EVERYMAN'S SCIENCE

Vol. XLIV No. 4 (October '09 – November '09)

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

Past General Presidents of ISCA

1. Prof. S. K. Mitra	**(1955)**
2. Dr. M. S. Krishnan	**(1956)**
3. Dr. B. C. Roy	**(1957)**
4. Prof. M. S. Thacker	**(1958)**
5. Dr. A. L. Mudaliar	**(1959)**
6. Prof. P. Parija	**(1960)**

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EDITORIAL

WHY DO PEOPLE COOPERATE ?

We will discuss this question in some detail and what follows has been largely inspired by an interesting write-up by Elizabeth Pennisi in a recent issue of Science (4 sept. 2009, Vol. 325.)

That our society stands on cooperation amongst individuals for mutual benefit is well known. Often it is a case of reciprocal altruism. (You scratch my back and I scratch yours). Yet there are many puzzling facts. Some of these and the possible answers are discussed.

- When two monkeys groom each other, no doubt it is pleasurable for the one groomed. Yet scientific studies through probes, implanted in the brains, have shown that actually the groomer benefits more as his brain signals release far more feel good chemicals in his body by cooperating.
- A person with reputation about helping others gets help from others more readily. People like to cooperate with helpful persons without the aim of an immediate gain. Moreover, they themselves may not have received help from the person of reputation. Obviously, this is explained by our innate desire to be associated with do-gooders, unconsciously to aquire some merit.
- As is well known, workers in our industry cooperate well with the management if they are paid well. However, often the cooperation extended exceeds what is solely expected based on self-interest.

Amongst the workers there is a feel good feeling if they are paid fairly and they respond very positively. On the other hand, the perception of an unfair pay may generate hostility beyond what is rational, the dissatisfaction is disproportionate. However, the perception of fairness is subjective and this can be influenced by factors other than pay.

- Some people help strangers and cooperate with them in their hour of need even though there may be no question of reciprocal behaviour.

  Altruistic behaviour may be intrinsic, individuals being conditioned by the society to value honour, pride and self interest.
- The sacrifice of soldiers in battles is an example of extreme cooperation in affairs of the state. The answer to why one will fight to death is not an easy one. The reasons will include struggle for a cause, love of something, hatred against the enemy, revenge or simply the habit of obeying a command.

A very senior general of the army once explained to me that, at least in the Indian army, love of the motherland is not the first cause, nor the hatred for the enemy. The first thing that overrides everything else is the solider's desire to keep up his reputation in his family and community. His pride in his battalion and loyalty to the commanding officer come next. In the Indian army the tradition of regiments based on caste, region and ethnicity is a time-tested one.

The terrorists out on suicide missions also cooperate with their masters. Obviously they are brainwashed to believe that their mission is noble and there are big rewards waiting for them in afterlife. Those who are trained to kill may not have the emotional feelings like ordinary persons when they take lives and destroy things.

- In every society there are always cheaters who are only for themselves, they will not help others. Thus many students, even class toppers, will not share their books and class notes and some even hide library books so that others cannot find them.

  Normally, the number of such cheaters is kept in check. If unchecked the society falls apart.

- It has been established that punishments are generally not very effective in elimination of cheaters and deviants. In fact, those punished can well become serial offenders, a kind of hardened criminals. Punishments may worsen the situation by escalating interpersonal conflicts. Yet the dilemma remains that if there are no exemplary punishments then fear of punishment also disappears as is evident today amongst highly placed people. The fear of court martial in the army for quitters who do not obey to cooperate in operations is effective because punishment is quick and this means loss of face.

- Cooperation and sacrifice are rampant in nature and there are numerous examples amongst the so-called lower animals and even microbes. Thus there must be something genetic and instinctive that goes beyond conscious decision making.

  Groups that enjoy more cooperation within have better chance of survival and reproduction. So cooperation became essential in evolution. Mutants do produce cheaters but as mentioned previously, the cooperating members keep the cheaters in check.

- Charles Darwin had found difficulty in explaining why a worker bee would labour for the good of the colony even though its efforts do not lead to its own reproduction. They are genetically programmed to cooperate in large numbers to do what individuals can never do. Lions hunt in packs and so do criminals, in such cases with some intelligence, of course.

- Darwin had observed that selection might favour families whose members were more cooperative, even though some deviants i.e. cheaters may enjoy an edge over others through aquiring benefits without making sacrifices or spending energy for others. Deviants threaten stability and are often firmly dealt with.

- Cooperation is enhanced amongst members of a family. There is a theory that says that one's relatives, progeny share some of one's genes. This implities that relatedness enhances chance of cooperation. This mind of bonding is strong amongst animals and this may also explain ethnic bonding where

kinship drives cooperative behaviour. The Arabs have a saying, 'I against my brother, my brother and I against the cousin, the cousin, my brother and I against everybody else'.

This theory however, does not explain why humans often cooperate with a non-relative or even a stronger who has nothing to give in return.

- Like in everything else, there are aberrations in matters of cooperation. We have earlier mentioned cheaters. Then there are some who compel others to cooperate when they operate. In the other extreme there are a few who extend generous help and cooperation but prefer to remain anonymous refusing to receive any rewards. Contrary to this, sadly there are people who corner undue rewards for 'services rendered' when actually some other persons have done the work. Those are the real cheaters.

Hem Shanker Ray

"It is not enough to have a good mind. One must use it well."
—Descartes

PRESIDENTIAL ADDRESS

GRAMMAR OF SCIENTIFIC DEVELOPMENT

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The convention, that the President of the Indian Science Congress should address the annual gathering of scientists, enjoins me to stand before you this afternoon, but while conventionally, the President elects to speak on a specialized field of Science or technology, with which he is intimately associated, I propose to make a departure and address you on a subject which is not connected with my expertise, but which concerns us all and, at the same time, is in conformity with the main objective of the Association, namely, "to advance and promote the cause of Science in India". I felt, and I felt strongly, that an opportunity such as this should be utilized for sharing with you my thoughts and musings, my dreams and hopes, on the basic requirements for the advancement of Science as a whole. I am convinced that without addressing ourselves to what I may call the "grammar" of scientific development, our progress can at best be halting and our achivements, of a routine character.

It would be trite to say, today, in plan-conscious India, when the nation's endeavours are canalised to raise productivity and through it, the standard of living of the people, that the advancement of Science and technology is a dire necessity. I am not a believer in slogans, but I cannot help giving expression to my conviction that without an abundance of Science and technology and without establishing them on self-perpetuating and exponentially expanding basis, I see little hope of progress. This may sound strong, but the writing on the wall is clear, thanks to the stupendous and far-reaching developments in nuclear fission and fusion and artificial earth satellites. We can ignore Science and technology only at our peril.

What are our responsibilities, then, as scientists in the promotion and advancement of the cause of Science in India ? We have been endeavouring, particularly since Independence, to expand facilities for teaching and research in Science and technology, and while we have achieved during one decade much more than in many previous decades, I may be pardoned if I feel impatient and say that we have not done enough. The problems before us are many and the need for solving them is urgent. In the context of the developments which are taking place in other countries, our attempts appear to be feeble. If we have to make progress, the "climate" for Science and technology must be made much more propitious, much more responsive, much more encouraging, and in this matter all of us have a responsibility.

From the vantage point of mid-twentieth century, we may take a peep into history to learn the nature of the causes which operated inexorably through the various epochs to give Science and technology the dominant position they have come to occupy today. History teaches us that Science and society

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inevitably act and react on each other with consequences to both. While the impact of Science has always been to revolutionze the conditions and conventions of society, the latter tends to resist the changes Science has progressed in those periods of history, and in those geographical areas, where society has not only acquiesced in, but has actually encouraged Science and its applications. While there is a prodigious amount of literature, including fiction, on the impact of Science on society, comparatively little appears to have been written on the role of society in the evolution of Science. Most historians of Science take Science as the main theme for exposition and everything else as secondary consequences flowing from discoveries, but such treatment does not permit the examination of the social background which made possible the great developments which have made the present, the Age of Science and Technology.

Science came into existence at a comparatively late stage in man's history, long after religion, long after man had adapted himself to community living, and only after he had outgrown the anti-scientific tendencies and inherently false approaches of primitive cultures. It developed independently of the useful arts, but only after the social organization had created a class of thinkers with sufficient leisure and intellectual curiosity to inquire into and understand the world of Nature. The great founders of Science sought intellectual satisfaction and no more, only theoretical, contemplative *weltanschauung*. Practical applications of knowledge were not their concern. This disinterested desire "to know, to understand" has continued to be the main impulse actuating scientists in their discoveries from the ancient period down to the present day. It is stated that one of the rare occasions when Newton laughed was when a friend, to whom he had lent a copy of Euclid's *Elements* asked him of what use or benefit in life the study of the book would be !

The possibilities of applying the method of scientific deduction for practical ends were recognized and demonstrated even in the heyday of Greek civilization, as for instance, by Archimedes, although they were not extolled or made much of by the scientists themselves. We know, on the authority of Virgil, that the seed of technology was sown at a comparatively early period of history. Due to the paucity of records in the pre-printing age, a proper appraisal of the developments in the earlier periods has not been possible. The social environment from the time of the Italic Renaissance onwards became favourable for technological adventures in Europe, and great writers of the period acclaimed the importance of discoveries and inventions. It was during the Renaissance period that people in Europe threw off the yoke of Middle Ages and the restraining bonds of theology. The French Revolution, found use for physicists and chemists and the New Republic "hired" them for systematizing weights and measures. In the age of the Industrial Revolution, the rule of arioscracy bowed down before the rise of the middle class. The practical applications of Science gained emphasis over the disinterested pursuit of knowledge and social support for Science became available. The rise of capitalist industrialism created a demand for inventions and the secuarl universities which came into existence gave a dominant place to Science teaching and scientific research. The potentialities of Science for catering to the material comforts of man came to be deliberately explored.

The march of civilization in the West since the nineteenth century has become inevitably bound with progress in technology. The tools and instruments which technology designed and fashioned are employed for probing more penetratingly into the realms of Nature ; thus helped, scientific research has been producing

results which technology utilizes to advance material civilization. Marching in step, and in resonance, Science and technology have ventured into new horizones producing marvels of human ingenuity. The pace of development is so quick, that it has become difficult for any scientist to keep track of advances even in his own limited field. Discoveries of today become the nucleus of a new Science of tomorrow. The two world wars provided proving grounds for technological creations, and the world witnessed with surprise and dismay, the powers which Science and technology have unleashed ; they demonstrated, at the same time, in a most eloquent way, the possibilities of Science for achieving peace and plenty and for making man's life rich and meaningful.

Science has emerged as a carrier of a new socialism, realistic in emphasis and rationalist in aim. In an astonishingly short period it has brought radical changes in the patterns of industry and in the organization of Science itself. The scale of scientific and industrial activity outgrew, long ago, the social institutions which gave rise to the Industrial Revolution. Research has come to be recognized as an industrial asset, and invention as an occupation of professionals. Laboratory research has found new meaning and new purpose.

It is not my intention today to discuss the implications of the achievements of Science and technology in Western countries ; my purpose is rather to emphasize that social awareness and social support have determined the progress and direction of Science. If history has a lesson, it is this : everything that sustains and progresses comes as an upsurge from within, not as a result of something imported or invited, from without. Nothing sustains unless it is of the people and by the people.

The Present Position

We started with the premise, which in the context of the present situation has the status of an axiom, that the rapid advancement of Science and technology is a pre-requisite for the development of the nation's material resources and economic welfare. We have emphasized the lesson of history that such advancement can come only when the effort of scientists are backed by social support. On our innate ability to achieve results there can be no doubt ; we are endowed with an abundance of nature resources and we have a rich wealth of human talent ; we have the tradition for objective inquiry and acquisition of knowledge. Where we have lagged behind is in the application of knowledge to useful arts, and the establishment, through such application, of industrial production on a continuously progressive basis. While nothing is to be gained by deploring past neglect, the awareness it has engendered should spur us to action and promote Science and technology boldly and with determination.

The need for improving industrial productivity has always existed ; it has now acquired urgency. We have hitherto sought inspiration from outside. We have imported plant and machinery, know-how and expert assistance. Perhaps this has been necessary in the circumstances. The result has been that the larger mechanized industries of India are, by and large, those which have been developed in other countries. Those based on indigenous inventions are few and far between. In the context of the new socialistic trends which permeate western technology, a liberal amount of assistance may be forthcoming. We, no doubt, seek knowledge, wisdom and friendship from whatever source they are to be had, but like the bee gathering nectar from whichever flower it is available, and transforming it into honey which is entirely its own, we should adapt such assistance to our own needs and requirements, and evolve a pattern of industrialization which we can call our very own.

This will be possible only if we succeed in developing Science and technology. Scientists and technologist have thus a responsibility, challenging but meaningful and with potentialities of a great achievement.

The contemporary scientific scene in India is one of considerable complexity. On the one hand, we are faced with a shortage of personnel with specialized skills and on the other, we are confronted with fragmention of Science and the need for liberalizing the education of the scientist so that he may combine knowledge with wisdom, expertise with vision. We are witnessing the peculiar spectacle of technical men being weaned away to other walks of life ; our universities and technological institutions are being depleted of their best teachers who find more gainful employment in Government departments and industrial establisments. Research results of proved value remain unutilized by industry, while the hunger for new processes and techniques continues unabated. All these may be signs of a fast developing techno-economy, but the problems are real and we shall be open to the charge, by posterity, of indecision and pusillanimity if we do not find satisfying solutions for them expenditiously.

The systematic promotion of improvements in production—agricultural, industrial, or otherwise—has created a continuously rising demand for the services of persons trained in a variety of skills and knowledge. While much has been done, and is being done, to train personnel, the real solution can emerge only when a serious effort is made to seek out all those who have the talent to profit by a scientific career. In a country richly endowed with human wealth, there can be no dearth of men and women gifted with curiosity and imbued with a passion for inquiry. The task is to stimulate these human endowments wherever they lie latent. No systematic "talent search" appears to have been so far undertaken on a nation-wide scale. No effort has been made to tend and nourish the talents, abilities and aptitudes of the youth and kindle their enthusiasm to the delight of learning, at first hand, something new about Nature. It is time that we thought of enlisting new colleagues among the youth to help explore Science in its diverse aspects. Each one of us should undertake, in a spirit of dedication, the task of mobilizing the untapped resoures of the nation and guide the new recruits to the high adventure of discovery and invention.

The demand for personnel has outstripped the facilities available for training and has necessitated evaluation of our training programmes. We need an increasingly large number of teacher and scholars, research scientists and engineers, doctors and public health specialists and persons equipped to manage, lead and venture into new enterprises. The process of equipping large numbers of men and women to undertake tasks with knowledge, competence, intiative and enterprise is a matter of vital concern. The levels of accomplishment called for must be achieved with the resources we have. Our academic institutions and research organization must be husbanded with insight and imagination. We should initiate a system of interchange of scientists and specialists between universities and research laboratories on the one hand, and between these and industry on the other. I have, on many an occasion, emphasized the need for building up a system of exchange of personnel between organizations engaged in training and those concerned with utilizing personnel, not only for vitalising individual institutions, but in the overall interest of inducting a sense of urgency into our programmes and achieving the targets demanded by the realities of the situation.

The tempo of the requirement of scientific and technical personnel must be accelerated. This problem is urgent in the context of the dire need for the services of the all-too-scare specialists—be they scientists, engineers or technologists—in national reconstruction tasks, for which the demand is large and the supply limited. We must determine the pattern of their deployment which would yield results from the point of view of both immediate and future requirements. Several Indian students with brilliant academic records have received or are receiving advanced training in laboratories and institutions in India. A large number of our young men and women are at present undergoing specialized training in various countries abroad. The placement of such personnel is engaging our attention. But our administrative procedures must be considerably simplified so that such personnel may be absorbed in appropriate places as soon as their training is over.

We are also concerned with shortages which exist at the level of high intellectual talent. There cannot be enough talent at this level at any time, and shortags will always exist. A small percentage at this level would be in the genius category, and all that we can and ought to do is to create the "climate" under which geniuses uncover themselves.

I have often asked myself the question whether the conditions in which some of our able scientists are functioning are such as to get the best out of them. Too often we load the scientists with routine and other non-productive work. Our administrative machinery has not been designed to encourage just the "out-of-the-wayness" or "idiosyncracy" of the scientists, which distinguishes him from the ordinary man, and guided by procedures and precedents, it tends to bring scientists and others into a common rigid steel frame. It is well to remember that scientists are not just the ordinary run of people. They are not normal, in the sense that they seek to do things which are out-of-the-ordinary and it is precisely such adventures that are rewarding. Administrative procedures, which perhaps are necessary elsewhere, may prove too cumbersome to the creative genius of the scientists.

Administration should recognize and respect the interests of scientists and permit them to explore the areas in which their talents lie. As Dr. Conant, President of Harvard, observed sometime ago, there is only one proved method of getting results in scientific research : picking men of ability, backing them heavily, and giving them freedom to pursue whatever path appears to them most promising. Science is a delicate plant, exacting in its demands and can thrive only in the warmth of encouragement and deference. Wise administration can go a long way, a very long way, in providing conditions which would enable scientists to give off their best to the nation.

Scientists should also recognize that besides contributing to the enrichement of different fields of research, they have also certain extramural responsibilities, as for example, in the training of personnel in its manifold aspects and in the creation of enlightened self-interest. Too often we hear of lack of buildings, lack of equipment, lack of funds, and so on ; what we really lack is the determination To Do. Buildings and equipment do not make for scientific progress. I have often observed that quite remarkable work is turned out in plain simple laboratories, some of them even improvised and many not lavishly equipped or housed. A good many items of equipment can be designed and fabricated with available facilities without having to wait for import licences or provision of foreign exchange. We have to woo Science with greater ardour, greater devotion and greater faith than hitherto, if our approaches are to be favoured and rewarded.

From whatever angle we survey the contemporary scene—personnel requirements, training of scientists, liberalising education, or any other—we are impressed by the urgency for a deeper comprehension of the fundamental needs and for relating knowledge with action. Science, technology and invention are the most important element for improving the material welfare of the people and their development is conditioned by social purposes and social support. Without such support, Science and technology cannot find the means or the inspiration for development. Without a well-defined social purpose, the search for technological facts will degenerate into dilettantism ; and all measures which we may formulate to promote science and technology in isolation, will prove inconsequential. The clear requirement, then, is to exert and spread the understanding of Science among the people so that, assured of public support, we may move with freedom and explore the beneficent results which Science and its applications make possible.

Social Understanding of Science

Penetrating minds have held the view that the consequential value of the scientific way of thinking transcends the material benefits which science has conferred on mankind. It is to the propagation of this sustaining value of Science that scientists must address themselves. It is a big responsibility which can be discharged only when the scientists revise their "ivory tower" attitude and recognize that their responsibility to society is no less important than their loyalty to Science and that there is no conflict between the two.

Science is not merely thematics, that is, the study of certain subjects. It is study by a certain method which emphasizes observation and experiment, reasoning and deduction, a method based on facts, their sequence and relative significance. The scientific method enjoins one to be critical of all things and accept only facts which are amenable to verification and test. It has a place as much in the education of the scientists and technologist as of the craftsman and citizen, whether he be employed in a skilled or unskilled job, in agriculture or administration.

Everyone longs in a vague sort of way, for an uderstanding of Science, and this has to be satisfied, not by providing bits of information, but by making him aware of the basis on which Science rest, the method by which rational knowledge is gleaned. The real danger to education is to mistake the provision of information for the imparting of knowledge. It is easy to acquire strands of information from diverse sources, but that does not help in understanding Science. The greatest common factor of all Sciences is the method ; and the mind that has been trained in the scientific method and habituated to form judgements on the basis of facts, their relative sequence and significance, converts all the passes through it into Science. It is such a mind that is best equipped to meet the challenge of change in a dynamic and forward-looking society.

The educational task involved in promoting the understanding of Science is a gigantic one, but all the attention that is devoted to it and all the effort expended on it will prove most rewarding. A primary requirement is to dispel the popular conception that Science is some sort of a super-discipline practised by specially trained people using very complicated precision instruments. This incorrect, if exalted, view of Science has tended to separate the scientist as a class from the people. Science is a very human enterprise and is basically a methodological approach to understanding. The best way to obtain an insight into the method and to acquire the habit of dispassionate thinking is to take a live interest in some small area of natural

phenomena. The material for science is co-extensive with the whole physical universe and there are many problems which are amenable to investigation by tools and techniques which are ordinarily available to the layman. I may mention, as instances, observations relating to weather phenomena, variable stars, bird migrations, distribution of plants and animal species and minerals. The opportunities for study are limitless and the whole book of Nature is open to those who possess an inquiring mind and are acquainted with the alphabet of Science. Science has room for everyone for all time, and it stands to gain by mass-participation in its work. Mendel, Darwin and many other names that adorn the book of discovery were amateur scientists.

I have referred to amateur Science as one of the means of spreading an appreciation of the scientific method. There are, no doubt, other means open, which can be worked out by scientists and educationists working in concert. The important thing is to stimulate interest in enquiry among the people as a whole, particularly among the children, and no effort should be spared to attract the youth to the vast field of Science ; it is to the youth we look for promoting the resurgence we are striving for.

The "climate" for this great educational task has become particularly favourable since Independence. The nation is, as it were, in a ferment and unprecedented enthusiasm for economic reconstruction permeates all sections of society. Craft-centred instruction has become the pattern for primary education throughout the country and a bias for practical and social values is being inculcated, along with the teaching of the Three R's, from the earliest stages. The Five Year Plans are bringing goals and targets into the picture, and working to a time schedule to attain predetermined objectives has become the economic philosophy of the nation. The introduction of the national calendar, the decimal coinage, and the metric weights and measures has brought in new systems and standards in social transactions. A new order geared to progressive ideals and ideas is coming into existence. The ground has been prepared for the spread of the understanding of Science and through it, the spirit of inquiry, the critical habit of mind, and rationalist approach to practical affairs.

The duty of scientists in promoting the public understanding of Science assumes importance in the context of the newer Promethean creations of technology, which are being released in breathless succession. Francis Bacon stated that "God has placed no limits to the exercise of the intellect He has given us on this side of the grave". Bacon envisaged the exercise of the intellect only for the emancipation of man. The newer developments, from the point of view of knowledge gained, have extended the glory of man, but they have inculcated, at the same time, a fear of knowledge which has potentialities for more harm than good. In this situation of uncertainty and doubt, safety lies in the collective social wisdom, for it alone can determine the direction of technological applications and can hinder or nullify injurious experimental ventures.

The Task before Us

If our faith in Science and technology as a promoter of public good is sincere, then our clear duty is to create those conditions which will permit us to pursue Science and promote its applications. The lesson of history and the requirements for scientific progress all point to the need for promoting the public understanding of Science, and it is to the creation of this understanding that we should dedicate ourselves. Our success will be determined by our sincerity and zeal, and in tackling

a problem of this magnitude, we should act collectively as disciplined armies, not individually as "guerilla" fighters. Scientists, engineers and technologists mush willingly and gladly shoulder this responsibility. Let us get together without loss of time, formulate programmes of action, and strive forward with all the zeal at our command, to achieve the desideratum for progress.

The finances required for the overall progress in Science will bo doubt be large, but no impassional plea is called for, to convince the people of this great country that development is possible only through science. Our resources are perennial, and if we reckon even at one rupee *per capita* which is less than half of one per cent of the national income, we should be able to find funds within our own means and resources to make a headway.

Scientists and technologists in India occupy a position of trust, and the country as a whole avidly awaits the benefits that stem from their work. Our Prime Minister, Shri Jawaharlal Nehru, has, time and again, stressed the important role which scientists and engineers have to play in the reconstruction of India and has made appreciative references to their work. We should not allow this sense of importance to lull us into complacency. Let us remember that we are on the threshold of an era of great and revolutionary changes in our land. It is not every generation that has the challenging opportunity to serve the motherland.

Most of this onerous responsibility will devolve on the shoulders of the younger generation and it is to this generation we look for leaders and the rank and file of builders of resurgent India. I take this opportunity to appeal to the youth of this country to rise to the occasion and equip themselves for the tasks of tomorrow. It has been a great blessing to us that, in our Prime Minister, we have a stalwart champion of the cause of Science, and all of us can set about our tasks with the firm conviction that we enjoy his invaluable support in our endeavours.

STEM CELL THERAPY : PROBLEMS AND PROSPECTS

K. P. Agrawal*

The stem cell research is mainly focused on : (1) to understand the process of development to learn how specific cell types and specific tissues and organs are formed (2) to understand what goes wrong in cells to cause various diseases and (3) to study therapeutic value of stem cells. These unique characteristics make stem cells very promising to treat debilitating diseases like Alzheimer's disease, cancer, Parkinson's disease, type-1 diabetes, spinal cord injury, stroke, burns, heart disease, osteoarthritis, rheumatoid arthritis, etc. Stem cells also have the potential for developing organs and tissues which are used to replace organs that are diseased or destroyed.

INTRODUCTION

Stem cells are undifferentiated, "blank" cells which under proper conditions can develop into specialized tissues and organs. Stem cells have two important distinguishing characteristics, first, they can replenish their numbers for long periods through cell division and second, after receiving chemical signals, they can differentiate, or transform into specialized cells with specific functions. Stem cells can be classified into different cell types. Totipotent stem cells can differentiate into any cell type in the body plus the placenta. A fertilized egg and the cells produced in the first few divisions are totipotent. Pluripotent stem cells are developed 4-5 days after fertilization and can differentiate into any cell type, except the cells of the placenta. Pluripotent stem cells cannot grow into a whole organism. Multi-potent stem cells are descendents of pluripotent stem cells and antecedents of specialized cells in a particular tissue. For example, hematopoietic stem cells which can give rise to all types of blood cells, neural stem cells which can differentiate into nerve cells and skin stem cells that give rise to various types of skin cells. Progenitor stem cells (or unipotent stem cells) can produce only one cell type, for example, erythroid progenitor cells.

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SOURCES OF STEM CELLS

There are two main sources of stem cells : embryonic and adult. Umbilical cord, placenta, amniotic fluid, baby teeth are other important sources of stem cells.

Embryonic Stem Cells (ESCs) : All human beings start their lives from a single cell, called the zygote. The zygote divides and divides and after about five days of conception, a hollow ball of cells called the blastocyst is formed. The blastocyst contains two types of cells, the trophoblast and the inner cell mass. Embryonic stem cell are derived from the inner cell mass of the blastocyst. These cells have unlimited potential of growth and differentiation. Embryonic stem cell cultures are created in the laboratory by transferring the inner cell mass from a blastocyst into a specially treated plastic culture dish. The cells divide and, after several days when culture dish is crowded, the cells are removed and plated into several fresh

culture dishes. This process is repeated many times, eventually yielding millions of ESCs. If after six months, the cells keep dividing without differentiating, still pluripotent and are genetically normal, they are referred to as an ESC line. The embryonic stem cells are more versatile, have a much greater utility and potential than the adult stem cells, because the embryonic stem cells may develop into most of the 220 types of cells found in the human body. Embryonic stem cells also continue to divide indefinitely when placed in culture, while this may not be the case for adult stem cells.

Adult Stem Cells (ASCs) : Stem cells can also be found in very small numbers in various tissues in the adult body. For example, bone marrow stem cells found in the marrow of the bone can give rise to all specialized blood cell types. Adult stem cells after programming if form different cell types of their own tissue, are called multipotent stem cells. An example of multipotent stem cells is haematopoietic cells. These are blood stem cells, produced by the adult body. Adult stem cells have not yet been identified in all vital organs. The most common place to obtain adult stem cells is from the bone marrow. The marrow is harvested from human donors at the iliac crest (the back of the upper hip bone). Different types of stem cells are found in the bone marrow : hematopoietic stem cells, endothelial stem cells and messenchymal stem cells. Hematopoietic stem cells form blood, endothelial stem cells form the vascular system (arteries and veins) and mesenchymal stem cells form bone, cartilage, muscle, fat and fibroblasts. The cells from the bone marrow also contribute to regeneration of damaged liver, kidney, heart, lung and other organs.

Other Sources : Stem cells can also be obtained from sources like the umbilical cord, placenta, amniotic fluid and baby teeth etc. This is an easily accessible source of stem cells, compard to adult tissues. Stem cells from umbilical cord blood or the pulp under baby teeth are "younger" stem cells than those obtained from adults. They are able to divide for longer times in cell cultures than most adult stem cells, and may give rise to different tissues. Other potential source of stem cells is from early fetal tissue. An embryo is called a fetus at about 7-8 weeks following fertilization. Human aborted tissue is the source of cells. When isolated and cultured, these germ cells have properties similar to stem cells isolated from the inner cell mass of blastocysts. Frozen embryos are another source of pluripotent stem cells. Therapeutic cloning is another way to obtain pluripotent cells. In this procedure, which is called somatic cell nuclear transplantation, DNA from an individual patient is inserted into an egg and the egg is activated to divide. After only a few cell divisions, the pluripotent stem cells are extracted. The advantage of this technique is that the extracted stem cells are genetically matched to the recipient, posing little or no risk of rejection.

THERAPEUTIC USES OF STEM CELLS

Stem cells can be used to generate healthy and functioning specialized cells, which can then replace diseased or dysfunctional cells. Some conditions or injuries can be treated through transplantation of entire healthy organs. Thus, any disease in which there is tissue degeneration can be a potential candidate for stem cell therapies, including conditions and disabilities as Parkinson's and Alzheimer's diseases, multiple sclerosis, spinal cord injury, stroke, paralysis, heart disease, Type 1 diabetes, osteoarthritis, rheumatoid arthritis, muscular dystrophy, liver and kidney diseases, auto-immune and metabolic disorders (amyloidosis), chronic inflammatory diseases (lupus) including cancer, eye diseases (retinal degeneration (blindness), glaucoma and macular degeneration), skin grafts to treat serious burn cases, and hair cell degeneration (hair loss). In all of these diseases, the healthy cells are integrated into the body and begin to function like the patient's

own cells. Serving as a sort of repair system for the body, stem cells can divide without limit to replenish other cells as long as the person or animal is alive. The human life span can also be extended due to the replenishment of tissues in aging organs.

Replacing diseased cells with healthy cells, called cell therapy, is similar to the process of organ transplantation, only difference is transplanting cells insted of organs. Adult, fetal and embryonic stem cells as a resource for various specialized cell types such as nerve cells, muscle cells, blood cells and skin cells, can be used to treat various diseases. For example, in Parkinson,s disease, stem cells may be used to form a special kind of nerve cells, that secrete dopamine. These nerve cells if transplanted into a patient, will re-wire the brain and restore functions, thus treating the patient. Umbilical cord blood stem cells are used for stem cell transplantation to reconstituted blood cell formation (the hematopoietic system) in patients that have been irradiated or treated with specific drugs for cancer or leukemia. In some genetic diseases, where patients have problem of normal blood cell formation, a transplantation of matched umbilical cord blood cells can give them a new blood-forming system. The new cells are infused into the vein of the patient and then they are able to find their way into the bone marrow, in a process called "stem cell homing".

Adult stem cell replacement, through bone marrow transplantation with a matched donor, has been a well-established treatment for blood cancers and other blood disorders. However, problem of toxicity and donor availability are serious limitations of this approach. It is hoped that genetic alteration in patient's own bone marrow stem cells, and subsequent transplantation, will provide a viable alternative in near future. Recently, new possibilities for the use of adult stem cells have emerged wherin cells from the bone marrow can give rise to specialized cells in a variety of tissues as different as blood, muscle, kidney, pancreas and liver. Soon it will be possible to isolate patient's own bone marrow cells, treat them and reintroduce them back into the body to renew or repair cells in a number of different organs. The approach will eliminate chances of rejection. Hematopoietic stem cells (HSCs), present in the bone marrow are commonly used to treat leukemia, lymphoma and several inherited blood disorders.

Human cord blood, neural stem cells and human embryoni stem cell banks have been established in various countries for the treatment of specific genetic and acquired dieases. Three organizations (Life Cell, Cryobank and Reliance Biotech) are presently concentrating in stem cell activity in our country. Life Cell launched in Chennai in November, 2004, is India's first private cord blood bank and in just 20 months of operation, about 3000 expectant parents enrolled for stem cell banking. Many other young couples are queuing up to store their offsprings stem cells with the hope that it can be used to treat any disease their Child might suffer from. Storing the umbilical cord blood is the greatest life insurance and protect their children from future ailments. The facilities for umbilical cord blood have been created in many places in India. The cost of storage of umbilical cord blood in India is about Rs. 70,000/- which is much less as compared to developed country like Britain where storage cost is about 1500-2000 pounds. Some companies in India are now offering installment options also.

The procedure of stem cell banking from umbilical cord is very simple and painless for both the mother and the baby. In this procedure, immediately after the delivery, the baby's umbilical cord is clamped and cut. The sample is then collected from the detached umbilical cord, processed and preserved in cryo-vials (-196□C). These samples can be used for years by the baby, its siblings or immediate family. There is no ethical dilemma in using cord blood stem cells as the

blood is drawn from the discarded umbilical cord and placenta after child birth.

Even cosmetic surgery could be transformed by cell therapy. American firm, Solagen is offering a treatment to banish wrinkles. It involves taking tiny skin sample to grow vast quantities of fibroblasts which are injected back into the face where they make new collagen which keeps skin taut and wrinkle free. Some research teams have cured paralysed animals, using cells harvested from their bone marrow to encourage damaged nerves to regrow. Brazilian scientists have claimed to restore feeling in 12 paralyzed patients treated with their own stem cells and given electrical stimulation. Urinary incontinence, which affects lakhs of people around the world, could be cured using adult stem cells extracted from muscle tissue in the arm. Austrian doctors are already using the technique to treat the women affected by the condition.

The use of stem cells to mend wear and tear to spinal discs has been sucessfully tested in the laboratory. Extracted from a person's bone marrow, the cells are developed in the laboratory, where chemicals are added to coax them into becoming disc cells. The disc cells mixed with collagen when injected into the spine through a fine needle, they repair any damage to the discs. The addition of collagen aids the healing process. British scientists have grown a miniature human liver from stem cells first time in a world. The organ can immediately be used to test drugs, therefore reducing the need for animal experimentations. The liver tissue is created from stem cells found in blood removed from the umbilical cord minutes after birth. They are then placed in a 'bioreactor' to mimic the effects of weightlessness. Inside this, the freedom from the force of gravity allows them to multiply more quickly than usual. Various hormones and chemicals are then added to coax the stem cells into turning the liver tissue. Some time back, a heart patient whose bypass surgery was difficult, when treated with stem cell therapy a significant improvement was noticed. Very recently scientist in University of Minnesota in America revived dead heart in an animal by stem cell therapy.

German researchers successfully developed skin from the stem cells obtaind from hair root. Ulcers and old wounds can be successfully treated with this technology. In a new technique developed at Kyoto University, the skin cells are exposed to viruses, each carrying one of four critical genes. These accomplish the same reprogramming task as the egg, or at least one very similar. The technique is much easier to apply than nuclear transfer, does not involve the controversial use of human eggs, and should avoid all or almost all of the ethical criticism directed at the use of embryonic stem cells.

The other approach of stem cell therapy is through organ replacement. In-vitro production of organs from patient's own stem cells and transplanting back to the patient has been possible in recent years. In this process, danger of organ rejection is eliminated. Growing of entire organs like heart, liver and even kidneys under laboratory conditions is at experimental stage.

CHALLENGES OF STEM CELL THERAPY

There are several scientific challenges that need to be addressed before the power of stem cell therapy is truly harnessed. The challenges are : (1) difficulty to identify and isolate stem cells in tissue cultures, which contain numerous type of cells ; (2) developing right biochemical solution to cause these progenitor cells to differentiate into the desired cell types. As embryonic stem cells grow very fast, one must be very careful in differentiating them into specialized cells. Otherwise, any remaining embryonic stem cells can grow uncontrolled and form tumors ; (3) integration of implanted stem cells into the patient's own tissues and organs and "learn" to function in consort with the body's natural cells. Cardiac cells that beat in a cell

culture, for example, may not beat in rhythm with patient's own heart cells and the neurons injcted into a damaged brain must become "wired into" the brain's intricate network of cells and their connections in order to work properly ; (4) another challenge is the phenomenon of tissue rejection. As in organ transplants, the body's immune cells will recognize transplanted cells as "foreign", setting off an immune reaction that could cause the transplant to fail and possibly endanger the patient and (5) possible risk of cancer. There is a need to maintain a balance between fostering the growth of new cells to replenish damaged tissues and making sure that cells do not overgrow and become cancerous. Several laboratories are working to overcome these obstacles so that the power of stem cells can be harnessed in a big way.

RELATIONSHIP BETWEEN STEM CELL TECHNOLOGY AND CLONING

Stem cell and cloning are powerful technologies and complementary to each other and if used together have the potential to contribute to major advances in biomedical and veterinary sciences. Stem cell technology is often confused with cloning because both areas involve the use of embryonic cells. Both fields got even more confused when the term therapeutic cloning was introduced as a means to produce embryonic stem cells. But stem cell technology does not always involve embryonic stem cells. Cloning is the creation of multiple copies of a single individual. There are two kinds of cloning : therapeutic cloning and reproductive cloning.

In therapeutic cloning, the cloning technology is used to develop stem cells for therapeutic purpose. Therapeutic cloning is based on a technology called somatic cell nuclear transfer. In this process, "normal egg cell is enucleated. Then the nucleus from a patient's somatic cell who needs an infusion of stem cells to treat a disase or injury is inserted into the egg. The egg, which now contains the patient's genetic material, is allowed to divide and in 4-5 days time becomes a blastocyst. The cells from the inner cell mass of blastocyst are isolated and used to develop new embryonic stem cell (ESC) lines. The goal of therapeutic cloning is to produce stem cells, and subsequent tisues and organs, which can be used to replace damaged tissue. The advantage of therapeutic cloning is that the resulting ESCs are unlikely to be rejected by the patient's immune system when transplanted into the body. Reproductive cloning on the other hand, is intended to produce identical offsprings by cloning embryos. In this process, a new individual is created from a single cell by replacing the nucleus in an egg cell with the nucleus from another cell of the body. the cloned egg cell grows and develops into an embryo. The embryo is implanted inside a surrogate mother's womb to mature and produce a viable fetus. After birth the clone would be the genetic copy of the adult whose nucleus was used for cloning. In reproductive cloning the application of the technique is for replication. There is ban on reproductive cloning in many countries.

BIOETHICAL ISSUES

Bioethics, or medical ethics, is the study of the moral and ethical issues in the fields of scientific research, medical treatment or, more generally, in the life sciences. With advancing technology and modern innovations, new and exciting insights are being gained for many scientific processes and diseases, but at the same time, new questions of medical ethics continually arise.

Varied segments of society ; social, political, ethical and religious are seriously concerned about the implications of stem cell technology particularly in reference to human embryos and fetuses. Some ethicists are very much concerned with the ethical implications of embryonic stem cell technology as they view it as a form of abortion. In a bid to sidestep the ethical debate over the use of human

embryos, scientists have developed a way to derive viable stem cell lines without harming the embryos. They did so by extracting a single cell from the embryo, and introducing a common molecule called laminin to keep it in a stem cell or pluripotent state.

US federal funding for research involving mouse embryonic stem cells and adult stem cells (both mouse and human) is avaiable and not restricted. However, federal funding for research involving human embryonic stem cells is limited to research involving only those cell lines that were already in existence, grown from fertilized eggs that were to be discarded at in-vitro fertilization clinics. In contrast, no restriction is imposed on stem cell research that can be performed with private funds.

In India, Indian Council of Medical Research in 2003 developed guidelines on stem cell technology, but these guidelines were never notified. After lot of hue and cry on stem cell technology in developed countries, the Council constituted a National Committee to examine scientific, technical, moral, legal and social issues for framing the policy. Outcome of this committee is not yet known.

DO YOU KNOW ?

Q1. What is Nocebo effect ?

Q2. How many legs or hands do crabs and lobsters have ?

EARTH'S MAGNETIC FIELD AND POLARITY REVERSAL

Laxmi Shivehwari* & H.N. Sinha**

The earth has been divided into three distinct layers based on the study of seismic waves. It has been found that the earth's magnetic field is generated at the core-mantle boundary by the self exciting dynamo mechanism. The magnetic poles have changed their polarity periodically throughout the geological time which has been recorded at the time of rock formation. The Deccan lava-flows took place during the reverse magnetic interval during the past 63 million years in Indian subcontinent. The present paper describes in detail the generation of magnetic behaviour of earth and its changing polarity.

INTRODUCTION

The magnetic compass has been used globally for finding out the North-South direction because a freely suspended magnet orients itself in the N-S direction. The south pole of the magnet points towards the magnetic north which corresponds to the geographic N-S direction. However, the earth's present magnetic field approximates to that of a uniformly magnetised sphere or a magnetic dipole located at the centre of the earth, inclined at an angle of 11.5° to the geographical axis. The palaeomagnetic (magnetism in geological past) data indicate that its position corresponds closely to geographical axis when averaged over a period of 10^4 years i.e. the magnetic dipole axis coincides with the geographical axis. The origin and mechanism of the earth's magnetic field is still not fully understood. Based on the seismic wave study carried out by the geophysicists, the earth has been divided into three different layers—the outermost thin layer, called crust, is heterogeneous in composition, extending between 3 and 33 kms. The crust is the thinnest below the ocean and the thickest below the continents such as mountains like the Himalaya. Below the crust is the mantle which extends upto 2900 km and more homogeneous in nature. The origin of magmas, triggering of deep-focus earthquakes and continental drift is in the upper mantle region. The crust and mantle are composed mainly of lighter silicates. Below the mantle at a depth of 2900 km, lies the core. It extends from 2900 km to 6400 km[1].

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ORIGIN OF EARTH'S MAGNETIC FIELD

R.D. Oldham first discovered the three distinct forms of earthquake (seismic) waves. The are primary (P), secondary (S) and long (L) waves. From the study of P and S waves which are recorded on seismograms, the knowledge of the internal structure of the earth has been gained.

The passage of S seismic wave (medium wavelength) through the core has not been found. This implies that the core is liquid at least in it outer part. It has been established that the inner core is solid by the study of passage of P waves (shortest wavelength) and it is mainly composed of iron and nickel,[2] The temperature of inner core

varies from 400°C to 500° C with 3.5 million kgs/sq.cm pressure. The notion that the solid iron-nickel inner core may be the cause of permanent magnetism since the formation of the earth, is no longer valid. The predicted high core temperatures negate the possibility of any material in this region being responsible for generating permanent or remanent magnetism. Hence some other mechanism is responsible which is generating magnetism. The cause of sustained magnetic field is regeneration of electric current in the molten outer core rather than in the silicate mantle by the process of "self exciting dynamo" or "geodynamo" mechanism. In a dynamo, a loop of wire when rotated around a magnetic field, produces an electric current. Thus generated electric current produces a weak magnetic field[3]. Very much similar to this phenomenon is happening at mantle-core boundary. The earth's rotation and convective thermal motions result in some kind of spiralling and churnning action of the conductive and molten outer core, producing a self-sustaining magnetic field. The magnetic field thus created vary with time.

The secular variation of the geomagnetic field is the result of convection current in the fluid core. This variation throughout the geological past is preserved in the permanent magnetism of rocks formed at the earth's surface. The preservation of permanent magnetism in rocks is described under magnetostratigraphy by the earth scientist.

REVERSAL OF MAGNETIC POLES

The magnetic poles have the peculiarity of wandering which is a global phenomenon. It is a mystery that the earth's magnetism has been changing its polarity (reversal of the north and south magnetic poles) periodically throughout the geological past[4]. The wandering of magnetic poles is thought to be due to irregularities in the motion of the liquid in the outer core of the earth. The time spent in one or the other state varies from about 10^4 to 10^7 years and the transition from one to the other appears to take between 10^3 and 10^4 years. Hence it is an instantaneous event in geological time scale. In addition, the shifting of magnetic poles (polarity reversal) are also influenced by solar winds which cause daily and short term shifts.

POLAEOMAGNETISM

In 1906, the French physist B. Brunhes was studying ancient Earth's magnetic field from rocks. Certain types of crustal rocks, solidified volcanic lavas, and oceanic clastic sediments contain tiny grains of magnetite (a compound of iron and oxygen). These magnetite particles magnetise and orient themselves along the then magnetic lines of force. Brunhes was studying the magnetism in such solified volcanic rocks of France. He observed, in half the volcanic rocks the magnetic rocks were oriented along the present N-S direction while in the rest half of the rock samples, the particles were oriented in a direction opposite to the present days' earth's magnetic field. Later, geophysicists found hundreds of such reversed polarity rocks which were dated to be of different geological ages. This finding led to believe that the magnetic polarity reversal are the result of the flipping magnetic poles of the earth and not due to any other geological or chemical processes.

The important carriers of remanent magnetism in rocks are members of the magnetite-ulvospinel hematite-ilmenite solid solution (a homogenous mixture of one substance in other) series.

In igneous (parent) rock the magnetism appear when the cooling of lava drops below the curie point which varies from 400°C-600°C. As melt cools and solidifies into crystal / mineral a few ten of degree below curies point it passes through blocking temperature. Once this stage is reached the magnetism is consolidated, and change in the external geomagnetic field does not alter the

minerals's magnetism. Thus the geomagnetic field with a specific direction with polarity at that particular site and that time is "Frozen in" which is preserved in the mineral. This type of acquired magnetism is called Thermoremanent Magnetism (TRM).

In sedimentary (secondary) rocks, magnetic mineral grains which have acquired an earlier TRM will orient by geomagnetic field as they settle to the basin (site of deposition) and are incorporated within sedimentary fabric. Such acquired magnetism is called depositional remanent magnetism (DRM) which is more stable in fine grained rocks such as shale.

Marine magnetic anomalies potentially provide the single source of information on the pattern of geomagnetic field reversals from the Late Jurassic (150 million years back approximately) to the Recent. Oceanic crust is characterised by linear to curvilinear magnetic stripes which are roughly parallel to the Mid Oceanic Ridge (MOR – place where new magma comes out from the upper mantle) crests. The anomalies are 5 to 50 km wide, hundreds of kilometer long and range from 400γ to 700γ in amplitude. These stripes are composed of basalt (a ferromagnesian rock) and are roughly symmetrical about the ridge crest.

RECORDS OF MAGNETIC POLARITY FROM INDIA

The fissure type of lava eruption at the end of Mesozoic era (63 million years ago) took place over vast areas of western, central and southern India and is popularly known as Deccan Volcanism. In 1968 Mc Elhinny first studied the magnetic polarity sequence of Deccan Trap and concluded that the entire duration of enormous lava outpouring occurred in only 5 million years. It has been found that the Deccan lava (basalts) were erupted during a reverse magnetic interval and the Mesozoic (a period from 225-63 million year ago)–Cenozoic (period from 63 million year ago to till date) boundary lies within Deccan activity[5].

It has been found that the most recent reversal took place only 20000 years ago. Study reveals that over the last century, the earth's magnetic field strength has been gradually diminishing. If this trend continues it will become zero within 1500 years. David Gobbins of the University of Cambridge has found that the magnetic field near the tip of Africa and South America is showing signs of opposite polarity to the present field direction perhaps indicating the beginning of another of earth's polarity reversal.

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DO YOU KNOW ?

Q3. Which animal grows maximum from the moment of birth to adulthood ? (In terms of relative body weight).

Q4. Will a lake freeze if the air temperature falls to 1ºC ?

SUPERABSORBENT POLYMERS—A BOON

Suman Katiyar*

This article describes the basics and the versatility of superabsorbent polymers which promise useful application in many areas including agriculture, medicine, construction and electrical engineering.

INTRODUCTION

Superabsorbent polymers (SAP) can absorb water and other fluids up to a very high extent and can retain them for a longer period of time also. They can absorb up to 1000 gram of water per gram of the polymers and about 100 gram of dilute salt solutions per gram of the polymers.

The first generation SAPs were developed in the late 1950's for ophthalmological application and were mainly based on hydroxyl alkyl methacrylate and related monomers. Concept of absorbent in personal care developed in mid 60's and the development of ultrahigh absorption material started in 1970's. Successful commercialization started in 1980's which was prepared by radical grafting of acrylonitrile on starch or cellulose using cerium nitrate initiators.

As these materials are dry substances and act as the gelling agents, sometimes they also are referred to as xerogellents. Their affinity for water makes them especially useful for personal hygiene products such as the disposable diaper, covering about 90 percent market share. The other main application of these SAPs are in the field of controlled release of charges, pesticides, fertilizers, electronic and cabling, food and packaging. In these applications, superabsorbent materials are inexorably replacing traditional absorbent materials.

STRUCTURE

Superabsorbent Polymers are crosslinked network of flexible polymer chains. The most efficient water absorbers are polymer network that carry dissociated ionic functional groups. A schematic drawing of such a network is shown in figure-1. Here the dot represent the cross linking between the coiled polymer chains, which have ionic carboxylate functional groups spaced along their length.

Fig. 1. Structure of a super absorbent

Superabsorbent polymers are in distinct contrast to the ionic absorbent polymers. The energetic and entropic mechanism present with nonionic polymers are still operative, but are largely overshadowed in magnitude by the presence of the ionic charges

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that are spaced along the polymer chains of superabsorbent polymers, as shown in Figure 1. The presence of the polymeric ions results in increased absorption because the ions are more strongly solvated than nonionic function groups as a result of strong ion-dipole interactions.

TYPES OF SUPERABSORBENT POLYMERS

On the basis of the 'degradability' of the polymer we can classify the Superabsorbent Polymers mainly in two following classes.

1. Non-Biodegradable Superabsorbent Polymers.

2. Biodegradable Superabsorbent Polymers.

1. Non-Biodegradable Superabsorbent Polymers

These are the polymers which are not degradable in the open atmosphere because they are not attacked by bio-organisms.

Among the superabsorbent polymers of this type the crosslinked, partially neutralized poly (acrylic acids) are commercially most important. Numerous other polymers have been crosslinked to form water-swellable gels, but no other polymer can provide the high charge-to-mass ratio as economically as poly (Sodium acrylate). For this reason we will mainly discuss this specific polymer. Superabsorbent Poly (acrylate) is prepared by free-radical initiated polymerization of acrylic acid and its salts, with a cross-linker, in aqueous solution or as suspension of drops of aqueous solution in hydrocarbon.

The two principal processes, solution polymerization and suspension polymerization, are used to carry out this reaction. The monomer and crosslinked concentration, polymerization modifiers, the relative reactivities of the monomers, the basic polymerization kinetics, and the reaction temperature are all significant factors in both processes.

Radiation technology, a recent innovation, has been recognized as an alternate source of energy and it finds wide application on the industry including abatement of pollution. For the past three to four decades, vigorous attempts are being made to use radiation energy for prompting and accelerating chemical process. The types of radiation most commonly employed in industrial processes are electron beams, gamma rays, X-rays and Ultraviolet light.

2. Biodegradable Superbsorbent Polymers

Because about 90% of all Superabsorbent materials are used in disposable articles that are mostly disposed in landfills or by incineration, there is a perceived environmental problem with the superabsorbent polymers. To avoid these problems scientists have diverted to biodegradable superabsorbent polymers which release carbon dioxide, methane, water, biomass under bio chemical reaction.

Biodegradable polymers are of the following types : Poly (acrylic acid)—based superabsorbent polymers, Modified polysaccharides, Poly (aspartic acid) an Blends and grafts of poly (acrylic acid) with biodegradable substrates.

Poly (acrylic acid) of molecular weight below about 1,500 g/mol can traverse the microbial cell membrane, where it can degrade completely. Modified polysaccharides are based on sod. carboxymethylcellulose (NaCMC). To prepare an effective superabsorbent from (NaCMC), the polyelectrolyte must be crosslinked by some means. Multivalent ions of valency greater than 2 such as AI, have long been used to crosslink or gel (NaCMC). Poly (aspartic acid) is the homopolymer produced by the condensation polymerization of the amino acid aspartic acid.

Blinds and grafts involve mixing the polyacylate superabsorbent polymer with a biodegradable microbial food source, such as starch. This will provide a locally high concentration of microbial activity, leading to degradation of acrylate polymers.

FORMS OF SUPERABSORBENT POLYMERS

The forms in which the superabsorbent polymers are being used other than the granular form include fibers, films foams, coating, spray and laminates. Of these fibers, film, and laminates and foams have received the more attention. The most commonly available superabsorbent polymenrs are hard, dry, granular powders that look much like clean white sand or granular table sugar. When these polymer particles are placed in water, a slurry of water and the particles is formed. Gradually the superabsorbent polymer absorbs the water, turning into a soft, rubbery gel. The commercial superabsorbent polymers fiber producers claim a variety of property enhancement over conventional granular superabsorbent polymers. Especially an enchanted rate of absorption. Superabsorbent polymers are also widely used as the composites of the granular form or the fiber form with other superabsorbent polymers. The composites are made according to the need of product. Superabsorbent films are another physical form that may offer some processing and performance advantage over existing commercial superabsorbent polymers. Superabsorbent films will not migrate in an absorbent core and they may be less likely to create dust, depending on their brittleness. Superabsorbent foams have attracted considerable attention as candidates for replacing multiple components of an absorbent core. They hold the potential of offering some of the sea advantage sought for film or fiber foams. Performing the absorbent function of multiple component of a conventional diaper, not migrating in product, and no creating dust.

APPLICATIONS

Applications of the superabsorbent polymers include the following :

Disposable infant diapers, agriculture and horticultural applications, controlled release of drugs, water absorbing construction materials, electronics and cabling, food packaging, recreational activities, sensors, aqueous waste management and medica wound dressing.

DO YOU KNOW ?

Q5. One has to remove 80 cal of heat from water to make ice. How much heat needs to be taken out of 1 gramme of steam to make water ?

Q6. For a good fit what is the best time to buy shoes, morning or evening ?

HAZARD EFFECTS OF EXCESS ZINC IN DIET–A TRACE MINERAL

K. Birla Singh* and S. K. Taneja**

Zinc is one of the trace minerals which is required for huge range of bodily functions. However since last many years Zinc as micronutrient is being used indiscriminately in agricultural and husbandry practices and also in baby foods and multivitamin supplements. The harmful effects of excess Zinc in diet is given in this paper.

INTRODUCTION

Several minerals serve as micronutrients and constitute important components of balanced diet. They are required in minute quantities for their participation in a number of life processes in the body. Zinc is one metal in several minerals which is required for a huge range of bodily functions. It is found in virtually every tissue in the body and is particularly important for the correct functioning of the immune system, growth and development, and the antioxidant system. Also, for the activity of a large number of zinc dependent enzymes (approximately 300) both in plants and animals, zinc is as an essential component (known as a "cofactor"), proteins act as catalyst, enabling the body to carry out the chemical reactions essential for life. Due to wide range of functions, daily requirements of Zn is 8μg at 1 month of age decreasing to 5μg at 4-12 months of age and subsequently it again increases to the order of 3-5 mg in 1-10 years old children. Normal adults on an average require 5-15 mg and pregnant women 10-25 mg zinc.

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Table–1 : Recommended Dietary Allowance (RDA) for Zinc for Infants over 7 months, children, and Adults (mg/day)

AGE	INFANTS AND CHILDREN	MALES	FEMALES	PREGNANCY	LACTATION
7 months to 3 years	3 mg	—	—	—	—
4 to 8 years	5 mg	—	—	—	—
9 to 13 years	8 mg	—	—	—	—
14 to 18 years	—	11 mg	9 mg	13 mg	14 mg
19 year+	—	11 mg	8 mg	11 mg	12 mg

ZINC RICH FOODS

Zinc is present in a wide variety of foods, particularly in association with protein foods. A vegetarian diet often contains less zinc than a meat based diet. Rich sources of zinc for human consumption are nuts, wheat, legume, seeds, seafoods, dairy products, beans and lentils, yeast, and wholegrain cereals and other animal products. Its quantity is very low in cereals, vegetables and fruits. White flour is a poor source, both because the zinc is mainly found in the outer layers of the grain and because the fibre in grain contains phytates, which inhibit the absorption of minerals. Pumpkin seeds provide one of the most concentrated vegetarian food sources of zinc. Fortified foods

including breakfast cereals make it easier to consume the RDA for Zn, however they also make it easier to consume too much zinc, especially if supplemental zinc is being taken.

ZINC : PRESENT SCENARIO

Inspite of the impressive progress that has been made in the field of trace element nutrition in the past, the biological role and minimum requirement of trace elements are still hypothetical. Since the minimum requirement of some of the trace elements is low, it is generally believed that a purely nutritional deficiency of these trace element rarely occur in the man. The latest development in the food technology gave enable the food industry to offer the general public in affluent countries an enormous choice of food products during the last couple of decades. Both deficiency of essential elements and toxicity of heavy are fairly common in many countries of Asia, Africa and Latin America. In order to assess the nutritional importance of trace elements, it is relevant to consider the factors regulating their metabolism. Actual intake levels and bioavailability are two key factors that are nutritionally very important. Barring the occupational exposer, the food chain remains the major pathway through which trace elements enters human body. Only limited information is available in developing countries, trace element problems have low priority as dietary intake is often unsatisfactory since it is based on conventional techniques involving food tables.

During the last two decades, Zn as a micronutrient is being used indiscriminately in agricultural and husbandry practices and also in body foods and multivitamin supplements because Zn is nontoxic and promotes linear growth and body weight in the consumers. Percentage of Zn consumed from Zn-fortified food doubled from 14% (1994) to 28% (1998) in US preschool children and for all age groups and the percentage of this will further increase over the time[1].

Recent survey on trace metal status of different vegetables in the State of Punjab around Chandigarh, India, revealed that due to use of different inputs in the fields by farmers during the growth of vegetables : Zn levels (more than 40 mg and 120 mg Zn/kg diet in above ground and underground vegetables (daily recommended range is 12.8-20 mg Zn/kg diet) but Cu was normal[2].

Table–2 : Showing Zn and Cu concentration in vegetables and other food stuffs found in State of Punjab around Chandigarh and Manipur State (Where the level of Zn is higher while the Cu is within the normal range)[3, 4] :

FOOD STUFFS	ZINC (Zn) mg/kg	COPPER (Cu) mg/kg
WHEAT	46.2	46.8
RICE	40.8	58.8
RAJMA	21.6	10.0
BAJRA	38.4	31.8
MALKA MASHER (PULSE)	35.4	12.6
HORSE PEA	54.6	48.6
MUNG	54.6	47.0
KALA CHANA	98.4	34.8
PEANUT	34.8	48.0
EGG	109.8	46.8
FISH	78.0	51.0
PORK	174.0	48.0
CHICKEN	135.0	57.0

Even though Zn is an essential element in our diet, but too much can be harmful. Harmful effect of too much Zn generally begins at levels from 10 to 15 times higher than the recommended dietary allowances of 5, 12, and 15 mg per day for infants, women and men respectively.

HARMFUL EFFECTS OF EXCESS ZINC IN DIET

Excess presence of Zn in diet promotes appetites absorption of nutrients and cell proliferation, acting through genes, resulting in the growth of

individuals. The investigation conducted on growth hormone transgenic and genetically obese mice have shown that the growth promoting effect of zinc occurs through hormone whose activation is zinc dependent. Excess zinc intake during the growth phase increases the growth hormone level in the blood which enhance the growth rate, increases the number of fat cells in the body, promotes absorption of fat and elevates insulin activity. On withdrawal of growth hormone on approaching adulthood, the absorbed nutrients are directed to fat cells under the influence of elevated insulin activity where they are deposited as fat. The exogenous treatment of growth hormone or its analogues couple with high concentration of zinc as zinc sulphate in commercial feeds is being exploited in rearing the livestock on large scale for higher yield of animal products. As a consequence of this, the animals grow faster and their tissue are loaded with fat and zinc. The unabsorbed zinc leaves the body with the faeces that form the manure for agricultural use. Zinc being equally essential for well being of plants, additional zinc in high amounts is employed as micronutrient in agriculture practices for higher agriculture produces which results in elevation of its concentration in plants products also.

Such food items loaded with zinc when consumed make the children grow faster and add some fat in their tissues which make them to appear healthy but impose serious health problems on attaining adulthood. The continuous input of excess nutrients in tissues particularly in fat cells caused by excess nutrients in tissues, particularly in fat cells, caused by zinc over a period of time contributes to obesity in adults. Obesity poses a formidable challenge to the growing population as it is etiologically linked to insulin resistance ; an accompanying insulin dependent diabetes mellitus, hypertension and coronary artery disease.

Nor only this, the excess free zinc ions in diet inhabited the copper absorption as a consequence of the similar physiochemical properties of these two elements and copper-zinc antagonistic reaction at intestinal level producing copper deficiency in them. The interaction between zinc and copper is of practical concern because, it can occur with relatively low amount of zinc supplementation and zinc induced copper deficiencies are relatively easy to produce in adult humans. Cu-deficiency further impairs enzymes of antioxidant system including SOD, Catalase and Glutathione peroxidase and results in increasing the oxidative stress[3]. Copper deficiency is also known to induce hypertension, increase blood cholesterol (hypercholesterolemia), and low density lipoprotein fraction increment blood which add to the condition favouring heart attack. The excess zinc ions on the other hand, either make the insulin inactive or binding of insulin with its receptor reduces due to copper deficiency and the existing risk factor of non insulin dependent diabetes mellitus (NIDDM) are exacerbated.

Thus intake of Zn-fortified food for longer periods of time may make the growing children more venerable to these diseases. Therefore, possible measures have to be taken to control the consumption of high Zn in diet and Zn-fortified foods[1]. A random survey of nutritionally adequate healthy young individuals (25-35 years) of Chandigarh population conducted by us showed a strong positive linear correlation of body weight (BMI) and tissue zinc concentration. The overweight and obese possess higher zinc concentration in tissues than those of lean or normal body weight individuals. The descendants of NIDDM and ischemic heart disease parents (destined to develop NIDDM and ischemic diseases) posses 2 to 4 times higher tissue zinc and less than half of copper concentration than their counterparts on diabetic parents. This copper and zinc imbalance continues for some time which after exceeding threshold level manifest as disease. Their perturbation caused by excess zinc in diet has links with obesity and obesity related diseases in India. One of our study on animal model revealed that the supplementation of Zn in amount equal to 80 mg/kg in semi-synthetic diet fed to the rats resulted in significant higher gain in their body weight,

displayed significantly higher blood pressure and heart rates and their urine reacted positively with Benedict's test suggesting the onset of glucosuria in them.

HIGH ZINC DIET AND DIABETIC PATIENTS

Excess Zn in the diet is also vulnerable to those who already develope diabetes mellitus. When excess Zn was taken for a longer period of time by diabetic patients, it increases in the level of glycosylated haemoglobin (HbAlc), urinary Zn excretions and altered glycosylation. High level of haemoglobin $A1_c$ is a reliable quantitative indicator of long-term increase of blood sugar level (hyperglycaemia) and it also contribute to the changes in the profile of blood trace elements and as results of these the degree of oxidative stress increases further. During high Zn-supplementation in individuals with diabetes, serum zinc concentrations increase and block insulin receptors of cell and lead to decreased glucose tolerance. Moreover, the use of zinc supplements in free-living population has been discouraged because it results in copper deficiency.

HIGH ZINC DIET AND PREGNANT WOMEN

When there is presence of excess Zn in the diet of pregnant women, it can induce fetal copper deficiency and negatively affect human pregnancy. This condition is also found in experimental animals where maternal zinc supplementation can induce fetal copper deficiency[4]. Long term deficiency of Cu in pregnant women and animals results in early embryonic death, gross structural anomalies including skeletal, pulmonary and cardiovascular defects and persistent biological, neurological and immunological abnormalities. It leads to the acute respiratory distress syndrome in neonatal rats and premature infants. The respiratory distress syndrome may be the major cause of the morbidity among the premature infants[5]. Thus expects recommend that the copper supplement should be added with zinc supplements during pregnancy.

CONCLUSION

Obesity, diabetes, hypertension and heart attacks, and developmental defects, all genetic disorders rise dramatically and their onset at relatively young age a recent phenomenon that is associated with excessive and extensive use of micronutrients in agriculture. In this, Zn stands prominently. The abandoning of traditional copper containing metallic utensils, the compulsory sources of copper through its leaching into food during cooking has further aggravated the condition. Zinc management in food, therefore is essential to contain the obesity related diseases. This can be targeted by immediate and long term strategies. The immediate strategy involves the restricted consumption of zinc rich food items such as cheese, met, eggs, nuts, wheat products and increased inclusion of zinc binding products such as fibre leafy vegetables and phytate rich legumes such as soyabean and its product that should reduce its bioavailability. The use of copper utensils for cooking will not only help in preventing the copper deficiency but also reduced the influx of zinc in them. The long term strategies required a stator controlled use of zinc in commercial feeds and agriculture practices through legislation in the interest of human health ; otherwise the obesity related diseases would dominate further in the days to come.

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THE IMPACT OF CLIMATE CHANGE

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Climate change has now become a matter of most serious concern for the humanity. This article discusses amongst other things, causes of climate change, the indicators, impact of climate change and measures to control climate change.

INTRODUCTION

The earth system has been in existence for over 5 billion years. The atmospheric layer surrounding the planet consists of mostly nitrogen and oxygen. The climate of a place is the average weather that it experiences over a period of time. Climate and climate change are determined by many things including distance from the equator, closeness to an ocean or major body of water, and geographical conditions such as mountains, plains and forests. There are 12 distinct types of climates on our planet, ranging from tropical to polar.

Climate change, a frequently discussed issue, can be caused by internal and external forces like the Earth's orbit, solar radiation and greenhouse gas concentrations, The natural causes of Climate change are of far less significance compared to the interference of humanity with the nature. Warm winters and irregular monsoon are just a few visible instances of climate change.

INDICATORS OF THE CLIMATE

The indicators of Climate are : rainfall, sunshine, relative humidity, wind and temperature.

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Factors that influence climate are shown in the following diagram (figure–1)

CAUSES OF CLIMATE CHANGE

The cause of climate change can be natural or changes may be caused by human interference.

Natural Causes :

1. Earth's orbital Characteristics comprise one natural cause.

i. Eccentricity

The earth orbit gradually changes from being elliptical to being nearly circular and then back to elliptical in a period of about 100000 years. The greater the eccentricity of the orbit (i.e. the more elliptical it is), the greater the variation in solar energy received between the Earth's closest and farthest approach to the Sun.

The difference in Earth's distance from the Sun between perihelion and aphelion (which is only about 3%) is responsible for approximately a 7% variation in the amount of solar energy received at the top of the atmosphere. When the orbit is most elliptical, the difference in this distance is at it maximum (9%), the difference in solar energy received is about 20%.

ii. Precession of Equinox

As the Earth rotates on its polar axis, it wobbles like a spinning top changing the orbital timing of the equinoxes and solstices. The precession of the equinox has a cycle a approximately 26,000 years. At present we have perihelion in January and Aphelion in July while it will be reversed after 13,000 years.

iii. Solstice

Summer Solstice : The first day of the Season of Summer. On this day (June 21 in the northern hemisphere) the Sun is farthest north and the length of time between Sunrise and Sunset is the longest of the year

Winter Solstice : The first day of the Season of Winter. On this day (December 22 in the northern hemisphere) the Sun is farthest south and the length of time between Sunrise and Sunset is the shortest of the year in the northern hemisphere.

In the southern hemisphere, winter and summer solstices are exchanged. Summer : December 22. Winter : June 21.

iv. Equinox

There are two times of the year when the night and the day are about the same length. The Sun is crossing the Equator (an imaginary line around the middle of the Earth) and it is an equal distance from the North Pole and the South Pole.

Spring Equinox : This indicates the first day of the season of Spring and the beginning of a long period of sunlight at the Pole. In the northern hemisphere : March 20 (the Sun crosses the Equator moving northward). In the southern hemisphere : September 22 (the Sun crosses the Equator moving southward).

Autumn Equinox : This is the first day of the Season of Autumn and the beginning of a long period of darkness at the Pole. In the northern hemisphere : September 22 (the Sun crosses the Equator moving southward). In the southern hemisphere : March 20 (the Sun crosses the Equator moving northward).

v. Qbliquity of Earth's axis of Rotation

During a 41,000 year cycle the tilt of earths' Axis can deviate from approximately 22.5 to 24.5°. Presently the tilt of earth is 23.5°. When the tilt is small there is less climatic variation between the summer and winter seasons in the middle and high latitudes. At these times winters tend to be milder and summers cooler. The net effect of a smaller tilt would be more extensive formation of glaciers in the polar latitudes. Periods of a larger tilt result in greater seasonal climatic variation in the middle and high latitudes. At these times winters tend to be colder and summers warmer. Thus the net effect is that Glaciers in the Polar Regions should be generally receding, during this part of the obliquity cycle with other contributing factors constant.

2. Atmospheric CO_2 Variations

Certain atmospheric gases, like carbon dioxide, water vapor and methane, are able to alter the energy balance of the Earth by absorbing longwave radiation emitted from the Earth's surface. The re-emission of longwave back to the Earth's surface increases the quantity of heat energy in the Earth's

climatic system. Without this process called greenhouse effect, the average global temperature of the Earth would be a cold –18º Celsius rather than the present 15° Celsius. Human activities like the burning of fossil fuels, conversion of natural prairie to farmland and deforestation have caused release of carbon dioxide into the atmosphere. From the early 1700's, carbon dioxide has increased from 280 parts per million to 380 parts per million in 2005. Most computer climate models suggest that the globe will warm up by 1.5–4.5° Celsius if carbon dioxide reaches the predicated level of 600 parts per million by the year 2050.

3. Volcanic Eruptions

Volcanic eruptions cause SO_2 emission. This SO_2 interacts with water vapour in atmosphere to form a dense bright haze layer that reduces the transmission of suns radiation to the earth surface. Greater reflectivity causes the temperature drop at the earth's surface.

4. Variation in Solar Output

A change in solar output of only 1 percent would alter the Earth's average temperature by between 0.5 to 1.0° Celsius. Measurements made during the early 1980's showed a decrease of 0.1 percent in the total amount of solar energy reaching the Earth over just an 18 month time period. If this trend were to extend over several decades, it could influence global climate. Sunspot activity causes reduction in surface temperature of the sun.

B. Human Interference Causes

1. Industrialization

By burning fossil fuels and deforesting the earth, mankind is increasing carbon dioxide levels. Our industries are emitting chlorofluorocarbons (CFCs). Nitrous oxide levels are also increasing rapidly because of industrialisation due to which the protective ozone layer is depleting. Emission from automobiles are a major cause of air pollution and increase the concentration of Green house gases in the atmosphere. Man-made disasters such as chemical spills and industrial wastes have polluted rivers and watersheds. As result of this we have reached to a state where we are facing scarcity of drinking water. The rise of CO_2 concentration in air is shown in the following diagram (fig–2)

2. Deforestation

New research confirms that avoiding deforestation can play a key role in reducing future greenhouse gas concentrations. Tropical deforestation releases nearly 1.5 billion tonnes of carbon each year into the atmosphere. It has been said that "Deforestation in the tropics accounts for nearly 20 per cent of carbon emissions due to human activities, this will release an estimated 87 to 130 billion tonnes of carbon by 2100, which is greater than the amount of carbon that would be released by 13 years of global fossil fuel combustion. So maintaining forests as carbon sinks, will make a significant contribution to stabilizing atmospheric greenhouse gas concentrations."

3. Population Explosion

The world currently adds about 250 thousand people every day. The population explosion figures are shown in the following diagram (fig–3)

A larger global population means a larger demand for everything-most urgently, energy and food security which implies greater pressure on our natural resources leading to what can be said as over-consumption of the resources. The signs of the strain on the planet are all around...from global warming, ever-dwindling food production, pollution, deforestation to make room for more farm land housing, and the vast and growing list of endangered species.

IMPACT OF CLIMATE CHANGE

The impact is now seen in the following changes.

● Sea level is rising

During the 20th century, sea level rose about 15 cm (6 inches) due to melting glacier ice and expansion of warmer seawater. Models predict that sea level may rise as much as 59 cm (23 inches) during the 21st Century, threatening coastal communities, wetlands, an coral reefs.

● Arctic sea ice is melting

The summer thickness of sea ice is about half of what it was in 1950. Melting ice may lead to changes in ocean circulation and speeding up warming in the Arctic.

● Glaciers and permafrost are melting

Over the past 100 years, mountain glaciers in all areas of the world have decreased in size and so has the amount of permafrost in the Arctic. Greenland's ice sheet is melting faster too.

● Sea-surface temperature are warming

Warmer waters in the shallow oceans have contributed to the death of about a quarter of the world's coral reefs in the last few decades. Many of the coral animals died after weakened by bleaching, a process tied to warmed waters.

● Heavier rainfall causes flooding in many regions

Warmer temperatures have led to more intense rainfall events in some areas. This can cause flooding.

● Extreme drought is increasing

Higher temperatures cause a higher rate of evaporation and more drought in some areas of the world.

● Ecosystems are changing

As temperature increase species may either move to a cooler habitat or die. Species that are particularly vulnerable include endangered species, coral reefs, and polar animals. Warming has also caused changes in the timing of spring events and the length of the growing season.

● **Hurricanes have changed in frequency and strength**

There is evidence that the number of intense hurricanes has increased in the Atlantic since 1970. Scientists continue to study whether climate is the cause.

● **Heat waves more frequent**

It is likely that heat waves have become more common in more areas of the world.

● **Warmer temperatures affect human health**

There have been more deaths due to heat waves and more allergy attacks as the pollen season grows longer. There have also been some changes in the ranges insects that carry disease e.g. mosquitoes.

● **Seawater is becoming more acidic**

Carbon dioxide dissolving into the oceans, is making seawater more acidic. There could be impacts on coral reefs and other marine life.

● **Increase in Global temperature**

If present emission patterns continue the average temperature of earth would rise by 12 degrees in a century. The main cause of this global warming is the unrestricted GHG emissions. Global warming is altering the way nature functions. This is shown in the diagram (Fig. 4).

MEASURES TO CONTROL CLIMATE CHANGE

Measures will comprise efforts by individuals the population and the Governments.

Conservation is one of the many steps towards checking the environmental problems. Changes in lifestyle and behaviors that favor resource conservation can contribute substantially towards climate change mitigation. Changes in lifestyles and consumption patterns that emphasize resource conservation can contribute to developing a low-carbon economy that is both equitable and sustainable. In cities, urban planning and education can reduce car usage and promote efficient driving habits. The ideas are summarised in the following Table–1.

Sector	Key Technologies and Practices for Better climate
Energy Supply	An increase in the price of fossil fuel could make low-carbon alternative more competitive
Transport	Hybrid vehicles, cleaner diesel engines, bio-fuels. Shift from road transport to rail and public transport. Alternatives such as cycling and walking. Urban planning that reduces the need for road transport.
Buildings	Building should be constructed on the concepts of **'Green Building'** which are more energy efficient. HVAC (Heating Ventilation & Air Conditioning) system should be solar based. Recycling or using fluorinated gases in refrigeration.

Industry	The use of more efficient electrical equipment, heat and power recovery system, recycling of goods which help in checking the CO_2 gas emissions.
Agriculture	Agricultural practices collectively can make a significant contribution at low cost by increasing the amount of carbon stored away in soil (carbon sinks), by reducing methane and nitrous oxide emissions. By improving fertilizer application to reduce nitrous oxide emissions and manure management to reduce methane emissions.
Forestry/Forests	Afforestation, reforestation, improved forest management, reduced deforestation, and use of forestry products to replace fossil fuels can considerably reduce greenhouse gas emissions and help capture CO_2 from the atmosphere.
Waste	The post-consumer waste sector is a small contributor to global greenhouse gas emissions (<5%), yet it can contribute to mitigation efforts at low cost through landfill methane recovery, waste incineration with energy recovery, composting, recycling, and waste minimization.

Government Initiatives

Technological initiatives by the Government would reduce carbon emissions will include the following.

- Investing in the reduction of energy consumption rather than in new energy supply infrastructure.
- Switching from coal to gas ; Nuclear power, although safety, weapons development and waste management remaining as constraints.
- Use of renewable energy (hydro, solar, wind, geothermal an bio-energy) ;

The following Table–2 suggests some initiatives :

Areas	Initiatives
Policies and legislation	Helps better adherence to the emission norms.
Carbon price	A cost of each Unit of Green house gas emitted acts as major mitigate for GHG emissions. It creates incentives for producers and consumers to significantly invest in products, technologies and processes to reduce greenhouse gas emissions.
Carbon trading	Helps in technological advancement, reduction in costs and progress towards stabilization. Also it helps in technology transfer over nations.
Subsidies and tax benefits	Provide for financial support for new technology and its diffusion.
Awareness campaigns	Help in Climate Change control by promoting informed choices and possibly contributing to behavioral changes among people.

Just like our bodies, this earth is the only one we have. When we treat it badly it gets sick. Perhaps we should demand that other people do not abuse our earth, because it is just as much ours as it is theirs. It is just as much yours as it is mine.

Technology has transformed our lives, but so far it has constantly made human beings drift away from nature. Time has come when people must use technology to bridge this gap.

CHOLERA : SOME CLINICAL AND BIOCHEMICAL ASPECTS

Aryadeep Roy Choudhury*

Enteric infection, including diarrheal illness, is one of the greatest causes of mortality in humans, of which cholera, a clinical-epidemiologic syndrome caused by the bacteria *vibrio cholerae*, evokes more fear because of its past history. This article examines the disease in terms of its spread globally, past pandemics, symptoms, the causal pathogen and its toxin action, diagnosis, prevention and treatment of the disease with special reference to the potentiality of designed cholera vaccines.

INTRODUCTION

Cholera, also called Asiatic cholera, is one of the most outbreak-prone and acute diarrheal infection of the small intestine that continues to strike fear in the population wherever it occurs and caused mostly by the ingestion of the bacteria *Vibrio cholerae* 01 and 0139. This enteric disease was first identified by Robert Koch in 1833 during a cholera outbreak in Egypt. The name of the disease comes from a Greek word meaning "flow of bile". The severity of cholera is related to many factors, including inoculum size, infecting biotype, presence or absence of preexisting immunity, and blood group, among others. Transmssion occurs through direct fecal-oral route during ingestion of a large inoculum of organisms via contaminated water and food and is closely linked to inadequate management practices. Contamination usually occurs when human feces from a victim seeps into a community water supply. Cholera bacteria live in warm, brackish water and can infect person who eat new seafood, especially raw oysters, crab or shelfish obtained from such water or from seafood transported from cholera-endemic countries. Raw, unpeeled or uncookd fruits and vegetables and uncomposted manure fertilizers or irrigation water containing raw sewage are also frequent sources of infection. The absence or shortage of safe water and sufficient sanitation, combined with a generally poor environmental status like poor health, inadequate or overcrowded refugee camps aggravated by the massive displacement of populations in the wake of complex emergencies like poverty, conflict, war or natural disasters are the main causes for the spread of the cholera epidemic. Typical risk-areas include peri-urban slums, where basic infrastructure is not available, as well as camps for internally displaced people, which are particularly vulnerable to major cholera outbreaks. The WHO estimates that during any cholera epidemic, approximately 0.2–1% of the local population will contract the disease. Death rates associated with untreated or poorly treated cholera are often 20%–50%, can be even over 50% during severe epidemic. However, now-a-days with prompt treatment, death rate may be as low as 1–2%.

GLOBAL CHOLERA-ENDEMIC AREAS

Improved sanitation, sewage and drinking water treatment facilities and minimum hygiene standards virtually eliminated cholera over a century ago

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from industrialized or developed countries. Since 2005, the re-emergence of cholera has been noted, with the ever-inreasing size of vulnerable population living in unsanitary conditions. It remains a concern globaly, a significant cause of morbidity and mortality in third-world or developing countries of the world[1] like Asia, Middle East and particularly India, Indonesia, Iran, Sub-Saharan Africa, Mediterranean and more recently, South (Latin) and Central America and Mexico, where it is a marker for inadequate drinking water and public sanitation infrastructure. Cholera-endemic areas chiefly include the East Africa corridor, large estuarine deltas in Asia (Ganges, Mekong) and countries in Northwest Africa, where the disease is an annual problem and where cholera vibrios have established a permanent home in the environment. The number of cholera cases reported to WHO during 2006 rose dramatically reaching the level of the late 1990s. A total of 236,896 cases were notified from 52 countries, including 6311 deaths, an overall increase of 79% compared with the number of cases reported in 2005. Each year, about 120,000 death cases attributed to cholera are reported to the WHO from almost 50 countries. These numbers are still believed to be underestimates as under reporting is common. There are inconsistencies in the case definition and there is a lack of standard vocabulary e.g., some report the laboratory confirmed cases only, whereas the other cases are labeled as acute watery diarrhea. As part of the Diseases of the Most Impoverished (DOMI) Program at the International Vaccine Institute, analysis of the incidence of cholera ranged from 0.5 per 1000 population per year in North Jakarta. 1.6 per 1000 population per year in Kolkata and was the highest in Mozambique at 4 per 1000 population per year.

HISTORY OF CHOLERA PANDEMICS

The first described cholera pandemic was in Europe from 1817 to 1823. However, the disease was known in Asia, prior to that, with the first possible description datig back as far as 2000 years ago, emerging in Bengal and then spreading across India and China. From 1829-1851, the second cholera pandemic affected Europe, London and Paris claiming thousands of victims, it soon reached Russia (Cholera Riots), Quebec, Ontario and New York and the Pacific coast of North America by 1834. In 1849, cholera was spread along California, Utah and Oregon. From 1852-1860, the third pandemic mainly affected Russia, with over a million deaths. In 1854, cholera outbreak in Chicago took the lives of 5.5 per cent of the population (about 3,500 people). The fourth pandemic during 1863-1875 spread mostly in Europe and Africa. The fifth pandemic during 1881-1896 was marked by the 1892 outbreak in Hamburg, Germany with the death of about 8,600 people in Hamburg, causing a major political upheaval in Germany. This was the last serious European cholera outbreak. The sixth pandemic from 1899-1923 had little effect in Europe because of advances in public health, but Russia was badly affected again. From 1961-1970s, the seventh pandemic began in Indonesia at Sulawesi, called El Tor after the strain, and reached Bangladesh in 1963, India in 1964, and the USSR in 1966. In 1970, cholera was found for the first time in West Africa. In the late 1970s, there were small outbreaks in Japan and in the South Pacific. During January 1991 to September 1994, there was an outbreak in South America where the causative agent was as 01, El Tor strain, with small differences from the seventh pandemic strain. In 1992, a new strain appeared in Asia, a non-01, non-agglutinable vibrio (NAG) named 0139 Bengal, which was first identified in Tamil Nadu, which probably markd the beginning of the eighth pandemic. 61 cases of cholera in American citizens were reported to the Centers for Disease Control and Prevention (CDC) even in recent times from 1995-2000. In 2007, the U. N. reported of a cholera outbreak in Iraq. Outbreaks are still probable in this 21st century particularly following such natural disasters as the Tsunami

that struck countries surrounding the Indian Ocean in December 2004.

SYMPTOMS OF CHOLERA

Cholera can cause a spectrum of disease, from no clinical symptoms to severe diarrheal illness resulting in even death. The short incubation period, of 1–3 days, can range from a few hours to five days depending on the inoculum size and underlying health of the person. The symptomatic infections[2] include those of general GI tract (stomach) upset with an abrupt onset of copious and massive watery diarrhea, often accompanied by terrible muscle and abdominal cramps, nausea, vomiting, fever, convulsions, extreme drowsiness, stupor or even coma, preceding the death by hypovolemic shock (where a low blood volume causes a drop in blood pressure and collapse of circulatory system). The diarrhea is typically clear with a "rice water appearance" and mucous flecks—often described as "rice water stools" having a "fishy" odour. Uncomplicated cholera is a self-limited disease that resolves in 3-6 days. In more severe cases, fluid and electrolyte losses can amount to over 20 liters a day leading to profound dehydration that produces dry mouth, intense thirst, loss of skin turgor, sunken eyes and cheeks, sunken "soft spots" (fontanelles) in infants, lethargy, weakness, little or no urine output, rapid or irregular heart beat (arrhythmia) and renal failure. Only about 1 in 10 infected people develop the typical signs and symptoms of cholera. People exposed shed cholera bacteria in their stool for 7-14 days infecting others. Average death rate is 50% in untreated cases and as high as 90% in epidemics ; but with effective treatment, it is less than 1%.

COMPLICATIONS

Cholera can quickly become fatal leading to death within two to three hours in the most severe cases. In less extreme situations, people who do not receive treatment may die of dehydration and shock 18 to 48 hours after cholera symptoms first appear. Other devastating complications that might arise are : (a) during abnormally low blood glucose level (hypoglycemia) in children ; with severe cholera, people become too ill to eat, so they do not get glucose from food and the body becomes unable to carry out normal glucose absorption, which can cause seizures, unconsciousness and even death, (b) during low potassium levels (hypokalemia) in people losing large quantities of minerals, including potassium, in their stools. Very low potassium levels interfere with heart and nerve function and are life-threatening, (c) during kidney (renal) failure when the kidenys lose their filtering ability so that excess amounts of fluids and wastes build up in the body which accompanies shock. Some people are at greater risks like those (a) taking proton pump inhibitors, histamine blockers or antacid to control acidity, (b) suffering from chronic gastritis due to *Helicobacter pylori* infection, (c) having a partial gastrectomy (surgical removal of a portion of stomach) and (d) having a lower immunity or living with AIDS.

TESTS AND DIAGNOSIS

Rapid diagnosis can be confirmed by identifying the bacteria after examining a stool sample under the darkfield microscope. A blood test may reveal the presence of antibodies against cholera bacteria. Other vital signs might also be monitored such as blood pressure and pulse, blood sugar and electrolyte levels and the amount of O_2 and CO_2 in blood. Isolation of *V. cholera* employs thiosulfate-citrate-bile salts-sucrose (TCBS) agar, which is selective for the organism.

CHOLERA TOXIN-ITS BIOCHEMISTRY AND GENETIC REGULATION

The genus *Vibrio* consists of gram-negative straight or curved rods, mobile by means of a single polar flagellum. Most vibrios have relatively simple growth factor requirements and grow in synthetic media with glucose as a sole source of carbon and energy. *V. cholerae* is non-invasive,

affecting the small intestine through secretion of a protein enterotoxin (product of *ctx* genes) called the cholera toxin whose action on the mucosal epithelium is responsible for the characteristic diarrhea[3]. The enterotoxin has been characterized and contains 5 binding (B) subunits of 11,500 daltons (encoded by *ctxB),* an active (Al) subunit of 23,500 daltons, and a bridging piece (A2) of 5,500 daltons (both encoded by *ctxA)* that links Al to the 5B subunits assembling the toxin in the appropriate 1A: 5B proportion. Once it has entered the cell, the Al subunit enzymatically catalyses the covalent modification of the regulatory protein Gas protein by transferring or attaching an ADP-ribosyl (ADPR) moiety from NAD to an arginine residue at the GTPase active site of the adenylate cyclase (AC) system forming Gas-ADPR. This ADP-ribosylation prevents Gas from hydrolyzing GTP, thus causing the protein to become permanently activated. This process is complex. The activation is normally brief because another regulatory protein (Gi) hydrolyzes GTP. Since GTP hydrolysis is the event that inactivates the adenylate cyclase, the enzyme remains continually activated. The activated adenylate cyclase leads to the abnormally increased levels of intracellular cAMP in cells of the intestinal mucosa converting the damaged cells into pumps, which extract water and electrolytes like Na^+, K^+, Cl^-, and HCO^-_3 from the blood and tissue causing their hyper-secretion into the lumen of the small intestine. H_2O, Na^+ and other electrolytes actually follow due to the osmotic and electrical gradients caused by the loss of Cl^-. The loss of fluids leads to dehydration, anuria, acidosis, cardiac complications, circulatory failure and shock[4]. The secretion of a large volume of isotonic fluid constitutes watery diarrhea that contains enormous numbers of vibrios. This effect is dependent on a specific receptor, monosialosyl ganglioside (GM1 ganglioside) present on the surface of intestinal mucosal cells. The determinants for the colonization of the small intestine in pathogenic *V. cholerae* include invasin, adhesins and neuraminidase during the colonization stage, which has the interesting property of degrading gangliosides to the monosialosyl form, which is the specific receptor for the toxin. *V. cholerae* is resistant to bile salts and can penetrate the mucus layer of the small intestine, possibly aided by secretion of neuraminidase and proteases (mucinases). Once the cholera bacteria reach the intestinal wall, they do not need the flagella propellers to move themselves any more, so they stop producing the protein flagellin, thus again conserving the energy and nutrients. Specific adherence of *V. cholerae* to the intestinal mucosa is probably mediated by long filamentous fimbriae termed Tcp pili (for toxin coregulated pili), because expression of these pili genes is coregulated with expression of the cholera toxin genes. Two other possible adhesins in *V. cholerae* are a surface protein that agglutinates red blood cells (hemagglutinin) and a group of outer membrane proteins, which are products of the *acf* (accessory colonization factor) genes, *acf* mutants have been shown to have reduced ability to colonize the intestinal tract. *V. cholerae* might use these nonfimbrial adhesins to mediate a tighter binding to host cells than is attainable with fimbriae alone. *V. cholerae* produces a protease originally called mucinase that degrades different types of protein including fibronectin, lactoferrin and cholera toxin itself. Its role in virulence is not known but probably it is not involved in colonization. Mucinase might contribute to detachment rather than attachment, which are needed to reattach to newly-formed mucosal cells. Once the cholera toxin has bound to the GM1 receptor on host cells, the Al subunit is released from the toxin by reduction of the disulfide bond that links it to A2, and enters the cell by an unknown translocation mechanism. One hypothesis is that the 5B subunits form a pore in the host cell membrane through which the Al unit passes. Transcription of the *ctxAB* operon is regulated by a number of environmental signals, including temperature, pH, osmolarity, and certain amino

acids. Thus the *ctx* operon and the *tcp* operon are part of a regulon, the expression of which is controlled by the same environmental signals. The proteins involved in control of this regulon expression have been identified as ToxR, ToxS and ToxT. ToxR is a trans-membranous regulatory protein ToxR dimers, but not ToxR monomers, bind to the operator region of *ctxAB* operon and functions as an inducer in a system of positive control activating its transcription. ToxS is a periplasmic protein, which probably responds to environmental signals, change conformation, and somehow influence dimerization of ToxR. ToxR and ToxS appear to form a standard two-component regulatory system with ToxS functioning as a sensor protein that phosphorylates and thus converts ToxR to its active DNA binding form. ToxT is a cytoplasmic protein that is a transcriptional activator of the tcp operon. ToxR activates expression of ToxT, which in turn, activates transcription of *tcp* genes for synthesis of tcp pili. It is reasonable to expect that the environmental conditions that exist in the GI tract (i.e., 37°C, low pH, high osmolarity, etc.), as opposed to conditions in the extra intestinal (aquatic) environment of the vibrios, are those that are necessary to induce formation of the virulence factors necessary to infect.

ANTIGENIC VARIATION

Antigenic variation plays an important role in the epidemiology and virulence of cholera[5]. The flagellar (H) antigens of *V. cholerae,* are shared with many water vibrios and therefore are of no use in distinguishing strains causing epidemic cholera. The major somatic surface antigen O, however, does distinguish strains into 139 known serogroups or serovars. The strains belonging to O group 1 are responsible for cholera gravis causing pandemics. The serogroup Ol strains are further sub-divided into three antigenic forms called serotypes or subtypes namely Inaba, Ogawa and Hikojima, and the O antigen of Ol strains consists of three factors A, B and C. Ogawa produces A and B antigens and small amounts of C, Inaba only A and C, while Hikojima, the rare and unstable one, have all the three factors and react with both antisera. Ol strain consists of two different biotypes, classical, causing the six pandemics, and El Tor, the causative agent of the seventh pandemic. Previously it was assumed that non-Ol strains cause only sporadic infection and are non-virulent. However, the cholera outbreak in India and Bangladesh in October 1992, postulated to mark the beginning of the eighth pandemic, was ascribed to a strain with a novel non-Ol serotype designated O139 Bengal. O139 strains failed to agglutinate with antisera raised against 138 known serotypes and lacked at least two of the genes whose products are necessary for Ol antigen biosynthesis. Thus the emergence of the Bengal strain represents an example of antigenic variation.

PREVENTION

The measures for cholera prevention mostly consist of providing large-scale clean, chlorinated and boiled water and proper sanitation to the potentially affected populations. Health education, cleanliness, good food hygiene, treatment of sewage and safe disposal of human feces are equally important. Up to 80% of the patients can be treated adequately through the administration of oral rehydration solution (ORS) in two stages—the initial phase treats the existing dehydration, while in the maintenance phase, the fluids are continually replenished until diarrhea stops. Severely dehydrated patients are treated through intravenous fluids, preferably Ringer lactate.

TREATMENT

The WHO has established guidelines for cholera treatment[6]. The cornerstone of therapy is to replenish the fluids and electrolytes lost and counteract massive dehydration through Oral Rehydration therapy by a simple solution, called WHO-ORS containing specific proportions of water, salt and sugar. Adjunctive antibiotic therapy may also

be undertaken to reduce the volume of rehydration fluids; a single dose of azithromycin (Zithramax, Zmax) in adults or children shorten the diarrhea duration and decrease vomiting. Oral tetracycline was recommended for reducing the period of vibrio excretion and mitigating the clinical course of disease. Other antibiotics including ciprofloxacin, erythromycin, furazolidone or doxycycline are all effective. Worsening this situation are signs of increasing antibiotic resistance among clinical isolates of *Vibrio cholerae* 01. Routine treatment of a community with antibiotics or "mass chemoprophylaxis" has no effect on the spread of cholera and has adverse effects by increasing antimicrobial resistance. Scientists in Bangladesh have recently reported the emergence of multi-drug resistance, to all standard drugs except ciprofloxacin, in nearly 100% of current clinical isolates from cholera patients. A possible complementary or alternative treatment is a plant-derived compound, an extract from the tree-bark of *Croton lechleri,* found in South American rain forest. An experimental vaccine using a modified strain has been attempted. This strain, called "Texas Star", produces a toxin that has the B domain but not the A (biologically active) domain. Ingestion of this organism should allow production of sIgA against the cell-binding moiety (thereby preventing binding) without producing overt disease.

CHOLERA VACCINES

The fact that a clinical episode of cholera induces long lasting protection has fueled a sustained effort to develop an affordable, safe and effective cholera vaccine. Provisions for safe water and adequate sanitation, which are the mainstays of prevention, are cost-beneficial. Improvements in these areas require substantial long-term, sustained investments and commitments from governments and donor communities. In the short term, vaccines provide an immediate alternative. Vaccination to prevent cholera outbreaks should be undertaken only in concert with other prevention and control measures currently recommended by WHO. The properties expected from an ideal cholera vaccine are: (i) clinical safety, (ii) rapid onset of extended and long-term, if not lifelong, protection against Ol and O139 cholera after a single dose, (iii) can be stored for extended periods at room temperature, (iv) inexpensive to produce and deploy, and in the same price range as vaccines included in the WHO Expanded Program on Immunization, (v) safe to the environment[7]. Significant advances have been made toward these goals during the last 10 years, yet much remains to be done. Exploiting safe, immunogenic and protective cholera vaccines as versatile antigen delivery systems to induce cross protection against a broad range of infectious disease will also increase the cost-effectiveness of cholera vaccination and contribute to the prevention of other infectious diseases. Since mucosal immunity plays a prominent role in protection against cholera, efforts were initially directed towards developing oral vaccines capable of stimulating this type of immune response. Since 1999, the WHO has advocated the use of oral cholera vaccines as an adjunct in the control of cholera. Although internationally available, oral cholera vaccines are not extensively used in public health settings in developing countries where they are most needed. There are currently three licensed oral cholera vaccines[8]. The first, Dukoral, stimulates both anti-bacterial and anti-toxic immunity without any clinically significant adverse reaction. However vaccine safety could not be ascertained and the price of this vaccine remains too high to be deployed in programs for the poor countries. The second, CVD 103HgR or Orochol, is live genetically attenuated vaccine shown to be safe and immunogenic in various trials. Due to the limited market potential, production of this vaccine was halted several years ago. Another killed oral whole cell vaccine (WC) available only in Vietnam has been shown to be safe and immunogenic in subjects aged 1 year and older. The killed whole cell oral cholera vaccines have several limitations.

They require a two-dose regimen, confer only moderate levels of direct protection and are licensed for administration only for individuals 12 months and older. Thus, several new candidate vaccines are currently in the pipeline like Peru-15 (live-attenuated non-toxigenic), which is safe among adults and children; *V. cholerae* 638 (another live attenuated oral vaccine); CVD111, combined B-subunit bivalent O1/O139 vaccine; the VA1.3 and the IEM 108. Other oral cholera vaccine candidates are derived from *V. cholerae* O139 such as the CVD 11258 and Bengal-15. A parenteral (phenol-killed whole cell) conjugate cholera vaccine has also been developed and preliminary studies show the vaccine to be safe and immunogenic but it is as yet unproven whether it will be protective.

CONCLUSION

With the exception of Vietnam, no cholera-endemic country currently uses cholera vaccine in its routine public health programs. There are at least three oral cholera vaccines available in the International market, catering mainly for travellers but none in India and other countries where the vaccine is most needed. This is the paradox of cholera. India has the technical expertise to develop a cholera vaccine, has some of the best certified vaccine manufacturing units in the world, has a large population that would immensely benefit from a cholera vaccine but yet we do not have a cholera vaccine nor are the currently available oral cholera vaccines licensed in our country. Killed oral cholera vaccines are internationally licensed for older children and adults, but not for infants and young children. While we are in the frontiers of research in many aspects of cholera, we are at the abysmal ebb of translating all this knowledge into useful public health tools that would control and prevent cholera. We need to put our act together; otherwise with cholera in our backyard the Indian economic miracle that we talk about will remain a myth[9].

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DO YOU KNOW ?

Q7. If an ordinary plastic mug is filled with water, will it float or sink in a bucket of water ?

Q8. You engrave your name on a tree trunk at say a height of five feet. The tree is growing and after 10 years will the engraving be at the same height ?

ECOLOGICAL BACKLASHES OF WETLAND DESTRUCTION

Shashi* and Anil K. Dwivedi**

Most projects in developed countries need to be screened through environmental agencies so as to avoid the ecological backlashes. Nature stabilizes itself for any major interference. This stabilization may be in a form which may be destructive for humanity. The proposed Ganga Express Way is a project which can lead to ecological backlashes. Some of its possible consequences are discussed here.

INTRODUCTION

A 1047 km. long Ballia to Noida ultra modern Ganga Express Way, a project of the Uttar Pradesh Government, has been initiated. According to the plan, an eight-lane highway is to be constructed along the left side of the River Ganga between Ballia and Noida. With this project 36 tehsils belonging to 19 districts would be benefitted. This Expressway while originating from Ballia will pass through Ghazipur, Ram Nagar, Varanasi, Chunaar, Allahabad, Unchahar, Unnao, Kanpur, Bithur, Kannauj, Fatehgarh, Badaun, Naraura, Bulandshahar and end at Noida. Under this project, Kanpur–Agra, Kanpur–Gorakhpur, Kanpur–Jhansi, Bhadohi–Gyanpur–Shaharanpur–Bansawa, link express ways would be constructed. With the completion of the Ganga Expressway the travelling time from Eastern UP to Delhi would be reduced to 10 hours by road.

This write up deals with a critical analysis of the project in the context of the environmental concerns. This project will consume 1,047,000 × 8 × 7 sq. m fertile agricultural land, excluding the adjoining area and the link roads. This Indo-Gangetic Plain is well known for its fertility and productivity. In the light of this, in no way does it appear justifiable to sacrifice such a huge area and that too at a time when the world is facing problems feeding the exploding population. The policy has provisions to allot land to the affected families, whose houses had been acquired. The compensation of housing plots with a maximum limit of 250 sq. m. for rural areas and 150 sq. m. in urban areas, will convert farmers in to land-less labors.

SILTATION AND FLOOD

The planners say that it would stop erosion of land and save lakhs of hectares of cultivable land. They ignored the fact that each year the Ganga brings billions of tonnes of fertile soil instead of eroding it. This fertile soil is deposited along the river basin. It is this soil which is responsible for high fertility of the area. Now, if a road is constructed along one side of the river, it will act as a dam or barrier for the free flow of water. As a result, huge amount of mud will be deposited on the riverbed, decreasing the cross-section area of the river. During rainy season, when excess amount of water flows through the Ganga, the water will

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find its way into cities, resulting in floods. After a few years, when the river bed would be almost filled, Ganga may be forced to change its path and pass through cities, i.e. perennial floods would become common[2]. One cannot deny the fact that the same process in the coronary artery of human leads to heart attack resulting in to death.

DESERTIFICATION OF DOAB

The Indo-Gangetic Plain is fertile because it receives fertile and fresh soil each year and also the river regularly provides water for irrigation. After construction of the road, the high barrier will lead to two disadvantages. First, the off-side of the road will become waterless. Since soil of the adjoining belt is sandy, in no way does it appear feasible to perform irrigation through other sources in such a soil. In the years to come, this will lead to desertification. Secondly, construction of the huge barrier would also require large amount of soil, as in normal practice the soil would be dug from the nearby agricultural field[3]. This will give rise to another problem. The low land generated in this way will collect the rainwater on the off-side of the river, which will promote the development of sodic and saline soil. Both the above processes will led to progressive development of desert area. In addition, the temporary lentic ecosystem would become a prominent source of various water-borne diseases, such as dengue, malaria encephalitis, etc.

WATER POLLUTION

According to the planners, the developer will incur cent percent investment for constructing this Express-way. In lieu of this capital investment the developer would develop "investment regions" near the Express Way. About 500 large and 7000 medium and small scale industries would be set up in 10,000 acres of land. Nearly 500 large and small scale agro-based industries would also be set up[1]. Not only will the agricultural land reduce, but also all the industrial effluents and garbage would be directly dumped into the Ganga. Kanpur is an ideal example for such experiment where colour of Ganga shows diurnal variation. Ganga would be welcomed by the industries effluents, right from its entry in Uttar Pradesh. Further, this situation would not last in Ballia; instead, during its course in Uttar Pradesh Ganga would be converted into "moving poison". Ganga in Bihar and West Bengal would also suffer. Ground water aquifers are interconnected with the perennial aquatic bodies ; as a result the ground water of the adjoining towns would also no more remain pollution free[4]. Under all these situations the area of doab would no more be better than the hell.

AIR POLLUTION

As a consequence of the above not only the ground and surface water will be affected but air in the areas will also no more remain safe. The harmful gasses released from the industries as well as the vehicular exhaust will ruin the life in this area. Industries generate a variety of gaseous pollutants which lead to different abnormalities in the life of human, plant as well as animals[4]. On one hand the world is worried for the present level of pollution, at the same time we are being pushed in the blow of pollution.

BIODIVERSITY DEGRADATION

Every ecosystem has its own community and there is also the existence of equilibrium among the components of the ecosystem. Any change in the system, whether it is physical, chemical or biological brings about a considerable change in its structure. It is a universal fact that biodiversity is maximum in the optimum situation[5]. Now, the changes discussed above will directly affect the biodiversity of this state. The present commercialized mass is unaware of the benefits of the biodiversity. Biodiversity degradation will destroy the composition on cormophytes, thallophytes, microorganisms, and animals in aquatic as well as the terrestrial forms. As an expectation, the oxygen in atmosphere will not be

sufficient for respiration for living beings. In addition, no one can even imagine of presence of any life form including fishes in water.

INVITATIONS TO ROAD ACCIDENTS

Path of rivers is wavy, we need not explain that the shortest distance between any two points is a straight line. This wavy path will also increase the cost of construction, maintenance and fuel consumption in addition to the time required for the journey and cost of transportation[3]. The 1047 km. distance would be covered in just 10 hours, as according to the planners[1], meaning thereby that the average speed of the vehicle would be 104.7 km per hour ; is it not sufficient to invite the accidents, that to when the roads are wavy.

EXPRESSWAY VERSUS WATERWAYS

Under this project, an investment of Rs. 40,000 crore on the basis of public-private partnership and Rs. 80,000 crore in development areas is expected. A project of such magnitude is being implemented for the first time in the country, the planners themselves accept this[1]. As an alternate suggestion, it would be advantageous to develop the Ganga Waterways, This will not only prevent the economic loss, but the water resources available to us are properly utilized. It would require less than 20% of the budget of the proposed plan towards development of the Ganga Waterways. The voyage would be economical, pollution-free as well as long lasting.

CONCLUSION

Finally, our emphasis should focus on sustainable development, rather than on just development. India is an agriculture based country, and we should aim to feed the ever-increasing population. To fill the belly we need grains and not the coins ; at the same time industries cannot generate the grains. Still there are many roads which need repairing. Self reliance in the power sector would leave the other states behind.

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SOMETHING TO THINK ABOUT

WHAT CHOICE DOES THE FEMALE HAS ABOUT HER OFFSPRING ?

Hem Shanker Ray

In India it is common for a woman to be chastised if she delivers a baby girl. The mother-in-law or the husband, even if they are professors of biology, may not accept what the science says, and that the husband's chromosones and God's will alone decide the sex of the body. If cloning is possible and the male is kept out of the picture, then a female delivers only a female. It appears that the female crocodile may have some choice, at least in theory. The sex of the baby is decided in this case by the temperature of incubation, a female below about 77°C an a male above about 81°C, in between it can go either way. The female kangaroo has a special capacity to store her fertilised egg indefinitely and plan the delivery when weather condition is right and food plentiful. The human female can neither delay delivery nor control her womb temperature, she is kind of helpless.

Women, however, do often have the opportunity of choosing a mate. Even in the case of arranged marriages, a bride's opinion often counts, though not always. In history many princesses have chosen husbands through *Swayambara* or set tough criteria for potential mates to fight amongst themselves. In the animal kingdom, the right to mate is often decided by physical contest which is cooly watched by the female. However when there is a clear victor she no longer has much choice at best she can test out the male for physical durability by making him chase her. Amongst the birds, physical strength counts less than other attributes, such as talent in making nests, gorgeous feathers and other things that define look and personality. The males sometimes have to compete in courtship dances and amongst the birds of paradise, the funnier the dance the better is the score. In the animal kingdom the females do choose.

We come to another question. When a couple is monogamous and the female is stuck with only a single male, then this male alone can fertilize her eggs. However, if a female mates with several males then which male is the eventual winner ? Does the female have any choice about the sperms deposited within her ?

The conventional theory is that males of all species of animals compete to fertilize the female's eggs to produce its own progeny and, perhaps, the fertilization proceeds on 'first come first served basis'. Who came first may be debatable though. The females of the world's largest snake Anaconda sends out pheromone signals when in heat and that draw dozens of males from far and wide, sometimes even from a distance as large as 4 kilometers. Soon the female has company of not one but dozen or more males who, because they are much smaller in size and because they choose not to fight amongst themselves, all simultaneously wrap themselves around the female's body creating what we can call an Anaconda ball. In this mass of slithery snakes there are many heads and tails which grip

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the female trying to impregnate her. Some succeed, some do not. Now the question is can the female decide as to who will be the winner ?

Researchers in Reproductive and Developmental Medicine at the University of Sheffield, U.K. have opined that female mammal can mate with several males but may still actually choose whose sperms shall fertilize her eggs. During their study on pigs, they found that the reproductive system of female mammals can 'sense' the presence of sperms and reach it by changing the uterine environment. Pigs have been chosen for the study because their reproductive system is similar to that of humans.

The oviduct environment needs to be prepared for storing the sperm and for this there is alteration in the Falopian tube's protein profile which influences the early embryonic development. Apparently, the female sex organs can pick and choose, keep some sperms dormant and others activated. In promiscuous species, such as Baboons, the female can mate with several males during the productive cycle, but usually offsprings mostly belong to a particular male. It is doubtful though if human female has this capacity. If only she had then victims of rape will not be compelled to carry the offspring of some brute.

KNOW THY INSTITUTIONS

INSTITUTE OF LIFE SCIENCES, BHUBANESWAR

Established by the Government of Orissa in the mid eighties to undertake research in the broad field of moleculor biology, the Institute of Life Sciences (ILS) came of age in 2002 with DBT taking over the institute under its fold. While this change eased the resource constraints considerably, it also brought about a pressure to match renewed and high expectations from its 4-5 scientists and about 7-8 Ph. D.

The faculty strength has increased to 14 with about 50 full time Ph. D. students currently pursuing their degrees. By the year 2012, ILS should have about 25 faculty and 120 graduate students.

To match these targets, ILS has structured its laboratories to ensure that every facility is accessible to every student and faculty including high end facilities such as confocal microscopes, flow cytometers etc. that are managed by trained staff.

While lack of a 'critical mass' is often the reason for institutions getting clustered in major cities, the geographical location of ILS has the advantage of having a large pool of motivated students, culturally committed for pursuing a carrier in science.

RESEARCH ACTIVITIES

The research program at ILS is clustered into three broad areas : (a) Infectious Disease Biology ; (b) Gene Regulation and Function and (c) Technology Development.

INFECTIOUS DISEASE BIOLOGY

Under the area, molecular & Cellular biology and immunology of infectious diseases such as Malaria, Lymphatic Filariasis, Cholera, Chikungunya and Epstein-Bar, Viral infections are addressed. The objective is to gain insights into the genetic composition of pathogens, interactions of the host with invading pathogens, host immune responses during experimental as well as natural infections and the consequent host immuno-regulatory mechanisms in these diseases. Generation and persistence of the wrong subset of immune cells has deleterious consequences not only in infectious diseases but in auto-immune diseases and allergies. Ongoing studies attempt to regulate this process towards elimination or protection of the unwanted/preferred T cell subset to apoptosis and redress the immune balance.

GENE REGULATION AND FUNCTION

ILS has taken advantage of availability of endogamously bred population to study genetic polymorphism of several human genes and association with susceptibility/resistance to diseases in human communities. Study of microbes in the environment is an area that has allowed ILS faculty to understand the evolution of pathogenic bacteria and in discovering novel unreported extremophils which have bioprospecting applications.

The focus has been on evolutionary processes involved in the emergence CTX pathogenic *V. cholerae*, SXT-related ICE and to characterize those pathogenic genes and their protein products that are expressed during various-stages of infectious precess/preservation. Micro-organisms, particularly extremophiles represent the largest reservoir of undescribed biodiversity and discovery of new bacteria and new biomolecules is still a distinct possibility. Over the years the ILS has identified several new bacteria viz., *Thiomonas bhubaneswarensis, Chelatococcus sambhunathii and Gulbenkiania indiensis*.

Human cancer models are used to broadly address issues on gene function and regulation. Ongoing studies include : (i) the role of specific genes/proteins (known or novel) in the progression of chronic myeloid leukemia molecular (ii) studies on chromatin remodeling activities in breast cancer and brain tumor (iii) studying abiotic stress identification of salt responsive genes using differential gene expression techniques.

TECHNOLOGY DEVELOPMENT

ILS faculty has been using nano-technology to devise novel drug delivery systems for treating cancer. Successful development of magnetic particles technology being patented by ILS for *in vivo* as well as *in vitro* use is one example of the direction the institute is taking. The other area is developing novel constitutive, tissue specific and inducible promoters with non-homologous sequences to control gene function and expression in eukaryotes. Approaches like DNA shuffling, hybridization, swapping, hybridization-shuffling and inserting synthetic cis-elements etc. have been used to develop novel pararetrovirus based shuffled, shuffled-hybrid and synthetic-hybrid promoters with enhanced promoter activity. A sensitive spectroscopic (UV-Visible) probe has been developed for quantifiation of the anti-malarial drug Artumisinin for the first time ; currently an assay that detects nano-mol quantities of the drug does not exist in public domain. The assay is expected to find wide application in Pharma industry and by public health personnel.

HRD LINKAGES & COLLABORATIONS

ILS has collaborative projects with a broad range of institutions that include University of Edinburgh, University of Leiden, Tata Institute of Fundamental Research, IIT Chennai, Sankara Nethralaya, National Institute of Immunology, Bhubaneswar Eye Institute, Bose Institute and Orissa University of Agriculture and Technology.

As an institute under DBT in Eastern India, ILS has taken upon itself the responsibility of training a large pool of manpower in cutting edge technologies in biotechnology. It conducts biannual workshops on molecular biology lasting 6 days and imparting intense training that include wet experiments at the bench. Laboratory workshops on confocal microscopy and flow cytometry are conducted annually when faculty from India and abroad spend quality time with students. These training programs have been followed by 'opening-up' of the core facilities of ILS to student participants from institutions in the region. An extension of this fruitful activity will be the development of platforms for live cell analysis by imaging and cytometry technologies in the next two years. With the objective of giving a wider exposure to its Ph. D. students. ILS has been hosting national and international conferences on subjects like nanotechnology, immunology, biochemistry and cancer. This has offered opportunities for students to 'find' their mentors both in India and abroad. On several occasions the mentors have found their 'wards'!

Training Ph. D. students has been a prominent part of mandate at ILS. The number of Ph. D. scholars has increased from 9-10 in 2006 to about 50 in 2009. The Ph. D. program has been the most viable acitivity of the institute attracting a large pool of well qualified and motivated students.

INFRASTRUCTURE

This is an aspect that has seen quantum growth. Additional laboratories have been constructed during the last 4 years. A four-storey laboratory block that offers about 60,000 sq ft of bench space is under construction. A separate animal facility (to accommodate about 8,000 small animals) and a research scholars residence are expected to be completed later this year.

PUBLICATIONS AND PATENTS

Over the last two years ILS faculty and student have been publishing in well cited journals at a rate of about 2-3 papers per investigator per year. More significantly, technology development seems to have caught the imagination of ILS faculty. Three patents have been filed during the last two years and if the ongoing discussions with industry fructify, the institute should be able to transfer the technologies within the next one year.

THE FUTURE

While the current campus is yet to became fully functional, serious debate on the future expansion and course of development has already been initiated. Government of Orissa has been forth-coming in support. Faculty residences, visiting scientists lodge, and additional accommodation for Ph. D. and post-doctoral students will be constructed in a 3 acres plot acquired recently near the present campus. Keeping in view the need for developing a niche area of research for the institute, a Center of Excellence in viral biology and nanoscience has been proposed. If the on-going discussions take shape ILS should have a large self-contained 30 acre second campus in not too distant a future. The institute is moving forward with a well planned strategy. But as it is famously said, "however beautiful the strategy, one should occasionally look at the results !" ILS has begun to witness very clear signs of emerging excellence in both 'Science' as well as in "Technology Development'. Posterity will judge whether or not the strategy has yielded results. 'Going-up' is the only option that ILS faculty and students have given themselves.

Contact : Institute of Life Sciences, Nalco Square, Chandrasekharpur, Bhubaneswar-751023, Orissa. (www.ils.res.in)

Conferences / Meetings / Symposia / Seminars

30th Annual Symposium on Sea Turtle Biology & Conservation, April 27–29, 2010 in Goa, India

Theme of the symposium is sea turtles inhabit the land and the sea. They connect the shallow nearshore waters to the open sea, cold temperate to warm tropical waters. They migrate across ocean basins ; and through several thousands of years, they have connected us ecologically and culturally to the sea. The 30th annual symposium on sea turtle biology and conservation will seek to explore these connections and focus on the world they live in. The world of coral reefs, seagrass meadows, open seas and sandy beaches. The world of people, living and working on the coast or at sea ; of fishing cultures and livelihoods. All connected by sea turtles and by us. The 30th symposium will also draw attention to the concerns of fishing communities, especially those across the South Asian region, within the conservation paradigm and will address how marine conservation issues can be approached without jeopardizing–but rather by enhancing– the livelihoods of communities that depend on these resources and the same environments that are needed by the turtles. In this context, discussions will also focus on traditional fishing communities, whose practices have often been questioned by the conservation community, but whose contributions to maintaining and ensuring the "health" of the marine ecosystems must be acknowledged and addressed.

Contact : Kartik Shanker, President, International Sea Turtle Society and Centre for Ecological Sciences, Indian Institute of Science, Bangalore 560012, India (E-mail : kshanker@ces.iisc.ernet.in)

2nd International Conference on Engineering Optimization (EngOpt–2010) on September 6-9, 2010 Lisbon, Europe.

The main goal of EngOpt conferences is to periodically bring together engineers, mathematicians and computer scientists working on research, development and application of optimization methods applied to all engineering disciplines of basic techniques in this field. Modern design techniques seek for the best design to perform. Engineering Optimization deals with the optimal design of elements and engineering fields. Modern Engineering Optimization is strongly interdisciplinary and to solve real engineering problems required the cooperation of engineers, mathematicians and computer scientists. A fundamental need for MDO is also the establishment of a strong communion of scientists and practitioners acting in different engineering disciplines. EngOpt is intended to be a forum to expose and share current and future innovation in all techniques in Engineering Optimization.

Contact : Conference Secretariat, Centre for Mechanical Design, Mechanical Engineering Department, Instituto Superior Tecnico, Av. Rovisco Pais, 1049-001 Lisbon, Portugal. Phone : +351 218417914, Fax : +351 218417915, Email : engopt2010@dem.ist.utl.pt

S & T ACROSS THE WORLD

FORMULATING TECHNOLOGY ROADMAP

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

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

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

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

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

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

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

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

(TIFAC, Sep 2009)

PREVENTING OF BLOOD CLOTS

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

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

(BHU, Jul 2009)

MICROORGANISMS REVOLUTIONISE PRODUCTION

In many industrial sectors, biotechnological processes have become an inherent part in the repertoire of production processes. Biotechnological processes can keep up with "conventional" processes in many cases : in pharmaceutical production, food manufacturing, in the chemical industry or in the production of energy sources. Besides the classical fields of application like specialty and fine chemicals, new applications, e.g.

in the use of renewable resources, are emerging. Worldwide production volumes of biomaterials and bioenergy are expected to be in the range of Euro 300 bn by 2030, accounting for around a third of total industrial production.

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

(Chemical Weekly, Jun 9, 2009)

WIRELESS POWER SYSTEM

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

(BBC News, Jul 23, 2009)

ANSWERS TO "DO YOU KNOW ?"

1.A. It is opposite of placebo effect where sugar pills or saline injections seem to have curative effect often on 50% patients even in the case of Parkinson's disease. The effect is largely psychological and induced by belief of the patient in immediate cure. In Nocebo effect, often 20-25% of the cases, there are adverse reactions e.g headache, nausea, sleeplessness etc. although no drug is administered.

2.A. 10

3.A. The kangaroo.

4.A. Not necessary to freeze water one needs to take out 80 cal of heat from each grame of water. This takes time and normally a much lower temperature.

5.A. About 540 cal, i.e. much more.

6.A. Evening, because the foot size graws to maximum till then.

7.A. It will float.

8.A. Yes.

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2. Manuscripts should be typewritten on one side of the paper with double spacing. Articles should be written generally in non-technical language and should not ordinarily *exceed 2000 words.* Articles must be understandable by the average enthusiastic readers with some modest scientific background but outside the field. It should not be a review article in a specialised area. Without being too technical, it must also reflect state of the art situation in the field. *A summary* in 50 words should be submitted along with the paper highlighting the importance of the work. *Two copies* of the manuscript complete in all respects should be submitted. The title should be written in capital letters and name(s) of the author(s) should be given along with the Department, Institution, City and Country of each author.

3. Illustration & Tables : The size of illustrations should be such as to permit reduction to about one-third. Legends and captions should be typed on a separate sheet of paper. Photographs should be on glossy paper with strong contrast in black and white. Typed tables should be in separate pages and provided with titles and their serial numbers. The exact position for the placement of the tables should be marked in the script. Authors are specially requested to reduce the number of tables, illustrations and diagrams to a minimum (maximum of 3)

4. References : References to be given on a selective basis, (maximum of 10) and the order of placement should be numerically with (a) name(s) of the author(s) (surname last), (b) name of the journal in abbreviated form according to the 'World list of Scientific Periodicals' and in italics, (c) volume number (in bold) (d) page number and (e) year of publication.

For citations of books the author's name should be followed by the (a) title of the book, (b) year of publication or edition or both, (c) page number, (d) name of publishers, and (e) place of publication.

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2. Four copies of full paper along with four copies of the abstract (not exceeding 100 words) shall have to reach the office of the General Secretary (Hqrs.) not later than May 31, 2010. At the top of each copy of the paper and its abstract, the name of the Section where the paper is to be presented should be indicated. The Sections are : (1) Agriculture and Forestry Sciences (2) Animal, Veterinary and Fishery Sciences (3) Anthropological and Behavioural Sciences (including Archaeology and Psychology & Educational Sciences and Military sciences) (4) Chemical Sciences (5) Earth System Sciences (6) Engineering Sciences (7) Environmental Sciences (8) Information and Communication Sciences & Technology (including Computer Sciences) (9) Materials Science (10) Mathematical Sciences (including Statistics) (11) Medical Sciences (including Physiology) (12) New Biology (including Biochemistry, Biophysics and Molecular Biology and Biotechnology) (13) Physical Sciences and (14) Plant Sciences.
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4. Work should have been carried out in India and this has to be certified by the Head of the Institution from where the candidate is applying.
5. The candidate should give an undertaking that the work which is being submitted has neither been published in any Journal, presented in any other Conference/Seminar/Symposium nor been submitted for consideration of any award.
6. In case of a paper by more than one authors, the candidate (young scientist) has to be acknowledged by the other author(s) (in terms of a certificate) as having made the major contribution.
7. A Young Scientist could present only one paper in any one Section (and not a second paper with the same or related work in any other Section).
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9. The final selection for the awards will be done by a duly constituted committee and the awards will be given at *98th Indian Science Congress* to be held at SRM University, Chennai from January 3-7, 2011.
10. The last date for receiving papers is **31st May, 2010**.

All correspondences should be made to :

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