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EDITORIAL

GROWING POPULATION VERSUS FOOD PRODUCTION

One of the formidable challenge before the world is to match the increase in global food production with the increase in world population which is predicted to increase by 2.5 billion by the year 2050. Even India's population is predicted to grow to approximately 1.5 billion by 2030 and overtake China. The available land for agriculture is limited. The economic growth in developing countries throughout the world is making them more affluent and there is a trend to increase the meat content in their diet. Thus the requirement of all kinds of meat (chicken, pork and beef) is increasing in the world. Since the production of meat, say 1 kilogram of meat consumes about 2 to 7 kg of maize and other agriculture produce, this situation is putting an additional pressure on the increase of global food production.

Most of the food production on agricultural land is done by conventional agricultural method that is by using chemical fertilizers and pesticides or in other words by the use of chemicals which on one side enhance the productivity and on the other side provide protection against harmful insects , weeds and crop diseases. At the present time the farming in the world is done on approximately 1.5 billion hectares. In order to meet the growing demand of food for the increasing population there appear to be only two solutions. (i) Either we will have to increase the cultivable land by about three fold which would mean a drastic reduction in the forest cover, grassland and prairies which in turn will have an adverse effect on climate change. (ii) Or we will need to employ the best available technologies, high yield seeds with optimum use of pesticides which do not cause damage to the environment, maintain ecological balance and sustain biodiversity. Increase in the amount of global food production with the use of modern agricultural technologies, chemical fertilizers and controlled use of pesticides appears to be the preferred alternative for meeting the future demand of food for the growing population.

There is common perception that in the conventional farming there is excessive use of chemical fertilizers and unwanted spray of pesticides. It may be true that many farmers do the over spraying of the pesticides, fungicides or herbicides due to ignorance. But over spraying is bad for crops as well as for the environment. Farmers need to be trained or informed that they should spray the minimum to protect the crops . The companies as well as the agricultural scientists and advisers are encouraging the farmers not to use too much of these products but only a small amount. It is now well recognized that if a pesticide is found to be carcinogenic or harmful in any manner then it will not get registered /approved for use by the regulatory bodies.

Another challenge is the ingenuity of bugs, insects, fungi and weeds to develop resistance to these chemicals. It is a phenomenon quite similar to the disease causing bacteria, virus etc. in human beings which develop resistance to antibiotics and other life saving drugs. Thus there is a need for continued research and innovation in the area of crop protection techniques and technologies. Friedheim Schmider, director general of the European Crop Protection Association, Brussels, Belgium says "Having affordable and sufficient food available, taking care of consumer health and protecting the environment are all essential for the future. Our planet is not expanding with the population and we have to produce more from less.

If diseases kill half of the crops, that is real waste of limited national resources. We need to address public concerns and hopefully do better tomorrow than we did in the past".

Organic farming is another way of crop production in contrast to the conventional farming. International Federation of Organic Agriculture movements (IFOAM) defines organic farming as follows :

"Organic agriculture is a production system that sustains the health of soils and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and good quality of life for all involved".

A successful organic farmer does not see every insect as a pest, every plant different from the crop as a weed and does not think chemical spray as the solution to every problem. The goal is not to eliminate all pests and weeds but to reduce them to an acceptable level and take advantage of their beneficial attributes. Global market for organic food is expanding very fast. According to Organic Monitor estimates, global organic sales reached U.S. $ 54.9 billion in 2009 as compared to $ 50.9 billion in 2008. The countries with largest markets are the U.S.A, Germany and France. The highest per capita consumption is in Denmark, Switzerland and Austria. According to Indian Government statistics, in 2002, from a total food production of over 200 million tonnes, the country produced around 14000 tonnes of organic food products. Most farms in India are organic but not certified. Certification of organic products (produce) has to be done by a certifying agency which itself is accredited by a designated agency.

India's farmers are doing organic farming by default. They are still using the organic methods used by their forefathers for thousands of years. Organic fertilizer and natural pest control are the only tools available to most of these farmers who were always short of financial resources to examine chemical solutions. The produce of these farmers is as organic as it could be, but it requires certification which could be expensive and time consuming, and they can't afford to pay the fee. Comparing 'organic' and 'conventional' farming Schmider says, 'There is a perception that 'conventional' production means using a lot of pesticides, whereas 'organic' production' uses none'. 'This is not so', he says. 'Both need pesticides in some form to fight against diseases, weeds and insects, but with organic production much more land is used leaving less available for habitats for nature protection'.

The available scientific evidence has not shown a consistent and significant difference between conventional and organic food in terms of safety or nutritional value. In 2009 a review of all the relevant research comparing organic to conventionally grown foods was carried out by the United Kingdom's Food Standards Agency which concluded as follows :

No evidence of a difference in content of nutrients and other substances between organically and conventionally produced crops and livestock products was detected for the majority of nutrients assessed in this review suggesting that organically and conventionally produced crops and livestock products are broadly comparable in their nutrient content. There is no good evidence that increased dietary intake of the nutrients identified in this review to be present in larger amounts in organically than in conventionally produced crops and livestock products, would be of benefit to individuals consuming a normal varied diet, and it is therefore unlikely these differences in nutrient content are relevant to consumer health.

Prof. S.S. Katiyar

PRESIDENTIAL ADDRESS

MATHEMATICS—QUEEN OR HANDMAIDEN

R. S. MISHRA, Ph.D., D.Sc., F.N.A.Sc., F.A.Sc, F.N.A.

I am very grateful to the scientists of India and to the members of the Indian Science Congress Association for the signal honour they have conferred on me by electing me the President of its Sixty-first Session. I deem it a great privilege especially when I look back and find that this office has been held by outstanding leaders of thought in Science like the late Pt. Jawaharlal Nehru, one of the noblest sons the country has produced. He was a symbol of people's aspirations and the achievements in Science and technology since independence are the result of his vision and encouragement. I am conscious of my limitations and derive consolation from the observation Sir Isaac Newton made nearly three hundred years ago. "If I have seen further it is by standing on the shoulders of giants". I owe you my sincere apologies for any lapses on my part in living up to the glorious tradition of the past.

A tree loves the ground on which it stands. Being interested in Mathematics from early childhood, though having no mathematical background in the family, I have decided to talk to you about Mathematics and its applications in Sciences and humanities with special reference to social behaviour.

From ancient times Mathematics has been regarded as the Queen of Science because as George Cantor had once remarked "The essence of Mathematics lies in its freedom". The wonderful freedom and joy of creation that Mathematics offers have been well recognized. The fourth verse of Vedang Jyotish brings out the fact as follows :

यथा शिखा मयूराणाम् नागानाम् मणयो यथा।
तदवद्वोदांग शास्त्राणाम् गणितम् मूर्धनि स्थितम्।।

As are the crests on the heads of peacocks, as are the jewels on the hoods of snake, so is Ganit at the top of all Vedanga sciences.

In ancient times the civilization of a country was measured by the mathematical advancement it had made. Through all these years Mathematics played a fundamental role in transforming society. It advanced, human civilization, helped man in adapting himself to his environment and assisted him to meet his material needs. It also made it possible for technologically advanced nations to achieve military power, security and economic strength.

Mathematics — the Queen of Sciences, is beautiful but not in general attractive. She attracts only those who are dedicated to her and who have made her a part of their being. In this connection I am reminded of an anecdote : Lord Rutherford once remarked to Neils Bohr, "Though you are BORE (BOHR), you have, a charming wife". Whatever you think of us, we mathematicians are undoubtedly proud of our charming Queen — Mathematics.

There was a time when Mathematics was studied for its own sake with curiosity as the impelling motive and for the sheer joy and thrill of its creation. Mathematicians felt satisfied with their

* General President, 61st Indian Science Congress held during January, 1974 at Nagpur.

discoveries and did not bother about their useful applications. Creators in Mathematics were comparable to wholesale dealers whereas the transmitters of knowledge to retail sellers. A Cambridge don when once asked what applications his theory had, replied "Thank God, it has one".

Initially there are two aspects of Mathematics — pure and applied. But it is extremely difficult to draw a line between the two. They cannot be put in air-tight compartments. Their intersection set is certainly a non-null set. Danzig had once remarked, "Applied Mathematics is like wine which becomes pure in course of time". There is a deep truth in this. A striking example supporting this statement is that of trigonometry which started with navigation but soon became a branch of Pure Mathematics.

Times are changing and the world is moving towards socialistic order. The queen is not lagging behind and has become modern. We hear now-a-days so much of modern or new Mathematics.

With the pressure of Science and technology steadily increasing on human affairs and with the renewed and added applications of Mathematics to Science and technology, mathematicians cannot afford to spend their precious time in absorbing useless mathematical knowledge acquired through obsolete methods. There has been a lot of rethinking on our Mathematics curricula leading to radical modifications. But old habits die hard and habits of thought are most difficult to shake off with the result that the teachers of Mathematics become antiquated and unrealistic in an age marked by new realism. It is necessary, however, that they "water the subsoil" and ponder over the basic attitudes and presuppositions with which the minds and personalities of students are formed. Thanks to the organisation of summer schools for school and college teachers by U.G.C., N.C.E.R.T., U.S.A.I.D. and other agencies, we have evidence of a new wave of consciousness about Modern Mathematics in the country and mathematicians now instead of living in the past, live rather in the future. The syllabi have generally been revised at all levels. Some of our Mathematics syllabi can compare favourably with the corresponding syllabi of any advanced country. It has generally been realised that the difficulty of imparting instruction in Modern Mathematics does not lie with the students so much as with the teachers, who suffer from stubborn misconceptions.

There is another aspect which has usually been lost sight of. In Classical Mathematics parents could help their children in home assignments. But they are unable to do so in Modern Mathematics with the result that though good students are able to develop their initiative and critical faculty, average students are not able to cope with the progress in the subject. This may result in parents losing control over their children. I would, therefore suggest to U.G.C. and N.C.E.R.T. that some summer or winter schools for parents may also be organised each year.

In Modern Mathematics too much of drill is avoided. Though there are varying views on problem solving, I would content myself by quoting a Chinese saying, "If you give one a fish, you feed him for a day. If you teach him how to fish, you feed him for many days".

Mathematicians have very aptly realized that the domain of the possible is much larger than their imagination. There are a number of examples where the results which seemed absurd when they were discovered, had wide and useful applications later on. Witness the study of matrix algebra by Sylvester and Cayley purely for mathematical curiosity and its indispensability in modern quantum theory. While discussing the reform of mathematical curriculum at Princeton University in 1910, physicist James Jeans asserted, "We may as well cut out group theory. That is a subject which will never be of any use in Physics". But Oswald Veblen disregarded Jeans' advice. It has turned out that group theory later grew into one of the central themes of Physics. As an example, one of the fundamental particles, the baryon Ω^-–was predicted by group theory and discovered later experimentally.

The doubling period of Mathematics, as of any other Science is ten years. This means that the next ten years will produce as many mathematicians or as much mathematical literature as the humanity has produced so far. The first statement may roughly be stated in other words as follows : Ninety percent of all the mathematicians who ever lived since the dawn of human civilization are living now. Though the activities of the present generation of mathematicians are based on the recorded achievements of the past, if the phenomenon of the doubling period continues for two or three centuries more, as it has continued so far, the majority of the people of the world will be mathematicians and on the same analogy scientists of all the disciplines. Thus everybody will become everything. Will it not be a sad day for all of us ?

It is my conjecture that a time would come when the growth of Mathematics would slow down from this fast rate. We may run out of men (which does not appear to be a possibility at present), materials or incentives or Mathematics may become so complex as to impede its own progress.

Mass education in Mathematics has, however, at least one advantage. We can build on a large base of students for the making of new mathematicians. Many potential mathematicians are lost after or even before their high school career. Of those who go through the mill of college or university education, a large number are able to take up postgraduate work and research. This means an opportunity for creative work for which generous financial support which is considered to be an important national investment, is given. But, I would like to put in a word of caution. Though with every financial support one is required to submit periodical progress reports not every research project meets with success; if every one ends with successful results, the investigator perhaps did not set sufficiently high goals before himself. Also, generally there are no direct and obvious returns. I would, therefore, suggest that agencies for academic audit must be created for every research project undertaken with or without financial aid.

The problem of language has been agitating the minds of scientists in this country and also in some other countries. It is a controversial issue whether scientific education should be imparted in the regional language or the national language or an international language. Mathematicians, by habit, try to avoid controversies. They tried to evolve a common language, for instance, the set theoretic language, which could be understood everywhere in the world. It is my fervent hope that the effort in having a common mathematical language will be continued so that Mathematics may know no barriers of language or national boundaries. I would urge other scientists also to develop their own language in their respective disciplines so that international communication is maintained. The importance of language in Mathematics is effectively brought home by the following anecdote: A leading mathematician was an important member of the senate of his university. For twenty-four years he did not speak a word in the senate meetings but because of his towering personality sufficient funds were always made available for his department. In the last meeting during the twenty-fifth year the Professor of Languages pleaded vehemently for a cut in the Mathematics grant and the corresponding increase in the grant for languages. His plea was that Mathematics did not require any grant since its professor had never sought it. When the grant for Mathematics was on the point of being slashed, the Mathematics Professor got up and spoke just a sentence, "But mathematics is a language" and sat down. The entire Mathematics grant was restored.

Recent advances in Mathematics and other Sciences have influenced one another so reflexively that it is difficult to state the relations between them unambiguously. Mathematics has changed it role due to the change of its relationship with other disciplines. Though keeping its individuality as the Queen, it has become in the words of E. T. Bell "Handmaiden of Sciences". Now its utilitarian aspect has become very important. At present there is no discipline in Science or humanities where the potential use of systematic research and knowledge

in Mathematics is not made. It has been observed that Mathematics has the power to solve many of the problems of human race. But then there is no national policy or the proper climate of public understanding and awareness which could ensure the free, effective and quick communication of mathematical ideas and researches to those who need them. Though mathematicians would like to make their own contributions to the formulation of the basic values and the objectives of social life, there has also been a lack of social awareness in the mathematical community.

It is true that useful work in sciences and humanities requires mathematical methods. This means that Mathematics should be learnt by men of other disciplines as well. But unless one has a strong background in Mathematics, one may not be able to see beyond the models already in use and may not be able to make effective contributions. Again, mathematical knowledge means not only technical Mathematics but the whole range of empirical enquiry in a controlled way. For non-mathematicians the task of learning Mathematics and having a firm grasp over it from the point of view of its healthy and effective use is not an easy one. Wrong use of Mathematics may lead to disastrous results. It would perhaps be more advantageous if mathematicians acquire knowledge of some other disciplines. Let them cast mathematical nets over chains of happenings in the physical world and obtain equivalence relations between mathematically predicted and experimentally observed results. Just as individuals who create wealth share it with others through trade, income taxes etc., creators in Mathematics must share their knowledge with others. They must develop a sense of social responsibility through social motivation. It must be realized that the betterment of mankind, depends not on Mathematics and the mathematicians alone but on the application of mathematical knowledge to human affairs, and the spirit of rationalism, Mathematics fosters.

We will now deal with some of the applications of Mathematics. Massive efforts have been made for tackling problems in agriculture, defence, population, industry, energy, health and poverty. Recently we have gone in for space research and exobiology. Mathematics has a major contribution to make in all these spheres. Its role, however, is so implicit as to go unnoticed. There is an impression that the mathematical community has not been responsive to the nation's problems because of its exclusive concern with abstractions. This impression, however, is absolutely wrong. Mathematicians are very much alive to the problems of humanity. Their contribution to human welfare is by no means insignificant.

We are prone to consider the problems of social life in isolation from each other. Such an approach, however, results in a waste of efforts. Mathematics is a Science which can give an integrated view of things apparently disjoint and hence its validity in dealing with the problems of life. In the words of our Prime Minister, Mrs. Indira Gandhi, "Life is one, the world is one ...".

Though we are contracting horizontally and expanding vertically through explorations in space and time, the problems on earth and its environment are not only increasing exponentially but are having jumps. With the development of Medical Sciences leading to the eradication of some of the infectious diseases like plague, cholera, smallpox, and the decline of infantile mortality, longevity has increased and so also the population of the world. This has necessitated the balance of population against resources, the production of more food grains, increase of cattle wealth and the growth of industrial, commercial and other human activities. All these involve more of automation with the resultant problems of population of land, water and atmosphere. Consequently our crops, cattle and other live stock, birds, fish and marine life are all getting affected. Increase in national income and changes in the pattern of life are responsible for environmental anomalies and depletion of natural resources. Any scientific, economic, technological and political measure also produces degradation of the environment.

The more affluent a society, the greater are its environmental problems. India is a developing country and naturally its problems of environmental deterioration and pollution are gradually increasing.

In many western countries pollution has been responsible for the increased rate of death and disease, child delinquency and mental disorders.

There are two aspects of pollution. It may be taken as a mere nuisance. In that case it does no more than inconvenience the society and can be cured by political decisions and investment of funds. Secondly pollution damages and depletes the environment irretrievably and has unpredictable and unmanageable consequences. It ignores all political boundaries.

Rene Dubos drew pointed attention in 1972 to the transformation of environmental and social situations arising out of their interactions. Man evolved, on the earth as any other animal, but is perhaps the most recent amongst about 1.3 million species of plants and animal populations. He differentiated from the others because of his mental faculty and resultant cultural evolution though always sharing with them the resources of the biosphere. It is significant that these very organisms had earlier created environmental conditions favourable to man and so the latter appeared on the scene. Even today man's life support system is maintained by the activities of plants and other organisms. But Meadows' exercises in mathematical modelling in 1973 clearly demonstrated how exponential rates of population growth concomitant with increases in industrial exploitation along with lagging supplies of food, have jeopardised our existence. It is true that Meadows did not take into account the social feedback system while projecting the trends of growth found during the last few decades, in his five independent parameters of the-world model. But knowing the slow impact of educational processes against mounting technology to satisfy the unbridled needs of man, it is realised that the catastrophe predicted by the mathematical reasoning to happen within the lifetime of the next generation, could be postponed but only by a few years. Thus social scientists have very limited choices to offer to save our race. The dilemmas of life are of such a baffling nature that Sir Kingsley Dunham in his presidential address at the 1973 Canterbury Meeting of the British Association for the Advancement of Science raised the query : "Can our species survive the next few hundred years ?" There is a ray of hope in pursuing the reasoning of mathematical modelling for the desired conservative-management of resources. The International Biological Programme due to complete its decade of activity this year had a built in modelling programme in the analysis of divert ecosystems of the world as its objective. Predictive modelling and simulation techniques are showing the way of managing grasslands, forests and aquatic systems.

Environmental problems pertain not only to one country or nation but to the whole world. Environmental or ecological science is a branch of Science where the collaboration of all the countries of the east and the west on equal terms is required. An International Institute near Vienna sponsored by the academies of many countries has been established. U.N. E.S.C.O. has also launched a long-term multidisciplinary and intergovernmental programme known as Man and the Biosphere programme inviting input of the world scientists towards the solutions of the critical problems of our age.

The Government of India established "The National Committee on Environmental Planning and Coordination" under the Ministry of Science and Technology, which is forging ahead the coordinated planning of the environment.

These considerations lead us to the question posed by our Prime Minister in June 1972 at the Stockholm conference of U.N.O. on Human Environment "Are not poverty and need the greatest polluters ?" We have to examine how best the world resources and cultural efforts can be channalised and shared by all the inhabitants of the planet. Mathematics and Statistics of high order are

needed for social engineering to be practised for वसुधैव कुटुम्वकय् (The whole world is a family).

All developments are energy-based. We have gone a long way from muscular energy to fuel and fossil energy and thence to nuclear energy. The measure of civilization today is the per capita energy requirement. There is a race amongst nations for producing more of energy. The main source of energy for the biosphere is the sun. Fossil fuel resources are being used for producing extra energy. But the indication is that all the fossil fuels will be exhausted before the other forms of energy are put to common use. Moreover, the deposits of fossil fuels contain the carbon withdrawn from the air and set aside by nature. In the process, the air was purified by the green plants through the geological periods. Thus carbon dioxide was reduced to 0.03 percent and oxygen was increased to 21 percent. This natural withdrawl of carbon from the grand elemental cycle, created part of our life support system and man evolved within this nature-made system. Burning all the fossil fuel will mean reversing the process to our own danger. The consequences of increase of carbon dioxide in air through its thermal effects need not be pointed out.

Use of nuclear energy through radioactive elements on a large scale, is also fraught with danger. Besides posing ecological problems giving rise to crisis of highest magnitude like pollution, calculations clearly indicate the cumulative effect of escaped nuclear radiations in the biosphere and indeed the claims made by technologists in providing clean energy from atomic fission is too tall a talk. As such solar power is our major hope. The sun has set life moving on this planet and it alone has the secret of keeping it in motion in the future. I will come back to solar energy a little later.

Environmental problems are difficult because they involve conflicts of interest. In a city with cloth mills, for example, the cloth will be made available to the customers at cheap rates. But the smoke with sulphur and carbon dioxide and dust will pollute the atmosphere affecting the health of a large number of people. Moreover, a river might be used as a costless sewer to dispose of waste material. This will mean pollution of water.

Another point for consideration is that we have to take a long-range view of our environment and ecological balance. If action is not taken immediately, it may not be possible to retrieve the situation.

The nature is bountiful. Tempo of modern life, however, means imbalance in nature. Mathematics has proved helpful to the biologist and the ecologist by way of suggesting predictive models and the present day development of "system analysis" is a boon to the scientist. The development of Mathematical Biology is a gift of Mathematics. During the last 25 years quantification of biological information became an essential requirement and many mathematicians learned Biology as many biologists learned Mathematics. This interaction led to the development of gene engineering, mathematical biology, system analysis etc. Mathematics also determines the limits beyond which the solutions to problems cannot be effectively sought.

Since environmental problems are highly complicated requiring expert knowledge for a satisfactory solution, it is but necessary that Mathematics be brought into the picture when common structures of concepts and natural laws thus obtained are built up to develop models. It can then help in clear formulation of the problems, in pointing out various possible alternatives and in arriving at meaningful solutions.

Environmental science is now being studied in many universities and institutes. It is a Science with multldisciplinary approach. It gives an opportunity to build on a non-pollutive technology so as to avoid mistakes of the developed countries. But it is not my purpose to examine the possible role of the various disciplines represented in I.S.C.A *vis-a-vis* environmental problems. I would like to submit that the task of the scientist is to measure, understand and predict environmental changes. For

this monitoring instruments have to be developed and meaningful experiments carried out. The results have to be mathematically analysed and understood so that the environmental processes may be correctly predicted.

Production and productivity can be estimated. But so far we have no effective means of measuring deprivation and human misery due to pollution. We have to devise means so that there is maximum gain with minimum loss. At present net loss is greater than the net gain. In this Mathematics will play a major role. However, any action against environmental degradation must cover a large area and the public must be educated to develop environmental consciousness.

I turn now to yet another problem of grave importance. The country as a whole is facing power shortage. Ignoring the factors responsible for power crisis, I would plead for new sources of energy being found out so that our requirements for industry, transport, communication, heating cooling and generation of electricity are adequately met. Fossil fuel is one source of energy but besides its harmful use indicated earlier, it would not last indefinitely. Atomic energy will last much longer, but the raw materials required, like uranium and thorium are limited and its use also is fraught with danger. The energy which the country can bank on for a long time is the solar energy the supply of which is continuous and ample The sun pours energy onto the earth 100,000 times more than world's present electric power capacity. The amount of solar energy' absorbed by the Rajasthan desert during a year may be equivalent roughly to the heat generated by all the coal, oil and gas burnt in a year in the whole world. India is a tropical country and the sunshine is abundant. But the collection, storage and use of solar energy are at present much more expensive than using fossil fuel. On the other hand, because of the limitations of resources and working cost, fossil fuel also is becoming more expensive. Research on solar energy must, therefore, receive high priority. Methods must be devised for its storage and cheap distribution. So far sufficient financial help has not been forthcoming for research on harnessing solar energy. But it would be a worthwhile undertaking. Development of appropriate technology to concentrate this energy at a cheap rate requires the use of mathematics at every stage including the tool-making stage.

Connected with solar energy research is the problem of improving the design of outer surfaces of homes and offices so that the heating and cooling load is properly controlled. Materials which withstand long weathering and exposure to the sun have also to be developed.

Another area which is multidisciplinary and in which Mathematics can be fruitfully employed is gerontology (science of ageing). It is a problem of universal importance. One can perceive a decline in the vigour of every organ of the body after the age of forty or so. Efficiency or output of work begins to decrease ; the rate of decrease becomes faster with increasing age. What initiates this phase of decline is still a mystery.

Advances in Medical science have increased the average length of the human life. Consequently the number of people living beyond the age of 60 has increased considerably. In India approximately 3 percent of the population would come in this category and the number is increasing. Taking the country as a whole there are about 15 million people in this age group.

This comprises a large number who have retired from active life and have no means of livelihood. They are entirely dependent on the younger generation. This load is appalling. In advanced countries the proportion of old people is even higher and national plans have been formulated to solve the problem.

Much effort has been made to control dreadful diseases like polio, leprosy, tuberculosis etc. The disease of ageing is the most dreadful of all. It incapacitates man slowly but surely till death, for any kind of useful work. We are helpless spectators of the process that goes on in the body. It is rather surprising that though the problem is one of the

most challanging ones and a lot of work can be done on it and though everybody is interested in having the least ageing effect while growing old, very little work is being done in this direction. Its solution maybe one of the greatest of all discoveries. A mathematical analysis of the various parameters responsible for the decay will be helpful in constructing necessary models to deal with the problem in a systematic way.

We are living in the age of computers. They have assumed tremendous importance in practically all branches of science and humanities, industries, government offices and private and public undertakings. But we do not have as many computers as we require for the national development. I would, therefore, urge the government and the industries to turn their attention to the manufacture of indigenous computers on a large scale so that the country's needs are met. The use of computers, however, has to be made with a certain measure of caution so that the problem of unemployment in this over-populated land does not get accentuated. For developing software and machine languages for computers highly sophisticated mathematical theories of operations research, Boolean algebra, mathematical logic, automata theory, recurrence function theory etc. are required. But there are very few universities and institutes in the country where computer science is a subject of independent study though there is a great potential for its development. All these matters need urgent attention.

I will now indicate the areas of Mathematical applications required in some of the fields mentioned above. For mathematical models in biology and medicine we require mathematical genetics, ecology, programming and neurophysiology, heamodynamics and reliability and information theory, biomechanics, bioengineering, bio-electronics and cybernatics. Computer science requires the use of mathematical logic, automata theory, recurrence function theory etc. Econometrics, operations research, mathematical programming, control theory and information and reliability theory are some of the tools in industry. In space research, space mechanics, space physics and space dynamics are the main contributors. These are some of the typical applications of Mathematics. There are numerous others which are not being mentioned for want of space and time.

Finally, I would like to address a few words to and for Mathematics teachers. Mobility amongst them is very much lacking in the country. The reasons for this are social restrictions, domestic responsibilities, ways of life, climatic and weather conditions at different places and the restrictions imposed by institutions and governments. The advantages of mobility are manifold. lt promotes national integration and does a lot of good to the individuals as well as to the subject proper and the allied subjects.

Generally the more resourceful teachers in Mathematics and other Sciences move from one place to another. Because of their resourcefulness, they are able to collect costly equipments at the place of their work. But when they change places the equipment remains unused. If statistics were collected one would simply be appalled to learn how much of costly equipment has been lying idle in a number of institutions due to the reasons given above and due also to other causes like the nonavailability of spare parts, scarcity of trained hands to handle and repair the machines etc. Working out the details in a leading university I noticed that with the interest on the dead money in the form of instruments lying unused, the university can have as many more technicians as they have lecturers. It is, therefore, my fervent desire that mobility amongst teachers be encouraged by all concerned. At the same time wastage must be avoided at all costs and ways and means must be found so that no equipment lies unused. Duplications also should be avoided. The country is poor but even the advanced countries cannot afford wastage-and duplication.

In India our aim is to achieve complete self-reliance in the vital sectors. As far back as 1958 the Government of India formulated the National Science Policy through the Scientific Policy

Resolution to generate a scientific ethos in the country. This applies to Mathematical Sciences as well. Recently we have reiterated our resolve to achieve this objective and our government has taken commendable steps in this direction. It appears, however, that we have developed a psychology of dependence on foreign technical know-how and several of our industries have yet to come forward and undertake the responsibility of developing indigenous talents.

I have dwelt on some of the applications of Mathematics. There are many other applications which are important not only for other disciplines but for Mathematics also, which is a self-generating Science.

Most of what I have said above applies not only to Mathematics but to other Sciences as well. I have done so because of my obvious transparent and strong bias towards Mathematics.

I have drawn attention to some of the outstanding situations that a mathematician has to face. There are numerous other problems which he has to encounter. He is like a cork bobbling on the surface of the ocean. No matter how rough the ocean is, the cork stays afloat. Nothing can happen to it. But a mathematician has an explicit advantage that he is not a bureaucrat and as such he is sure to be consulted and listened to by the governments, the public and the society.

The study of Mathematical Sciences which includes Pure Mathematics, Applied Mathematics and applications of Mathematics must be provided adequate incentives. Though there are specialised Councils in India catering to the needs of various disciplines like Atomic Energy Department; Botanical, Geological and Zoological Surveys, Council for Scientific and Industrial Research, Defence Science Organisation, Department of Space Research, Electronic Commission, Indian Council of Agricultural Research, Indian Medical Research Council, Research and Development Organisation of Railways etc. no council exists for Mathematical Sciences. Mathematics research in India has been made the responsibility of the Atomic Energy Commission. The University Grants Commission created some advanced centres, but they are either in Pure mathematics or in Applied Mathematics only. I would suggest, therefore, the formation of a Council for Mathematical Sciences with wide advisory powers. The University Grants Commission also should establish an advanced centre with provision for research in all the three aspects of Mathematics viz. Pure Mathematics, Applied Mathematics and applications of Mathematics. Mathematical Science should be treated as an integrated whole and should be nursed at all levels.

I cannot close my address without a little introspection. In the recent past India has produced outstanding experimental scientists in disciplines like Physics where costly equipments are involved. Though in Mathematics we generally require only paper, pen, books and journals and not very costly equipments, the country has not produced as many first rate Mathematicians as it should have done. The traditions of Mathematics in the country have been rich but I do not understand why there has not been continuity in the thread.

I have referred above to some of the problems which a mathematician has been facing and trying to solve. He has his absolute reliance in the respect for truth and independence of learning. Whatever he has achieved so far is a challenge for the future. However, his plight is like that of a physicist who is born blind. The physicist has mastered the theory of colours so that he is able to work successfully on the formulae which he has obtained. Somebody intending to acquaint him with the true meaning of colours tells him that fire is red, snow is white and grass is green. Since he has never seen colours, he associates heat with red colour, coldness with white colour and softness with green colour without ever getting into the meaning of colours. Similar is the predicament of the mathematicians who try to understand nature. They evolve formulae, get results, interrogate, interpret, observe, predict, verify and yet remain wonderstruck. God does not reveal his creation so easily.

HYDRO POWER DEVELOPMENT IN INDIA : PROSPECTS AND LEGISLATION

Virender Salman[1] and Achintya[2]

Growing economy, expanding energy intensive industries, rising urbanization, increasing population and on top of all, a quest for modernization and improved quality of life have increased the demand of electricity in India. Government of India plans to provide 'Electricity for All' by 2012 for which 1.0 X 10^5 MW of additional power is required to be generated. Accelerated development of hydro potential in India has become a critical compulsion for sustaining the regional grids. The Government of India has liberalized its policy on hydropower development and approved a simplified 'Three Stages Clearance' procedure for hydro projects. This paper discusses the future prospects of hydropower development and legislation along with the necessary investment set up for hydropower development in India.

INTRODUCTION

Hydroelectric development in India began on November 10, 1897[1]. A century ago, on this day, the first 200 kW capacity hydel power station of 200 kW was commissioned at Sidrapong near Darjeeling town[2] (Fig. 1), is located at the

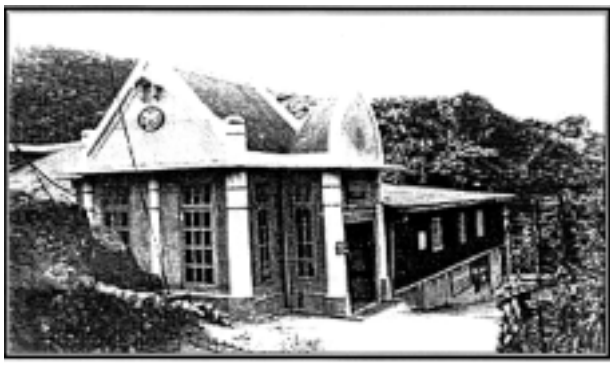

Fig. 1 : Sidrapong Hydel Power Station

foot-hills of Arya Tea Estate at an altitude of about 1000 m and 12 km from Darjeeling town. Perhaps it was the first hydel power project in Asia too. The Government of India declared Sidrapong Hydel Power Station as a 'HERITAGE POWER STATION' of India on the eve of its centenary.

The first major Hydroelectric Project (4.5 MW) in India was as Cauvery River at Sivasamudram (Fig. 2), commissioned by the Maharaja of Mysore

Fig. 2 : Cauvery Power Scheme, Exterior of Transformer House, Sivasamudram, Circa 1900

in 1899, commenced supply to Kolar Gold Mines in 1902[3]. The original agreement of 1900 between Mysore State and the Madras Presidency had stipulated that "all water diverted from the river for

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the power works shall be returned to the river below the Falls without being fouled or diminished in quantity." Plans in 1910 were made to build a reservoir across the Cauvery River just above Mysore City. This was to be one of the world's first multipurpose reservoirs, for developing more power at Sivasamudram and for irrigation. This brought the Sivasamudram power development into the context of a long standing dispute over the Cauvery River's water. The capacity of hydro-electric power at Sivasamudram was increased to 42 MW in stages by 1927.

Inspired by Niagara Falls Hydroelectric Scheme[4] and followed by the enthusiastic effort by George Westinghouse[5], Jamshedji Tata dreamt of power project by utilizing the water resources available in the Western Ghats for supplying power for lighting and industrial needs of Bombay. To this effect, he collaborated with Mr. Muller to form the Bombay Hydroelectric Syndicate in 1899 and appointed Alfred Dickinson & Co. as advisor to prepare a full length project report based on Mr. David Gostlings findings about hydroelectric potential in Developed Countries for a Period of 5 years for helping the done countries to chalk out appropriate development plans for implementation. "Micro-hydel" was the expertise of Mr. Mankhouse who was put in the office of the Chairman of the then Central Water Power Commission (CWPC) New Delhi[6].

The installed capacity of power generation from 1947 to 2010 in chronological order is shown in (Fig. 3). The present installed generating capacity in the country is 159398.49 MW (March 2010)[7]. The share of hydro is 23.1% with 36863.4 MW as

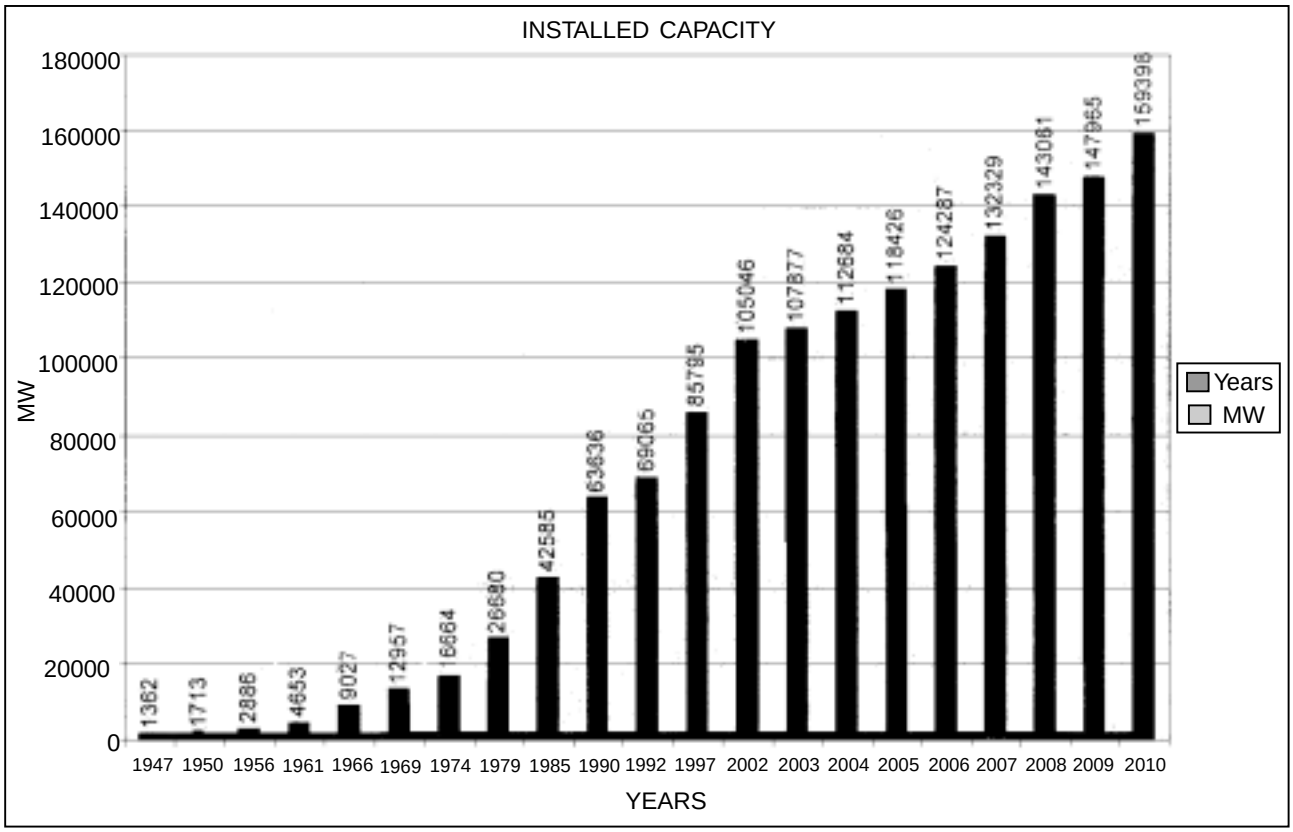

Fig.3

shown in Fig. 4 and Fig. 5 respectively. The thermal power accounts for maximum share of 64.3% with 102454 MW of which 84198 MW (52.8%) is from coal, 17056 MW (10.7%) from gas and 1200 MW (0.80%) from diesel. The share of nuclear power is about 2.9% (4,560 MW) while renewable energy sources account for 9.7% i.e. 15521 MW. The attainment in significant. However, what India achieved in over 50 years will now need to be attained in only 10 years.

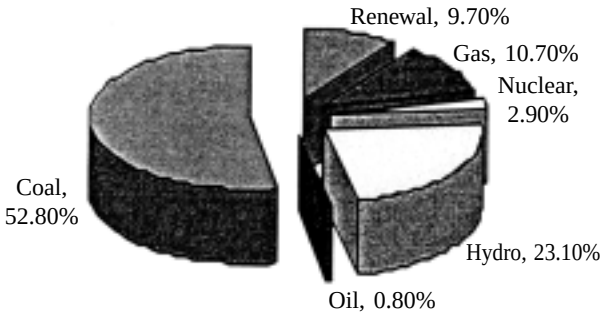

Fig. 4 : Hydro Share in Installed Capacity March 2010

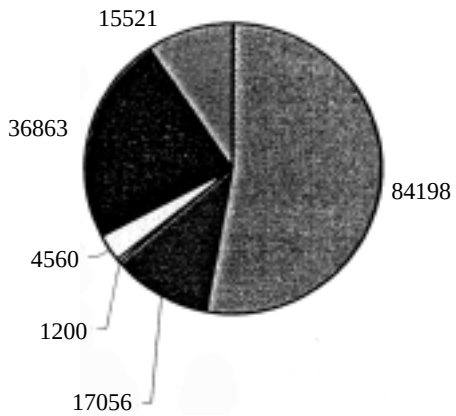

Fig. 5 : All India Generating installed capacity (MW) (As on 31.03.10)

After the Second World War, India witnessed an enormous impact of electrical technology. Most importantly, people realized that the electric power was now a necessity, not a luxury, as the power was the lifeline for prosperity and development. The rapid industrialization after independence increased the demand of power but it could not cope up with the desired rate of production.

TRANSMISSION AND DISTRIBUTION LOSSES

The problem of meeting the power demand is aggrevated by the theft of electricity and non-payment of bills by consumers. Till date, Transmission and Distribution (T & D) losses in India continue to be among the highest in the world and are a major concern in the development of the power sector. The reported all India average T & D losses increased from 19.8% in 1992-93 to 33.98% at the beginning of the Tenth Plan[8], (2006–2010). There is a wide variation in the losses reported by different states. T & D losses for the country as a whole are estimated to be in the range of 35% to 45%.

As the data of T & D losses did not capture the gap between the billing and the collection, the concept of Aggregate Technical and Commercial (AT & C) losses was introduced in 2001-02 to capture the total performance of the utility. The AT & C losses are presently in the range of 16% to 50% in various States. The average AT & C losses in country in about 33%. There is wide variation of losses among the States and variation among the distribution companies within the States. The major portion of losses is due to theft and pilferage, which is estimated at about Rs. 20,000 crore annually as per the Economic Survey of 2006-07. More than 75%-80% of the total technical loss and almost the entire commercial loss occur at the distribution stage.

The encourage distribution reforms, the Accelerated Power Development and Reforms Programme (APDRP) was launched in March 2003 consisting of an investment financing component and an incentive component for improved performance. Under the investment component, projects worth Rs. 17033.58 crore had been sanctioned. All of these projects were designed to reduce the AT & C losses through strengthening of the sub-transmission and distribution system. While the total investment needs for projects in special

category States were to be met by the GoI, the non-special category States were required to fund 75% of the approved project outlay through counterpart funding arranged by the State Governments[9]. APDRP was promoted with the promise of bringing down AT & C losses to 15% over five years. Actual performance has not come anywhere close to the targeted level. The reasons for this have been listed subsequently (Table 1) summarizes the performance of State Electricity Boards (SEBs). The scope for further tariff increase is limited since tariffs for paying customers are already among the highest in the world and it may make sense for them to opt out for captive generation.

typical load pattern. The fuel mix of power of 40 : 60 was maintained till 1980 and since then the share of Hydro Power is coming down and presently the ratio is 25 : 75 which must be corrected immediately to meet peak load requirements as well as system and frequency stability. The capacity addition target for the Tenth Plan was 41,109.84 MW. Against this, a capacity addition of 21080.24 MW was actually achieved during the Plan period. While 14,393 MW hydro capacities was planned to be added in 10th Plan[10], 7886 MW could be added and during the XI Plan, 15627 MW of Hydro Power with total capacity addition of 78,700 MW action has been taken and in the first two years of the Plan,

Table 1 : Viability of State Utilities not Improving (Rs in Crore)

	2001-02 (Actual)	2002-03 (Actual)	2003-04 (Actual)	2004-05 (Actual)	2005-06 (Provisional)
Energy Sold/energy available (%)	66.02	67.46	67.47	68.75	69.58
Revenue from sale of electricity (Rs in crore)	68135	76640	85942	91738	100000
Cost of electricity sold (Rs in crore)	98541	102247	110553	118975	128853
Loss on sale of electricity (Rs in crore)	30407	25607	24611	27237	28853
Average cost of supply (paise' kWh)	374.57	351.72 (-6.10%)	353,80 (-5.54%)	357.35 (-4.60%)	366.96 (-2.03%)
Average tariff (paise kWh)	258.99	263.63 (1.79%)	275.04 (6.20%)	275.55 (6.39%)	284.79 (9.96%)
Gap between the cost of supply and tariff (paise)	115.58	88.09	78.76	81.80	82.17

The annual energy requirement in 2008-09 was 7,74,324 MU of which only 6,89,021 MU was available, leaving a shortfall of 11% while the peak requirement was 1,09,809 MW and a peak of 96,685 MW only could be met, leaving a shortage of 12%. The Indian power system requirement has been assessed to the extent of a hydropower and thermal/ nuclear powers mix in the ratio of 40 : 60 for flexibility in system operation depending on the

3392 MW of hydro power has been added and so far 12,717 MW overall have been added on XI Plan (March 2009). Generating Capacity Anticipated at the End of the Eleventh Plan is shown in Table 2.

FUTURE DEVELOPMENT OF HYDRO-POWER

To encourage greater participation of Indian and foreign entrepreneurs in hydroelectric power

generation, a number of measures has been taken by the Government for increasing the hydro capacity. Government of India has made an ambitious plan of providing 'electricity for all' by 2012. For achieving the target 100,000 MW of power is required to be generated and this will involve a minimum investment of Rs. 80,000,000 million. New lines, inter-connection of regional grids and other basic infrastructures are also required for transferring power from one area to other area keeping in view that no state is allowed to overdraw more than the specified power in the grid, as this defeats the entire purpose of the power supply system from the grid.

Table–2

Generating Capacity Anticipated at the End of the Eleventh Plan					
	Hydro	Thermal	Nuclear	Wind and Renewable	Total
Installed capacity as on 31 March 2007	34653.77	86014.84	3900.00	7760.00	132329.21
Addition during Eleventh Plan	16553.00	58644.00	3380.00	14000.00	92577.00
Total capacity anticipated as on 31 March 2012	51206.77	144658.84	7280.00	21760.00	224906.21

Of the 1 X 10^5 MW to be produced 48,500 MW is from Public Sector Units (PSUs), 41,800 MW from State and Private Sector, 6,400 MW from nuclear and 10,000 MW from renewable sources, So, the first big step aimed at promoting hydel power generation in the country, 50,000 MW hydroelectirc initiative has been launched. The pre-feasibility reports for 162 hydroelectric power scheme with an installed capacity of 50,560 MW in 16 states have been taken up Central Electricity Authority (CEA)[11].

POWER SECTOR REFORMS

Power sector reforms have been underway for over a decade. Enforcement of 'Electricity Act 2003' during the Tenth Plan was an important step towards reforms in the power sector. The objectives of the Act are to consolidate the laws relating to generation, transmission, distribution, trading and use of electricity and taking measures conducive to the development of electrical industry, protecting interests of consumers and supply of electricity to all areas, rationalization of electricity tariffs, ensuring transparent policies regarding subsides, promotion of efficient and environmentally benign policies, constitution of Regulatory Commission and establishment of Appellate Tribunal for matters connected therewith or incidental thereof.

HISTORICAL BACKGROUND OF LEGISLATIVE INITIATIVES

The Indian Electricity Act, 1910 was concerned with the following

- Provision of basic framework for electric supply industry in India.
- Growth of the sector through license, License by State Govt.
- Provision for licence for supply of electricity in a specified area.
- Legal framework for laying down of wires and other works.
- Provisions laying down relationship between licensee and consumer.

Subsequently the Electricity (supply) Act of 1948

Mandated creation of State Electricity Boards (SEBs) and directed the State to step in (through SEBs) to extend electrification (so far limited to cities) across the country.

Then there were the following amendments.

- Amendment in 1975 to enable generation in Central sector.
- Amendment to bring commercial viability in the functioning of SEBs — Section 59 amended to make the earning of a minimum return of 3% on fixed assets a statutory requirement (w.e.f. 1.4.1985)
- Amendment in 1991 to open generation to private sector and establishment of Regional Load Dispatch Centres (RLDCs).
- Amendment in 1998 to provide for private sector participation in transmission and also provision relating to Transmission Utilities.

The Electricity Regulatory Commission Act, 1998 provided for setting up at Central/State Electricity Regulatory Commission (CERC/SERC) with powers to determine tariffs and constitution at SERC optional for states. It distanced the Government from tariff determination

The Electricity Act of 2003 has repealed above three Acts namely (i) The Indian Electricity Act, 1910 (ii) The Electricity (Supply) Act, 1948 and (iii) The Electricity Regulatory Commission Act, 1998. The provisions of State Reforms Acts have been saved under section 185 (3) of the Electricity Act subject to the condition that the provisions of the State enactments not in consistent with Electricity Act, shall apply to the State in which such enactments are applicable.

The salient features of the Electricity Act are as follows :

(i) Competitive tariff-based bidding from Independent Power Producers (IPP)

(ii) No license is required for Generation and captive generation has been freely permitted, hydro projects exceeding the capital cost notified by Central Government however, need concurrence of the Central Electricity Authority.

(iii) No license required for generation and distribution of power in notified rural areas.

(iv) Transmission Utility at the Central as well as State level, to be a Government Company with responsibility for planned and coordinated development of transmission network. Provision for private licensees in transmission.

(v) Trading, a distinct activity recognized with the safeguard of the Regulatory Commissions being authorized to fix ceilings on trading margins, if necessary.

(vi) Open access in distribution with provision for surcharge for taking care of current level of cross subsidy with the surcharge being gradually phased out.

(vii) Distribution licensees would be free to undertake generation and trading.

(viii) The State Governments are required to re-organize the SEBs. However, they may continue the SEB as State Transmission Utilities and licensees for such time the State and Central Government agree.

(ix) Setting up of the State Electricity Regulatory Commission made mandatory,

(x) An Appellate Tribunal to hear appeals against the decision of the CERC and SERCs.

(xi) Metering of all electricity supplied made mandatory,

(xii) Provisions relating to theft of electricity made more stringent.

(xiii) For rural and remote areas stand alone systems for generation and distribution permitted,

(xiv) Thrust to complete rural electrification and provide for management of rural distribution by panchayats, cooperative societies, non-government organizations, franchises, etc.

POLICY ON HYDRO-POWER DEVELOPMENT—POLICY LIBERALIZATION

To accelerate capacity addition in the Power Sector, a liberalized policy to encourage greater participation of private entrepreneurs in India and abroad in electric power generation has been announced. The Government has issued notifications for hydro projects incorporating several incentives to private developers which broadly cover incentives for better availability of machines, for generation of extra energy above design energy, compensation for hydrological risks, etc. The first step was announcing of hydro policy and followed with the Electricity Act 2003. To accelerate the development of Hydro Generation, revised hydro policy 2008 was introduced.

A Hydro Policy was announced earlier in August 1998 for the development of Hydropower incorporating several enabling steps and measures. The Hydro Policy among other things lays emphasis on basin-wise development, evolving consensus on inter-state issues, mitigation of geological risks, and simplified procedure for transfer of clearances, promoting joint venture arrangements etc. The main features of the policy are the following :

- Additional budgetary support for ongoing and new hydro projects under Central PSUs.
- Creation of Power Development Fund by levying a tax on electricity generated in the country.
- Basin-wise development of hydro potential.
- Advance action for Capacity Addition in the 10^{th} Plan and beyond.
- Emphasis on survey and investigations.
- Resolution of small Inter-State issues.
- Renovation, modernization and upgrading of existing hydro stations.
- Promotion of small and mini hydel projects.
- Simplified procedures for transfer of clearances by CEA.
- Rationalization of hydro Tariff by allowing premium on sale rate during peak period.
- Realistic estimates of completion cost considering geological surprises.
- Promotion of hydel projects with joint ventures.
- Selection of developer through MoU/bidding route.
- Government support for land acquisition, resettlement and rehabilitation, Catchment Area Treatment (CAT) etc.

Even after adopting this policy, some of the measures announced by Government of India have already been also introduced. These included simplified procedures for transfer of techno-economic clearances, streamlining of clearance process. The 'Three-Stage Clearance' approach for development of hydro Projects in Central Sector / Joint Ventures was also made. The Central Electricity Regulatory Commission (CERC) has also approved 5% hydro development surcharge on annual fixed charges for central hydropower generation.

HYDRO POWER POLICY – 2008

As the addition in Hydro Power was only 7886 MW against the target of 14393 MW and the participation from Private Sector meagre 700 MW only. So, for encouraging the Hydro sector, revised Hydro Policy in 2008 has been formulated and main features of the Policy are:

Since the vital issues of location of the Project, Geology and Resettlement and Rehabilitation were not covered earlier, the same have been taken care of in order to balance the competing interests of the various stakeholders.

- Existing dispensation available to Public Sector under National Tariff Policy 2006, regarding exemption from tariff based bidding

up to Jan. 2011 is also extended to Private Sector Hydroelectric Projects, which obtain CEA's concurrence, sign PPAs with distribution licensees and achieve financial closurebefore Jan. 2011.

- Selection criteria in transparent procedure with stress on financial strength, experience, past track record of the developer.
- Developer to follow International Competitive Bidding (ICB) for award of civil and E&M works and to follow the procedure as applicable to Central/State utilities.
- Tariff to be decided by appropriate Regulatory Commission and any free power provided beyond the mandatory 13% (12% free power to State Govt. and 1% Fund for Local Area Development) to be met by the developers from their own resources and not to pass it to tariff.
- Merchant sales up to a maximum of 40% of the saleable energy to enable the developer to recover the costs and delay of every six months in the commissioning date to result in reduction of merchant sales by 5%.
- 100 units of electricity per month for a period of 10 years to be provided by developer to Project Affected Family.
- Resettlement and Rehabilitation Package made more liberal and 10% of the share of Rajiv Gandhi Gramin Vidutikaran Yojana (RGGVY) and the distance of Yojana implementation decided as per the capacity of the Project from 2 km to 10 kms.

THREE STAGE CLEARANCE PROCEDURE

The Government has also approved a 'Three-Stage Clearance' procedure for hydro projects to be executed by the Central Power Sector Units (CPSUs) in consultation with the Ministries of Finance, Environment and Forests. Under Stage-I, the CPSUs will incur expenditure on survey, investigation and preparation of a pre-feasibility report. Under Stage-II, the CPSUs will undertake activities relating to detailed investigation and preparation of Detailed Project Report (DPR). During this Stage, pre-construction activities and infrastructure development including land acquisition will also be undertaken. Under Stage-Ill, investment will be sanctioned through the Public Investment Board (PIB) / Cabinet Committee for Economic Affairs (CCEA).

The investment policy has been made more attractive from time to time and provides for (i) Debt: Equity ratio upto 4 : 1 (ii) 100% foreign equity participation (iii) liberalized rates of depreciation in respect of assets (iv) import of equipment for power projects at concessional custom duty (v) 16% rate of return on equity (vi) generating companies can sell power on the basis of a suitably structured two part tariff- one part to cover fixed costs and the other to cover variable costs at a prescribed level of performance.

Since hydroelectric projects have lower internal rate of return compared to the thermal and gas based projects, the Government has notified new norms for incentives where the availability factor threshold has been reduced from 90% to 85%. Similarly, the sale rate of secondary energy has been notified of the same rate as primary energy. The procedures relating to transfer of clearances from State Government to the different Central Public Sector Undertakings and- the State Government to Private Sector have been simplified. Under the revised guidelines, clearance is automatically transferred to the new agency if the scope of work has not changed whereas CEA only examines the revised cost and financial package of the new proposal before transferring the clearance. Ceiling limits of capital costs upto which techno-economic clearance of CEA is not required has been enhanced for hydro projects. According to the present notification issued under Section 29 of the

Electricity (Supply) Act, 1948, hydro projects are covered by the following limits :

- Rs. 2500 million for projects awarded through the MoU route.
- Rs. 10000 million for projects awarded through competitive bidding.
- Rs. 25,000 million for projects whose tariff is determined by the CERC / SERCs.

All hydroelectric projects utilizing water of inter-state rivers shall be submitted to CEA for its concurrence (irrespective of capital cost).

CATEGORIZATION OF HYDROELECTRIC POTENTIAL

To give the necessary fillip for the development of the balanced hydroelectric schemes, Central Electricity Authority, Government of India, undertook ranking studies to determine inter-se priority for their development. The objective was to facilitate identification of the projects for implementation in order of their priority so that hydropower development could be taken up in appropriate sequence. Studies were carried out in consultation with the agencies related to environment, forests, water, geology and survey, etc. The ranking study was completed in 2001-2002. Based on this ranking study, the Preliminary Feasibility Reports (PFRs) of selected schemes are being prepared incorporating the general description of the schemes, essential drawings, engineering aspects, approximate estimated cost and economic evaluation.

On the basis of the study conducted, the development of any river basin will be taken up as a whole so as to maximize the benefits and execution of priorities of the projects. This would enable an optimal harnessing of hydro potential in each river basin. The Government of India has taken prior action for capacity addition in the coming years.

INVESTMENT SET UP FOR HYDROPOWER DEVELOPMENT

In view of the various geological risks and engineering difficulties that are encountered in the development of hydroelectric power projects, private sector development has been slow in spite of good enthusiasm and incentives. Consequently, hydropower development has been taken up primarily by the public sectors in the 10^{th} and 11^{th} Five-Year Plans of Government of India.

The 50,000 MW hydroelectric initiative to be implemented in 11^{th} and 12^{th} Plans require funds to the tune of Rs. 22,50,000 million with an equity of 700,000 million and debt of 15,50,000 million[11]. It has been proposed that the equity of 700,000 million can be met by way of gross budgetary support of Rs. 200,000 million each in 11^{th} and 12^{th} Plan and the remaining equity by proposing levying a tax of 3 paisa per unit on generation for a period of 10 years.

FUNDING OF HYDROELECTRIC PROJECTS

All the ongoing Central Sector hydroelectric projects are provided with full budgetary support till completion. Government of India will a|so provide budgetary support for new projects to be taken up by the CPSUs during the coming five-year plans of the government. Considering the large capacity addition envisaged in the state sector, it is necessary to

(a) provide a mechanism for funding hydro projects by earmarking funds in the plan allocation of the State Governments by the Planning Commission of Government of India, and

(b) organize supplementary funding of hydel projects where more than 50 percent of the expenditure has already been incurred.

Besides providing fund, the monitoring of all the projects has been intensified and a task force is constituted to ensure timely completion of the hydel

projects. Awareness of the public is a must to improve the system by making people understand that timely payment by the consumer will give the impetus to the system, as non-availability of finance is the biggest obstacle in its development. The system can be made more economical, dependable and cost effective by taking steps in the following steps :

- Reducing transmission losses.
- Reducing power theft.
- Decreasing the Rate of Return (ROR) on equities from 16% to 8% to 10%.
- Decreasing the share of 12% free power to the State where the Hydro Power station is coming so as to make the Project more feasible.
- Taking of loans from World Bank and other financial agencies at LIBOR value (London Interbank Offered Rate) as the interest rates vary from 1.30% to 2.7%.
- The rate of interest still can come to lower side, if the guarantee to these loans by Government of India with the exemption of license fee.

WHAT WENT WRONG WITH APDRP

Earlier there has been a reference to APDRP and it was mentioned that several things went wrong with APDRP, Some of them are the following :

- It was an investment driven programme without any outcome accountability.
- The project reports were ill-prepared. The replicated the same type of investments without a full buy-in by the host utility.
- There was no baseline data established on the distribution losses or on billing/collection efficiency. This makes it difficult to determine what has been achieved.
- Unrealistic targets were set and the scheme did not provide incentive for SEB staff to co-operate.

So APDRP needs to be restructured in order to obtain better results.

STEPS TO BE TAKEN UP FOR ACCELERATION OF HYDRO DEVELOPMENT

Further, the following steps need to be taken in order to accelerate the pace to hydro development :

- Preparation of a DPR based on economic viability is to be expedited.
- Clearances for pursuing priority projects are to be streamlined.
- Approval procedures need to be simplified.
- Early financial closure of projects is to be ensured.
- Priority is to be given to projects for which concurrence has already been issued by the CEA.
- High priority should to be accorded to smaller capacity Run of the River-type hydro projects having gestation period less than five years.
- Basin-wise optimization studies for all the major river basins should be carried out.
- Competitive bidding other than tariff-based competitive bidding could also be considered, for hydro projects since there are formidable risks in hydro power construction due to geological uncertainties and other factors.

CONCLUSIONS

A country's level of development and quality of life largely depends on the quantum of power generation and utilization. Power development has more pervasive effect on the quality of life as it is destined to play a pivotal role in the development of human society well into the future. At the flick of a switch, electricity provides all comfort, convenience and better quality of life.

The future development and policy on hydropower development in India along with investment setup is discussed in the paper. The policy liberalization of Government of India on hydropower development in the country will certainly accelerate the development of hydropower projects in the country. Besides it will increase the share of hydropower as compared to the thermal power in the country.

Simplified 'Three-Stage Clearance' procedure and funding of hydropower projects will also ensure a remarkable increase in hydro share of the country. This will in turn have a positive impact on environment with reduced emissions and cleaner environment that will improve the human health in the coming years. The development of electricity is going to take place enormously and continue for the days to come when electricity will be for everyone - so contribution of one and everyone is needed for its development.

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HIGH THROUGHPUT DNA SEQUENCING AND ITS IMPLICATION IN PLANT SCIENCE RESEARCH

Tapan Kumar Mondal* and Mukesh Kumar Rana

High-throughput DNA sequencing technologies are the most recent technologies used in biology to sequence the selective or entire genome of an organism. They generate millions of short nucleotide sequences which have various applications in biology, particularly in genomics, epigenomics and transcriptomics that are described here.

INTRODUCTION

The living organisms consist of cells which contain the genetic material that is popularly known as chromosome. Further, the chromosomes are made up of the DNA and protein. This DNA is a linear arrangement of genes made up of four basic units. i.e. adenine (A), thymine (T), guanine (G), cytosine (C), in different combinations. Sequencing of part or full genome always remains; a central focus of biotechnological research, therefore development of faster, cost-effective sequencing technology remains a/challenge to the scientists. Significant achievements have been made in sequencing from a simple short-length manual sequencing during 1977 to millions of bases per-day presently. The advancement of sequencing technology within 3 decades can be segmented in 3 different phases which are known as first generation, second or next generation and third generation.

First generation sequencing : The sequencing of DNA was started with the landmark discovery of Sanger's and Gilbert's groups during late 1970s which are known as Sanger dideoxy sequencing[1] and chemical cleavage method[2], respectively. Thereafter, Sanger's method remained major technique in sequence-driven research for several decades so much so that it was used to complete the human genome sequence which was led by the International Human Genome Sequencing Consortium and Celera Genomics[3-5]. However, in 1970s, and 1980s, scientists used to do sequencing manually by themselves through polyacryl amide gel electrophoresis, although in later stage it used to be done by automated sequencing machine with the same principle.

Next generation or second generation sequencing : Due to certain limitations such as low throughput, higher cost of sequencing per base. Sanger method has been partially supplanted by several "next-generation sequencing" or "second generation sequencing" technologies that offer dramatic increase in cost-effective high throughput sequencing, albeit at the expense of sequence lengths[6]. Several next-generation technologies are commercially available today as provided in Table 1. However, for a review of the history of DNA sequencing, the readers are referred to Hutchison (2007)[7].

Third generation sequencing : The technology of next-generation sequencing is evolving at a breath taking pace, with the latest version involving primarily the sequence of longer length at lower

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cost as compared to the second generation sequencing techniques. Thus, they are termed as 'third-generation sequencing'[8]. A major advantage of third-generation sequencing system is the use of real time single DNA molecule sequencing, rather than cluster of amplicons of step by step sequencing. This eliminates the risk of phasing errors which are encountered by second generation sequencing systems.

NEED OF SEQUENCING

Although the DNA of any organism in this universe is made up of four basic units or their derivatives, one may wonder as to how diverse organisms, starting from tiny bacteria to giant dinosaurs or small grasses to big banyan trees, are created by nature. This is because each of them has different genes in their DNA or in more simple sense, it is the difference in sequence of their genome. Thus, understanding or knowing the sequence of the entire genome is pre-requisite for modern day genomics study which can be achieved by whole genome sequencing, known as *de novo* sequencing: a terminology which is often used to indicate the sequencing of the entire genome for the first time. Once the genome sequence is known, then the information can be utilized in several ways but primarily for two purposes : (1) to detect the dissimilarity between the two organisms or group of organisms; (2) to identify new or different genes which make mosquito small or elephant so big or a mangrove tree can survive in high salty water of sea when others can not. Thus, sequence level variation can answer many of the questions which scientist can utilize either to identify improved superior cultivar or to create a specific cultivar.

CHEMISTRY OF DIFFERENT SEQUENCING TECHNOLOGIES

Although different sequencing techniques use different chemistry yet there is commonality in the process of sequencing. First, DNAs of interest are broken into small pieces, sequenced and then these small sequences are aligned or joined one by one to form contig or bigger piece of DNA molecule. Finally, the contigs are joined together to get entire long sequence of the genome.

First generation or Sanger sequencing method is popularly known as "chain termination" reaction which is based on DNA polymerase-dependent synthesis of a complementary DNA strand in the presence of regular deoxynucleotides (dNTPs) and modified one (2′, 3′-dideoxynucleotides : ddNTPs) that serve as nonreversible synthesis terminators[1]. The DNA synthesis reaction is randomly terminated whenever a ddNTP is added to the growing oligonucleotide chains, resulting in truncated products of varying lengths with an appropriate ddNTP at their 3′ terminus. The products are separated then by their size in polyacrylamide gel electrophoresis and the terminal ddNTPs are used to reveal the DNA sequence of the template strand. Four different test tubes are required to sequence one piece of DNA for four different ddNTP terminator i.e. ddATP, ddCTP, ddTTP, or ddGTP. However, there is one major limitation of the technique i.e. sequencing of DNA strand requires an *in vivo* support which is normally done by cloning or inserting the DNA to be sequenced into bacterial plasmid but this cloning step is prone to host-related biases, is lengthy, and is quite labor intensive. Sanger sequencing is suitable for sequencing of individual gene.

The cloning in bacterial plasmid, prior to sequencing, was eliminated by various second-generation sequencing technology, although, they differ in chemistry of sequencing. As an example, instead of cloning, a highly efficient *in vitro* DNA amplification method, known as 'emulsion PCR' is done in Roche 454, the first next generation Sequencing technology to come to the market in 2005. The 454 approaches is known as pyrosequencing which is based on sequencing-by-

synthesis technique that measures the release of inorganic pyrophosphate (PPi) by chemiluminescence during sequencing reaction. The sequence of DNA template is determined from a "pyrogram," which corresponds to the order of correct nucleotides that had been incorporated. Since chemiluminescent signal intensity is proportional to the amount of pyrophosphate released and hence the number of bases incorporated, the pyrosequencing approach is prone to errors that result from incorrectly estimating the length of homopolymeric sequence stretches. The advantage of this technique is that it can do the sequencing for longer read length but has demerits of having higher cost per unit of sequence. Nevertheless, due to larger sequencing length, this is used for *de nova* sequencing[8-9].

In Illumina / Solexa, the DNA templates are sequenced in a massively parallel fashion using sequencing-by-synthesis approach which employs reversible terminators with removable fluorescent moieties and special DNA polymerases which can incorporate these terminators into growing oligonucleotide chains. The major merit is that it can generate more information volume but reads are smaller. Nevertheless, this technique is the most popular and also suitable for resequencing which has greater application for studying epigenetic modifications (change of chemical nature of DNA sequence) by chip-seq (identification of protein binding sequence of DNA), small non-coding RNA sequencing and degradome sequencing.

In SOLiD (Supported Oligonucleotide Ligation and Detection System), the chemistry of sequencing is based on massively parallel sequencing by ligation which is quite similar that of 454 but differs in the sense that after amplification, the sequencing is done in sequential rounds of hybridization and ligation with 16 dinucleotide combinations labeled by four different fluorescent dyes (each dye used to label four dinucleotides). The advantage of this technology is that it has higher sequencing accuracy with the generation of larger amount of sequencing data at minimum time. Due to generation of large number sequencing result, it gives better coverage, a term which is often used to describe the number of times a region of the genome has been sequenced and which is an valuable information for accuracy in genome sequencing.

'Ion torrent' is another second generation sequencing technology which is based on the fact that adding one nucleotide in the DNA chain always releases one H^+ in the medium that causes the change of pH which is then detected by ion sensor somewhat like a pH meter. This technique is also suitable for *de novo* sequencing of the genome with higher accuracy.

Recently in 2011, PacBio, a revolutionary third generation sequencer has come to the market based on SMRT (Single Molecule Real Time) technology which does single molecule DNA sequencing in real time. It has the potentiality of sequencing up to 20,000 bp long DNA within one hour. Therefore, this technique is highly recommended for *de novo* sequencing. Another third generation technology, known as 'Helicos', is gaining popularity with an advantage of direct RNA sequencing. Therefore the step of making cDNA library (collection of all converted RNA molecule to their complementary DNA) is eliminated which ultimately reduces the cost of sample preparation.

However, based upon the principle of nanotechnology, there are several, "future generation sequencing" or "fourth generation sequencing" technologies which will be available for commercial use in near future. These are based on single molecule real time sequencing but the sequencing length will be potentially unlimited which differs from the third generation sequencing.

Table 1 Different technologies used in sequencing

Technology	Approach	Length of sequences	Manufacturer
First generation sequencing			
Automated Sanger sequencer e.g. ABI3730 × 1	Synthesis in the presence of dye terminators	> 1000 bp	Applied Biosystems
Second generation sequencing			
454/Roche FLX system e.g. 454 XLR	Massively parallel pyrosequencing by synthesis	> 1000 bp	Roche Applied Science
Illumina/Solexa e.g.Hi Seq 2000	Sequencing by synthesis with reversible terminators	> 150 bp	Illumina, Inc.
ABI/SOLiD e.g. 5500 × 1	ABI/SOLiD Based base massively parallel sequencing by ligation	> 50 bp	Applied Biosystems
Ion torrent e.g. PGM_{318}	Change of pH	> 400 bp	Life technologies
Third generation sequencing			
PacBio e.g. PacBio RS	SMRT (Single Molecule Real Time)	> 10,000 bp	Pacific Bioscience
Helico	Sequencing by synthesis	> 55 bp	Helicos Bioscience Corporation
Future generation sequencing			
IBM Nanopore	Transistor mediated DNA sequencing	Potentially unlimited	IBM
Oxford Nanopore e.g. Grid ON system	Direct electrical detection of single molecule	Potentially unlimited	Oxford nano pore technology

APPLICATIONS

Although compiling the various applications of high throughput sequencing is the beyond the scope of this articie and readers may refer to the recent review for this purpose[10], yet an introductory, account is given below.

IDENTIFICATION OF DIFFERENTIALLY EXPRESSED TRANSCRIPTS

When the primary objective of a biological study is gene expression profiling between two samples, mRNA sequencing (RNAseq) is the most appropriate approach for number of reasons. This sort of analysis is particularly relevant for detecting the difference of mRNA population between the wild-type and mutant strains, between treated versus untreated cells, cancer versus normal, and so on.

Although this can be studied in a number of ways such as SSH (selective subtractive hybridization), cDNA-AFLP (amplified fragment length polymorphism), MPSS (massive parallel sequence signature), SAGE (serial analysis of gene expression) and microarray, yet each of them is embodied with merits and demerits. Nevertheless, newer techniques become always superior to older one. Thus, besides larger dynamic range and sensitivity of RNA-seq, several additional factors have contributed to the rapid acceptance of sequencing for differential expression analysis. For an example, microarrays are simply not available for many non-model organisms (for example. Affymetrix offers microarrays for approximately 30 organisms). Additionally, sequencing gives unprecedented detail about transcriptional features that arrays cannot, such as novel transcribed regions,

allele-specific expression, RNA editing and a comprehensive capability to capture alternative splicing.

DE NOVO SEQUENCING OF CROP SPECIES WITHOUT REFERENCE GENOME SEQUENCE

This is particularly important for sequencing of a crop for the first time. For years, people were doing in little different way which is known as 'shot gun' technique based on bacterial cloning. However, shot gun technique is slow, less efficient than this *de novo* sequencing or high throughput sequencing. It is noteworthy to mention here that recently pigeon pea and neem have been sequenced for the fist time by Indian scientists.

DISCOVERY OF SNP

One of the central themes in genomics is to study allelic differences or variations which can be detected by discovering biallelic markers such as single nucleotide polymorphism (SNP) or haplotype i.e. group of SNPs that are associated in particular trait. Short sequences can be compared to a reference genome sequence to detect the variants. These SNPs are of very good molecular marker for developing the genetic map which is useful information for plant breeder.

WIDE CROSSES AND ALIEN INTROGRESSION

Pre-breeding is an important component in plant improvement particularly for crops that have a narrow genetic base. Sequencing of wild races is anticipated to have a profound effect because additional molecular markers could be rapidly developed on a genome-wide scale that help to target more narrowly defined genome regions to trace introgression and selection cycles.

MAPPING OF DNA-BINDING PROTEINS AND CHROMATIN

ChlP-on-chip [ChIP (chromatin immune-precipitation) using microarrays] is a key approach to map *in vivo* binding sites of various DNA-binding proteins across the genome. Here DNA-protein complex is precipitated with the protein specific antibody after which DNA was isolated with protease K digestion for sequence. This approach is termed as 'ChIP-Seq', which should produce a huge windfall, in particular for studies of multi-cellular eukaryotes where whole genome coverage has generally required the use of several arrays.

EPIGENETIC MODIFICATIONS

Epigenetics is different from genetics which means changes of phenotype without any change in genetic material that is normally associated to methylation in cytosine bases of DNA or post-translational modification of amino acid present in histone tails. They play a key role in gene expression and in plant development under stress. Genome-wide analysis of epigenetic modifications of DNA is an active area of research.

SMALL NON-CODING RNA PROFILING AND THE DISCOVERY OF NOVEL SMALL RNAs

Small RNAs play important role in eukaryote gene expression. A related application of next-generation sequencing technologies to the analysis of transcriptomes is small noncoding RNA (ncRNA) discovery and profiling. These ncRNAs are RNA molecules that are not translated into a protein product. This class of RNAs includes transfer RNA (tRNA), ribosomal RNA (rRNA), small nuclear and small nucleolar RNA, and microRNA and small interfering RNA (miRNA and siRNA).

CONCLUSION

The technology of sequencing has dramatically changed from a manual mode to fully automated machine generated operation[11]. Greater speed, lower cost of sequencing, longer sequencing length with lower error rate are the main criteria for advancement of this technology which will yield the genome sequences of many organism in near future. This will help to discover new genes or

developing new varieties with greater yield or suitability to grow in the context of climate changes. Thus, this will be a significant step towards the development of hunger free world : a dream of 'green revolution father', Dr Norman E. Borlaug.

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FERTILITY ISSUE OF CANCER SURVIVOURS

Debojyoti Dutta* and Sanjib K Das#

In recent times, due to advances in Cancer therapy survival rate of cancer patients has greatly increased. However, the treatment is toxic to gonads leading to impairment of sperm production in males and ovarian atrophy, marked loss of ovarian reserve leading to premature cessation of menstrual cycle in females. To solve the problem novel approach will be preservation of ovarian and / or testicular tissue (Biopsy) in liquid Nitrogen (Temperature –196°C) prior to therapy would enable the individual to utilize his or her own eggs/ sperm to have baby.

INTRODUCTION

Cancer is one of the important threaten multifactorial disease, which had no answer in the past. But now a day due to collaborative approaches among different branches of science fruitful outcome is the radiotherapy, chemotherapy or combination regimen. These life saving techniques are available to increase the chance of survivalists in many patients and these treatments lengthen the total life span of a patient. Unfortunately, many of these treatments are damaging the reproductive organ in qualitative way and resulting in loss of fertility in patients and render him / her infertile. Infertility is one of the primary concerns for cancer survivors. The dimension of the problem is much more acquitted in case of childhood cancer survivors. In this article attempts are taken for the options for maintain fertility in the women and men undergoing treatment for cancer. It is also found that option available to any cancer survival will depend on the age of the patient at the time of treatment, cancer type severity and location of the cancer[1, 7].

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STATISTICAL EVIDENCE

Globally the burden of new pancer Cases in 2000 was estimated to be around 10 million with more than half of these cases originating from the developing world population. Although is estimated that by the year 2020 there will be almost 20 million new cases [4]. The magnitude of the problem of cancer in the Indian sub continent in terms of sheer numbers is the most alarming. From the population census data for India in 1991, 609000 new cancer cases were estimated to have been diagnosed in the country. The figure had increased to 800,000 by the turn of the country. The estimated age standardized rates per 100000 were 96.4 for males and 88.2 for females. The most common cancer found in males is lung while among female is the cervix followed by breast[2, 6].

IMPACT OF ONCOLOGICAL THERAPY ON FERTILITY

Cancer can occur in any part of the body. Several techniques, such as surgery, radiotherapy and chemotherapy arise by which a patient can survive from the life threatening disease, cancer. But the applications of these techniques can hamper the fertility potential of man or women or even children. As a result though they become cured from cancer but find them infertile after cancer treatment.

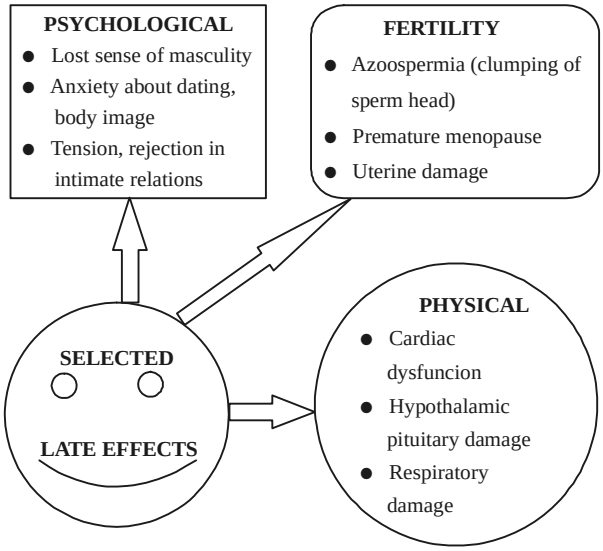

Fig. 1. Word diagram explaining Selected Late Effects of Cancer treatment

(a) Effect of radiation therapy on fertility :

The first established technique for cancer treatment is the radiation therapy. The principle of radiotherapy is based on the ionization of cellular atoms and molecules leading to the destruction of double and single DNA structures within the cell structure. A chain of events is setup, disrupting the cell cycle leading to apoptosis of the cells. Radiotherapy has its use in cancer treatment because unlike normal cells, most normal cells have the inert ability to recover from the effects of radiotherapy. Radiation therapy can damage the gonads temporarily as well as permanently. The extent of the damage in males and females due to radiation therapy depends on the dosages, fractionation schedule and treatment field.

Damage induced by radiation is progressive and irreversible in the ovary resulting in amenorrhea and infertility. Radio therapeutic effect on infertility is dose dependent. The female body is not only concerned with issues regarding fertility but also with hormone production as both seem to be equally affected by radiotherapy[4]. Although the uterus is relatively resistant to radiotherapy there is no doubt the uterine irradiation is harmful and even if fertility is conserved, uterine irradiation will result in poor Implantation. The vagina relatively radio resistant however, irradiation of this organ carries with it the risk of loss of lubrication and stenosis which may result in physical impairments to fertility as well as major psychosexual issues. Total body abdominal and pelvic irradiation can lead to an increased incidence of intrauterine growth retardation and spontaneous miscarriage, perhaps due to muscular or vascular injury.

The effect of radiotherapy on male fertility is dose dependent. Irradiation is cytotoxic to differentiating spermatogonia. Fractional radiotherapy to testis for treatment of carcinoma in *situ* of the testis usually involves high dose of radiotherapy which lead to permanent azoospermia. In addition libido and erection usually remain normal in men and development of secondary sexual characteristics continues to unaffected[4, 5].

EFFECTS OF CHEMOTHERAPY ON FERTILITY

Chemotherapy, with its various combinations and dosages can complete predictions of infertility risk. However, all chemotherapeutic drugs have the potential to cause gonadal injury. The extent of damage is determined by drug type, dosage and the age and gender of the patient[3]. Although the gonadotoxic effects of chemotherapy are well established, research on the effects of chemotherapy on future offspring is more promising. Numerous studies have found that there is no risk of toxicity to children of patients treated with chemotherapeutic drugs before pregnancy. Furthermore, teratogenic risk only exists during or immediately following chemotherapy and DNA integrity returns for men and women overtime. Unlike radiation, chemotherapy is not associated with an increased risk of congenital malformation or preterm labor in female cancer survivors.

REPRODUCTIVE OPTIONS FOR CANCER SURVIVOURS :

Infertility with its Biological and psychosocial implications cannot be narrowly defined. The prevalence complexity and detriment of infertility after treatment make it one of the most difficult and significant late effects to be addressed. Traditionally few options have existed for cancer patients- particularly women- wanting to have their own biological children. Recent advances in reproductive science have changed what is possible now and what may be possible in the future.

(a) Traditional Option

Traditional options include adaption and third party reproduction such as gamete donation and surrogacy. Although these reproductive options exist for everyone seeking to have a family, they present more difficult challenges for survivors of cancer. Due to high demand, the majority of couples- regardless of their medical histories- struggle to adopt a healthy infant.

Table 1. Traditional options for fertility preservation

Option	Advantages	Limitation
Adoption	Commonly avaibale	Limited availability of infant's emotional, financial constraints, possible discrimination.
Third party reproduction	Ability to raise child from birth	Not as socially acceptable, religious contentions

(b) Fertility Preservation Options For Female Cancer Patients :

Fertility preservation options in females depends on the patients age, type of treatment diagnosis whether she has a partner, the time available and the potential that cancer has metastasized to her ovaries[1]. The only two established techniques women have for fertility preservation are protecting the ovaries from radiation and emergency IVF here mature oocytes are collected and fertilized and an embryo is cryopreserved [2].

Table 2. Option for female cancer survivours

Intervention	Definition	Comment	Consideration
Embryo cryopreservations (s)	Harvesting eggs, *in vitro* fertilization and freezing of embryos for later implantation	The most established technique for fertility preservation in women	● Require 10-14 days of ovarian stimulation from the beginning of menstrual cycle ● Require partner or donar sperm ● High cost
Oocyte Cryopreservations (I)	Harvesting and freezing of Unfertilized eggs	Approximately 2% live births per thawed ooctyes (3–4 times lower than standard than standard IVF)	Requires 10-14 days of ovarian stimulation from the beginning of menstrual cycle
Gonadal shilding during radiation therapy (S)	Use of shielding to reduce the dose of radiation deliverd to the reproductive organs	Case series	Expertise is reguired to ensure shielding
Ovarian trans positions (S)	Surgical repositioning of ovaries away from the radiation field	Large cohort studies and case series suggest approximately 50% chance of success due to altered ovarian blood flow and scattered radiation	● Same day outpatient surgical procedure ● Transposition should be performed just before radiation therapy to prevent return of ovaries to former positon ● May need repositioning or IVF to conceive

Intervention	Definition	Comment	Consideration
Other conservative gynecologic surgery (S/I)	Minimization of normal tissue resection	Large case series and case reports	Experties may not be widely available
Ovarian suppression with Gonadotrophin releasing hormone analogs or antagonist	Use of hormonal therapies to protect ovarian tissue during chemotherapy or radiation therapy	Small randomized suties and case series	Medication given before and during treatment with chemotherapy

(c) Fertility Preservation For Male Cancer Patients

The available evidence suggests that sperm cryopreservation is an effective method of fertility preservation in male patients treated for cancer. The other available options for males are testicular hormonal suppression and testicular tissue cryopreservation. In contrast gonadoprotection through hormonal manipulation is ineffective.

Table 3. Option for Male cancer survivours

Intervention	Definition	Comment	Consideration
Suprem cryopreservation after masturbation (S)	Freezing sperm obtained through masturbation	The most established technique for fertility preservation in men; large studies in men with cancer	Outpatient procedure costly
Testicular suppression with gonadotrophin releasing hormone analog or antagonist (S)	Use of hormonal therapies to protect testicular tissue during chemotherapy	Studies do not support the effectiveness of this approach	Testicular sperm extraction need specialized surgical procedure.
Gonadal shielding during radiation therapy (s)	Use of shielding to reduce the dose of radiation delivered to the testicles	Case series	● Only possible with selected radiation fields and anatomy ● Expertise is required to ensure shielding does not increase dose delivered to the reproductive organs
Testicular tissue cryopreservation (I)	Freezing testicular tissue or germ cells	Has not been tested in humans ; successful	Outpatient surgical procedure

CONCLUSION

Increased cancer care is associated with increased cure rates. As cancer survival rates continue to increase, secondary issues such as reproductive outlook are becoming a primary concern among researchers. Infertility is one of the major outcomes after cancer treatment and addressing it through reproductive options that are available now a day can help the survivours to have their own offspring. Survivours who have lost his / her fertility after cancer treatment. IVF and ICSI are the very useful techniques the change their reproductive outlook. Reproductive endocrinologists and Urologist continue their efforts to perfect cryopreserving technologies to retain ovarian and testicular function. Conservative treatment is an option which is highly motivated young women desiring future fertility with certain cancers of the reproductive treat. Other than these treatments hormonal gonad protection, ovarian suppression, spermatogonia transplantation

is the options that are available to female and male patients to restore his / her fertility. Patients need to be made aware of their options. However, the knowledge needed to translate many of their options to the reproductive clinic is missing. Patients must be aware of the standard therapies, risk and benefits of conservative treatment and need for careful follow up. As research continues to excel, bringing men, women and children a way to preserve their fertility, the role of the provider in delivering these advances will become vital to returning survivors to the lives they once knew.

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LIFE SKETCHES OF OFFICE BEARERS, SECTIONAL PRESIDENTS & RECORDERS OF THE INDIAN SCIENCE CONGRESS ASSOCIATION, 2012-2013

DR. MANMOHAN SINGH

General President

Hon'ble Prime Minister of India

India's fourteenth Prime Minister, **Dr. Manmohan Singh** is rightly acclaimed as a thinker and a scholar. He is well regarded for his diligence and his academic approach to work, as well as his accessibility and his unassuming demeanour.

Prime Minister Manmohan Singh was born on September 26, 1932, in a village in the Punjab province of undivided India. Dr. Singh completed his Matriculation examinations from the Punjab University in 1948. His academic career took him from Punjab to the University of Cambridge, UK, where he earned a First Class Honours degree in Economics in 1957. Dr. Singh followed this with a D. Phil in Economics from Nuffield College at Oxford University in 1962. His book, "India's Export Trends and Prospects for Self-Sustained Growth" [Clarendon Press, Oxford, 1964] was an early critique of India's inward-oriented trade policy.

Dr. Singh's academic credentials were burnished by the years he spent on the faculty of Punjab University and the prestigious Delhi School of Economics. He had a brief stint at the UNCTAD Secretariat as well, during these years. This presaged a subsequent appointment as Secretary General of the South Commission in Geneva between 1987 and 1990.

In 1971, Dr. Singh joined the Government of India as Economic Advisor in the Commerce Ministry. This was soon followed by his appointment as Chief Economic Advisor in the Ministry of Finance in 1972. Among the many Governmental positions that Dr. Singh has occupied are Secretary in the Ministry of Finance; Deputy Chairman of the Planning Commission; Governor of the Reserve Bank of India; Advisor of the Prime Minister; and Chairman of the University Grants Commission.

In what was to become the turning point in the economic history of independent India, Dr. Singh spent five years between 1991 and 1996 as India's Finance Minister. His role in ushering in a comprehensive policy of economic reforms is now recognized worldwide. In the popular view of those years in India, that period is inextricably associated with the persona of Dr. Singh.

Among the many awards and honours conferred upon Dr. Singh in his public career, the most prominent are India's second highest civilian honour, the Padma Vibhushan (1987); the Jawaharlal Nehru Birth Centenary Award of the Indian Science Congress (1995); the Asia Money Award for Finance Minister of the Year (1993 and 1994); the Euro Money Award for Finance Minister of the Year (1993), the Adam Smith Prize of the University of Cambridge (1956); and the Wright's Prize for Distinguished Performance at St. John's College in Cambridge (1955). Dr. Singh has also been honoured by a number of other associations including the Japanese Nihon Keizai Shimbun. Dr. Singh is a recipient of honorary degrees from many universities including the Universities of Cambridge and Oxford.

Dr. Singh has represented India at many international conferences and in several international

organizations. He has led Indian Delegations to the Commonwealth Heads of Government Meeting in Cyprus (1993) and to the World Conference on Human Rights in Vienna in 1993.

In his political career, Dr. Singh has been a Member of India's Upper House of Parliament (the Rajya Sabha) since 1991, where he was Leader of the Opposition between 1998 and 2004. Dr. Manmohan Singh was sworn in as Prime Minister on 22nd May after the 2004 general elections and took the oath of office for a second term on 22nd May 2009.

Dr. Singh and his wife Mrs. Gursharan Kaur have three daughters.

DR. MANOJ KUMAR CHAKRABARTI

General Secretary (Membership Affairs)

Dr. Manoj Kumar Chakrabarti is the Deputy Director (Senior Grade) of the National Institute of Cholera and Enteric Diseases, Kolkata. He did his M.Sc. from University of Calcutta and in 1982 received his Ph.D. degree from the same University. He did postdoctoral research on the mechanism of action of *E.coli* heat-stable enterotoxin at the Department of Microbiology, University of Kansas, USA. He also worked at the Department of Bacteriology of Nagasaki University, Japan.

Dr. Chakrabarti has contributed in the understanding of pathogenesis of different diarrhoeagenic bacteria, development of vaccine, Super ORS and use of proper antibiotics against diarrhoea. His current research interest is investigation of receptor specificity and signal transduction of different bacterial toxins. He is also working towards the development of a candidate vaccine against shigellosis. He has been working on different projects some of which are as follows :One of his studies reveal that oral immunization of rabbits by heat killed *Shigella flexneri* 2a can give 100% protection against shigellosis. 34 kDa outer membrane protein (OMP) has been identified as a protective antigen. Recombinant 34 kDa protein has been found to be cross-reactive, surface exposed and induces protective immune responses, which are the criteria of an optimal vaccine antigen. This study may lead to develop a simple, practical and effective vaccine against shigellosis. Furthermore, it has been shown that the protein is antigenically conserved among *Shigella* spp., and hence can be used to develop a diagnostic kit. In another study the intracellular signal transduction pathway involved in the induction of intestinal secretion by *E.coli* heat-stable toxin (STa) has been evaluated. It has been shown that besides cyclic Guanosine – 3', 5' –mono phosphate *E.coli* STa also involves phosphatidy1-inositol specific phospholipase C, inositol trisphosphate, diacylglycerol, calcium and Protein kinase C-in its mechanism of action in a human colonic carcinoma cell line COLO-205. Recently, it has been found that actin cytoskeleton network plays a crucial role in the activation and translocation of PKC-Recently, it has also been shown that *E.coli* STa downregulates the cell proliferation through Protein Kinase G-Mitogen Activated Protein Kinase pathway and has been considered as a potent anti-angiogenic and anti-metastatic molecule.

Apart from this, he is also involved in teaching and other academic activities of different Universities and professional societies in India. A large number of students have been trained by him for their Ph.D. / M.Sc. /M.Tech. program. Several collaborative projects are also going on with many National and International Scientists of different Organizations and Institutes and published several papers in National and International Journals of repute.

He has participated as WHO sponsored inter-country course facilitator and guest lecturer on various pathophysiological aspects of diarrhoea. Dr. Chakrabarti acted as a resource person on various orientation/refresher programmes of Academic Staff College of different Universities. He has been invited to deliver talks and to chair Sessions in Microbiology and Immunology in different National and International Conferences and has been serving as a member of the Editorial Board of the three Indian Journals and reviewer of different International Journals.

Dr. Chakrabarti is serving as Vice-President of the Physiological Society of India. He was the president of the Section of Physiology (presently Medical Sciences including Physiology) during 89th Session of Indian Science Congress, 2001-2002. He has been elected as Fellow of West Bengal Academy of Science and Technology in 2001 for his contribution in research on pathogenesis of diarrheal diseases. Presently, Dr. Chakrabarti is the convener of Medical and Veterinary Sciences section of the Academy. He was awarded Ramendra Sundar Sinha Memorial oration of 1999 by the PSI, Platinum Jubilee oration of 2007 by Indian Science Congress and Prof. A. K. Mukherjee Memorial Award in 2007. He was the Convener of ISCA Kolkata Chapter from 2007 to 2010.

DR. (MRS.) VIJAY LAXMI SAXENA
General Secretary (Scientific Activities)

Dr. Vijay Laxmi Saxena is at present Head of the Department of Zoology, D. G. College, C.S.J.M. University, Kanpur, and Coordinator, Bioinformatics Infrastructure Facility Centre of DBT (Govt. of India).

She was appointed as Lecturer in Zoology Women's College B.H.U. Varanasi, worked in P.P.N. College, Kanpur for 3 sessions, worked as a lecturer in A.N.D. College, Kanpur and joined Dept. of Zoology, D.G.College, Kanpur in 1983 and working there till to date.

Dr. Saxena had held different posts in different organizations like General Secretary,Indian Science Congress Association (Scientific Activities) 2010-11,2011-12,2012-13, General Secretary-Indian Society of Life Sciences from 2008 to 2010, Convener, Kanpur Chapter, ISCA from 2007 to 2010, Elected Executive Committee Member of ISCA from 2006 to 2009, Elected Council Member of ISCA from 2005-2006, Elected Recorder of the Section of Zoology, Entomology & Fisheries of ISCA in 1996 to 1998, Elected Member of the Section of Zoology,Entomology & Fisheries of ISCA in 1994-1996.

Dr. Saxena has received several Awards/Prizes like Dr. B.S. Chauhan Medal was awarded by Zoological Society of India on 29 Dec 2011 at the Inaugural Session of 22nd All India Congress of Zoology held at Lucknow Univ., Lucknow, Women Scientist Award for the year 2009-2010, Certificate of Award for outstanding contribution for advancement of Science and Welfare, Certificate of Honour from Society of Pest Management & Environment Protection, Winner of Gold Medal award of Indian Society of Life Sciences, etc. Member of Editorial Boards-Connect journals, Asian Journal of Environmental Science, Trends in Life Sciences, International Journal, Science India, National Science Magazine, published from Cochin, Kerala.

Dr. Saxena has research experience of 36 years and teaching experience of 30 years. Thirty students

have obtained Ph. D. under her guidance. She has sixty three papers in journals of National and International repute and edited twenty books. She is member of several professional bodies and have participated and presented papers in several National and International Symposia/Seminar and also gave invited talks in SKK,University,South Korea. She has travelled worldwide i.e. Italy, Paris, Germany, Innsbruck, Malaysia, Austria, Singapore, Hongkong, South Korea and America, Chaired several Sessions as a Resource person and conducted many research projects funded by U.G.C., D.S.T. and J.S.P.S. (Japanese Society for Promotion of Science). She was Coordinator N.S.S., C.S.J.M. Univ., Kanpur, organized National Integration Camp, C.S.J.M. Univ., Kanpur, Participated as Contingent Leader in All India N.S.S. Republic Day Parade and Camp, New Delhi, Organized Aids Symposium sponsored by N.S.S. Regional Centre, Lucknow, Organized Life Style Education Centre Workshop, organized Aids Rally and Poster Competition sponsored by U.T.A., N.S.S. Regional Centre, Lucknow, and Member of University Advisory Committee (N.S.S.) of C.S.J.M. Univ., Kanpur .

SRI NILANGSHU BHUSAN BASU

Treasurer

Born on 14th day of July, 1956, Sri Nilangshu Bhusan Basu graduated in Civil Engineering from Bengal Engineering College in the year 1977 with distinction. He completed Master's degree in Structural Engineering from Jadavpur University in the year 1983 with distinction and successfully undergone training in River Basin Management at Thames Water Authority, U. K. in the year 1989. He has served as Chairman of Architectural Engg. Division of Institute of Engineers, West Bengal Chapter. He is also adorning the honoured post of the Vice President at the Institute of Public Health Engineers. Presently, he is working at The Kolkata Municipal Corporation in the capacity of the Principal Chief Engineer (civil). Under the supervision of his Engineering skills a good number of infrastructure projects for the city of Kolkata have been completed successfully. 40 MGD water treatment plant at Palta, 100 MGD pressure station for clear water at Palta 100 MGD intake jetty with intake station of Palta, Networking for water mains, Booster pumping stations at Parkcircus, Bagmari, Ranikuthi, Kalighat Drainage pumping station of Southern Avenue, Automated computerized car parking system at Rowdan street (over ground) at Lindsay street (underground) etc, are only a few among the large number of successful projects that he has so far undertaken. All the JNNURM projects of KMC worth Rs. 1000 crores had also been formulated and is being executed in his leadership. These prestigious projects include 134 year old underground brick sewer rehabilitation of Kolkata also.

DR. PROBIR KUMAR GHOSH

President

Section of Agriculture and Forestry Sciences

Dr. P. K. Ghosh was born on 13th December

1962 at Kumarpur, Murshidabad, West Bengal, did schooling at native place, graduated from Visva-Bharati, Santiniketan and obtained M.Sc. (Agri) and Ph.D. degrees from GBPUA&T, Pantnagar with an illustrious academic record of excellence. He started his career as an ARS scientist in 1993 at Directorate of Groundnut Research, Junagadh, Senior Scientist at Indian Institute of Soil Science, Bhopal (1999-2006); Principal Scientist at ICAR Research Complex for NEH Region, Shillong (2006-2009) and former Head, Crop Production at Indian Institute of Pulses Research, Kanpur (2009 onwards). He is presently Director, Indian Grassland and Fodder Research Institute, Jhansi.

Dr. Ghosh by virtue of hard work and foresight established himself as a renowned Agronomist of country in the field of cropping system research, soil fertility and fertilizer use, crop nutrition and soil quality, conservation tillage, soil water conservation. His cited pioneering research works are assessing carbon sequestration potential in groundnut, soybean and pulse based cropping systems, developing a new concept for assessing nutrient competition and inter-specific interaction of above and below ground components in intercropping system, identifying perennial grasses for improving soil quality and checking soil erosion in fragile hill ecosystems, standardizing and perfecting conservation Agriculture for North-East hill region, demonstrating participatory rainwater management through low-cost *in-situ* soil moisture conservation practices and micro-water harvesting structure. He is a fellow of National Academy of Agricultural Science and Indian Society of Agronomy and is a recipient of many awards viz; Groundwater Augmentation Award, Dr. K.G Tejwani award, ICAR Inter-disciplinary Team Research award, PPIC-FAI Award, AAAS Senior Award, IMPHOS-FAI Award, Best Scientific Oratory Award. Dr. Ghosh has around 150 publications in the journal of national and International repute including 4 books.

DR. ANIL PRAKASH SHARMA

President

Section of Animal, Veterinary and Fishery Sciences

Dr. Anil Prakash Sharma, began his professional career in fisheries in 1982 after completing Doctoral Degree in Zoology (Limnology) from Kumaun University, Nainital. He presently serves as the Director of Central Inland Fisheries Research Institute (CIFRI), ICAR, Barrackpore, Kolkata. Dr.Sharma is known for distinguished services to the cause of development of the fisheries sector, through his long association with the College of Fisheries, G.B. Pant University, which rose to the status of Centre of Excellence under his stewardship as the Dean from 2003 to 2009. His contributions in establishing advanced farming systems and seed production facilities for a number of fish species are highly acclaimed. He has evolved a package of research management strategies, squarely focussed on brood-stock improvement, input-use efficiency, diversification and sustainable management of fishery resources, which are well accepted at the grass root level. Dr. Sharma has served with distinction in many responsible capacities in the National Agricultural Research System (SAUs & ICAR) with remarkable achievements to support the food and nutritional security of the country. Dr. Sharma played an instrumental role in triggering the drive for much needed conservation of germplasm of golden mahseer, the endangered cold water fish

species from Himalaya and the Sub-Himalayan regions. He achieved a high degree of success in launching the restoration mission for fishery of mahseer in the most polluted natural lake of Central Himalaya, i.e., Nainital lake. He developed a unique aeration technology that greatly facilitated complete aeration of the lake for ecological restoration. This was hailed as the first ever successful attempt in any mountain lake in the country with constructive and tangible results in combating pollution in Nainital lake. As the Dean, College of Fisheries, Pantnagar University, he played a crucial role in strengthening and developing all support facilities to elevate the College to the status as the National Centre of Inland Fisheries Education. Under his leadership the College of Fisheries was accredited by ICAR and got recognised as ISI 9001-2000 Institution. He was responsible for developing bilateral exchange programme of education with the Institute of Piscicola, Legta De Lozere, Ministry of Agriculture, France, which paved the way to launch bilateral exchange programmes for students and faculty members for international exposure and further improvement in education. He spearheaded successful implementation of a large number of projects under different modes, in different agro-climatic conditions, opening up new vistas in fishery conservation, fish seed production, recirculatory aquaculture system etc.

Prior to joining ICAR, Dr. Sharma has served with dignity in various capacities, such as Vice-Chancellor, Dean, College of Fisheries, Officer In-charge, Fisheries Research and Training Center, Head, Department of Fishery Hydrography, G.B. Pant University of Agriculture and Technology, Pantnagar. During Dr. Sharma's stint as the Vice-Chancellor, the university has released as many as 10 High Yielding Varieties of rice, wheat, soybean, sugarcane, pea, vegetables, mango etc. A number of new initiatives were taken to make the G.B. Pant University of Agriculture and Technology, Pantnagar as an Institution of Excellence viz., advanced analytical instrument, ICT, development of linkages with renowned agriculture universities like University of Illinois, Michigan, Minnesota etc. A number of university programmes were accredited by reputed organisations in order to bridge the gap between Lab and Land, while also paving the way towards effective linkage with farmers and Government agencies of Uttarakhand in the field of agriculture, horticulture, fisheries and animal husbandry. He has served in the board of the Institute / Universities.

Under his leadership as the Director several initiatives had been undertaken to actively involve the Department of Fisheries, State of Uttarakhand on the National Map and development of a roadmap for fisheries initiative, human resource development, renovation of farms and hatcheries etc. As a direct outcome of this the reservoir fisheries development programme in the state was energised. The Uttarakhand State Seed Certification and Organic Agency was also energised when he served a stint as the Director of the Agency.

Dr. Sharma has published several research papers in the national and international journals and participated in world class workshops, conferences and symposia. He had a pioneering role in revising commemorating publication titled 'Five Decades of Pantnagar'. Dr. Sharma has been conferred with many national and international honours. He is a Fellow of a number of professional societies, viz., Institute of Applied Sciences, Allahabad (FIAS), National Institute of Ecology, New Delhi (FNIE), Inland Fisheries Society of India, ICAR (IFSI), Association of Aquaculturists, ICAR (FAA), Agriculture Science, Engineering and Technology (ASET) and is now serving as the President of Inland Fisheries Society of India. In recognition of his devoted work and commitment to the cause of science and fisheries, Dr. Sharma has been decorated with several awards, i.e., 'Uttaranchal Ratan', 'Life Time Achievement Award', 'Bharat Jyoti Award', 'Dr. VRP Sinha Gold Medal', to cite just a few.

PROF. ARUP RATAN BANDYOPADHYAY

President

Section of Anthropological and Behavioural Sciences (including Archaeology and Psychology & Educational Science and Military Sciences)

Dr. Arup Ratan Bandyopadhyay, born in Kolkata is currently the Professor of Anthropology, University College of Science, Technology and Agriculture, University of Calcutta and Deputy Coordinator of the Post Graduate Course in Human Rights, University of Calcutta. Prof. Bandyopadhyay received his B.Sc. (Hons.) degree as well as M.Sc. in Anthropology and Ph. D. degree from University of Calcutta. He also obtained M.Phil. in Environmental Science in 1986. Furthermore, Prof. Bandyopadhyay has received National Scholarship from Government of India in Post Graduate study. The area of Research of Prof. Bandyopadhyay for his Ph. D. dissertation was selection and polymorphism of human serum protein (Haptoglobin groups). Prof. Bandyopadhyay has received ISCA Young Scientist Award in 1991 as the first candidate from Department of Anthropology, University of Calcutta.

Prof. A. R. Bandyopadhyay served as Guest Lecturer for post graduate study in Vidyasagar University, Midnapore. He has been a permanent faculty member in post graduate faculty of Anthropology Visva Bharati, between 1993 and 2000. During the tenure in Visva Bharati he designed the curriculum development to introduce specialization in Biological Anthropology. He also successfully guided one Ph. D. student to receive the Ph. D. degree in the research area of reproductive performances of Santal females of India and Bangladesh under the auspices of Visva Bharati.

Prof. Bandyopadhyay joined Department of Anthropology, University of Calcutta in 2000 as Reader in Anthropology and is currently serving as Professor since 2008. So far, three Ph. D. students have received their degrees in the research field of Variation of Primate Hairs, relationship of anthropomteric and metabolic variables in Type 2 diabetes mellitus (NIDDM) and Somatotype variation in two discrete tribal population of India under the auspices of University of Calcutta. Currently seven students are working under him in the major research areas around nutritional status assessment from scalp hair, breast cancer and BRCA genes in Bengalee females, prevalence of sex chromatin and relationship with breast cancer among Bengalee females, evolutionary biology of Primate Hair in terms of morphological and quantitative traits towards developmental biology, Hemoglobinopathy and dermatoglyphics with various research funding such as UGC, DST, Anthropological Survey of India. Ph. D. students of Prof. Bandyopadhyay have been also awarded with Young Scientist Award from ISCA. He has been Recorder in the section of Anthropological and Behavioural Sciences, ISCA (2005 and 2006). Prof. Bandyopadhyay also supervised five MD students of West Bengal Health University for their dissertations in anatomy. His current research areas are anthropometry with references to bio-medical application specially non-communicable disease, population and ethnic variation, somatotyping, reproductive health relating biosocial aspects, Dermatoglyphics with reference to genetic study and population variation, Morphological and histological studies of human scalp hair with reference to quantitative genetics,

forensic application and age effect, Evolutionary significance of hair study: Morphological, histological and quantitative aspect of non-human primate hair, Cytogenetics in terms of sex chromatin study, Sero-genetics with reference major blood group population variation, polymorphism, segregation, selection effects, Electrophoresis of polymorphic genetic markers with reference serum protein (Haptoglobin groups and Transferrins) polymorphism and selection effects, Growth and development, Nutritional aspects of rural, urban and tribal population, Forensic Anthropology and personal identification, Osteometry including craniometry with reference to evolutionary and Forensic study. Prof. Bandyopadhyay has about sixty original research publications in National and International peer reviewed Journals of repute.

PROF. (DR.) KAMAL KANT DWIVEDI

President

Section of Chemical Sciences

Prof. Dr. Kamal Kant Dwivedi is the Vice Chancellor of Apeejay Stya University in India. He is a Scientist, Researcher, Teacher, Educator, Administrator, Diplomat and Science Communicator. For over 40 years he served in India and abroad in different capacities. Previously, Prof. Dwivedi served as the Vice-Chancellor, Arunachal University, Head of Division, Adviser, and Director in the Ministry of Science and Technology, Govt. of India, Counsellor (Science, Technology, Health and Education), Embassy of India, Washington DC, Visiting Professor/Scientist, University of Giessen, University of Marburg and Hahn-Meitner Institute, Berlin, Germany and Faculty member at North-Eastern Hill University, Shillong. During his tenure as Vice-Chancellor of Arunachal University now a Central University named as Rajiv Gandhi University, Prof. Dwivedi steered the University to become a 'University with Potential for Excellence' a highest UGC recognition.

Prof. Dwivedi has significantly contributed to enhancing scientific understanding by participating in over two hundred scientific conferences, symposia and seminars, by chairing technical sessions and delivering plenary and invited talks. His area of specialization covers - Interaction of heavy ions with matter, Studies on fusion-fission and particle evaporation in 4π-geometry, Development of computer codes for range and energy loss, Heavy ion induced creation of Buckminsterfullerene in graphite, Radiation induced modification of polymers, Use of food animals as indicators of air-pollution, Radon monitoring for Radioprotection and for earthquake prediction, Assessment of breathing level air quality in urban environment.

For about 20 years, He served as a member of the editorial advisory board of 'Radiation Measurements' an International scientific journal published by Elsevier Science. Prof. Dwivedi has been heading a number of National and International professional and scientific organizations as their President, Chairman, Fellow or Member. From 2000-2002, Prof. Dwivedi held a prestigious position of the President of International Nuclear Track Society representing more than 40 countries. He is recipient of 10 different national and international fellowships and "India 2000 Millennium Award (1999)". Prof. Dwivedi is elected as a Fellow of the Indian Chemical Society (FICS), and also a Fellow of the International Academy of Physical Sciences (FIAPS) in 2010.

He obtained his Ph.D. in 1977 from I.I.T. Kanpur and M.Sc. in 1972 from Lucknow University. He has specialized in the fields of Chemical, Nuclear

and Environmental Science, Science and Technology Cooperation, Administration and Communication. Prof. Dwivedi pursued research in truly inter-disciplinary areas and published about 200 research papers in refereed journals in the area of Chemical, Environmental, Nuclear and Material Sciences. Some of Prof. Dwivedi's research work has been prominently cited in Science and Engineering text books published by leading international publishers.

DR. AJAI
President
Section of Earth System Sciences

Dr. Ajai, born on October 5, 1953 at Allahabad, obtained his master's and doctorate in 1972 and 1977 from the University of Allahabad. He joined Space Applications Centre, ISRO in 1978 as Scientist –SC and contributed significantly to the earth observations programme of ISRO and its applications in various capacities during the past 34 years. He is presently the Group Director of Marine, Geo and Planetary Sciences Group at Space Applications Centre and leading a team of scientists working on several important and challenging aspects of earth system sciences, these include snow and glaciers, coastal zones and desertification that have assumed greater significance in the context of global climate change. He is also leading another team of researchers investigating the Moon and Mars using orbital remote sensing data.

Dr. Ajai has led a national team of scientists to prepare desertification status map of India. This national inventory has been made for the first time and will be used as a base line for future monitoring of the desertification/land degradation in India as well as an indicator of climate change. Large scale inventory of the entire Himalayan glaciers has been done by the team led by Dr. Ajai. More than 2000 glaciers, well distributed across the Himalaya, have been monitored for retreat/advance. This information is valuable for climate change studies. Another notable work of national importance led by Dr. Ajai is monitoring of the entire coastal zone of India. He has also developed model for assessing the vulnerability of Indian coast to sea level rise.

His systematic investigations of lunar surface morphology, rheology, mineralogy and surface age, using Chandrayaan-1 and other orbital mission's data, have led to several novel results which are very significant in understanding the evolution of moon, specifically. These include, identification of a new lunar mineral (Mg-spinel), records of recent lunar volcanism, exposure of sub-surface pluton during the Tycho impact event and a suitable site (a large volcanic tube) for future habitability on moon. His earlier important contributions include experimentations for selection of optimum spectral bands for the Indian Remote Sensing Satellites, IRS-1.

Dr. Ajai's contributions in the field of earth and planetary sciences is very well recognized, nationally and internationally. He is on the panel of experts at the United Nations Convention to Combat Desertification (UNCCD). He is expert on the Benchmark and Indicators (B&I) for desertification and has played key role in development and finalization of B& I for Asian region. He has served as consultant to UNCCD for Impact indicators and as moderator and chaired several sessions conducted by UNCCD on monitoring and assessment of desertification. He is also on the board of editors of the "World Atlas on Desertification" being made by UNEP and European Commission. Dr. Ajai is a

fellow of National Academy of Sciences and the Society of Earth Scientists, India. He is the recipient of National Remote Sensing Award (1997) and ISRO's team excellence Award (2008).

He has delivered JJ Chinoy memorial lecture (Gujarat University), 2006. He has been National vice President of Indian Society of Geomatics (2003-09). He is member of the many professional societies and also in various committees constituted by the government of India. He is an honorary Professor, guiding research students, at Gujarat University, NIRMA University and CEPT University. Dr Ajai has 290 publications to his credit that includes 60 papers in peer reviewed journals, four atlases and two books.

PROF. DEBABRATA PAUL

President

Section of Engineering Sciences

Prof. Debabrata Paul, Head, Mechanical Engineering Dept., Dr Sudhir Chandra Sur Degree Engineering College, JIS Group, Kolkata, is a former Principal Scientist, National Institute of Research on Jute & Allied Fibre Technology (NIRJAFT), ICAR at Kolkata, and a consultant in biomass energy & waste management. Born in 1947, Prof. Paul worked in the industry after graduation from NIT (erstwhile R.E College) Durgapur in Mechanical Engineering in 1969, and thereafter joined the ICAR service as Junior Scientist in 1975 where he served in different capacities. He had post graduation in Mechanical Engineering from Jadavpur University and developed JUROBOT, an indigenously designed pneumatically operated microprocessor controlled robot in 1982.

Prof. Paul held many key positions in NIRJAFT as Head, Design, Development & Maintenance and carried out innovative research in multidisciplinary fields on mechanizing the extraction of jute & allied fibres from different plant crops by developing appropriate ribboner machine. He was co-investigator in IJO-FAO project on ribboning & ribbon retting and presented papers in international conferences. He nurtured ardent interest in exploitation of agro-residues and biomass waste for carbon neutral green energy and explored new avenue by utilizing jute caddies as a potential source for renewable energy. The technology of briquetting of biomass waste and its thermo-chemical conversion to gaseous fuel for thermal energy and power has been his attempt towards mitigating the global warming, climate change during the last two decades.

Prof. Paul was deeply associated in various academic assignments for more about 13 years in engineering institutions under Calcutta University and West Bengal University of Technology in different capacities viz. senior faculty & Head, Mechanical /Automobile Engg., visiting faculty for post graduate management study, member of Board of Examiners, Calcutta University, member of the governing body of post graduate institute and others. He is also a regular reviewer of engineering text books of reputed publishers. He has many publications in journals, proceedings of seminars, conferences, workshops, books and presented papers in various national & international seminars & conferences apart from editing 36 volumes of reports, research documents and contributing some chapters in books. Prof. Paul is a regular invited speaker in various seminars, conferences, including awareness campaigns on renewable energy also for school children and writer of popular scientific & technical articles in Bengali periodicals very often. Prof. Paul

is a past Recorder of Engineering Sciences Section (2010-12) and life fellow of the Institution of Engineers(I). He is also life member of several professional bodies.

DR. SHASHI BHUSAN MAHATO

President

Section of Environmental Sciences

Shashi Bhusan Mahato was born on 1935. He obtained Ph. D. from Calcutta University, He was Deputy Director & Emeritus Scientist (CSIR), Indian Institute of Chemical Biology, Kolkata and Professor of Biotechnology, Haldia Institute of Technology, Haldia, West Bengal. He is credited with pursuing pioneering research in natural products, medicinal chemistry, microbial steroid biotransformation and plant cell culture towards development of potential products and methodology for the benefit of mankind. He has to his credit 132 original research publications, 18 comprehensive reviews , 8 book chapters and 7 Indian process patents.

Dr. Mahato played a key role in developing chemotherapeutic agents for the treatment of leishmaniasis. In addition to developing suitable processes for preparation of antileishmanial drugs such as urea stibamine and pentamidine, he synthesized some potential pentamidine analogues. The indolyl quinolines synthesized by him by his novel one-step process under Freidel-Crafts conditions were found to inhibit the relaxation and decatenation reactions catalysed by Type I and Type II topoisomerases of *Leishmania donovani*, the causative agent of Indian Kala-azar. The results suggested that the compounds act as dual inhibitors of enzymes and can be exploited for rational drug design in human leishmaniasis. Moreover, these indolyl quinolines were also tested cytotoxic to *L.donovani* promastigotes and amastigotes *in vitro* and effective in treating murine visceral leishmaniasis. His approach to the one-step synthesis of the biologically important analogues under Freidel-Crafts conditions is notable for its preparative simplicity, general applicability and conceptual novelty. His exhaustive work on novel and potential natural products particularly saponins (glycosides), terpenoids and alkaloids received wide acclaim as would be evident from his invited scientific articles published in prestigious scientific journals of world repute and world renowned book series.He delivered lectures all over the world.

Dr. Mahato had the leading role in developing methods for isolation and structural elucidation of six new saponins, bacopasaponins A-F, paving the way for proper standardisation of the drug. A simple process of isolation of asiaticoside the major saponin from *Centalla asiatica*, another medicinal plant in great demand was patented. Asiaticoside is known for its antilaprotic property. Its structure and stereochemistry was determined by single crystal x-ray crystallography. It was tested in liposomal form against *Mycobacterium leprae* and *M.tuberculosis* which demonstrated that liposomal asiaticoside has better microbicidal property against these two bacterial pathogens.

Dr. Mahato's work on cleomiolide, a diterpene lactone with unprecedented structural features from the commonly available plant *Cleome icosandra* has assumed much importance of late. The chemical convertibility of this diterpene to a tricarboxylic

system analogous to that found in taxane disclosed its potential for use as a base material for the synthesis of taxol analogues which are drawing much attention in recent years for their use as anticancer drugs Caesalpinine A, a spermidine alkaloid with a novel skeleton isolated from the shrub, *Caesalpinia digyna* has also attracted attention for its use as an anticancer agent.

Dr. Mahato's work on microbial biotransformation led to the development of several new potential steroid metabolites as well as methodology for beneficial exploitation. His process of employing acetone –dried fungal cell in presence of β-Cyclodextrin in steroid biotransformation for improvement of product yield holds promise in preparative organic chemistry. He made valuable contribution on the development of certain microbial strains for the production of several useful steroids which are otherwise inaccessible by chemical means. Moreover, microbial transformation methodology are compatible with green environment. His contributions on the use of plant cell culture for the production of secondary metabolites for the production of pharmaceutical importance are notable. His works, e.g. on the production of forskolin in *in vitro* cultures and in untransformed root cultures of *Coleus forskolii*, emetine and cephaeline from cell suspension and excised root cultures of *Cephaelis ipecacuanha* and rapid micropropagation of *Mucuna pruriens* f.*pruriens*, etc. attracted considerable attention.

Dr. Mahato is Member of several Professional Bodies, Societies and Academies and Fellow of Royal Society of Chemistry (London), West Bengal Academy of Science and Technology, Indian Chemical Society, etc., Twenty Ph. D. were awarded under his supervision.

PROF. (DR.) UTTAM KUMAR SINGH

President

Section of Information and Communication Science & Technology (including Computer Sciences)

Prof. Uttam Kumar Singh completed his Bachelor of Science in Bio-Sciences Degree, Master of Business Administration from Bihar University, Muzaffarpur in the year 1972 and 1974 and was awarded Ph.D. in Management from IOU, Netherland in the year 1992. From the very beginning, he opted to act as an institution builder and established Indian Institute of Business Management at Patna in the year 1979 and initiated for the first time Post Graduate Programme in Management, Computer Sciences in undivided Bihar. He founded Dr. Zakir Husain Institute at Patna, Asian Institute of Information Technology, Bangalore and in due course established institutes at Pune, Bhubaneswar and other 22 locations in India. He is credited for establishment of first Microsoft IT Academy in India in the year 2002 and for introduction of MBA(e-Governance). Prof. Singh also established Software Technology Park Unit at Patna under Ministry of IT in the year 1999 in the state of Bihar. Presently, he has been appointed as Pro-Chancellor of The Global Open University, a State University of Govt. of Nagaland.

As an institution builder and pioneer personality in the areas of technical and vocational education, especially in Computers & IT, he was instrumental

in initiating computer science programme for women's, school teachers & Govt. officials in the year 1984 . He is also the founder of Computers India Limited, the first computer manufacturing company in the year 1988 in Bihar inaugurated by Hon'ble Dr. Sam Pitroda.

Prof. Singh is Life Member of various Institutions and founder Vice Chairman, Computer Society of India Patna chapter. Later, on served CSI as the Chairman, Patna Chapter, Divisional Chairman (Data Communication), Regional Vice President (East), Member Nomination Committee. He was also nominated as TC Member of Education to the International Federation of Information Processing (IFIP), Vienna, Austria. Prof. Singh was elected as National President of Indian Commerce Association for the year 1997-98 and also served as member of All India Council for Technical Education (AICTE) for five years. Prof. Singh is a prolific writer on and his book was recommended by the Govt. of Bihar as text book for intermediate students in the year 1984. Prof. Singh is also national evaluator & examiner of DOEACC scheme, Ministry of IT, Govt. of India, City & Guilds, U.K. and several institute's & Universities of National and International repute.

PROF. SHANKER RAM

President

Section of Materials Sciences

Prof. Shanker Ram was born on August 15, 1954, at village Sherpur (Sachui), District Mau Nath Bhanjan (UP). He started his academic career in Physical sciences with M. Sc. (1978) and Ph. D. (1982) in Physics from Banaras Hindu University. In Ph. D. thesis, he studied vibrational and electronic spectra of organic molecules of biological importance. He is serving at Materials Science Centre, Indian Institute of Technology, Kharagpur, as a faculty member since 1996 in various capacities from assistant Professor to full Professor. He was promoted to full Professor of Materials Science & Engineering in 2004, followed by high academic grade Professor in 2010, and at present he is heading the Materials Science Centre.

Before a regular faculty, he served as a postdoctoral Research Associate at Advanced Centre of Materials Science, IIT Kanpur (1982-87), where he developed variety of optical, electronic, and magnetic materials in the forms of single crystals, glasses, fine glass-ceramics, or ceramics. He developed for the first-time hexagonal ferrites in controlled shapes of small fibrils from glass-liquids, useful for high frequency applications at low power loss, radar, or microwaves devices. During 1988–89, he worked as a Visiting Scientist at the Department of Materials Science & Engineering, McMaster University (Canada) on optical glasses and superionic conductors of nanoglasses. In 1989, he joined Domain University, Grenoble (France), as an Associate Professor and served till 1992. Along with the French group he introduced a novel chemical co-reduction reaction for synthesizing finely divided loose magnetic nanopowders of pure metals and alloys with bonded surface layers. Now it is a well-identified economic route for producing nanomagnets of alloys and composites from natural resources. Specific examples include amorphous and nanocrystalline powders of high-energy-density magnetic materials of rare-earth (R/R′) based $R_{1-x}R'_xCo_5$, R_2Fe_{17}, or R-M-B alloys (M = transition metal), and polymer bonded composites useable for space technology, defence, and medicals.

Dr. Ram joined as a visiting faculty at IIT Madras in 1992. He moved to National Metallurgical

Laboratory (Jamshedpur) and was promoted at Scientist EI before availing Alexander von Humboldt Fellowship at Technical University Berlin (1994-96). Other distinctions include CNRS Fellow-1989 (France) and MRSI (India) medal-2003. He is life member of several professional bodies.

Professor Ram's field of current research interest are glasses, magnetoceramics, intermetallics, nanofluids, magneto-optic materials, cermets, high-energy-density magnets, multiferroics, magnetic sensors, GMR, GMS and GMC materials, hydrogen energy storage materials, solid fuels, nanostructured materials, fibres and composites, photonics, and energy materials. This includes development of green synthesis from herbs to produce value aided nanomaterials with graphene for medicines, drugs, and biosensors. He has active research collaborations with several German Universities and Defence/ CSIR laboratories in India. Till date, he has published over 220 peer-reviewed papers, 11 patents, 06 book chapters, supervised 12 Ph. D. (15 ongoing), 38 M. Tech., and 20 B. Tech. theses, carried out about 12 sponsored projects on nanomaterials and applications, and organized seven conferences and winter/summer schools.

PROF. DINESH SINGH

President

Section of Mathematical Sciences (including Statistics)

Prof. Dinesh Singh is the Vice Chancellor of the University of Delhi since October 2010. Prior to his assuming charge as the Vice Chancellor, he served as the Director of the University of Delhi South Campus. He has also been the Head of the Department of Mathematics of the University of Delhi.

Apart from his present distinguished engagement, Prof. Singh is Adjunct Professor of Mathematics, University of Houston, USA since 1999. He serves as a member of several important committees of the Government of India such as the Scientific Advisory Committee to the Cabinet, on the senate of the Academy of Scientific & Innovative Research, CSIR, the Steering Committees on Science & Technology and Higher & Technical Education, Planning Commission, Government of India as well as a member of the Board of Governors of IIT Mumbai and as Chairman, Executive Committee of National Science Centre, Delhi. He is a member of the Governing Council of All India Institute of Medical Sciences, New Delhi. He is on the Boards, Executive Councils and Committees of many universities, professional bodies and institutions. At the international level too, Prof. Singh has been involved in many organizations promoting Mathematical research and education. He has been the Member of the Executive Organizing Committee of the International Congress of Mathematicians, 2010. He has lectured at various universities all over the world.

Prof Singh is a graduate from St. Stephen's College, University of Delhi from where he also received his Masters and M. Phil. degrees. He obtained his Ph.D. degree from the Imperial College of Science, Technology and Medicine, London. His area of specialization is Functional Analysis, Operator Theory, and Harmonic Analysis on which he has published extensively in national and international journals of high repute. His work has been cited extensively in books and journals and he has been awarded for his academic achievements. He has co-authored/coedited three books. His contribution to the quality and effectiveness in furthering education and research has been widely acknowledged. He has received several awards and honours for his academic

achievements. He has received the AMU prize of the Indian Mathematical Society, and has delivered the Ramaswamy Aiyar Award Lecture of the Indian Mathematical society in its centenary year as well as the Platinum Jubilee Award Lecture (Mathematical Sciences) of ISCA, and was conferred the title of Adjunct Professor, University of Houston, Houston, Texas, USA and in 1994 received the Career Award in Mathematics of the University Grants Commission, India. He takes an avid interest in literature (English and Hindi) and painting and has held a successful solo exhibition. He is an acclaimed public speaker and has published an article in Hindi on the life of Evariste Galois which has been widely acclaimed. He is a student of Gandhian philosophy.

PROF. TUSHARKANTI GHOSH

President

Section of Medical Science (including Physiology)

Dr. Tusharkanti Ghosh, Professor in Physiology, University of Calcutta pursued Physiology throughout his career life and passed out B.Sc. (Hons.) and M.Sc. in Physiology from the University of Calcutta. After his post graduation he continued his career as Junior Research Fellow, CSIR at the Centre of Neuroscience, University College of Medicine, Calcutta University and the topic of his Ph.D. thesis was "Cerebellar Modulation of Cardiovascular Reflexes in cats". He completed his post doctoral research in the Department of Pharmacology, Howard University College of Medicine, Washington DC, USA. The research interest of Prof. Ghosh includes neurophysiology, neuropharmacology, chronobiology and neuromuscular development in undernutrition. He has published a large number of research papers in national and international journals of repute and also published few books.

Dr. Ghosh was selected for Pradhan foundation fellowship, USA, 1986-87, Prof. A.K. Mukherjee Memorial Oration, 2007, Dr. J.N. Maitra Memorial Oration, 2008. He participated in the meeting of Federation of American Societies for Experimental Biology 1986 (St. Louis), American College of Neuropsychopharmacology 1986 (Washington DC), Society of Neuroscience 1987 (Washington DC). He was elected Recorder of the Section Medical Science (including Physiology) for the year of 2002-2003 and 2003-2004. He taught at Dept. of Physiology, Surendranath College, Kolkata, Dept. of Human Physiology with Community Health, Vidyasagar University, S.N.Pradhan Centre for Neurosciences, University of Calcutta and finally joined Dept. of Physiology, University of Calcutta as Professor. He was visiting teacher/guest lecturer in Tripura University, Kalyani University and in many other institutions. Prof. Tusharkanti Ghosh is the life member of several societies and professional bodies.

PROF. N. R. JAGANNATHAN

President

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

Professor N. R. Jagannathan obtained his M.Sc.

in Physics and Ph. D. in Physics (Biophysics) from University of Madras in 1982. He had his post-doctoral training at the University of British Columbia, Vancouver, Canada; Colorado State University, Fort Collins, USA; and at University of Arkansas for Medical Sciences, Little Rock, USA. Presently, he is Professor & Head, Department of NMR & MRI Facility, All India Institute of Medical Sciences, New Delhi, India, since 1998. Prof. Jagannathan's research interests are in the area broad area of Clinical and pre-clinical cancer research using molecular imaging methods like magnetic resonance imaging (MRI), diffusion MRI, dynamic MRI and MR Spectroscopy. His specific area of research is on (a) Application of advanced MRI functional MRI and MR spectroscopy methods in breast and prostate cancers; (b) Magnetic Resonance Imaging (MRI) including functional MRI/MRS and *in-vivo* NMR spectroscopy in animal model of various diseases; (c) MR metabolomic studies using high-resolution NMR of tissues, serum, CSF, etc. He is author or co-author of over 290 publications and 5 edited volumes.

Prof. Jagannathan is an elected Fellow of the International Society for Magnetic Resonance in Medicine (ISMRM), USA. He is also a Fellow of National Academy of Sciences (India), FNASc; Fellow of the Indian Academy of Sciences, FASc; and a Fellow of the National Academy of Medical Sciences (India), FAMS. Prof. Jagannathan is a member of the Editorial Board of several journals of international repute. Prof. Jagannathan serves in many National and International bodies related to NMR, MRI and Biophysics. He is currently President, Asian Biophysics Association; Member, Executive Council, International Union of Pure and Applied Biophysics, Member of the Steering Committee, Asian Biophysics Association ; Member of the Chapters Committee, International Society for Magnetic Resonance in Medicine, was President, Indian Biophysical Society, Members of Education Committee, International Society for Magnetic Resonance in Medicine, FIST Committee of DST; PURSE committee of DST; Scientific Advisory Committee of the National Brain Research Center and SAIF committee of the NMR Facility at the Indian Institute of Science, Bangalore.

DR. AWADHESH KUMAR RAI
President
Section of Physical Sciences

Dr. Awadhesh Kumar Rai, Professor of Physics in the University of Allahabad, Allahabad, was born in 1958 in village Reotipur, district Ghazipur, UP. He obtained his M.Sc. and Ph.D. degrees from Banaras Hindu University (BHU), Varanasi, India, in 1978 and 1983 respectively. He started his research career in the field of molecular and laser spectroscopy at Physics department, BHU. He proceeded to Max-Planck Institute, Munich, Germany as a Max-Planck Post Doctoral Fellow (1984-85) and worked on generation of tunable Vacuum Ultra Violet Radiation, using four wave mixing process. During 1985-88, he was Pool Scientist at the Physics Department, BHU, and had developed a new experimental facility in the area of Laser Optogalvanic Spectroscopy to study the molecules. He joined G.B. Pant University of Agriculture & Technology and became Associate professor. During his stay at Pantnagar, Dr. Rai developed the experimental facility of Photoacoustic Spectroscopy to study plant and biomaterials. He has visited ICTP, Trieste, Italy, in 1987 and 1992 to participate in the workshops on Laser Spectroscopy and Biophysics respectively. He has worked as

Visiting Professor at Mississippi State University, USA, and had developed a laser-induced breakdown spectroscopy sensor for the online analysis of molten Aluminum alloy. Dr. Rai joined University of Allahabad in 2004 as a Professor of Physics. He has developed a new laser based experimental research facility in the area of laser-induced breakdown spectroscopy for the study of materials of any kind and any phase.

Professor Rai is a recipient of Indian Science Congress Association (ISCA) Young Scientist Award in 1987. He had been selected as UGC Research Scientist "A" 1988. Prof Rai was Recorder of the Physical Science Section in 98th and 99th Sessions of Indian Science Congress Association. He is Visiting Fellow in Physics, School of Physical Sciences, Swami Ramanand Teerth Marathwada University, Nanded. His biography was listed in Marquis Who's Who in Science and Engineering-2009, Marquis Publishers, New Jersey, U.S.A. Prof. Rai is the recipient of Vijay Shree Award by India International Friendship Society for Meritorious Services. His research papers have received best paper awards in various conferences; Indian Science Congress Association held at Mysore in 1982 and Indian Phytopathological Society 2000.

Prof. Rai has visited Addis Ababa University, Ethiopia as examiner of Ph. D. theses. He is Life member of National Academy of Sciences India, and other professional bodies. Prof. Rai has one patent to his credit on Fiber Optic Laser-Induced Breakdown Spectroscopy Probe for Molten Material Analysis and two of his patents are in pipeline. He has edited one book and published more than one hundred fifty research papers in national and international journals and has delivered nearly fifty invited lectures in the conferences/workshops/ refresher courses. He has guided seven Ph.D. students so far and several students are working under him. He has organized several conferences/symposia and is the reviewer of several journals. He has worked as Principal Investigator in several major projects funded by DRDO/DST/CSIR/BRNS/BRFST. His research interests are conventional spectroscopy, laser optogalvanic spectroscopy, photoacoustic spectroscopy, laser-induced breakdown spectroscopy and laser induced fluorescence.

DR. UMESH CHANDRA LAVANIA
President
Section of Plant Sciences

Born on July 08, 1952 in village Taintigaon of Mathura district (U.P.), Umesh Chandra Lavania earned his M.Sc. (1973) in Botany from the Agra University. He joined the faculty of the PG Department of Botany at Hindu College Moradabad in August (1973). He worked at the Centre of Advanced Studies in Cell and Chromosome Research at the Botany Department of Calcutta University as a UGC Teacher Fellow to earn his Ph.D. (1980) and D.Sc. (1998) from Calcutta University. He joined the CSIR-Central Institute of Medicinal and Aromatic Plants (CIMAP), Lucknow as Scientist 'C' in July 1982, became Scientist 'G' in April 2002, and Head of the Division of Genetics and Plant Breeding in August 2006, and continues there as the Chief Scientist. He has visited UK and Japan under various exchange, invitation and collaborative programmes.

Lavania's scientific contributions are focused on structure and behavior of chromosomes at cellular, *in vitro* and organismic level, to elucidate evolutionary dynamics of chromosomes and genomes

in speciation and genetic improvement. Based on extensive studies on cytogenetics of polyploids he has proposed and implemented 'polyploid model' for fixation of heterozygosity, suggested and implemented 'genotypic strategy' for pre-selection of diploid progenitors for distal chiasma localization to realize high fertility and stability of autopolyploids, elucidated differential response of polyploidy to body size *vis-à-vis* qualitative composition and metabolic costs of native secondary metabolites, underpinned mining of *de novo* diversity in palaeopolyploids, and demonstrated that elevated ploidy level causes enhanced cytosine methylation as revealed from immunodetection *in situ* . He has the credit of developing the species cladogram in *Papaver* based on karyo-evolutionary features and postulating that there is equal reduction of DNA in homoeologus chromosomes leading to increased karyotype asymmetry with speciation, and pinpointing that there is progressive reduction in heterochromatin through preferential loss of intercalary followed by telomeric fraction as adjudged from comparative banding of several taxa. His findings are published in reputed journals, including Nature, Plant Journal, TAG , Genome and Heredity.

Lavania has been on the editorial board of several journals of international repute including Associate Editor of J. Genetics, and reviewer of topnotch journals - Genome, J. Hered., Plant Breeding, Pl. Syst. Evol., Plant Cell Rep., Biol. J. Linn Soc.; Ph. D. Examiner of UNSW, Australia and Expert Member of the Plant Science Research Committee of CSIR. Lavania is a recipient of many awards and honours that include : Agra University Gold Medal, INSA Medal for Young Scientists ; Hira Lal Chakravarty Award of ISCA; YS Murty Gold Medal of the Indian Botanical Society ; RB Ekbote Prize of the Maharashtra Association of Cultivation of Science, JSPS Invitation Fellowship; Editorial Award by the journal Plant Genetic Resources (Cambridge); Uma Kant Sinha Memorial Lecture of the Indian Botanical Society, King of Thailand Vetiver Award Certificate of Excellence of Chaipattana Foundation, Thailand . He is an elected Fellow of the Indian National Science Academy.

DR. KRISHNENDU DAS

Recorder

Section of Agriculture and Forestry Sciences

Dr. Krishnendu Das joined the Agricultural Research Service of the Indian Council of Agricultural Research in 1986 in the discipline of Soil Science (Pedology) and was posted in the National Bureau of Soil Survey and Land Use Planning,Nagpur.He received his Ph. D. degree in Soil Science from Bidhan Chandra Krishi Viswa Vidyalaya, Mohanpur in 2000. He is presently posted at Regional Centre, Kolkata as Principal Scientist. Dr. Das has over twenty five years research experience in National Agricultural Research System with respect to formulation, monitoring and accomplishment of various projects viz. Institutional, Inter institutional, NATP, NAIP, Sponsored/ consultancy projects (DST, World Bank and several State Governments) as Principal Investigator/ Co-Principal investigator / Associate. He has handled about 20 research projects so far comprising the themes of soil resource inventorisation and monitoring at various levels viz. state, district, watershed, village etc., application of remote sensing towards natural resource inventorisation, preparation of soil and soil related maps, soil correlation, classification, assessment of land degradation, soil based data management by GIS for land evaluation

towards land use planning for the states of Jharkhand,Orissa,West Bengal, Gujarat, Rajasthan and Uttar Pradesh.

Dr. Das is actively involved as a faculty member for Post Graduate Education in the discipline of Agricultural Chemistry and Soil Science in co-operation with Department of Soil Science, BCKV, Mohanpur, Nadia, West Bengal with special reference to Land Resource Management. He was appointed External Examiner for M.Sc. and Ph.D. students in Palli Shiksha Bhavan,Viswa Bharati,BCKV Mohanpur and CAU, Imphal Universities. He was elected as Councillor (2008-2010) of the Indian Society of Coastal Research, West Bengal and served as Sectional Committee Member of the Agriculture and Forestry Sciences Section of Indian Science Congress during 2003-04 and 2009-2010. He is also the Secretary, Indian Society of Soil Science, Kolkata Chapter and Convenor, National Environmental Science Academy, West Bengal Chapter. Dr. Das has published more than 27 research papers in refereed Journals, 19 popular articles and 15 Technical Bulletin/Reports and attended more than 37 Seminar/Symposium papers.

DR. B. S. CHANDEL
Recorder
Section of Animal, Veterinary and Fishery Sciences

Dr. Babu Singh Chandel was born on 10th August 1955 at District Kanpur, U.P. , Dr. Chandel started his research –cum –teaching career as the assistant Professor of Zoology at D.B.S. College, C.S.J.M. University, Kanpur (U.P.) since 1988 till present as Associate Professor of Zoology at D.B.S. College. He has completed Ph. D. and D.Sc. degree in Zoology (Entomology) in the year 1984 and 1988, respectively.

Dr. Chandel held different posts in organizations like member of Advisory Board of Indian Society of Life Sciences, Society of Life Sciences and Editorial Secretary of Indian Academy of Environmental Sciences and also became a member of Research Board of Advisor by American Biographical Institute, North Carolina, U.S.A., Dr. Chandel was elected as member of sectional committee of Animal, Veterinary and Fishery Sciences section of ISCA, 2004-2005.

Dr. Chandel had been conferred with several academic honours. These include, Fellowship of Society of Life Science, Indian Academy of Environmental Sciences, Zoological Society of India, Society of Environmental Sciences, Entomological Society of India.

Dr. Chandel has been conferred with several awards for outstanding contribution for advancement of sciences. In this connection Zoological Society of India Awarded of Congress of Zoology Medal in 2006, Indian Academy of Environmental Sciences awarded Gold Medal of the Society, The American Biographical Institute, NC, USA awarded him with the Man of The Year 2008, India.

In various national and international conferences /seminars of Scientific Societies of Zoology and Environmental Sciences, Dr. Chandel delivered lectures in more than 20 occasions. He has research experience of 32 years and teaching experience of 27 years. Twenty two students have received Ph. D. Degree in Zoology under his guidance. He has published 43 research papers in national and

international journals of repute. Dr. Chandel has delivered invited Talks, Plenary Lecture, Keynote Address and Chaired Technical Sessions at various conferences, Seminars, Symposium and Workshops in India.

DR. MANOJ KUMAR SINGH

Recorder

Section of Anthropological and Behavioural Sciences (including Archaeology and Psychology & Educational Science and Military Sciences)

Manoj Kumar Singh was born in Ranchi, Bihar and completed all his education from Ranchi. He has done graduation in Anthropology from Gossner College, where he topped in the University. He completed his Master Degree in Anthropology in Ranchi and joined Department of Anthropology as a Ph.D. student and successfully completed his Doctorate Degree in 2002. His specialization is Archaeological Anthropology. He won three consecutive times **"**Best Poster Presentation Award" in Anthropology and Archaeology Section during the Indian Science Congress (1999, 2000 and 2001) and finally got **"**Young Scientist Award" in 2002. He was also elected "Sectional Committee Member" in Anthropology and Archaeology Section in 2001.

He joined Department of Anthropology, University of Delhi in 2002 as Lecturer. He teaches Archaeological Anthropology and Palaeoanthropology. He has visited several countries to attend the Conferences and presented papers. He was awarded Erasmus Mundus Post Doctoral Fellowship in 2005 for 2 years.

Now he is excavating a Lower Palaeolithic Site Kondapeta in Prakasam District of Andhra Pradesh. He has published 26 research paper and 1 Book. There are 4 Ph. D. Students working under his supervision.

He is one the Council Members of World Archaeological Congress, Australia and also Junior Representative of Southern Asia. He is also a member of International Union of Prehistoric and Protohistoric Sciences, France.

DR. ARVIND DIXIT

Recorder

Section of Chemical Sciences

Dr. Arvind Dixit (February 20, 1962) Associate Professor (Dept. of Chemistry,VSSD College, Kanpur since 1988) and Director Pt. Madan Mohan Malaviya Ethical Education Centre got his higher education in Chemical Sciences and later obtained his Ph.D. in 1989 from Kanpur University, Kanpur. He has supervised several Master's and doctoral students for their dissertations and Ph.D. He has published about 20 research papers in scientific journals and presented Papers in International and National Conferences. He is Ex-Member of Implementation committee Commemoration of the 50^{th} anniversary of Indian Republic, U.P. Constituted by Department of Culture, Government of India.

During 2003-2008 Dr. Dixit served as Member of U.P. Secondary Education Service Selection Board, Allahabad. He has also served as Expert Member, U. P. Public Service Commission, M. P. Public Service Commission, Subject Expert for DRDO, Member, Syllabus preparation committee of C.S.J.M. University, Kanpur, Resource Person in Academic Staff Colleges of different universities, Keynote Speaker in various National and International Seminars. He has been resource person/panelist in group discussion by Gyan-Vani, news channels & All India Radio, Kanpur.

Dr. Dixit was Director, College Development Cell, Formerly Director and Advisor of I.C.T. Lab. Advisor, Equal Opportunity Centre, Co-ordinator, Career Oriented Certificate Course Sponsored by University Grants Commission, New Delhi. Member, Anti Ragging Committee of Kanpur District. Apart from his active academic and administrative career, he has been associated with a several professional and scientific organizations as Fellow or Life Member.

He has visited various countries like Thailand, Bangladesh, Nepal, Malaysia and Singapore.

DR. DEVESH WALIA
Recorder
Section of Earth System Sciences

Dr. Devesh Walia (DoB-August 17, 1965) Associate Professor, Department of Environmental Studies, North-Eastern Hill University (NEHU), Shillong, India completed his University education B. Sc. (1985) and M. Tech. Applied Geology (1988) from Dr. Hari Singh Gour Vishwavidyalaya, Saugor and Ph. D. (1997) from Gauhati University. Subsequently, he joined NEHU as a faculty in 1990 and is actively engaged in teaching, research and consultancy with more than 22 years of experience. He has been the Associate NCC Officer, 20 Mizoram Independent Coy, NCC and as Lieutenant served the PUC- NCC unit (1999-2004). Dr. Walia is a recipient of NCC Scholarship (1985-86); has passed NCC 'A', 'B' and 'C' certificates and University (UGC) Fellowship (1997-88).

Dr.Walia has successfully completed and ongoing a number of research projects funded by various agencies. He has many research papers in reputed National and International Journals to his credit. He has participated and presented his research findings in various National and International conferences/seminars held in India and abroad. Some of the areas of interest of Dr. Walia include magnetotellurics; radon emanation studies; seismology; global positioning system, seismic disaster management and mitigation studies; Remote Sensing and GIS; Earthquake forecasting studies and Structure and tectonics of NE India. Dr. Walia is faculty for the training imparted to the Legislators, Architects, Engineers, Contractors and different level of Officers of Meghalaya on the seismic disaster mitigation, DM Act 2005 and building codes for the disaster resilient structural and non-structural elements.

Dr. Walia is life fellow of Geological Society of India, Indian Geophysical Union and Indian Society of Remote sensing and life member of a number of academic and professional bodies and Member of the Sectional Committee for 2009-2010 (97th Indian Science Congress) and for 2010-2011 (98th Indian

Science Congress). He has also worked as referee of scientific journals, expert in the area of disaster management and mitigation advisor/consultant and Member of the Shillong Disaster Management Plan Technical committee. He has been member of the Term Review Committee of GSI- NER and attended CGPB Group VIII meeting.

MR. ISMAIL HUSSAIN

Recorder

Section of Engineering Sciences

Mr Ismail Hussain born in a Transport business family handled the entire repairs and Maintainance of entire fleet. He passed Dip in Automobile engineering on the year 1992 and later on passed Marketing of Services in the year 2000 from ASCI Hyderabad. He also passed P G Dip Risk and Insurance Management from MIT Pune and is also Valuer for Plant and Machinary. He underwent Technical Programmes by SIAM at New Delhi by TELCO at Pune from Automobile International USA. He did Masters from Rochvelli University, USA. He is member on advisory council of Ministry of New & Renewable Energy, GOI. Having command in rectifying defects in automotive related designs his suggested modifications were accepted by M&M for auto electrical system as well as Telco for uneven tyre wear in utility segment vehicles. He is presently Director of Universal Academy of Tech Education which conducts various computer based courses in Automotive as well as Solar Power Technology related courses.

PROF. DHARMENDRA PRASAD

Recorder

Section of Environmental Sciences

Prof. Dharmendra Prasad, was born on 12th August 1955 at a village called Bodhaul of Nalanda district in Bihar. He did his graduation (B.Sc. (Hons) and Post graduation (M.Sc.) in chemistry from Patna University and Ph.D. from S.K.M. University, Dumka, Jharkhand. He is working as Head, PG Department of Chemistry at Deoghar College, Deoghar, which is a constituent unit of S.K.M. University, Dumka. He has teaching and research experience of 32 years. His field of specialization is Organic and Environmental Sciences. He has published many research papers in journal of national and international repute. He is also life member of different scientific organizations.

DR. (KU.) NEERU ADLAKHA

Recorder

Section of Information and Communication Science & Technology (including Computer Sciences)

Dr. Neeru Adlakha is presently working as

Associate Professor of Mathematics on Deputation at MANIT, Bhopal since 4th July 2012. Earlier she was working as Associate Professor in Mathematics at SVNIT, Surat during 11th June 2009 to 3rd July 2012. She has also worked as Faculty Position in Mathematics at Jaypee Institute of Engineering and Technology, Guna, Sant Hirdaram Girls College, Bhopal, Dr. H. S. Gaur University, Sagar and RKDF Institute of Science and Technology, Bhopal.

She has done her Ph.D. degree in Mathematics in the area of Mathematical and Computational Biology from Jiwaji University, Gwalior in 1994. She has won seven National awards for her research papers. She has forty publications in Journals of International repute. She is Secretary, special Interest Group on Bioinformatics of CSI, member of work group on Bioinformatics under TC 5 of IFIP. She has visited Ialy, USA and Singapore. She has organised first IFIP International Conference on Bioinformatics and several training programs on bioinformatics. She has supervised one Ph.D., Her current interests are Biomathematics/Biocomputing/ Bioinformatics, Dta Mining.

PROF. AMREESH CHANDRA
Recorder
Section of Materials Science

Dr. Amreesh Chandra is currently an Assistant Professor in the Indian Institute of Technology at Kharagpur, India in the Department of Physics. Dr. Chandra did his Ph.D. in 2004 from School of Materials Science and Technology, Indian Institute of Technology, B.H.U., Varanasi, India in the broad area of multiferroic ceramics. In 2005, he moved to the Max Planck Institute for Polymer Research in Mainz, Germany as a post-doctoral fellow where he worked in the area of preparation and characterization of polymer composites with tailor viable thermal expansion. In early 2007, he moved to University of Surrey, U.K. where he was involved in the designing, fabrication and characterization of supercapacitors and microbial fuel cells with special emphasis on materials. Ever since joining I.I.T. Kharagpur in 2009, Dr. Chandra heads the multifunctional and energy materials laboratory. The team mostly focuses on synthesis, characterization and applications of oxide ceramics and nanoparticles in power harvesters, supercapacitors and microbial fuel cells. Dr. Chandra has more than 30 research publications in international journals of high repute. Dr. Chandra has strong collaborative program with University of Surrey (UK), University of Malaya (Malaysia), Max Planck Institute for Polymer Research (Germany), TU-Darmstadt, CNRS-Paris (France), Deakins University (Australia), Delhi University (India), BARC (India), ARDE DRDO Lab (India), Dr. Chandra has more than 3 Young Scientists Awards to his credit, delivered more than 10 Invited Talks in the last two years and chaired sessions in 3 national and international conferences. Dr. Chandra was also a Guest Editor of the recently (2012) published special issue on Energy systems for the Journal (PNAS-Phys. Sci., India Publishers: Springer). This Journal is brought out by the National Academy of Sciences, India.

PROF MEENAKSHI PRALHADRAO WASADIKAR

Recorder

Section of Mathematical Sciences (including Statistics)

She passed B. Sc. (Honors) with First class and Distinction in 1977, obtained M. Sc. in 1979 and Ph.D. (Mathematics) in 1985 from the then Marathwada University, Aurangabad. She was awarded Giridharrao Deshmukh Gold Medal and C. V. Limaye Prize for securing First Rank at M. Sc. (Mathematics) Examination. She was a CSIR Junior and Senior Research Fellow from 1980 to 1985.

She worked as a lecturer in Govt. College of Arts and Science, Aurangabad, Institute of Science, Aurangabad, Elphinston College, Mumbai during 1986 to 1997. She joined as a Reader in Dept. of Mathematics, Dr. Babasaheb Ambedkar University, Aurangabad in 1997 and now working as a Professor.

She worked as the Head, Dept. of Mathematics, Member of Research and Recognition Committee in Mathematics, and member of Board of Studies (Mathematics), Dr. Babasaheb Ambedkar University, Aurangabad, from 2001 – 2003. She was a Member of the Book Writing committee of Govt. of Maharashtra for writing a text book for S. S. C. students (2010). She was a Member of the Sectional Committee **(**Mathematical Sciences including Statistics**)** of Indian Science Congress Association for the years 2008 – 2009 and 2009 – 2010.

She is a Reviewer for Mathematical Reviews published by American Mathematical Society. She has worked as a referee for various Journals. She has 19 publications in National/International Journals and Conference Proceedings. The number of citations of her papers is 22. She participated in four International Conferences (1 Invited talk and 2 paper presentations) and 22 National conferences (with 9 invited talks). She is a Member of the Indian Mathematical Society, Indian Science Congress Association,Jammu Mathematical Society. She has delivered lectures in various refresher courses, workshops, NET / SET training programs.

DR. DEBASISH BANDYOPADHYAY

Recorder

Section of Medical Science (including Physiology)

Dr. Debasish Bandyopadhyay obtained his M. Sc. Degree and Ph. D. degree in Physiology from University of Calcutta. He has visited University of Texas Medical Branch at Galveston, Texas, USA for his post-doctoral research works. He joined as Reader and founder Head of the Department of Biotechnology, Assam (Central) University, Silchar in 2004. Later on he Joined as a Reader and became Head of the Centre for Biotechnology, School of Life Sciences, Visva-Bharati, Santiniketan in 2005. Dr. Bandyopadhyay has joined University of Calcutta as a Reader in Physiology in September, 2006 and, presently serving as Associate Professor at the same department.

Dr. Bandyopadhyay's current research interests are in the areas of myocardial ischemia, stress and drug-induced gastric ulceration, heavy metal-induced oxidative stress, development of effective antioxidants from natural sources and flavin metabolism. Dr. Bandyopadhyay has national and international collaborations as well as inter and intra-departmental collaborations within the university. Received funding for research from UGC and is a participating scientist at the Centre with Potential for Excellence in Particular Area (CPEPA) awarded to University of Calcutta from UGC, Govt. of India. He has thirty one research papers to his credit in various national and international peer reviewed journals with high impact factors. Dr. Bandyopadhyay is a member of the Editorial Board of the Journal of Herbal Medicine and is also a reviewer of a number of high impact international journals. Besides, he is the Joint Editor of Indian Journal of Physiology and Allied Sciences. Dr. Bandyopadhyay is a life member of Society for Biological Chemists of India and Physiological Society of India.

DR. BADRI NARAIN PANDEY

Recorder

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

Dr. Badri Narain Pandey joined Radiation Biology and Health Sciences Division, BARC, Mumbai in 1995 after Graduation from 38th Batch of Biology-Radiobiology Orientation Course (1994-95), BARC Training School, Mumbai. He received his Ph.D. in Life Sciences from Mumbai University in 2003. His research activities involve studying mechanism of bystander effect in normal and cancer cells irradiated with low/high LET radiation. Moreover, his research interest also includes studying role of cellular oxidative damage in the mechanism of apoptosis induced by ionizing radiation relevant to radioprotection and cancer therapy. His current research activities also involve development of nanoparticles based novel strategies for cancer therapy and developing suitable strategies for amelioration of heavy metal radio-nuclide toxicity. Under a collaborative project with Tata Memorial Hospital, Mumbai, Dr. Pandey studied correlation between magnitude of apoptosis and clinical response in Non-Hodgkin's Lymphoma patients undergone to Low Dose Total Body Irradiation, which can be further developed as prognostic assay. Dr. Pandey and his research team showed oxidative mechanism of toxicity induced in different target organs by thorium and uranium at acute and sub-chronic doses, which could be prevented by chelating agent like DTPA during his post doctoral fellowship New Jersey Medical School, New York, USA (2004-05), Dr. Pandey studied role of oxidative damage in radiation induced bystander effect and modification in mitochondrial protein import in γ-irradiated cells. Dr. Pandey investigated role of translationally controlled tumor protein in mechanism of DNA damage repair in human cells exposed to low dose of radiation.

Dr. Pandey received Best Oral Presentation Award at International Conference on Free Radicals in Health & Disease, Lucknow, 2003. He has been awarded Fellowship from Department of Energy, USA to attend Gordon Research Conf. on Radiation Oncology, California. In recognition of his contribution in radiation biology, Dr. Pandey received M.R. Raju Award, AARR Young Scientist Award

and International Cancer Technology Transfer Fellowship by International Union Against Cancer Control (UICC), Switzerland to conduct bystander experiment using proton microbeam irradiation facility at NIRS, Japan. He is a Member of Podcast Committee, Radiation Research Society, USA and Treasurer, Indian Society for Radiation Biology. Dr. Pandey is a Fellow of Association of UICC Fellows, Switzerland. Dr. Pandey has published more than 50 research papers in refereed Journals, 4 book chapters and 4 scientific articles. Dr. Pandey is serving as Editor, 'Radiation Research Today', an eNewsletter published by Indian Society for Radiation Biology.

DR. I. HUBERT JOE

Recorder

Section of Physical Sciences

Dr.I.Hubert Joe, born in Thazhakkan Vilai, Kanyakumari District of Tamil Nadu, received his B.Sc. from Nesamony Memorial Christian College Marthandam, M.Sc. and M.Phil. from Bharathidasan University Trichy and Ph.D. degrees from, University of Kerala, Trivandrum . Joined as a lecturer, Mar Ivanios College in 1995, became reader in 2004 and is now serving as Associate Professor in the same college. He has presented research papers at the XIII International Conference on Raman Spectroscopy Sep, 1992 at Wurzburg, Germany, XIX International Conference on Raman Spectroscopy Aug, 2004 at Queensland, Australia and XXII International Conference on Raman Spectroscopy Aug, 2010 at Boston, Massachusetts, USA. He has Organized the II International Conference on Perspectives in Vibrational Spectroscopy February, 2008, Trivandrum. His research interests at the moment include design and development of non linear optical crystals, Quantum chemical computations using *ab initio* and Density Functional Theoretical methods for geometry Optimization and vibrational spectral prediction of Bio molecules , natural products with medicinal properties and anticancer drug molecules. He has published 101 research papers in various international journals and more than 170 papers in the conference proceedings. He has guided eight research scholars in earning Ph.D. degrees and six research scholars are currently working with him. He has successfully completed one minor and one major project sponsored by UGC and two respond projects sponsored by ISRO, Govt. of India. Now serving as a Member, Board of Studies in Physics (PG), Manonmaniam Sundaranar University, Tirunelveli. He is a regular reviewer of a number of International journals. He has received the Best poster presentation award in the section of Physical science at the 97th Indian Science Congress Association January, 2010.

DR. ARUN KUMAR PANDEY

Recorder

Section of Plant Sciences

Dr. Arun K. Pandey, Professor of Botany, University of Delhi, got his school to university education in Lucknow. After obtaining his masters degree from University of Lucknow in 1973, he

joined National Botanical Research Institute, Lucknow and obtained Ph.D. degree in 1978. He worked as Post-doctoral Fellow at the Ohio State University, Ohio, USA during 1987-88. He is recipient of Y.S. Murty medal of the Indian Botanical Society and V.V. Sivarajan medal of the Indian Association for Angiosperm Taxonomy. He has been Councillor, Secretary, Vice-President and President of the Indian Association for Angiosperm Taxonomy. He has been in the Executive Council of the Indian Botanical Society and is presently Vice President of the East Himalayan Society of Spermatophyte Taxonomy. He is member of 15 national and international societies and is on the editorial committee of several botanical journals. He has also served as Executive Editor of taxonomy journal "Rheedea". He has guided 17 students for Ph.D. degree and 4 for M.Phil. degree.

Dr. Pandey has published more than 120 papers in the journals of international and national repute. He has authored four text books and 8 reference books. He was awarded Bass Fellowship of the Field Museum, Chicago to work on molecular systematics. He was visiting Professor at the University of Vienna, Austria and INSA visiting Fellow at Korea Research Institute of Bioscience and Biotechnology. He is presently visiting University of Munich under INSA-DFG Exchange Programme (2012). He is also a Peer team Member of the National Assessment and Accreditation Council. He has worked in the field of floristics, ethnobotany, and molecular systematics of different angiosperm families. His present interest is in the systematics of sunflower family, Cucurbitaceae and legume family.

KNOW THY INSTITUTIONS

CALCUTTA UNIVERSITY, KOLKATA

The University of Calcutta, was founded on January 24, 1857. In 1845, the Council of Education consisting of F. Millett, James Alexander, C. C. Egerton, Rassomay Dutt, Prosonno Coomar Tagore and Dr. F. J. Mouat formulated a proposal for the establishment of the University. In July 1854, the Court of Directors of the East India Company sent a 'despatch' to the Governor General in Council, suggesting the establishment of the Universities of Calcutta, Bombay and Madras. In pursuance of the dispatch, an Act of Inporporation of the Legislative Council (Act No. II of 1857) founded the University of Calcutta.

Sir James William Colvile was appointed the first Vice-Chancellor of the University of Calcutta.

On January 1, 1890, the University of Calcutta got its first Indian Vice-Chancellor, Honorable Justice Sir Gooroodas Banerjee.

On March 13, 1875 Vice-Chancellor Bailey made a significant remark in his Convocation address that time had come when the University itself might very properly, within its means, assume to some extent, actual teaching of the highest character. The Indian Universities Act 1904 ushered in a new era in the role of the University. The University thus became an agency of teaching and research in addition to its role as knowledge- testing and knowledge-rewarding institution. The new principles laid down in the Act of 1904 and the measures for post-graduate teaching adopted by Sir Asutosh Mookerjee as Vice-Chancellor during the period from 1906 to 1914, culminated in 1917 in centralizing all post-graduate teachings under the direct and immediate control of the University.

The first two decades of the twentieth century witnessed further growth of the University. Sir Asutosh, the visionary, shaped up the University in truly modern mould. Noble persons like Taraknath Palit, Rasbehari Ghosh, Kumar Guruprasad Singh of Khaira came forward with munificent donations with the help of which several academic posts for post-graduate teaching were created and post-

graduate departments were established in Humanities and Science. During this time, several intellectual stalwarts like C. V. Raman, Acharya P. C. Ray, Meghnad Saha, S. N. Bose, etc., joined the University who, at a later period, brought laurels to the University by their genius.

Thus the University of Calcutta, the first modern University established in the country, was perhaps intended to promote western knowledge and learning in colonial interest. But ultimately, the University emerged as the nucleus of a range of academic activities which contributed to the development of Indian science and technology and our own understanding of the country's past and the nation's perceptions for the future. Besides, the University has always remained alive to emerging political, social and economic challenges of the nation and the world. In ensuring this the university has been able to strike a fine balance between social sciences, humanities, music, fine arts, basic sciences and emerging areas in biological and applied sciences.

The vision of the University may be described as follows :

- Pursuit of knowledge in a holistic manner
- Promoting the principles of equity, justice and access in higher education
- Development of cross-disciplinary and hybrid research programmes
- Promoting a balanced development of basic, theoretical and applied sciences
- Improving entrepreneurial skills
- Promotion of dialogue between scientists, technologists and social scientists
- Addressing issues of dialectics between science and society
- Addressing issues of nation building
- Responding to events in neighbouring countries

In recognition of its academic excellence, the University Grants Commission, New Delhi recognized the University of Calcutta as a University with Potential for Excellence (UPE).The NAAC has re-accredited the University with the highest A grade. The UNO has designated our university as the only Indian university to be the Academic Hub for its Education Impact Programme. The MEA, GOI, has sponsored the establishment of The Institute of Foreign Policy Studies, perhaps first of its own kind in India. Department of Science and. Technology identified the Science and Technology departments of the University under PURSE programme. The UGC has sanctioned a grant to the university to establish an interdisciplinary Centre of Potential for Excellence in Particular Area (CPEPA) on Electro-Physiological and Neuro-imaging Studies including Mathematical Modeling. The Department of Biotechnology, GOI, recognized the excellence of the university's Biochemistry, Biotechnology and Microbiology departments with a generous grant under the Inter-disciplinary programme of Life Sciences (IPLS). Other funding agencies such as DOD, DRDO, DST, DBT, CSIR and ICMR have also encouraged research carried out by the University with research grants. The National Bio-resource Development Board of the Biotechnology Department of the GOI has identified the Botany Department as a Bio-Resource Information Centre. The Ministry of Power, GOI, has given a prestigious R&D project to Applied Physics Department for Development of Remote Energy Metering System towards the Estimation of Zonal Energy Consumption with AMR. Applied Psychology Department has obtained research grants from Global Fund for researches relating to AIDS and from Kolkata Police on Drug Addiction in Kolkata. The Department of Jute and Fibre technology has received a five year project from Ministry of Textiles under the Integrated Skill Development Scheme.

This is a nutshell is about Calcutta University that has withstood many summers and winters and has been in the forefront in the area of teaching and research in the country for more than 155 years now.

Contact :

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Conferences / Meetings / Symposia / Seminars

4th International Conference on Recent Advances in Composite Materials, 18th-21st February, 2013, Goa

Theme :

- Polymer composites
- Wood composites
- Metal matrix composites
- Ceramic composites and advanced ceramics
- Nanomaterials and Nano-composites
- Biomaterials and Bio-composites
- Recycling & repair technology in composites
- Recent developments in fibre and particulate composites for structural and tribological applications (Fracture, Fatigue, Impact, Wear & Friction, Environmental studies)
- Critical issues in composites (Interfaces, processing applications and manufacturing)
- Testing & Quality control of composites
- Composites in intelligent and sustainable civil structure
- Application of composites in low cost houses and bridges
- Composite Technology - Industrial Applications

Contact : *Prof. V. K. Srivastava,* (Chairman-ICRACM), Dept. of Mechanical Engineering, Institute of Technology, Banaras Hindu University, Varanasi 0542-221 005, Email : icracm2013@gmail.com, Phone : + 91-542-6702833, Fax : + 91-542-2368174/2368428.

First International Conference on Bio-resource and Stress Management, 6-9th February, 2013, Kolkata

Theme :

Bio-resources

- Bio-resources, its utilization and processing
- Biodiversity, endangered and endemic species
- Traditional knowledge, primitive innovative technology, unused and under-utilized methods or tools, recovery of ethnic knowledge
- Microbial diversity, pathogenic and beneficial microbes
- Forest ecosystem, eco-management, eco-tourism
- Crop and soil management, Diversification and globalization of agriculture, conservation agriculture
- Bio-monitoring and bio-warning

Climate

- Climate change; soil, water, environmental pollution as well as atmospheric crisis; population pressure
- Environment education and capacity building

Stress Management

- Green Technology, Nano-technology, Bio-fortification, Genetic Engineering and Biotechnological tools for bio-resource and stress management
- RS & G1S applications in bio-diversity and landscape management
- Biotic and abiotic stress on plant, microbial lives, its management

Farmers' Meets

- Lab to land programme for the benefits of the farmers
- Socio-economic issues and livelihood security

Contact : *Prof Sampa Das*, Division of Plant Biology, Bose Institute, P-l/12. CIT Scheme, VII-M, Kolkata, 700 054, Email : sampa@bic.boseinst.ernet.in, sampadpb@gmail.com, Ph : +91-33-25693251

Eighth International Conference on Interdiscplinary Social Sciences, 30th July-1 August 2013, Charles University, Prague, Czech Republic

Theme :

- Social and Community Studies : On disciplinary and interdisciplinary practices in the study of the social
- Civic and Political Studies : On the processes of governance and nature of citizenship.
- Cultural Studies : On disciplinary and interdisciplinary practices in the study of human cultures and cultural interactions.
- Global Studies: On the dynamics of globalization and the transformation of the local.
- Environmental Studies : On the connections between human and natural environments.
- Organizational Studies : On the social dynamics of public, community and privately owned organizations.
- Educational Studies : On learning about the social and social learning.
- Communication : On the representation and communication of human meanings.

Contact : http://thesocialsciences.com/the-conference

S & T ACROSS THE WORLD

GENE THERAPY HOLDS PROMISE FOR REVERSING CONGENITAL HEARING LOSS

"This is the first time that an inherited, genetic hearing loss has been successfully treated in laboratory mice, and as such represents an important milestone for treating genetic deafness in humans," says senior study author Lawrence Lustig of the University of California, San Francisco.

Hearing loss is one of the most common human sensory deficits, and it results from damage to hair cells in the inner ear. About half of the cases of congenital hearing loss are caused by genetic defects. However, the current treatment options—hearing amplification devices and cochlear implants—do not restore hearing to normal levels. Correcting the underlying genetic defects has the potential to fully restore hearing, but previous attempts to reverse hearing loss caused by genetic mutations have not been successful.

Addressing this challenge in the new study, Lustig and his team used mice with hereditary deafness caused by a mutation in a gene coding for a protein called vesicular glutamate transporter-3 (VGLUT3). This protein is crucial for inner hair cells to send signals that enable hearing. Two weeks after the researchers delivered the VGLUT3 gene into the inner ear through an injection, hearing was restored in all of the mice. This improvement lasted between seven weeks and one and a half years when adult mice were treated, and at least nine months when newborn mice received the treatment.

The therapy did not damage the inner ear, and it even corrected some structural defects in the inner hair cells. Because the specific gene delivery method used is safe and effective in animals, the findings hold promise for future human studies. "For years, scientists have been hinting at the possibility of gene therapy as a potential cure for deafness," Lustig says. "In this study, we now provide a very real and big step towards that goal."

WILL WATER BECOME THE CHIEF COMMODITY OF THE 21ST CENTURY?

South Bend, Ind., avoided $120 million in upgrades and conserved millions of gallons of water by becoming one of the first cities on the globe to use cloud computing to manage its water systems.

In Oregon, local officials cooled down water from wastewater plants by planting trees near riverbanks rather than using cooling equipment, lowering investment costs at the same time.

The Department of Energy, meanwhile, is working with governors and transmission officials in Texas and the western United States on a multi-year computer project to find the best locations for new power plants faced with growing scarcity in nearby water resources to cool down their operations.

These examples underscore the many options available to alleviate a growing global water crisis exacerbated by climate change, water experts said at forum in Washington, D.C., sponsored by Growing Blue, a group created by Veolia Water in consultation with the United Nations, Columbia University and water conservation groups.

"Water is posed to be the commodity of the 21st century," said Richard Sandor, an analyst at Environmental Products, who also founded the Chicago Climate Exchange.

Current statistics—outlined in a new report from IBM at the event—highlight the challenges facing the water sector on everything from drought to storm runoff.

Between 2005 and 2030, the number of people living in areas where water demand will exceed available supplies could rise 40 percent, from 2.8 billion to 3.9 billion, the company said.

By 2070, the value of flood-exposed economic assets in 136 major ports could reach 9 percent of global gross domestic product. In global agriculture, 35 percent of annual water is wasted because of "poor resource management."

In the United States, there will be a need for 165 percent more water by 2025 above 2000 levels, the report says. Energy use—such as use for cooling down power plants during hot summers—accounts for 49 percent of U.S. water demand.

Tight supplies will be further squeezed by a potential shortage of workers managing stormwater, drinking water and wastewater systems, said Mary Keeling, a manager at IBM. The issue is "often overlooked," she said.

In the United States, the average water utility worker is 44.7 years old, with a retirement age of 56, Keeling said. That raises serious questions whether utilities will have the personnel they need to address problems such as drought, she said.

For Sandor, an obvious answer to future water shortages is water trading, which would allow water-stressed areas to purchase supplies from other regions. As one example, he said that it takes the same amount of water to make $250,000 worth of alfalfa as it does to run an Albuquerque, N.M.'s computer chip plant, yet farmers "can't sell their water rights" in the state, he said.

While it could take 10 to 20 years to build a water trading system in a given region, it is an idea that would boost conservation tremendously, he said.

The idea is a controversial one. A study in the *Journal of the American Water Resources Association* published this spring outlined the potential difficulties of setting up a water trading system in the American West, including the fact that there is not an umbrella authority over states in the 1922 Colorado compact.

Some critics also are concerned about trading altering river flows and disrupting hydroelectric dams, among other things.

Yet Sandor said Alberta, Canada, could be a first mover. The province faces multiple pressures of growing oil extraction, business development and population growth in an arid climate, and there are preliminary discussions about the concept *(ClimateWire,* Aug. 3, 2012).

FORM IV

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I, S. S. Katiyar, hereby declare that the particulars given above are true to the best of my knowledge and belief.

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S. S. Katiyar
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