 2025 as compared to 1990.[2]

The traditional rice production system not only leads to wastage of water but also causes degradation of soil-plant environment and reduces water-use efficiency. Along with higher water requirement, the traditional system of transplanted rice production leads to over-exploitation of groundwater. Another problem involves over-exploitation of groundwater which causes serious poblems. This practice causes pollution when aquifers are recharged with irrigation water contaminated with chemicals.

ARSENIC CONTAMINATION IN GROUND WATER-SOIL SYSTEM

The origin of arsenic contaminated groundwater in West Bengal, India and Bangladesh is geological, from sediments derived from the upland Himalayan catchments.[13] The arsenic–affected aquifer sediments were deposited from the Ganges River during Holocene.[4]

Over 200 arsenic containing minerals have been identified, with approximately 60% being arsenates, 20% sulphides and sulpho salts and the remaining 20% including arsenides, arsenates, oxides and elemental As. The most common of the As containing mineral is arsenopyrites (FeAsS), others being Orpiment (As_2S_3), Realgar (AsS) and Energite (Cu_3AsS_4) Onishi.[8]

1. Department of Agronomy.
2. Department of Agril. Chemistry and Soil Science. Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741252, Nadia, West Bengal. E-mail : hirak. bckv@gmail.com.

The scale of the problem is grave and unprecedented, covering a geographical area of 38,861 square kilometer, while exposing 50.4 million people in the Bengal deltaic basin to risk. The widespread arsenic contamination in groundwater in different parts of West Bengal, distributed over 111 blocks (3417 villages), located primarily in twelve districts in West Bengal even to the tune of 2500 jag L^{-1} (Tube well test data, JPOA with UNICEF, (http://www.soesiu.org) www.unicef.com).

The source of such contamination being of geogenic origin summer paddy *(boro)* cultivation using large amount of groundwater, is believed to play an important role. One of the major sources of origin of arsenic in groundwater in India is the over-exploitation of groundwater for agricultural irrigation, particularly in rice cultivation. The continuous use of irrigation water carrying high concentration of arsenic may lead to its accumulation beyond the critical limits and affect the quality of crops.[6]

Arsenic in groundwater is generally present in a dissolved state, namely, arsenites or arsenate or both, besides the organic forms. The toxicity of arsenic compounds in groundwater depends largely on its oxidation state, and hence on redox status and pH. The arsenites are much more soluble, mobile and toxic than arsenates in aquatic soil environments. Reduction of arsenate to arsenite is facilitated by low redox potential (E_h) which is encountered under anoxic soil conditions, with arsenite being more soluble and mobile than arsenate.[11]

Rice plant is susceptible to arsenic toxicity since it is grown under submerged conditions.[10,12] Hence, it is necessary to develop alternative rice cultivation systems that require less water and reduce excessive use of groundwater. To save irrigation water, an alternate cultivation method, namely, System of Rice Intensification (SRI) has been developed and it is reported that this system has high water productivity with some amount of saving (about 20%) without any compromise on productivity.

What this will mean for future rice production is that it will depend heavily on the development of water-efficient measures producing more rice per unit of water input. The trend now is to develop management policies for the efficient operation of irrigation systems, technologies that reduce water consumption, changes in the rice plant itself and the ways in which it is grown; so as to use water more efficiently and to provide economic incentives to farmers to reduce water losses. Therefore, considerable research efforts are now being focused to develop 'SRI' and 'Aerobic rice' cultivation system. Therefore, both the modern rice cultivation practices described below could be the answer towards over-exploitation of arsenic contaminated groundwater and thereby mitigating the problems of arsenic loading of rice crop (as high as 10 mg/kg). The methods, merits and prospects of both the rice production system are narrated briefly in the following sections.

ARSENIC MITIGATION THROUGH 'SRI' METHOD OF PADDY CULTIVATION

'Rice plant can grow in water but it is not necessary that the paddy field be inundated with water'—this is the philosophy behind the development of SRI technology [9]. System of Rice Intensification (SRI) is a cultivation practice for rice that is taken up in a different and more biologically enriched enviroment for growth. Yields are increased by 50-100% or more, with a reduction in plant populations (by 80-90%), less water (by 25-50%), withoutt using new 'improved' varieties (all varieties respond to the methods) or using chemical fertilizers (just adding compost to the soil), with usually lowered costs of production, and thus considerably increased net economic returns per hectare.

Because of some special anatomical features, rice can grow well even in standing water ; but it does not require standing water as a rule. The practice of growing rice in inundated condition is mainly to control weed growth. But such conditions result in lack of aeration and consequent stunted root growth. That is why the fields are not flooded under SRI method. Irrigation water is provided so as to wet the soil. The field should be irrigated again when the soil develops hairline cracks. Depending upon the soil and the environment conditions, the frequency of irrigation should be decided. As the soil is not flooded, the roots of the paddy plant grow healthy, deeply in all directions. As the field is intermittently irrigated and dried, the microorganisms survive well which make nutrients available to the plant.

Growing rice in an aerobic environment where As is adsorbed on oxidized Fe surfaces and is largely unavailable to rice. Arsenic may also be present as arsenate where uptake is suppressed by phosphate.[1] Rather than arsenite found in flooded soils which is readily taken up through aquaporin channels[7] and is not affected by phosphate.[1] The System of Rice Intensification (SRI) of Cornell University utilizes an alternating wet-dry water management for much of the season.

Fig. 1

Under SRI technology, instead of letting in the water until it reaches the end of the field, it may be stopped (depending upon the local conditions) after $^{3}/_{4}$ of the field is irrigated. The water automatically spreads to the entire field. In this way a considerable amount of irrigation water can be saved. Therefore, SRI technology may play a pivotal role in reducing excessive use of groundwater for irrigating *boro* paddy. Production of rice on the raised beds also reduced the arsenic content of rice plants, consistent with lower As availability. As soil arsenic increased, the concentration of arsenic in rice straw increased linearly in both the bed and conventional treatments, but was 3-6-fold lower in rice grown on beds.[5]

ARSENIC MITIGATION THROUGH AEROBIC RICE SYSTEM

Rice cultivated in traditional lowlands with continuous submergence conditions is the single biggest user of groundwater. Since water scarcity is increasing, it is imperative to develop alternative rice cultivation systems that require less water.

Aerobic rice cultivation is now getting considered with the aim of increasing water and nitrogen use efficiencies. Compared to continuous flooding, aerobic management lowers arsenic assimilation by the plant, thus reducing grain arsenic content.[3] However, this practice opens new issues related to the adaptive capability of traditional cultivars (from West Bengal) to the increased soil oxygen availability and, therefore, to their future quantitative and qualitative performances with respect to grain yield and quality.

The cultivars developed for lowland conditions, when grown under aerobic conditions (soil moisture below saturation) show drastic reduction in grain yield. This necessitates development of new rice cultivars that can respond to limited amount of water and produce high yields under aerobic conditions. Hence a new system of rice production called *'aerobic rice'* has been developed recently. It has been defined as cultivation of high-yielding rice varieties in direct-sown, non-puddled, aerobic soils (upland conditions) under irrigation.[2]

Water requirement of lowland rice varies from 1,500 to 3,000 mm. Aerobic rice production system eliminates continuous seepage and percolation losses, greatly reduces evaporation as no standing water is present, and thus helps in enhancing water productivity. A comparison of water requirement of transplanted paddy and aerobic rice system clearly shows that aerobic rice system can save about 45% water (Table 1).

Table 1. Seasonal water requirement (mm) of puddled lowland transplanted rice as compared with aerobic rice in tropical climate

Purpose	Lowland flooded rice	Aerobic rice
Land preparation	150-300	100
Evaporation	200	100
Transpiration	400	400
Seepage and percolation	500-1500**	335
Total seasonal water requirement	1,650-3,000	935

** = Soil with a seepage loss of 5-15 mm/day

SUMMARY AND CONCLUSION

Production of rice on raised beds is a viable strategy to minimize the effects of soil contamination with As on boro season rice productivity, and to reduce the As content of both grain and straw. Previous experience has shown that irrigation water inputs are reduced by 25-40% with raised bed culture, saving both water and reducing arsenic loading to soil. The more aerobic conditions of the raised bed reduced arsenic content of straw to one-sixth of that found with the conventional paddy at soil As levels < 25 mg kg^{-1} and to one-third when soil As was > 25 mg kg^{-1}, thereby substantially reducing arsenic exposure of animals consuming rice straw. The As content of brown rice from raised beds was halved from 0.5 to 0.25 mg kg^{-1} at soil As levels < 25 mg kg^{-1}, but was similar to that in conventional paddy at higher soil As levels.[5] Human intake of As from daily consumption of 400g rice containing 0.5 mg As kg^{-1} is equal to that from 4L of water containing 0.05 mg L^{-1}, indicating that intake of As from rice needs to be considered when setting drinking water standards. Raised bed culture can reduce human health risk associated with As intake from rice exposure route.

Taking due cognizance of the above facts, it can be concluded that both SRI and aerobic rice cultivation are promising methods of rice cultivation, which save about 40-50% water with a marginal reduction in grain yield of about 10-20% as compared with lowland submerged cultivation method. Thus both 'SRI Method of Paddy Cultivation' and 'Aerobic Rice System' could be the better option for less groundwater use, increasing water-use efficiency and mitigating the arsenic loading of rice crop.

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LIFESTYLE AND WELLNESS

Vinay Kumar Srivastava

This article submits that the relationship between lifestyle and diseases has now been accepted by the researchers and the practitioners of medicine. The Government of India has sanctioned a generous grant for carrying out research on lifestyle diseases. What is required is that the people internalize the understanding of the lifestyle diseases and bring about a consequent change in their living patterns. In a nutshell, there is a need that we subscribe to the emerging health culture and follow its dynamism.

We live in time and space, having an unceasing struggle with our environment, both animate and inanimate. With an indefatigable attempt to maximize our life chances, the probability of our enduring existence, we constantly evolve the ways of living, and modifying the existing procedures, norms, and customs. To understand these, we make use of the concept of 'lifestyle'.

Lifestyles are positively related with the ailments we periodically have. Some illnesses have their origin in the bio-genetic structure, whilst the others result from the ways in which we live. If we search the Internet, we find that the 'lifestyle diseases' are understood as the diseases caused by longevity and the impact of development; they are also defined as the diseases that follow the advent of civilization. This meaning, however, is parochial, for there are diseases reported from the so-called 'simple' societies, the genesis of which lies in their lifestyles. An eminent example to be cited here is of Kuru, the neuro-muscular disease found among the Highlanders in Papua and New Guinea, which was caused by the eating of the tit-bits of the diseased human brain[1]. Thus, instead of restricting the concept of lifestyle diseases to the developed world, it should be extended to all communities, irrespective of their level of development, that have enduring patterns of living.

Since we know more about the diseases that the middle and upper class lifestyles cause, we erroneously believe that lifestyle diseases are only confined to these classes. This assumption is further heightened by the fact that our cities advertise for a large number of the so-called 'wellness programmes' — some of these presented under the rubric of spirituality — the singular aim of which is to improve upon the health standards. So is the objective of a large number of massage centers, resorts and spas. We know less about the disease profiles in simple communities and so we assume that they do not have 'lifestyle diseases', which is not true. More research is required on tribal and peasant societies to see if there is any relationship between their lifestyles and the ailments they commonly have.

A spell of intensive fieldwork was conducted with a community of camel-tenders, and also sheep-herders, in Rajasthan. Known as Raika-Rabari, they keep a distinction between what they eat at home, i.e. the everyday food, and what they are served on ceremonial occasions (such as marriage,

Department of Social Anthropology, University of Delhi, and Principal, Hindu College, Delhi 110 007.

death feast, founding of a religious place, return from a pilgrimage), i.e. the special food. The former comprises thick leavened bread *(roti)* and seasonal vegetables, generally eaten with red chillis *(mirch).* If the household can afford, lentil are prepared, but not more than once a week. If it has run out of vegetables or lentils, or cannot afford these, it would satiate its hunger with *rotis* and jaggery *(gur)* or chillis. Day in and day out the Raika eat the same food without a streak of ennui.

On ceremonies, the feast-giver is expected to feed extremely rich food to all invitees. Comprising a particular variety of sweetmeat *(mitha)* known as *lapsi*, high-quality rice, fried bread *(puri)* and vegetables *(bhaji, sag, sabzi),* all these are cooked and served with an over-generous distribution of clarified butter *(ghi).* The feast-givers take especial care in buying the best quality of *ghi;* sometimes a group of elderly men would survey the local market in search of its best smelling and tasting type. Some of these ceremonies continue for three days and therefore, the invitees get an opportunity to eat a rich assortment of food on all these days. On average, a family gets invited to these occasions either in its village or some other more than a dozen times a year. If the host is left with food, which is not spoilt, it would give it to the guests as a 'return gift', to be carried home and consumed at leisure.

As herdspersons, they have to travel a lot in search of grazing grounds and brave difficult, and often inhospitable, terrains. Sometimes, their families (women and children) also travel with them, but if they do not, they stay put in the village, where the women carry out all those extra-domestic chores that are carried out by men in other societies. The peregrinating way of life the Raika men are expected to carry out greatly empowers their women, whose image of an intelligent, shrewd, cunning, sharp, and rational person is envied by the other communities[2]. In other words, both Raika men and women lead a hard and difficult life, and they know full well that if they do not keep good health, their existence will become miserable. Unfailingly, in general interactions, they emphasize the value of health and a spindly person (even when an outsider) is invariably a matter of concern, for, according to them, he is the most likely candidate for an illness.

The alternating cycle of eating the 'everyday food' and 'special food' is believed to be one of the secrets of their healthy life. The former sustains them, providing the minimal nutrition they need for their survival, whilst the latter provides them with the extra nutrition; but if the rich food is eaten everyday or too, frequently, which in any case is unaffordable, it is bound to cause serious health problems. Moreover, the family does not buy or prepare the 'special food' for its own consumption; in fact, the neighbours start pointing their finger towards the household that prepares the 'special food' without any valid reason. Yes, let us assume, if the family is expecting the visit of its son-in-law, then it will definitely prepare the ceremonial food. Put differently, perhaps in all cultures, the type of food prepared is one of the markers of the occasion — whether it is 'everyday' life or a 'celebratory' moment. In a nutshell, the 'special food' remedies the somatic nutritional deficiencies.

The paradigm that emerges from the Raika case helps us in understanding many other cases that anthropologists have so ably recorded, for instance the Melanesian pig slaughter feasts or the feasts of merit, where hundreds of people belonging to the same community, or a set of neighbouring communities, have partaken of rich food.[3,4] These feasts, and many others of the same type, provide an abundant opportunity to the participants to consume the 'proteinous diet' and take some of this home, to recapitulate here the analysis that Marvin Harris had put forth[5]. It is in the alternate cycle of 'everyday food' and 'special food' that people see the secret of health.

For the Raika, illnesses originate from the liberties one takes with the stomach — overeating is unhealthful, so is eating too frequently; talking while eating is harmful, so is eating in public, except for the community ceremonials; eating unfamiliar food is dangerous, so is eating when one is not hungry; craving for a particular food needs to be curbed, so is drinking of water while eating. Liquor must be shunned; however, Raika men are free to taste a few droplets of opium water in case their relatives and acquaintances welcome them with it, for this respectful attitude towards opium is a ritual[6]. It is because of the association of intoxicants and poisonous fruits with Shiva, one of the Hindu gods, from whom the Raika trace their genesis. But this reverential stance does not imply that one should develop an addiction to opium, for this would be lethal to the body and the mind.

Indubitably, deviations occur from the norms according to which the Raika are expected to regulate their life. Their men fall victims to opium addiction; for increasing their sexual prowess and for relief in pain, they regularly start taking small tablets of opium. Not only men, but women also become its prey; and to counteract this evil, some voluntary associations, founded and run mainly by the youth, have also sprung up, which repeatedly lay emphasis on the idea that the well-being of life is dependent upon what we eat, how we live, the kind of thoughts we nurture, and the relations we have with the world around us.

The paradigmatic idea that surfaces from the case study of the Raika-Rabari is that although medicines (of whichever type or system) are indispensable, what needs to be given the primary attention is the way we lead our lives; if it is critically looked at, we would know where lie the defects and shortcomings. Ipso facto, the efficacy of medicines increases if positive changes in the lifestyle have been effected.

One of the areas that needs investigation is the relationship between the acts of fasting and the idea of wellness. The anthropologists have time and again reiterated two notions: first, the acts are modified by human intentions; a secular act may become religious, or vice versa, and second, there are always unintended consequences of the given actions[7]. Although I may fast in honour of a given deity, for its veneration includes fasting, or to perform a penance, there is no doubt that it has long-term implications for my health. I may also fast for secular reasons - to reduce weight or to give rest to my stomach. Its implications will also be the same.

During the month of Ramzan, I read a newspaper article that Maulana Wahiuddin Khan (2010) had written, wherein he submits that according to the Hadith, the explicit purpose of fasting *(roza)* for twenty-nine or thirty days (depending upon the sighting of moon when the festival of Id is observed) is to gain control over the body, and this properly observed abstinence is health-generating[8]. It is not only that people give up the eating of food and drinking of water during the day, but also they sleep less, eat or drink in moderation, and abstain from carnal pleasures. Leading a renunciatory life, the 'fasters' are also supposed to keep a 'clean and pure mind and tongue', which means they neither think nor speak foul. The emphasis is on 'cutting the pleasures down', to learn to live with frugality, to experience equality with all, since fasting is for all, notwithstanding the class distinctions.

Further, the Maulana says that the significance of fasting can also be appreciated against the background of the phenomenon of 'global warming', which is surfacing principally because of our highly consumeristic lifeways. In order to lead a grotesquely rich and commodity-oriented life that stands on the instincts of acquisitiveness and hoarding, we are barbarously exploiting our resources, many of which are not-so-easily-renewable. The main solution to this is leading an

extremely simple life, the life of asceticism and self-discipline. This philosophy — essentially Gandhian — is in consonance with the thesis of sustainable development, where while consuming resources, we should always think of the posterity, since the practice of over-consumption reduces the survival chances of our future generations.

Ritualized fasting is found in other communities as well. Hindus and Jains are known for their fasting practices[9]. Not only do they observe food and water fasting, but also they have the 'fasting of speech' -*maun vrata* (ritualized observance of silence) - which is one of the ways to rest the vocal cords. I have also observed a kind of fast in which the faster eats with one side of his jaws, resting the other. Known as *ek dark ka vrata* ('fast of one molar'), it is also a ritual practice, although its latent function is to give rest to the 'half mouth'.

The discourse on fasting is fast emerging as one of international importance. Like the international practice of keeping the lights off with an objective to save power, the practice of fasting will also try to solve the world's food problem. Along side are also some researches, the veracity of which may be questioned, according to which the non-vegetarian and obese people are contributing more to global warming. Their line of argument is that meat consumes more energy to cook, thus heating up the environment; and, further, the obese people eat more, thus causing more carbon emissions from the extra food they consume. In addition, it is more likely that they would prefer not to walk or cycle, and thus take car to reach their destination. Because of their weight, the obese persons are a greater load on vehicles. Also, researches have pointed out that thin people are able live for longer number of years and enjoy a better quality of life than the fat people. This is an additional reason to eat less to keep oneself thin.

Let me now comment upon the contemporary Indian scenario as it is represented in the popular media. One of the well-known observations about the present day world is that while there is a decline in the number of cases suffering from one or the other physical disability, there is an increase in the incidence of diseases, including mental, notwithstanding the fact that there is a marked improvement in the quality of water and sanitation, an enlargement in health consciousness, and the availability of life-saving drugs. More and more people today are aware of the different types of vaccination and antibiotics. They also freely and frankly discuss their states of health and illness episodes with their physicians and counselors. No more is the knowledge of medicine esoteric; it is easily accessible and reachable. Not only are the medical books (some of them are highly summarized and lucidly written) easily obtainable, but also the periodicals (especially *The Reader's Digest)* and newspapers (like *The Hindu)* publish detailed articles, written in simple language, on diseases and how to cope up with them. On the World Heart Day (26 September), for example, all newspapers carry articles on how to keep a healthy heart. The value of traditional cures is also being recognized; for instance, there are research papers on the medicinal value of guava, turmeric, or the leaves *of neem.* In a nutshell, the world has become much more 'medicalized' — which means more conscious of health and illness, medicines and the medical profession — than was the case earlier.

In spite of this explosion of medical knowledge and the expansion of the health-care system, meant for all, the number of people suffering from cardiac ailments and carcinogenic conditions is fast increasing. Needless to say, they cause a pre-mature mortality. AIDS is another example of a condition that affects the young people — those in the most productive years of their life. Early death has important implications for the country's economy, since the people who are dead (or incapacitated) could have contributed to the developmental measures a great deal. Ailments

that were supposed to be geriatric and 'grown-up afflictions' in nature are now becoming common with both young people and children. *The Times of India* (22 August 2010) carried a news item on kidney stones that were found in children as young as two. It detailed the case of a one and a half year old boy who was detected with a complex kidney stone known as Staghorn calculi, which required surgery. It also referred to a study published in *The Journal of Paediatrics* (April issue, 2010), according to which a host of lifestyle factors -increased intake of salt, lower intake of milk, obesity and antibiotics -doubled the incidence of kidney stones in South Carolina's children between 1996 and 2007. Among the young, the incidence of hypertension, obesity, and heart diseases is fast increasing, and the lifestyle we are leading - such as leading a sedentary way of living, eating fatty food, stresses of the modern-urban life, consumption of alcohol and tobacco - is greatly contributing to them.

Certain numerical figures are really frightening. For instance, according to the World Health Organization (WHO), India is going to be the centre of most of the lifestyle diseases in near future. India also has the notorious distinction of being the 'diabetes capital of the world.' Ten per cent of our population, in comparison to seven per cent in the U.S.A. and Europe, suffers from cardiac ailments, and these are going to be the single greatest killer by 2015. Almost one hundred million people in India suffer from high blood pressure; over forty percent people in urban India have high lipid levels (cholesterol and triglycerides), which constitute a major risk factor for heart diseases. According to a study jointly conducted by the WHO and the World Economic Forum, India will 'incur an accumulated loss of $236.6 billion by 2015 on account of unhealthy lifestyles and faulty diet' *(The Times of India,* 20 May 2008). Some of the other figures related with the issues of health in India are: 37 per cent people are below the poverty line; 46 per cent children are underweight; 96 per cent of people have received primary education; under-five child mortality is 75 per 100 live births; maternal mortality is 254 deaths per one lakh live births; 18 and 51 per cent are without safe drinking water and toilet respectively *(The Times of India,* 19 September 2010).

How do we look at these facts? Yes, one may be skeptical of these figures and may argue that these 'exaggerated' figures are the handiwork of those who want to sell their medicines and laboratory equipments. Notwithstanding a grain of truth in the argument that pharmaceutical companies have their commercial interests, this view cannot be accepted with ease, for even if the figures are inflated and the warnings of the doom's day false, the lifestyle diseases, irrespective of their percentage, have to be controlled, since they are controllable. Here also emerges the role of the doctor not only as the medicine-giver, but also as the counselor, one who advises the patient to "keep an 'enlightened eye' on his body, listen to the signals, sometimes extremely feeble, that it sends, and critically examine his food habits, the state of his mind, and the strains to which his body and mind are subjected." In my opinion, the best doctor is one who empowers his patient to be 'his own *healer* in the sense that 'he is able to provide a non-drug, *non-doctoral* treatment to his body in terms of food and water, and the available resources,'

The pieces of advice given to the wider public are well known: exercise regularly, watch your weight, cut down on fatty foods, stop smoking, avoid alcoholic drinks and stressful situations, and go for health check up regularly and if a physical condition or parameter requires a regular intake of medicine and exercise regime, do it without break. Most of these advices have a class orientation — it is the middle and upper class that will be able to' choose what to eat and what not to, while the people from poor and downtrodden classes will eat

whatever is available; the former will be able to go for regular health examinations and afford medication, often expensive. But the point is that all, irrespective of the strata of society to which they belong, should know these measures about leading, relatively speaking, a disease-free existence. In addition to popularizing these steps and spreading medical and health knowledge in society, there is a need to critically look at the lifestyle that we lead, and if is found to be disease-friendly, it must be shunned without delay.

Let me give an example. During the days I was a college student (from 1969 to 1976), smoking was considered to be a culturally-preferred habit among the students, including female; the more radical they were in ideology, the more they used to smoke; and the one who did not was supposed to be 'unfashionable', 'conservative', 'afraid of parents', 'timid', and also, 'unfriendly'. I remember the peer group of smokers would coax a non-smoker to take to smoking - that smoking helped one concentrate and transcend tensions used to be one of the arguments. Smokers were glorified in advertisements and general conversations: that Karl Marx and Bertrand Russell were smokers was deemed enough to convert a teetotaler into a smoker! I remember the days when the teachers would smoke in the classrooms and the audience in a seminar hall. In a nutshell, it was a 'smoking society'.

No more now. We heavily criticize the habit of smoking. I was told that some years ago, the British doctors had resolved not to treat a sick that was accustomed to smoking. Today, a smoker is stigmatized; he is almost a 'leper'. That 'smoking kills' is today's cultural preference. For instance, for getting a job at the Rajkot People's Cooperative Bank, which was founded eleven years ago, in addition to the other criteria, the candidate should not consume tobacco or should be willing to give up this habit. Also, the Bank, which has at present seventy-five non-smoking employees, offers a lower rate of interest for those who do not consume tobacco; the tobacco-consumers are made to pay one per cent more *(The Indian Express, 25* September 2010). It has also been observed that those who continue to smoke feel far guiltier than they did earlier. These examples show how with the concerted effort of the different sections of society a health-harming practice can be curbed.

If similar efforts are undertaken with respect to the other health-harming practices, the results will definitely be positive; for instance, the consumption of more-than-the-required oily stuff or a strict adherence to the exercise schedule. We should have a critical look at our dietary practices, and not be ethnocentric about them. The idea that 'food and water are medicines' needs to be furthered and those foods that retard health or put a strain on it should be eliminated from our diets. All those stories that glorify sedentary or desk-bound existence should be taken to task. In other words, we have to build up a responsible and health-furthering culture, which would be possible if we have a critical and unbiased look at our lifestyles.

The aristocratic and affluent societies in traditional India did not 'work', that is, they did not render their labour for any task, either for themselves or the others. Those who worked for the others - and eked out their livelihood — were regarded as inferior to those who were self-employed, i.e. they worked for themselves. At the top of the hierarchy were those who loathed working. They led a stationary life, making the others — their dependents — work for them[10].

Today, the health experts advise us to carry out as much work as is possible — for instance, 'do housework yourself instead of hiring someone else'; 'instead of asking someone to get you a drink, get off the couch and get it yourself *(The Hindu,* 19 September 2010). They want us to reject the *'nawab* syndrome' and lead the life of a common person.

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MAJOR RECOMMENDATIONS
EMANATING FROM THE 98th INDIAN SCIENCE CONGRESS

Recommendations from the Address of the Hon'ble Prime Minister Dr. Manmohan Singh

- Need to create an innovation eco-system so that innovation becomes a way of life in our knowledge institutions.
- Special attention is to be given to the growth and development of university system. Funds have sanctioned for the creation of new universities and to increase the capacity of existing ones. An Academy of Scientific and Innovative Research which seeks to produce more than 1,000 doctoral and post graduate fellows every year is being established.
- Universities have to be more hospitable to creativity and genius, and less captive to bureaucracy and procedure. They should be more open to talent and to the challenge of established ideas.
- The question is whether scientists should step beyond their discipline and at least guide the social discourse on the use of scientific knowledge. Should they develop a code of conduct that defines the limits within which they will work on the application of their discoveries? Should there be a collegial process for deciding difficult cases? The products of science have been put to illiberal uses. It is necessary to guard against such tendencies, especially in our own country.
- The Science Advisory Council to the Prime Minister prepared a report setting out a vision and a roadmap for India to become a global leader in science. The council has *inter alia* recommended measures to attract the best of talent for science. The Ministries of Human Resource Development and of Science & Technology to jointly mount efforts to attract more young people to the study of science.
- The year 2012-2013 will be centenary year of the Indian Science Congress. The Ministry of Science and Technology should designate 2012-13 as the 'Year of Science in India'.
- Modern cyber technology now allows trans-continental collaborative research. More joint research projects between Indians in India and those abroad is needed so that the global talent pool can be drawn and teaching and research base can be strengthened. The high speed National Knowledge Network will greatly facilitate such collaborations.
- It is hoped that the "Year of Science in India' will unleash the energies of our young scientists and inspire a new generation of Indians to enter the world of science, cross new horizons, explore new possibilities.

RECOMMENDATION FROM THE ADDRESS OF SRI KAPIL SIBAL , HON'BLE MINISTER OF STATE (INDEPENDENT CHARGE) FOR SCIENCE AND TECHNOLOGY AND EARTH SCIENCES

- As declared by Hon'ble Prime Minister during 97th ISC, the year 2010-2020 was to be the decade of innovation. The National Innovation

Council (NIC) was set up accordingly to prepare a road map for the Decade of Innovation.

- In higher education scenario the Gross Enrolment Ratio is today around a mere 15%. Changing labour markets and demographics are driving a "new' demand for higher education. This will necessitate many more universities and colleges to be opened in the years to come.
- In myriads of private and foreign education providers imparting education through conventional, distance learning and online programmes. Most of the providers are in the areas which cater to human resource needs for the growth of the industries in India. We have over 3000 engineering institutions and colleges across the country that produce aggregately nearly 5 lakh engineering graduates. The quality of education imparted is a matter of concern.
- Need for better quality education, as also new courses, new content, and new delivery standards. This is exactly what we are seeking to incorporate in the thirty new Central Universities that we are setting up. Our vision for these universities is that they should become symbols of excellence, models of efficiency, and examples in terms of academic standards and university governance for other state and deemed universities to emulate.
- The Gross Enrolment in higher education should be doubled to at least 30% by the end of 2020, means tripling of enrolments in the tertiary sector from around 13 million to 40 million. This will entail massive capacity building, both institutional as well as human. Besides enhancing the quantum of teachers and faculty in colleges and universities quality to be improved.
- To put in place an effective quality assurance system and provide a common frame of reference for students and others to obtain credible information on academic quality across institutions, domestic as well as international. The National Accreditation Regulatory Authority for Higher Educational Institutions Bill, 2010 has been introduced in Parliament to provide for mandatory accreditation and creation of an institutional structure for the purpose.
- Plan to set up a National Commission for Higher education and Research (NCHER) for regulating higher education.
- To set up an Education Finance Corporation which will refinance educational loans to students, especially from lower income families seeking to pursue professional courses, at much more favorable terms than available presently and also provide not-for-profit educational institutions access to low cost funds.
- Need to focus on improving the quality of teaching-learning processes in our institutions of higher learning. To set up the National Mission on Education through ICT to link thousands of degree colleges and departments within universities, with a view to facilitate teaching sharing and providing access to open educational resources. The private sector is also contributing in this effort.
- Embarking on a joint initiative of the Ministry of Human Resource Development and Ministry of Science & Technology for 'Building Educator for Science Teaching (BEST)' in mission mode.

- Need a renewal of the missions and methods of existing institutions of higher education.
- Concept of having Navratna Universities or an Indian Ivy League. Intend to nurture these select universities, like the public sector Navratnas, by generous financial support, freedom in accessing external funding and total autonomy so as to free them from hackles of government control.
- Better utilisation of the assets of publicly funded academic institutions. We believe these assets could be a catalyst for developing several forms of Public Private Partnerships.
- To set up fourteen 'Innovation Universities'. These will be unique Institutions which will set benchmarks, in academics and more importantly, in research, comparable to the best in the world in the context of problems of hunger, water, poverty and diseases through cutting edge science and technology. These Innovation Universities would be innovative in their governance, in their financial structure, in their academic and research structure, in their content and in every other way.
- To realize the Vision of India as an Innovation Hot Spot? Strategy is :
    - First, realize long term academia-industry collaborative relationships with open access to and resources free of intellectual property (IP) entanglements;
    - Second, put in place better integration of corporates with higher educational and research institutions to create a pipeline for skills that will support growth industries. This I believe will help to reduce the training costs and learning time not only for corporates but also help to develop skilled human resource.
    - Third, encourage multidisciplinary collaboration among business government, academia and R & D thereby creating an environment that supports technological development which is aligned with and driven by industry needs.
    - Fourth, recognizing the contribution of young researchers to the vitality and quality of the research system put in place more programmes for support of young researchers.
    - Fifth, enhance significantly publicly funded research that reaches out to the market by engaging corporate executives as champions.
    - Sixth, take up in collaboration with concerned government economic Ministries the modernisation and upgradation of technology in use by the small and medium enterprises.
    - Seventh, encourage the formation of international R&D, technology and innovation consortia between Indian and foreign entities and last, provide tax incentives to businesses that collaborate with academia and R & D researchers.

RECOMMENDATIONS FROM THE PRESIDENTIAL ADDRESS OF PROF. K.C. PANDEY, GENERAL PRESIDENT, INDIAN SCIENCE CONGRESS ASSOCIATION-2010-2011

Quality Education and Excellence in Scientific Research in Indian Universities

- India lags behind key countries and some BRIC partners in research investment and output, particularly in the industrial sector.

- Non availability of suitable researchers in required numbers.
- India has systematically failed to capitalize on its basic research output. There is disconnect between research laboratories and industry.
- The output of research papers was practically constant from 1981 to 2000, when it started to go up, since 2004 the gradient is steep and our growth factor (vis a vis 1981) will catch up with UK, Germany, France and Japan in a few years.
- The number of papers published jointly with collaborators, abroad is about 20 percent of the total published by Indians; it has doubled in the period 1999-2003 to 2004-08.
- Our research profile is evenly balanced between physical and life sciences.
- Nonprofit research laboratories, the "request for proposal' system giving due support to theoretical research and support for research without strings for eminent scientists will be overall helpful to the scientific research effort.
- There are only few universities in India, known for good standards in research and teaching. Star researchers getting more salary than normal is step, helpful to quality.
- The recommendations of the three academies of science should be seriously considered for implementation. The main suggestion are :
- Four year BS program.
- Integrated program up to Ph.D.
- Introduction of post doctoral programs.
- Networking is the key to relevance and excellence.
- Foreign universities should be welcomed to have their own campuses or to collaborate with existing institution.
- Good teachers/researchers should be recognized and rewarded on the basis of evaluation.
- The universities should make the management supportive of research projects rather than making it an undesirable experience for researchers.
- Services of retired teachers should be utilized with suitable honoraria.
- In order to attract young talent a new scheme YTS for post graduate science student with guaranteed research job should be implemented.
- Serious consideration should be given to encourage private investment in higher education by lifting restrictions on fees and enabling profit. This will enable the development of world class institutions.
- Special educational zones on the lines of special economic zones may be established.
- Quality Institutions, run by private corporations for profit should be encouraged.

RECOMMENDATIONS OF SECTIONAL COMMITTEES (AS RECEIVED FROM SECTIONAL PRESIDENTS)

Agriculture and Forestry Sciences

- Cultivation of not only wheat and rice but also minor millets like Jowar, bajra and finger millet should be encouraged.
- Development of climate resilient agriculture to strengthen food security of the country.
- State government should pay more attention to farmers by implementing the national policy for farmers including proper sanitation, supply

of drinking water, good delivery system and infrastructure development of storage.

- There is a general lack of excellence in the agricultural education and listed several options to improve it further which included up gradation of skill of the faculty including bringing fresh blood from outside the parent university. New initiatives taken by ICAR including modernization and renovation of class rooms, e-resources, faculty development etc. ICAR Model Act-2009 will also be implemented to reform the agriculture education in the country.
- It is observed that universities are starved of operational funds, which affect the quality of academics and the research and development. There is need for plan allocation for agriculture education and research needs substantial enhancement in term of investment to make India a first rate country in agricultural research and education. Among the different interventions, well- trained faculty, incentives for the faculty, International and national collaborations in research and education, National Agricultural Education Project on the lines of NATP and NAIP with support from Govt. of India are important to improve the stakes of higher agricultural education.

Animal, Veterinary and Fishery Sciences

- Creativity is needed for which teachers and students should be curious and there should be scientific discussions, dialogue and criticism.
- There should be inter-disciplinary attitude of teaching and research.
- Basic research should be encouraged and teachers should generate interest in the young minds to come forward to accept the challenges of the emerging trends in animal sciences.

Anthropological and Behavioural Sciences (including Archaeology, Psychology, Educational Sciences and Military Sciences)

- In the light of the theme of the 98th Science Congress, i.e. **"Quality Education and Excellence in Science Research in Indian Universities",** the existing curricula of all the disciplines under the section should be revised and updated as far as possible and see that a parity should be maintained in the Indian Universities and also ensure quality discourses.
- The present teaching and research programme on human sciences, such as Bio- Archaeology, evolution and human migration, DNA mappings, Socio-cultural conflicts etc. should be strengthened.
- Different sub-committees may be constituted at the national level in order to examine and carry out necessary ground works and make proper recommendations.
- As has been felt that a comprehensive survey on food and nutritional status of the people of India, specially the children is necessary and for that, services of the Anthropologists who are trained in the techniques of nutritional assessment and nutritional ecology may be utilized.

Earth System Sciences

- A new strategic international and interdisciplinary approach to science is necessary to exploit fully the existing knowledge to identify and address the geo hazards.
- A key role of ESS in natural hazards / Risk and Mitigations, water management, interfacing of geology and agricultural sciences and climate change.

- To develop manpower in mathematical modeling and computer simulations for better understanding of processes and phenomena of ESS, which can fill up the present and future needs of the country.
- Research & explorations in gas hydrates and nuclear mineral resources as an alternating energy resources.
- The Earth system Science is for the integrated study of the Earth System, the changes that are occurring to the system and the implications of these changes for global sustainability.

Engineering Sciences

- There is a strong need of promoting ethical conduct in science education and research.
- Every researcher should swear an ethical oath of science.
- Scientific knowledge should be used for sustainable development.
- Science and engineering education should provide skills and tools to deal with sustainable development process with 'Holistic Approach'. The current decision making process needs to shift from cost benefit analysis into 'Multi-criteria Decision Making' in the face of uncertainty.
- There is need to include in modern teaching and research the concept of Green, Clean Closed Cycle operational CSR, Ecological foot prints and Security.
- Multi-disciplinary stake holder approach must find place in research and teaching to ensure sustainable development.
- To boost research, a parallel cadre of Research Professors, Research Associate Professors, Research Assistant Professors, and Research Lecturers etc. is required.
- Basic research should be encouraged in the universities.
- For economic benefits of research being carried out at various universities in addition to R & D, training in delivering aspects of research projects is very much required.
- Civil conscience is required to stop upward trend of environmental pollution.
- Need to increase awareness of importance of science and technology in daily life of Indians.
- Environmentally sound technologies should be promoted.
- Ways should be found to empower women as a resource for science and technology.
- Need to remove social obstacles and barriers that continue to exclude girl children and women from the study of science and technology.
- Energy should be saved through proper energy management techniques and conservation measure.
- Use of Biomass fuels should be promoted for sustainable development.
- Green technology should be adopted.
- Use of Ethanol may be promoted for sustainable development as alternate fuel.
- Continuous energy audit along with environmental audit is required for sustainable development of the technologies.

Environmental Sciences

- Appropriate Phytoremedaition methods have to be initiated to combat various environmental problems.
- For clean, Ecofriendly and Green Technology there is a need of integrated management

strategies involving different sections of the societies viz. Govt. Organization , NGO, Scientists, Researchers, common Public.

- Awareness on Environmental issues need of the hour, emphasis must be given on this field.
- Plastic below 40 Microns should be banned instead 20 microns to combat its ill impact.
- Climate Change: Case studies in Central Himalayas and Gangetic plains are shown that there are already adverse affect of climate change. There are certain adaptation Technologies that should be practiced and incentives be provided to poor small farmers to adopt them. At the same time there is a need of furthers researches to develop new technologies to mitigate the adverse affects of climate change and global warming.
- For effective use of role of media in specific dissemination of News related to, environment, the journalists must be well educated, i.e. there is a need of Environmental Journalism.
- An urgent need of conservation of natural resources like Water, Biodiversity (Flora and Fauna)
- Need of Rehabilitation of degraded lands by ecorestoration process.
- Need of Reclamation of abandoned mined area.
- Solar energy, wind energy used Biomass to be utilized as alternative sources of energy. Extensive energy Plautatious should be taken up.
- Application of Biofertilizer, Biopesticides & Biotoxicides should be enhanced for sustainable Environmental management.
- Need of Carbon trading / carbon reduction through carbon credit and CDM.
- It is important to insure safe and pure drinking water (Arsenic and Fluoride free) in several parts of India.

Information and Communication Science and Technology (including Computer Science)

- Factors that contribute to empower People & Society , Governments, regulators and operators should look for innovative ways of promoting community access to empower people in rural areas to join the rest of the virtual world. For example, community access points, such as rural Internet kiosks, can create a chain reaction, leading to demand for more connectivity throughout rural areas and hastening the development of local economies.
- Mobile phones have allowed farmers to sell their crops directly to the highest bidder & It is estimated that increasing broadband use by 10 per cent would increase Gross Domestic Product (GDP) by more than 1 percent.
- Community access represents a huge opportunity in changing lives, especially in the rural areas of developing country like India.
- The example of a solar-powered, self-contained, Internet rural kiosk cited during the various discussion why the Internet, and more broadly ICT, is in such high demand by people who in many cases do not have enough to eat or safe water to drink.
- The kiosk can operate in any environment and can bring the power of Internet access to any village.
- In the present era of globalization of education and research, quick access to information and widespread dissemination of knowledge has become very important. On the research front, sharing of scientific knowledge through

journals, conferences and other means is mired in many problems. Journal costs are escalating and conferences have their own inherent problem of high costs involved in organizing or attending. Further, everyone interested cannot attend all conferences.

- Improving ICT legislation, regulations, and enforcement are high priorities because most of the states lacks laws and regulations protecting researchers & consumers "confidential information and privacy", national copyright and intellectual property laws are poorly enforced, and inadequate regulatory structures govern the Internet and telecommunications.
- A viable and enforced legal regime must be in place to accelerate technology development and e-commerce. Governments should share legal research and analysis to speed promulgating laws and Regulations to:
- Protect personal data and information privacy;
- Protect Internet-related intellectual property, publishing rights, & software applications and accelerate the introduction of e-commerce legislation
- Green technology: Using ICTs to tackle climate > change and environmental challenges.
- National & State Level Initiatives Programmes in Environmental Protection/CO_2 Pollution Awareness in Schools, Colleges and Universities. National Awareness Programme dedicated to help save the planet from global warming.
- The whole society benefits of this action due to a reduced environmental impact. Energy, Education, Governance and Schools.
- Schools need to give consideration to environmental education, not just within the curriculum but across all areas of school life. A positive attitude towards the environment should be reflected in the aims of the school and consideration needs to be given to waste issues when developing policies for purchasing, efficient use of resources, waste collection, maintenance of the school and its' grounds and other aspects of school life.
- In order for today's students to function in the 21st century, they must be able to acquire, evaluate, and use information technology tools effectively. Today's students must become information literate workers, teachers, facilitators and coaches. Designing technological solutions and pondering benefits and risks should be an integral part of the middle school science experience. As students take the initiative to learn science and technology, they will learn about themselves, their community and potential career paths. The confidence to pursue such personal goals can be instilled through successful science experience.
- Children can act as a powerful lever and positive force for change, both at school and at home. School, college & universities should have programme to encourage students/children to recycle, most considered that information and advertising were paramount, but sadly lacking.

Mathematical Sciences (including Statistics)

- It is strongly reiterated that the birth day of Legendry Indian Mathematician Srinivasa Ramanujan, which is December 22, should be declared by the MHRD, Government of India as National Mathematics Day. By doing so we

will not only remember the great Indian genius, but also will succeed in making mathematics a popular subject by organizing various events for schools / colleges / university students. Moreover, such an attempt shall inspire both our students and teachers towards mathematics.

- In order to ensure the quality of research, for any person it should be compulsory before he or she can submit his/her Ph.D. / D. Phil. thesis that two of his/ her research papers must have been accepted/ published in a refereed journal of mathematics. A research announcement in good journal of mathematics can be taken as equivalent to research paper.

Medical Sciences (Including Physiology)

- Iodine deficiency disorders (IDD) are major public health problem in India and supplementation of iodine through iodized salt has been taken as only measure to prevent and control IDD. However, inspite of iodine supplementation more than a decade IDD is still a moderate public health problem in many regions of the country. Therefore with successful iodization programme, identification of region specific environmental goitrogens / anti thyroidal factors and their possible amelioration are very important.
- Positive and strong infrastructure requires to be developed to ensure a self – enforcing industrial environment where assurance of occupational health and safety are the norms.
- Melatonin may be used as a free radical scavenger in the reduction of oxidative stress in humans and economically important animals.
- Proteins promoting sperm motility and immortality factors in sperm head and epididymis may be used in the manipulation of fertility control/family planning.
- Adult brain stem cells may be used to control Alzheimer's and Parkinson's diseases.
- Polyunsaturated fatty acid in diet influences embryo survival in farm animals.
- An intronic polymorphism of Adiponectin gene and lower adiponectin levels associated with rapid growth of economy with changes in eating habits and marked decrease in physical activity are the possible factors for diabetic epidemic in India.

New Biology (including Biochemistry, Biophysics & Molecular biology and Biotechnology)

- The quality of scientific presentations both by invited speakers (including oral presentations) and posters are becoming of high standard day by day.
- More than two prizes should be kept for the poster presentations in this Section.
- It was also proposed that one special prize may be kept for the undergraduate students.
- More abstract books should be published and distributed in the venue to the participants.

Plant Sciences

- India being one of the 12 mega diversity centres is very important for biodiversity. During the past several decades, biodiversity has been considerably explored all over the world But still there is greater scope and need to continuously explore and update the biodiversity base of all the groups of plants. In the recent years the lower plants seems to have received little attention unfortunately. These groups of plants need greater attention,

support and encouragement as they are even more important ecologically and biologically.

- Equally and even more important is the *ex situ* and *in situ* preservation of the known biodiversity.
- *Ex situ* for both wild and cultivated plants by using modern techniques like cryopreservation, tissue culture and micro propagation
- Major and small biodiversity spots require immediate attention for conservation as they are rich in numbers as well as populations.
- Greater emphasis should be laid on biodiversity based and supported biotechnology by making biotechnology more relevant to human welfare and at the same time providing broader and stronger base to biotechnology. Therefore studies on ethno botany should be earnestly undertaken as many areas are still unexplored from ethno botanical point of view, more importantly such important areas are gradually and at times suddenly shrinking because of cultural invasions.
- Exploration of endophytes, secondary metabolites, nutraceutical potential of medicinal plants, mushrooms and lichens etc. and studies on nanomaterial's need to be undertaken with greater emphasis and direction so that the recorded biodiversity is put to greater use for the welfare of the society.
- More grants for Botanical Gardens, Herbaria and museum, should be provided. More centres for conservation of biodiversity should be established in different regions in addition to those already in place so that every bit of biodiversity wealth is recorded. More jobs for maintaining such centres should be provided with proper promotional avenues so that young people are attracted and play their role efficiently in the conservation of this national wealth which is extremely valuable for all future ventures.

SHORT COMMUNICATION

SCREENING TESTS FOR CANCER : AN OVERVIEW

Jyoti. D. Vora and Padma Srinivasan

'Prevention is better than cure' are well-said words of a wise person. This aspect goes down very well for the concept of 'Cancer Screening', which needs to be done as a routine procedure on persons with early symptoms, or even on healthy persons so that cure of the disease becomes easy and also much suffering in reduced. The following article contains a detailed study on various aspects of cancer screening.

What is Cancer Screening ?

Some types of cancer can be dected before they cause symptoms. Screening tests can help find cancer at an early stage, before symptoms appear. When abnormal tissue or cancer is found early, it may be easier to treat or cure.

There are different kinds of screening tests.

Screening tests include the following :

- Physical examination history : An exam of the body to check general signs of health, including checking for signs of diesease, such as lumps or anything else that seems unusual. A history of the patient's health habits and past illnesses and treatments to be also taken.
- Laboratory tests : Medical procedures that test samles of tissue, blood, urine, or other substances in the body.
- Imaging procedures : Procedures that make pictures of areas inside the body.
- Genetic tests : Tests that look for certain gene mutations (changes) that are linked to some types of cancer.

Department of Biochemistry, Ramnarian Ruia College, Matunga, Mumbai-400 019, India.

Screening tests have risks.

Not all screening tests are helpful and most have risks. It is important to know the risk of the test and whether it has been proven to decrease the chance of dying from cancer.

Some screening tests cause serious problems.

Some screening procedures can cause bleeding or other problems. For example, colon cancer screening with sigmoidoscopy. Screening test results may appear to be abnormal even though there is no cancer. A false-positive test result (one that shows there is cancer when there really isn't) can cause anxiety and is usually followed by more tests and procedures, which also have risks. Screening test results may appear to be normal even though there is cancer. A person who receives a false negative test result (one that shows there is no cancer when there really is) may delay seeking medical care even if there are symptoms.

Finding the cancer may not improve the person's health or help the person live longer.

For some cancers, finding and treating the cancer early does not improve the chance of a cure or help the person live longer.

What is a mammogram ?

A mammogram is an x-ray picture of the breast. Mammograms can be used to check for breast cancer in women who have no signs or symptoms of the disease. The x-ray images make it possible to detect tumors that cannot be felt. Screening mammograms can also find micro-calcifications (tiny deposits of calcium) that sometimes indicate the presence of breast cancer.

Benefits of screening mammograms :

Early detection of breast cancer with screening mammography means that treatment can be started earlier in the course of the disease, possibly before it has spread.

Potential harms of screening mammograms :

Finding cancer does not always mean saving lives : Even though mammograms can detect malignant tumors that cannot be felt, treating a small tumor does not always mean that a woman's life will be saved. A fast-growing or aggressive cancer may have already spread to other parts of the body before it is detected.

False-negative results : False-negative results occur when mammograms appear normal even though breast cancer is present. Overall, screening mammograms miss upto 20 percent of breast cancers that are present at the time of screening.

False-positive results : False-positive results occur when radiologists decide mammograms are abnormal but no cancer is actually present. All abnormal mammograms should be followed up with additional testing to determine whether cancer is present.

The additional testing required to rule out cancer can also be costly and time consuming and can cause physical discomfort.

Radiation exposure :

Mammograms require very small does of radiation. The risk of harm from this radiation exposure is low, but repeated x-rays have the potential to cause cancer. The benefits, however, nearly always outweigh the risk.

What is computed tomography ?

Computed tomography (CT) is a diagnostic procedure that uses special x-ray equipment to obtain cross-sectional pictures of the body. The CT computer displays these pictures as detailed images of organs, bones, and other tissues.

How is CT used in cancer ?

Computed tomography is used in several ways :

- To detect or confirm the presence of a tumor ;
- To provide information about the size and location of the tumor and whether it has spread ;
- To guide a biopsy (the removal of cells or tissues for examination under a microscope);
- To help plan radiation therapy or surgery; and
- To determine whether the cancer is responding to treatment.

Are there risks associated with a CT scan ?

Some people may be concerned about the amount of radiation they receive during a CT scan. It is true that the radiation exposure from a CT scan can be higher than from a regular X-Ray. However, not having the procedure can be more risky than having it, especially if cancer is suspected. People considering CTs must weigh the risks and benefits.

In very rare cases, contrast agents can cause allergic reactions. Some people experience mild itching or hives (small bumps on the skin). Symptoms of a more serious allergic reaction include shortness or breath and swelling of the throat or other parts of the body.

Laboratory tests :

A laboratory test is a medical procedure in which a sample of blood, urine or other tissues of substances in the body is checked for certain features. Laboratory tests also play an important role in diagnosis when a person has symptoms. In addition, tests may be used to help plan a patient's treatment, evaluate the response to treatment, or monitor the course of the disease over time.

Laboratory test samples are analyzed to determine whether the results fall within normal ranges. Normal test values are usually given as range, rather than as a specific number, because normal values vary from person to person. Many factors (including the patient's sex, age, race, medical history, and general health) can affect test results. Sometimes, results are affected by specific foods, drugs the patient is taking, and how closely the patient follows pre-test instructions.

What is a Pap test ?

The Pap test (sometimes called a Pap smear or cervical cytology) is a way to examine cells collected from the cervix. The main purpose of the Pap test is to detect cancer or abnormal cells from cervix that may lead to cancer.

Why are a Pap test and pelvic exam important?

A Pap test and pelvic exam are important parts of a woman's routine health care because they can detect abnormalities that may lead to cancer of the cervix. These abnormalities can be treated before cancer develops. Most cancer of the cervix can be prevented if women have Pap tests regularly. Also, as with many types of cancer, cancer of the cervix is more likely to be treated successfully if it is detected early. Samples that have no cell abnormalities are reported as "negative for intraepithelial lesion or malignancy. A Pap test result may also report certain benign (non-neoplastic) findings, such as common, harmless infections or inflammation. Pap test results also indicate whether the specimen was satisfactory or unsatisfactory for examination.

What if Pap test results are abnormal?

If the Pap test shows an ambiguous or minor abnormality, the doctor may repeat the test to determine whether further follow-up is needed. Many times, cell changes in the cervix go away without treatment. Follow-up testing for some cell changes may involve acolposcopy, in which an instrument much like a microscope (called acolposcope) is used to examine the vagina and the cervix. If colposcopy finds abnormal tissue, the doctor may perform endocervical curettage or a biopsy.

If testing shows abnormal cells that have a high chance of becoming cancer, further treatment is needed. Without treatment, these cells may turn into cancer. Treatment options include the following:

- **LEEP** (loop electrosurgical excision procedure): uses an electrical current that is passed through a thin wire loop to act as a knife to remove tissue.
- **Cryotherapy:** destroys abnormal tissue by freezing it.
- **Laser therapy:** uses a narrow beam of intense light to destroy or remove abnormal cells.
- **Conization:** removes a cone-shaped piece of tissue using a knife, a laser, or the LEEP technique.

How is HPV testing used in cervical cancer screening?

HPV testing alone is not useful for cervical cancer screening of women under 30 years of age because the rate of false-positive tests would be unacceptably high. A negative HPV DNA test increases assurance that there is very little risk of a serious abnormality developing over the next several years.

What is the prostate-specific antigen (PSA)test?

Prostate-specific antigen (PSA) is a protein produced by cells of the prostate gland. The PSA test measures the level of PSA in the blood. Because PSA is produced by the body and can be used to detect disease, it is sometimes called a biological marker or a tumor marker.

It is normal for men to have a low level of PSA in their blood; however, prostate cancer or benign (not cancerous) conditions can increase a man's PSA level. The U.S. Food and Drug Administration (FDA) has approved the use of the PSA test along with a digital rectal exam (DRE) to help detect prostate cancer in men 50 years of age or older. The PSA test is also used to monitor patients who have a history of prostate cancer to see if the cancer has recurred (come back).

For whom might a PSA screening test be recommended?

Several risk factors increase a man's chances of developing prostate cancer. These factors may be taken into consideration when a doctor recommends screening. Age is the most common risk factor, with nearly 63 percent of prostate cancer cases occurring in men age 65 and older . Other risk factors for prostate cancer include family history, race, and possibly diet.

How are PSA test results reported?

PSA test results show the level of PSA detected in the blood. These results are usually reported as nanograms of PSA per milliliter (ng/mL) of blood.

What if the screening test results show an elevated PSA level?

There can be different reasons for an elevated PSA level, including prostate cancer, benign prostate enlargement, inflammation, infection, age, and race. If no symptoms to suggest cancer are present, the doctor may recommend repeating DRE and PSA tests regularly to watch for any changes. If a man's PSA level has been increasing or if a suspicious lump is detected during a DRE, the doctor may recommend other tests like urine test or imaging tests like a transrectal ultrasound to determine if there is cancer or another problem in the prostate. If cancer is suspected, a biopsy is needed to determine whether cancer is present in the prostrate.

What are some of the limitations of the PSA test?

Detecting tumors does not always mean saving lives : When used in screening, the PSA test can detect small tumors. However, finding a small tumor does not necessarily reduce a man's chances of dying from prostate cancer.

False-positive tests : False-positive test results (also called false positives) occur when the PSA level I level is elevated but no cancer is actually present.

False-negative tests : False-negative test results (also called false negatives) occur when the PSA level is in the normal range even though prostate cancer is actually present.

Why is the PSA test controversial in screening?

Using the PSA test to screen men for prostate cancer is controversial because it is not yet known for certain whether this test actually saves lives. Moreover, it is not clear that the benefits of PSA screening outweigh the risks of follow-up diagnostic tests and cancer treatments. Over diagnosis, puts men at risk of complications from unnecessary treatment.

What are tumor markers ?

Tumor markers are substances produced by tumor cells or by other cells of the body in response to cancer or certain benign (noncancerous) conditions. These substances can be found in the blood, in the urine, in the tumor tissue, or in other tissues. Different tumor markers are found in different types of cancer, and levels of the same

tumor marker can be altered in more than one type of cancer. In addition, tumor marker levels are not altered in all people with cancer, especially if the cancer is early stage.

How are tumor markers used in cancer care?

Tumor markers are used in the detection, diagnosis, and management of some types of cancer. Tumor marker levels may be measured before treatment to help doctors plan appropriate therapy. In some types of cancer, tumor marker levels reflect the stage (extent) of the disease. Tumor marker levels also may be used to check how a patient is responding to treatment. A decrease or return to a normal level may indicate that the cancer is responding to therapy, whereas an increase may indicate that the cancer is not responding. After treatment has ended, tumor marker levels may be used to check for recurrence (cancer that has relapsed).

Can tumor markers be used as a screening test for cancer?

Most tumor markers are not sensitive or specific enough to be used for cancer screening.

Gene Testes for Cancer :

Gene tests for some cancers are also available. Specific genetic mutations have been identified as linked to several types of cancer, and, for some cancer types, this information has been converted into clinical tests. For example, scientists identified gene mutations that are linked to an inherited tendency to develop colon or breast cancer, and tests for an inherited susceptibility to these cancers are commercially available.

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KNOW THY INSTITUTIONS

INDIAN INSTITUTE OF TECHNOLOGY, NEW DELHI

Indian Institute of Technology, Delhi is one of the seven institutes of technology created as centres of excellence for higher training, research and development in science, engineering and technology in India. The others are at Kanpur, Kharagpur, Madras, Bombay, Guwahati and Roorkee. Established as College of Engineering in 1961, the Institute was later declared an institution of national importance under the "Institutes of Technology (Amendment) Act, 1963" and was renamed "Indian Institute of Technology Delhi". It was then accorded the status of a deemed university with powers to decide its own academic policy, to conduct its own examinations, and to award its own degrees.

IIT Delhi is situated at Hauz Khas in South Delhi, which is a landmark place in the colourful and chequered history of Delhi. The campus of the institute extends to an area of 320 acres. With many topographical features, imaginatively laid out with picturesque landscape, numerous buildings of various nature and stature, and clean and wide roads, the campus presents a spectacle of harmony in architecture and natural beauty.

In common perception as an institution, IITD is often identified with the traditional discipline of "engineering". It will be a surprise to many that IITD has a long history to interface with the world of life sciences. It all statrted in 1969 with the establishment of Center for Biochemical Engineering. Since then IITD has not only strengthened its efforts in this critical zone of interface between engineering and life sciences but also created a strong niche of expertise for itself (see box on page 121).

With a faculty strength of more than 50, bioresearch and training activities at IITD are organised under several units as under :

DEPARTMENT OF BIOCHEMICAL ENGINEERING AND BIOTECHNOLOGY (DBEB)

Established in 1989, the research focus at DBEB is on bioreactor design, process, optimization, down stream processing and scale up of microbial processes, enzymology, molecular biology and application of industrially relevant enzymes.

Efforts as DBEB have till date resulted in US/ Indian patents on) T7 DNA polymerase based novel Corynebacterium vectors; Process development for treatment of high strength wastes; Production of L-lactic acid ; Use of soluble lignin extract for production of hydrolytic enzymes ; combination treatment for decolorization/ detoxification of textile wastes ; Development of a suitable bioreactor system for azadirectin production by hairy roots of *Azadirecta indica* ; Plane cell/ hairy root cultivation using inert solid substrate and a process for enhanced production of bioactive compounds.

DBEB has also been involved in several technology transfers and consulting arrangements with private organisations like Ranbaxy (PenGacylase), Tetragon Chemie (Process for animal feed), International Panacea Ltd. (Xylanse for pulp and paper). This is in addition to the ongoing work with BCIL and Panacea Biotech.

DBEB has chalked out an ambitious plan for further research and development of infrastructure. On the research front, priorities include : Modification of Glycolytic pathway, Process optimization and scale up of Pichia pastoris for therapeutics, Novel Enzymes (Lactases, Glycosyl Hydrolases), Plant-microbe interactions, Regulation by RNA, Molecular motors and, Anaerobic and aerobic processes for waste treatement etc..

To achieve its objectives DBEB is working towards upgradation of its Bio-process facility to a state of the art center; setting up an Integrated Downstream Processing Facility for Proteins; establishing a protein Engineering Core Laboratory as well as a P2 Lab for Recombinant Therapeutic Protein Production.

DBEB also offers an active PhD programme and a dual degree programme for undergraduates entering through the JEE system.

CENTER FOR BIOMEDICAL ENGINEERING

Created jointly by IITD and All Indian Institute of Medical Sciences (AIIMS) in 1971, the CBME's niche research areas are :

Evolution of Bio-Engineering & Biosciences at IIT Delhi	
1969	Centre for Biochemical Engineering
1971	Centre for Biomedical Engineering
1980	Biochemistry Cell
1989	Department of Biochemical Engineering & Biotechnology
2002	Supercomputing Facility for Bioinformatics & Computational Biology
2008	School of Biological Sciences

Medical Diagnostics : Pathogenic bacteria detection, Early cancer detection, Bioactive ABO bloodgrouping card, Metal and Iron measurement in biological fluids, Affordable and non-invasive glucose monitoring systems, Hormone detection in body fluids.

Nano-Medicine and Drug Delivery Systems : Biodegradable nanoparticle based drug delivery systems for diabetes and frostbite, nanoparticulate system for macrophage and cancer targeting, Polymeric antimicrobial agents for sterilization and disinfection, Intranasal vaccine delivery.

Tissue Engineering : Polymeric scaffold for cell growth and toxicity testing; Implantology (Soft and hard tissue implants, antimicrobial bone cement)

Medical Devices and Bioinstrumentation : Electrically enhanced transdermal drug delivery

systems, low cost 12 lead ECG with telemetric capability, wireless ECG systems, intelligent above knee and below knee prosthesis.

The faculty at CBME has already earned more than 10 patents for instruments/products developed through their efforts. These include : Electrooculogram based Multi-mode controller, Device for External Counter Pulsation Therapy; Zig-G (a wireless ECG system); bioactive ABO Blood grouping Card; pneumatic damper controlled AK prothesis; fluorescence based sensing of myoglobin; test kit and method for measurement of metals in biological fluids; Novel Clinical Kit to estimate iron overload in humans; composition of oral insulin delivery of therapeutic agent and processes thereof ; a topical formulation for prevention and management of peripheral vascular diseases and a process of preparation thereof.

CBME faculty is engaged in transfer of knowhow to several private sector organsitions for commercialization and serial production of technologies products. These include TROIKA, Ahmedabad (Electrically enhanced trans-dermal drug delivery system); Johnsons & Johnsons, Mumbai (Abdominal Stapler); XL-Orthomed, Faridabad (Antimicrobial acrylic bone Cement) for fixation of Hip and Knee Joints); Kumar Printers, New Delhi (Heat sealable coatings for industrial and medical packaging); Ranabxy Ltd., Gurgaon (Immobilization of aminoacylase on functionalized acrylics for production of 6-aminopencillinic acid from pencillin) and Span Diagnostics, Ahmedabad (Bioactive ABO blood grouping card under negotiation). CBME is also a partner in the Stanford-India Biodesign Program of DBT, which aims to develop affordable medical devices in India. CBME trains the next generation biomedical engineers through a strong PhD program.

BIOCHEMISTRY LABORATORIES

Biochemistry Laboratories located within the Chemistry Department of IITD have been focused, since mid 70s' on applied enzymology, bioseparation and more recently, on biochemistry of extremophiles and nanobiotechnology. Some of the research work includes crosslinking for preparing Elisa conjugates & protein stabilization, bioseparation in the context of proteomics, efficient biocatalyst design for low water media, medium engineering, Enzymes based routes for biodiesel propagation, Efficient biocatalyst design for biomass conversion inclusive or microwave assisted pretreatment of cellulose, starch etc., novel extremophile genes & extremozymes, applications in nanobiosynthesis, nano toxicology, environment and food bioprocesses.

The Masters programme in Chemistry in the IIT system has been unique at Delhi in that it includes biochemistry as an integral part. The department also offers PhD in biochemistry.

The biochemistry faculty thus far have 10 patents and a strong publication record to their credit and have collaborations with industries such as Novoenzyme, Bioplus etc. and several international bodies.

SUPER COMPUTING FACILITY FOR BIOINFORMATICS AND COMPUTATIONAL BIOLOGY (SCFBIO)

SCFBio was created with funding from the Department of Biotechnology DBT in 2002 with a vision to develop novel science and new bioinformatics software tools. The facility has since developed Chemgenome for genome annotation, Bhageerath for protein tertiary structure prediction and Sanjeevini for lead molecule discovery. In 2009, SCFBio has been upgraded to a multi-teraflop facility under programme support from DBT. The hardware and the software of SCFBio has been made freely accessible to the student and scientific community on a 24×7 basis at www.scbio-iitd.res.in

Leadinvent, a startup company based on Sanjeevini for new molecule discovery, was successfully incubated at IITD (2007-2009) and is

now at a break even stage. Another startup company called Novoinformatics for genomic and proteomic consultancy work based on Chemgenome and Bhageerath is under consideration for incubation at IITD.

SCHOOL OF BIOLOGICAL SCIENCES (SBS)

Created in 2008 the vision of SBS, is to become the pioneers of modern interdisciplinary biological sciences by integrating emerging disciplines with biological sciences, and to nurture and sustain a vibrant comprehensive programme in research and instruction. To realize this vision, SBS has launched itself into promoting goal-oriented innovative interdisciplinary research. It seeks to achieve this by interfacing modern biology with applied engineering sciences to address problems affecting human health and welfare and training scholars to be the next generation scientists.

Efforts are on to understand issues associated with mechanisms of protein- protein interactions and amyloidogenesis in neurodegenerative disorders; production of therapeutic recombinant proteins through chaperone assistance; diabetes; hepatitis B; anti-malarials; cell penetrating peptides; virus-based nonoparticles and bioprospecting. For the times to come, SBS faculty has its eyes set on Genomics and proteomics of infectious diseases and non-communicable disorders. As a part of the first few initiatives in building the school, it has appointed a number of very well qualified and experienced faculty members. Some of their achievements include Ramalingaswami Fellowship, J. C. Bose Fellowship, S. S. Bhatnagar award and DBT Bioscience award. SBS is buildings BSL 1, 2 and 3 level laboratories. An active Ph.D. programme in Biological Sciences has already commenced. A minor area programme in Biological Sciences for engineering students is under consideration of the Institute. Future challenges for bioresearch programmes at IITD *inter alia* included :

- Affordable Diagnostics/Devices
- Design, Process Optimization & Scale up of Biological Processes (Microbial, plant & animal cell fermentation.).
- Genomics/Proteomics & Diseases Target Identification & Database Creation (Neurodegenarative/diabetes etc.)
- Novel Genes & Enzymes from extremophiles for Food Bioprocesses and Industrial applications
- Bioenergy
- Nanobiotechnology.

Contact :

Indian Institute of Technology Delhi
Hauz Khas, New Delhi-110 016, INDIA
Tele : (91) 011-2659 1999, (91) 001-2659 7135
Fax : (91) 011-2658 2037, (91) 011-2658 2277
E-mail:webmaster[at]admin.iitd.ac.in

Conferences / Meetings / Symposia / Seminars

International conference on Green Technologies for Environment Rehabilitation (GTER-2012), Feb 11th – 13th, 2012, Haridwar.

Major Themes

- Green Computing
- Electronic waste recycling
- Biodegradation of polymers
- Waste treatment management
- Green technologies for greener environment/ environmental protection and environmental rehabilitation toxic chemicals/pollutants, their detection, removal and management
- Pharmaceutical Sciences
- Biogeochemical cycles
- Eco-toxicology
- Processiong of recycled polymers
- Recyling of leather
- Recycling of paper
- Green building
- Recyling/reuse of polymers, Ionic liquids
- Eco-friendly paints
- Revewable resources
- Biodegradable rubbers
- Rubber recycling
- Nano-materials toxicity
- Air pollution
- Water pollution
- Soil pollution
- Environmental Science
- Cheimcal, Physical and Biological Sciences
- Analytical and Electrochemistry
- Mathematical Modelling etc.

Best poster and best oral presentation shall receive a cash award of ₹ 2500/- and ₹ 5000/- each.

Contact Persons : Prof. (Dr.) R. D. Kaushik, Chariman, GTER-2012, Dean, Faculty of Engineering and Technology, Gurukul Kangri University, Haridwar-249404, Uttarakhand, India, Phone no : +91-9719004456, +91-9837139345, Email : gter2012@gmail.com

NANOBIO 2012 Second International Conference on Nanotechnology, Kochi, Kerala, February 21th-23th, 2012

Focal themes : Regenerative Medicine & Tissue Engineering; Cancer Nanotechnology; Nano Drug Delivery; Molecular Medicine; Molecular Diagnostics, Nanobiomaterials & Nanotoxicology.

Contact :

Phone no. (484) 400-8750(2), E-mail nanobio 2012@gmail. com, website www.amrita.edu/nanobio2012.

7th Nutra India Summit-2012, March 15–17, 2012/Lalit Ashok, Bangalore

Themes :

- Driving wellness through Health and Functional Food New Products :
- Innovations Instant Foods, Drinks and Health Beverages.
- Enhancing Nutrition with fortification through Nutritionals.
- Empowering Snacking Habits with Healthy options for Energy & Health.

- Prevention and Disease Delaying through Nutraceuticals and Nutritionals (Diabetes and Cardio Vascular Diseases).
- New Food Laws form the perspective of functional foods, dietary supplements, nutritionals, health foods and ingredients.
- Role of Nutraceuticals in Sports Nutrition—Sportaceuticals : Emerging opportunities in India.
- Valued additions to Health Foods Ingredients through Enzymes.
- Pre and Probiotics enhancing the value of Diary products.
- Integrated approach of Traditional knowledge towards Lifestyle Management for Wellness.
- Developing more effective Nutritional strategies with Nutrigenomics for better health.
- Workshops.

Contact :

MM Activ, Mumbai : 240, Kaliandas Udyog Bhavan, Babasaheb Woralikar Marg, Near Century Bazar, Worli, Mumbai-400 25/ Tel : +91-22-2438-5007-9/Fax : + 91-22-2437 9882

Bangalore : #9, UNI Building, 1st Floor, Thimmaiah Road, Millers Tank Road, Vasanthnagar, Bangalore-560 052/ Tel : + 91-80-4114 1912/13 / Fax : +91-8--4113 1914

International Conference on Recent Advances in Computing and Software Systems (RACSS 2012), April 25th–27th, 2012, Kalavakkam, Chennai

Themes :

Software Engineering

Software Architecture and Design,
Empirical Software Measurement,
Software Testing
Re-engineering
Maintenance and Evoloution

Distributed Computing

Middleware
Service Oriented Architecture
Cloud Computing
Mobile Computing
Grid Computing

Machine Learning

Software Computing
Image Processing
Speech Processing
Data Mining
Multi-Agent Systems

Computer Networks

Network Security
Network Architectures
QoS and Resources Management
Wireless Sensor Network

Contact :

Dr. Chitra Babu, Conference Chair, RACSS 2012, SSN College of Engineering, Rajiv Gandhi Salai (OMR), Kalavakkam - 603 110, Tamil Nadu, India, Tel : + 91-44-27369700, Fax : + 91-44-27469772, Email : racss2012@cse.ssn.edu.in, Web : http:/www.racss2012.com

S & T ACROSS THE WORLD

ANTRIX/ISRO BUILDS COMMERCIAL COMMUNICATION SATELLITE, HYLAS

Highly Adaptable Satellite (HYLAS), an advanced communication satellite built by ISRO on a commercial basis in partnership with EADS-Astrium of Europe,, was successfully launched on November 27, 2010 at 00.09 hours Indian Standard Time (IST) by the European Ariane-5 V198 launch vehicle. The launch took place from the Guyana Space Centre at Kourou in French Guyana.

35 minutes after its lift-off, HYLAS separated from Ariane-5 launch vehicle after reaching its intended Geosynchronous Transfer Orbit (GTO) with a perigee of 250 km, apogee of 35,906 km and inclination of 1.99°.

Master Control Facility of ISRO at Hassan immediately took over the control and command operations of the satellite. The perigee was raised from 250 km to 35,521 km by firing the satellite's Liquid Apogee Motor (LAM) of 432 Newton thrust. The satellite has reached geostationary orbit and is working satisfactorily.

HYLAS satellite developed for Avanti Communications, UK consists of ten high power transponders that use eight in Ka and two in Ku band frequencies. The satellite's solar panels generate a maximum of about 3200 Watts of power. The satellite is designed to deliver high-speed broadband services through its spot beams over Europe. The satellite is expected to be operated from 33.5 deg. W longitude for European coverage. The contract for building of satellite was won in the year 2006 after competing along other leading manufacturers of USA and Europe through a strategic alliance worked out between Antrix/ISRO and M/s. EADS Astrium of France. The alliance was formed to jointly develop communication satellites with ISRO platforms and Astrium payloads and market them internationally.

Astrium had the responsibility for overall program management and delivery of the communications payload and Antrix/ISRO provided the satellite bus and also performed the satellite integration and testing at ISRO's facility in Bangalore. HYLAS satellite weighing 2541 kg at lift-off is the heaviest satellite built by ISRO for 1-2K bus capable of operating for over 15 years mission life as demanded by the customer. The satellite was handed over to the customer in March 2011.

DECTION OF A LAVA TUBE ON MOON USING THREE DIMENSIONAL CHANDRAYAAN-1

TMC Data From time immemorial, mankind has aspired to colonise the Moon for various reasons. Scientific quest has been the major impetus for visualising human habitability on Moon, as a transit base for outer space exploration missions. Adverse conditions on Moon's surface such as direct exposure to Galactic Cosmic Rays (GCR), Solar Particle Events (SPE), extreme temperature conditions, meteoritic impact, etc., have always challenged the prospects of human settlement on Moon. However, sub-surface hollow lava tubes provide such a conducive locale for safe and future human settlement on Moon. Lava tubes are primarily formed when an active low viscosity lava flow develops a continuous and hard crust due to radiative cooling of its outermost part, which thickens and forms a solid roof above the still flowing lava stream beneath. At the end of the extrusion period, an empty flow channel free from molten magma is left in the form of a near-cylindrical shape tunnel below the surface.

Previous laboratory analysis of radiation safety issues conducted on lunar lava tubes show that beyond 6 m depth, no effects of radiation due to GCRs are observable in the simulation, no effects of radiation due to or induced by SPE are observable beyond 1 m depth and natural or induced radioactivity does not seem to play any significant

role in the lava tube exposures. Past studies using telescopic and orbital data have shown prospect of detecting lava tubes on the Moon.

India realised its dream of planetary missions by successfully launching Chandryaan-1 on October 22, 2008. Among 11 different scientific payloads onboard this mission there was an important sensor — the Terrain Mapping Camera (TMC) — having high spatial resolution (5m) and three dimensional viewing capability. This had the best orbital sensor parameters ever flown to the Moon before this mission. The TMC could capture the Lunar surface features with an unprecedented clarity.

A buried uncollapsed and near horizontal Lava tube could be detected using TMC nadir image in Oceanus Procellarum area on Moon. The lava tube detected by TMC has been analysed thoroughly in terms of morphometry, topography, surface composition and surface ages of the surrounding regions using sensors onboard Chandryaan-1. A Digital Elevation Model was generated to view the feature in three dimensional perspective which has helped in estimating the dimensions of the tube which is about 1.7 kms long and approx. 120 meter in diameter. Compared to the most terrestrial lava tubes, this tube is larger. This may be due to the less gravity and absence of atmospheric pressure on the Moon. This lava tube lies between two rilles (collapsed portion of a larger original lava tube) indicating that the roof of this section of the tube has remained intact over the years.

Such a lava tube could be a potential site for future human habitability on the Moon and could be used for future manned missions aimed at scientific explorations, providing a safe environment from hazardous radiations, Galactic cosmic rays, meteoritic impacts, extreme temperatures, etc. This tube could as well be used as a transit out-post enroute to other planetary bodies.

It may be noted that dimensions of a lava tube has been demonstrated for the first time on any planetary body. Past detections have mostly identified the 'sky-light' holes believed to open into lava tubes or identifying candidate tube in 2 dimensions without dimensional estimations of individual tube.

SAVANNAS, FORESTS IN A BATTLE OF THE BIOMES, PRINCETON RESEARCHERS FIND

Climate change, land use and other human-driven factors; could pit savannas and forests against each other by altering the elements found by Princeton University researchers to stabilize the two. Without this harmony, the habitats or bidmes could increasingly encroach on one other to the detriment of the people and animals that rely on them.

The Princeton researchers reported this month the journal *Science*, October 2011, that sayamia wildfires, combined with climate conditions, maintain the distinct border between savannas and forests in many tropical and subtropical areas. Savanna fires keep tree cover low andprevent forests from encroaching on the grassland. When tree cover is high, as in a forest, fires cannot spread as easily, halting the savanna's advance into the forest.

But the Princeton team's findings suggest that savanna wildfires could be heavily influenced by factors such as climate change, road construction and fire-prevention measures. Less rainfall can result in an uptick in fires that can transform a forest into a savanna, just as breaking up the landscape through road construction and fire control disrupt natural blazes and allow a forest to sprout where there once was a savanna.

The researchers suggest that because of these factors, large stretches of South American and African forest and savanna could degenerate into chaotic mutual encroachment. The change over from one biome to the other — which can happen within several decades — can be extremely difficult to reverse once it has happened, explained lead author Garla Staver,a doctoral student in the laboratory of coauthor Simon Levin, the Moffett Professor of Biology in Princeton's Department of

Ecology and Environmental Biology. She and Levin worked with co-author Sally Archibald; a senior research scientist at the Council for Scientific and Industrial Research in South Africa.

Plants and animals that thrive in a forest or savanna often cannot transition from one habitat to the other, Staver said. The *Science* paper illustrates that the loss of savanna to forest is just as ecologically traumatic — though less well known — as deforestation, she said. "Savanna and forest are definitely not locally compatible," she said. "There is a risk of losing plants and animals endemic to one or the other, which would affect the people who depend on those species". "Savannas, for instance, are useful to people as cattle rangeland," she said. "When forests encroach, the grass productivity decreases dramatically and the land becomes much less useful. In terms of livelihood, that would have a huge impact."

The team's work provides among the first experimental evidence that fire feedback — the ecological effect of fires — is the dominant force in maintaining the division between forests and savannas, and that it can determine where the habitats flourish. The researchers used satellite data of fire distributions — combined with climate and soil data, as well as satellite data of tree cover — to survey the tropical and subtropical regions of Africa, Australia and South America.

The researchers found that the frequency of fires determines whether forest or savanna will dominate an area more than other factors such as rainfall, seasons and soil texture, especially in areas with moderate precipitation. Regular fires prevent trees from establishing and savannas from turning into forest. A lack of fires allows a forest to develop, which in turn excludes future fires.

Human alterations to the climate and landscape, however, may disrupt the natural spread of fire in many areas and lead to very rapid changes in biome distribution, the Prineeton researchers suggest. Direct actions such as building roads and deploying methods such as controlled burning that prevent the natural spread of wildfires could break up savannas, altering wildfires and allowing forests to take root. At the same time, drier conditions — particularly in areas now experiencing diminished monsoons — rob forests of their primary safeguard against fire, rain.

Under these circumstances, a forest can overtake a savanna, of vice versa, in a matter of decades, and a return to the original terrain would prove exceedingly difficult, even if the original climate conditions return, Staver said.

"If a savanna were to turn into a forest, for instance, that change would be quite sudden, much quicker than we might expect, and it would be hard to reverse," Staver said. "You'd cross a threshold where fire cannot spread anymore. Conversely, if a forest dried out and fire started to spread, it could turn into a savanna, maintained by fire. The magnitude of change needed to return a biome to its original state would be much more than it needed to change in the first place."

The Princeton research could be significant in determining the "future trajectory" of global forest cover, and also illustrates the natural obstacles to restoring cleared forests, said Brian Walker, who studies ecological sustainability and resilience as a research fellow at the Commonwealth Scientific and Industrial Research Organization in Australia.

(Source : Princeton University)

MEASURING THE DISTANCE OF STOCHASTIC PROCESSES MATHEMATICALLY

A milestone in the description of complex processes - for example the ups and downs of share prices-has been reached by mathematicians at the Ruhr-Universität Bochum. Researchers led by Prof. Dr. Bolger Dette (stochastics) have developed a new method in spectral analysis, which allows a classical mathematical model assumption, so-called stationarity to be precisely measured and determined for the first time. The approach also makes it

possible to construct statistical tests that are considerably better and more accurate than previous methods: The researchers report result in the prestigious "Journal of the American Statistical Association". Bochum's stochasticians Prof. Dr. Holger Dette, M.Scv Philip PreuB and Dr. Mathias Vetter, found the key to the whole issue by calculating a distance dimension between the Stationary and non-stationary process. "Just as we can determine distances on Earth between two places, we were able to measure the distances or the intervals between the processes" said Prof. Dette. The measure is exactly 0 when the assumption of stationarity applies to the process. This distance can be estimated frorn the data and thus provides a reliable tool for the spectral analysis of so-called time series, such as share prices or climate data. "The goal of statistical analyses of time series is always to understand the underlying dependencies in order to then deliver the most accurate predictions possible for the future behaviour of these processes" said Prof. Dette.

(Source : Ruhr-University Bochum)

SCIENTISTS DISCOVER GENE THAT HELPS PROTECT BODY FROM SQUAMOUS CELL CANCER

An extraordinary breakthrough in understanding what stops a common form of skin cancer from developing could make new cancer treatments and prevention available to the public in five years.

In research published today in the leading international cancer journal, *Cancer Cell,* November 2011 an international team of scientists led by Professor Stephen Jane and Dr Charbel Darido of Monash University's Department of Medicine at the Alfred Hospital, has discovered a gene that helps protect the body from squamous cell cancer (SCC) of the skin. The Cancer Council estimates that two in three Australians will be diagnosed with skin cancer before the age of 70 with SCC being one of the most common forms. Up until now, its genetic basis has not been well understood, with surgical treatments the only option.

Professor Jane said the team discovered that a gene with an important role in skin development in the foetus is missing in adult SCC tumour cells. Although the researchers initially focused on skin cancer, they found that the protective gene is also lost in SCC that arises in other tissues, including head and neck cancers, that are often associated with a very poor outcome for the patient. "Virtually every SCC tumour we looked at had almost undetectable levels of this particular gene, so its absence is a very profound driver of these cancers," Professor Jane said.

In collaboration with Associate Professor Rick Pearson from the Peter MacCallum Cancer Centre, the Monash researchers showed that loss of this particular gene knocks out the signal to stop skin cells from growing. Without this stop signal, the cells keep increasing in number and eventually forms a cancer.

Identifying this driver of cancer in skin and other organs provides a clear direction for developing strategies for both prevention and treatment in the relatively near future. "Our research indicates that drugs already in clinical trials for other cancers may actually be effective in treating SCC - they just need to be applied to skin or head and neck cancers. "This means that a number of the usual hurdles in getting therapies to trial have already been cleared, so patients could be reaping the benefits of this research in under five vears," Professor Jane said.

"It's a similar case with prevention. There are strategies by which we could increase the expression of this gene that will likely afford some protection from skin cancer, for example in the form of a supplement in sun-cream. The molecules that would increase this expression, are very well validated, so there would be few barriers to applying them in clinical trials."

(Source : Monash University)