EVERYMAN'S SCIENCE

Vol. XLV No. 2 (June '10 – July '10)

COVER PHOTOGRAPHS ***(From the Left)***

Past General Presidents of ISCA

1. Prof. N. R. Dhar	**(1961)**
2. Dr. B. C. Guha (died pre-maturely)	**(1962)**
3. Dr. B. Mukerji	**(1962)**
4. Prof. D. S. Kothari	**(1963)**
5. Prof. Humayun Kabir	**(1964-65)**
6. Prof. B. N. Prasad	**(1966)**
7. Prof. T. R. Seshadri	**(1967)**

Printed and published by Prof. S. S. Katiyar on behalf of Indian Science Congress Association and printed at Seva Mudran, 43, Kailash Bose Street, Kolkata-700 006 and published at Indian Science Congress Association, 14, Dr. Biresh Guha Street, Kolkata-700 017, with Prof. S. S. Katiyar as Editor-in-Chief.

Annual Subscription : **(6 issues)**

Institutional Rs. 200/- ; Individual Rs. 50/-

Price : Rs. 10/- per issue

CONTENTS

EDITORIAL

DENGUE : THE CONTINUED THREAT TO MANKIND

Dengue, the *"Ki Denga Pepo"* a disease of the antiquity has gradually engrossed the major regions of the world. It has been established as an important public health concern with a global incidence of about 100 million cases reported annually from the tropical and subtropical conutries[1]. India is endemoepidemic for dengue having experienced many outbreaks of dengue fever (DF)/dengue hemorrhagic fever (DHF) since 1963. Epidemics of dengue have followed the major construction activities in India : the Asian Games in 1981-82 or the present Common Wealth games in 2010. In the post monsoon months during 2006, India experienced the last major outbreak of DF/DHF affecting more than 12000 cases with 184 deaths, of which 3366 cases and 65 deaths were reported from Delhi alone[2]. This year till September, 11736 cases of dengue with 45 deaths have been reported to the Directorate of NVBDCP,GOI[3]. Increased construction activities without appropriate water management, rapid demographic changes, deterioration in public health infrastructure apart from globalization through travel and trade have favoured dengue transmission. This has become a reality because of the anthrophilic nature of the vector, *Aedes aegypti* and *Aedes albopictus*, where human beings remained the principal host. Aedes, the tiger mosquitoes, are usually peridomestic, frequent day biters and prefer to breed in artificial collections of clean water in discarded coconut shells, tires, tins, tubes, flower vases, tree holes and leaf axels. They do not fly more than 100 meters a day, hence as per the International health regulations of WHO all international airports and seaports should be free of the Aedes mosquitoes within 400 meters of perimeter[4].

Dengue virus, a member of flaviviridae, is responsible for the reemerging disease of the tropics and subtropics spread over urban and periurban areas. The virus exists as 4 district serotypes (DEN 1 to 4) in nature. Each serotype has several genotypes like DEN-1 (3-5 genotypes). DEN-2 (5-6 genotypes), DEN-3 (4 genotypes), DEN-4 (2 genotypes). Some types have restricted geographical distribution, while others are more cosmopolitan, reflecting their dispersal across the topical world[5]. Particular genotypes are associated with disease severity and any change in the circulating type may influence the severity of the outbreak. DEN-2 genotype IV having potential to cause DHF was in circulation since 1996 in Delhi[6] when DEN-3 (an epidemic strain) emerged as an co-circulating type with DEN-2 in 2003[7] whereas by 2006 DEN-3 replaced type-2 and co-circulated with DEN-1. This might increase the severity of the disease in a population already exposed to a previous serotype and therefore, warrants the study of epidemiological dynamics in populations with more than one DEN serotypes co-circulating simultaneously[8].

Because of common group reactive antigens on the envelope protein, faviviruses cross react extensively in serology making the serodiagnosis difficult. Following natural infection, the antibody developed is so type specific that prior[1] infection with one serotype does not completely protect the entry for the other. Rather the pre-existing heteroserotype specific non-neutralizing antibodies result in the development of immune complexes, thereby facilitating the transfer of the infecting serotype to reticuloendothelial systems (RES) via circulating monocytes (immune enhancement

hypothesis by Halstead et al)[9]. However, in some of the primary dengue cases the strain variations leading to increased epidemic potentiality has also been postulated[1]. In epidemic situations persons living in endemic areas are infected with more than one serotypes[1]. A case of dengue is commonly suspected on clinical features supported by hematological findings and platelet count below 100,000/cumm. Though detection of specific IgM by capture assay remains the mainstay of diagnosis, however within 3-4 days of onset of fever isolating the virus/detection of DEN RNA by RT-PCR is the choice needing a sophisticated laboratory. Presently detection of DEN NS1 antigen in acute blood samples is of great help, reliable and easy to perform[10]. The management of DF is symptomatic and supportive. However, in case of DHF/DSS in addition to the fluid replacement whole blood transfusion might be needed. In rare cases platelet transfusion may become essential.

Because the Indian subcontinent is endemic to dengue, circulation of multiple serotypes in the community during epidemic situations, observation of DHF tendency in the South East Asian strains of DEN-2[11] and over and above the preexisting antibodies against already circulating DEN types in the community limits the entry of the vaccine players in dengue. Presently tetravalent dengue vaccines are under clinical trials.

Since Aedes are the principal vector, mosquito control remains the best method to reduce the disease burden following judicious use of an "**Integrated approach"** with special reference to prevent environmental pollution with toxic chemicals and development of insecticide resistance[4]. Environmental control by **source reduction** appears to be very highly effective against Aedes larvae. Chemicals like paris green, mineral oils and synthetic insecticides have commonly been used with limitations. Biological measures using fishes like *Gambusia affinis* and *Barbados millions* are quite promising when used in conjunction with other methods. DDT and malathion are commonly used as residual sprays against adult mosquitoes although development of resistance is a major concern. During epidemics, for immediate reduction of outdoor mosquito population, space sprays with Pyrethrum extract using aerosol dispensers or residual insecticides like fenitrothion by ULV fogging are recommended. Personal protection is of more importance using Mosquito nets with 150 holes per square inch, chemical impregnated mosquito nets or screening the buildings with copper / bronze gauze meshes (16 meshes/inch) gives excellent results. For short duration protection, repellants like Deet / Dimethyl phthalate are also recommended as skin applicants[4].

REFERENCES

1. Gublar DJ. *Clin Microbiol Reviews* ; **11(3)** : 480-96, 1998.
2. Mustafa MM, Agrawal VK. MJAFI ; **64** : 161-64, 2008.
3. http://nvbdcp.gov.in/Doc/Dengue-September-2010.pdf.
4. Environment and health. Textbook of preventive and social medicine : K Park 18th ed. Chapter 12 p575-08.
5. Rico-Hesse R. *Virology* ; **174** : 479-93, 1990.
6. Singh UB, Maitra A, Broor S, Rai A, Pasha ST, Seth P. J *Infect Dis.* ; **180(4)** : 959-65, 1999.
7. Manoj Kumar, S.T. Pasha, Veena Mittal, D.S. Rawat, Subhash Chandra Arya, Nirmala Agarwal, Depesh Bhattacharya, Shiv Lal and Arvind Rai. Unusual Emergence of Guate 98-like Molecular Subtype of DEN-3 during

2003 Dengue Outbreak in Delhi Dengue Bulletin–Vol 28, 2004.

8. Zhang C, Mammen MP Jr, Chinnawirotpisan P, Klungthong C, Rodpradit P, Monkongdee P, Nimmannitya S, Kalayanarooj S, Holmes EC. *J Virol*. Dec ; **79(24)** : 15123-30, 2005.
9. Halstead SB & O' Rourke EJ. *J Exp. Med* ; **146** : 210-17, 1977b.
10. Singh MP, Majumdar M, Singh G, Goyal K, Preet K, Sarwal A, Mishra B, Ratho RK. *Diagn Microbiol Infect Dis*. ; **68(1)** : 50-4, 2010.
11. Cologna R, Armstrong PM & Rico-Hese R. Selection for virulent dengue viruses occurs in humans and mosquitoes. J Virol 2005 ; **79** : 853-9.

Prof R. K. Ratho and Prof R C Mahajan

This world, after all our science and sciences, is still a miracle ; wonderful, inscrutable, magical and more, to whosoever will think of it.

—Thomas Dekker

PRESIDENTIAL ADDRESS

IMPACT OF LIFE SCIENCES ON MAN

DR. B. MUKERJI, F. N. I.

I am deeply conscious of the honour you have done me in electing me to preside over the Cuttack Session of the Indian Science Congress. This honour, coming as it does when I am on the threshold of my sixties, is of great personal significance and joy to me. This is the first occasion in forty-nine years of the life of the Indian Science Congress that it is meeting in Orissa, the land where Emperor Asoka realized for the first time in history that war was futile and that the spread of *dharma* or righteousness was more important than the expansion of empires. The neighbourhood of Cuttack was once a great seat of learning and the Jaina monarch, Kharavela, had established many monasteries and hostels for monks and scholars there. For centuries afterwards, Cuttack and its environs remained a famous seat of Buddhism and streams of scholars came to study in the University, known as *Ratnagiri Mahavihara,* from Tibet and from areas in north-western India. It is also significant that some portions of the Vedas—the *Atharva Veda* in particular—are maintained as living tradition in Jaipur, as they are nowhere else in India. Ever since the Seventh Century A. D. Kalinga developed a distinctive style of sculpture and temple architecture, which have made Bhubaneshwar, Konarak and Puri household words wherever Indian art is admired. This great tradition and spirit of original expression in art, literature and culture were maintained till very recent times by an unbroken chain of scholars and artists, little known to the outside world except perhaps, the astronomer, Chandrasekhar Samanta Roy and the artist, Giridhari Mahapatra. In an atmosphere pervaded with such glorious culture, tradition and lore, I have every hope that the scientists assembled here today will be able to deliberate effectively on Science, its achievements and its impact on society.

The choice of a subject for a General President's address is not easy. In his Presidential Address to the British Association for the Advancement of Science over sixty years ago, Sir William Crookes remarked that while formerly the President "unrolled to the meeting a panorama of the year's progress in Physical and Biological Science, now he usually restricted himself to speculations connected with his own work or dealt with questions which for the time being were uppermost". No scientist is bold enough today to attempt a review of the tremendous progress the world has witnessed during the last year in the Physical and Biological Sciences. If a General President restricts himself to a critical analysis of his own contributions in a limited and specialized field, he is not likely to do justice to a gathering of this type in which at least thirteen different scientific disciplines with their sub-disciplines are represented. I have, therefore, attempted somewhat of a compromise in this Address keeping both these objectives in mind.

During the last three decades, it has been my privilege to be actively associated with the

* General President, Forty-ninth Indian Science Congress held during January, 1962 at Cuttack.

development of drug research in India. Initially in the role of a junior investigator and latterly as the leader of a team of workers drawn from different disciplines engaged in the common task of either exploring the efficacy of ancient Indian remedies or developing new ones, for the countless maladies afflicting the human body and mind. I am aware of the great complexity of many of the problems confronting the investigator in this field and have become more and more impressed with the necessity for utilizing methodologies of diverse Sciences in finding solutions for them. Drug Research, I might add, lies in the borderland of Physical and Biological Sciences and provides an exciting challenge for interdisciplinary contacts and coordination.

The scope of drug research is extensive ; it covers all the efforts directed towards the understanding of disease processes and the manner in which they can be combated by drugs. Besides investigations on pathological changes initiated by diseased conditions, it includes also studies on normal physiological processes in so far as they are affected by various stress syndromes or disease. Many lacunae exist in our knowledge concerning even the so-called normal activities of the human body and obviously these should be clarified before attempting any valid scientific appraisal of drug action. The development of a drug for a specific disorder has to be necessarily preceded by investigations on the causative factors with particular reference to the nature of micro-organisms invading the system, the pathological changes resulting therefrom and their impact on the bodily equilibrium not only in the patient, but also in experimental animals in which the disease process can be reproduced and followed at the level of the organ, the tissue, the cell and the sub-cellular structure. The tools and experimental techniques of several interdependent Sciences have to be judiciously employed for a meaningful pursuit of this objective. Inter-disciplinary collaboration has been the most characteristic feature of drug research, indeed of research in Life Sciences today, and such collaboration has proved most fruitful.

LIFE-SCIENCES VERSUS NON-LIFE SCIENCES

Life in all its unbelievable complexity and fantastic variety is undoubtedly the highest stage in the development of matter on earth and is distinguished by features of a new kind, quite foreign to non-living matter. Metabolism, heredity with its own specialized mechanism of transmission of biological patterns, the power of adaptation to the internal environment (homeostasis) and to surrounding conditions, the purposeful reactivity to external stimuli, intelligence and finally, memory, thought and creative activity of man—all these are the exclusive properties of life, determined by prolonged evolution of matter under specific conditions. It is important for our future that man should try to gain a deep and sound knowledge about life and its laws, of the living nature surrounding himself, with which he shall always be inseperably connected.

I should, therefore, like to discuss this afternoon some of the recent advances in Life Sciences which include all the branches of Biology in its broad fundamental and applied aspects and the field of study covered by Medical Sciences, and their impact on man. I make no apology for choosing this rather ambitious subject for my address and for venturing to unfold my ideas before the distinguished gathering of mathematicians, physicists, engineers, technologists, statisticians, chemists, agricultural scientists, biologists and medical research workers assembled here. Today, there is a much wider appreciation of the impact of "non-life" or Physical Sciences and technology on contemporary human life than of Life Sciences. The progress in Life Sciences though no less significant, has however, failed to elicit sufficient attention. This is due, perhaps, to the fact that the practical benefits arising out of the

large-scale application of knowledge of the Biological Sciences for betterment of mankind have become so interwoven with our daily lives that we alomost take them for granted. A space capsule circling every ninety minutes round the orbit of the earth is, to the popular mind, more awe-inspiring than the unravelling of the exceptional complexity of the macro-molecular systems,—the essential basis of living matter—the ultra-structure of the human gene, the extraordinary architecture of a virus particle, the histochemical make-up of the end plate in a peripheral nerve and the intricate pathways criss-crossing between the cortical nerve cells and the "centrencephatic centre" (Penfield and Jasper, 1954). But these latter are just as important, if not more, for unravelling the mysteries of life processes.

While marvelling at the stupendous achievement of contemporary Science and technology, let us not ignore the amazing advances made by Life Sciences which have helped, to create an understanding of the nature of the cell and of the vital processes that are incessantly taking place in it. Even at the risk of sounding partisan, I venture to submit that in the end, history may record that the most important scientific discoveries of the decade of the Hydrogen Bomb, the Sputniks and the Thor missiles were not of the Physical Sciences, but of Bio-sciences. The contradiction between the vast potentialities of nuclear energy for human welfare (when properly used) and its extreme destructiveness (when misused) have brought us today face to face with the social implications of Science and technology. The knowledge stemming from investigations into the molecular basis of life and heredity is likewise fraught with both pleasant and dangerous consequences ; and we owe it to humanity to assess these development and harness them exclusively for human welfare and happiness.

MEETING GROUND OF ALL DISCIPLINES

Life Science have today taken tremendous strides and it has become almost impossible to present a comprehensive or unified picture of the progress achieved in the last decade or two. One feature, however, stands out, namely, the evolution of Biology from the descriptive, codifying and cataloguing phase of a century ago to the present phase of analysis and measurement. While the biologist of yesterday fought shy of measurements, today he regards measurement as the very essence of his work; he is not content with merely recording changes of forms and functions; his studies go beyond to the very basic molecular patterns of dynamic life structures. This change of face is reflected in the ever-increasing multitude of instruments and appliances employed by the biologist ; even obstruse mathematical concepts are pressed into use. And this adoption of the tools of Physical Science has led to phenomenal developments. Far more elective than this has been the active participation of the chemist and the physicist in investigation of biological problems. It may be said without exaggeration that Life Sciences have literally come of age with the purposeful collaboration of biologists and medical men with chemists, technologists, physicists and mathematicians.

The far reaching developments ushered by this joint and coordinate effort may be illustrated by the remarkable work on deoxyribonucleic acid (DNA) which functions as the carrier of heredity and has come to be known as the "agent of destiny" residing in the nucleus. DNA has a molecular weight of about 10 million and it has been shown that this helical molecule is composed of 10,000 purine-pyrimidine pairs. The sequence of arrangement of so many base pairs would naturally give rise to the possibility for the formation of almost an infinite number of permutations and combinations, which would account for so many species and varieties which occur in the living world. The structure of DNA was first proposed by the physicists, Watson and Crick, and confirmed by Wilkins and Franklin by X-ray analysis. The crowning achievement was its synthesis by the

biochemist, Kornberg, using his brew of enzymes and substrates. No less exciting is the painstaking and masterly work of Sanger on the Chemistry of insulin which, besides revealing the active site of insulin action, laid the foundation for studies on peptide structure and amino acid sequence in proteins. Recent studies by du Vigneaud and colleagues on peptide hormones (Corticotrophin, melanotropic hormone, hypertensin, oxytocin, vasopressin, etc.) from the tissues of different animal species also indicate that different topochemical changes in molecular structure have quite different effects on biological activity of a particular substance.

A visit to a modern laboratory devoted to research in brain physiology, for instance, would be revealing. The digital computer, the electronic stimulator, the implantation electrodes, the electro-encephalograph, and the electronic pulse generator have become indispensable counterparts of the conventional kymograph, the respirometer and the Gieger-Muller counter. Refined tools have become necessary for attacking problems of organization, differentiation and function at the molecular level, and the methodology and techniques of the biochemist, the biophysicist, the pharmacologist, and the biometrician are utilized in abundant measure to gain an insight into the nature of the neuron, the biochemical changes at the end plates in nerve fibres by which the nerve impulse is conducted, and how the totality of sensory experience, apparent to us as memory, is stored. This is but one example of the coordination of diverse experimental approaches for the study of problems pertaining to an isolated aspect of Life Sciences. Often the combination of a variety of specialist techniques has become indispensable for achieving success in such investigations.

FORM AND FUNCTION

It may be rewarding to survey briefly the advancing frontiers of Life Sciences with a view to obtain an assessment of the current state of development. Classical Biology has concerned itself mainly with form and function and their interdependence. The most significant change in this field has been the extension of the earlier concepts of morphology and physiology from the level of the organism as a whole (or of discrete organs) to the dimensions of the cell and its sub-units. Thus, conventional histological staining, though it is still valuable, has become more meaningful with the introduction of histochemical techniques. The reproduction of a diseased condition in an experimental animal, important as it is for the study of its chemical pathology, is now being extended to the study of the isolated diseased organ and to cells grown in tissue culture.

The cell in its place has yielded to micromanipulation and fragmentation techniques of lysis, homogenisation, centrifugation, and partitioning in artificial media. Microinjectors now used in the dissections of cells can measure and control fluid volumes of less than one-fifty millionth of a drop and the hooks, scalpels, needles, scissors, etc. used in microsurgery have comparable micro-characteristics. By a combination of these highly precise mechnical devices it is now possible to isolate discrete anatomical units from the cell ; for example, from the nuclear material of mammalian liver cell, one can separate the nucleoli, spindle-fibres, nuclei, the mitochondria and the microsomal ribonucleoprotein particles, and these isolated sub-units can mediate specific functions, such as oxidative metabolism or biosynthesis of proteins. Studies on transplantations of nuclear material have special bearing on genetic processes. If transplanted so that it becomes part of the nuclear complex of a host cell, the nucleolus, for example, serves as a genetic marker that can be followed in the successive generations of the altered cell. Transplantaions of portions of chromosomes or of nucleolar organizers also offer precise ways of studying gene action and cell differentiation processes. An intelligent comprehension of such fundamental physiological phenomena as electron

transport or trapping of energy as Adenosine triphosphate (ATP) or permeation of metabolites across membrane structures is now possible by a reconstitution of sub-cellular units torn apart from the living cell. The main point that emerges from these studies is that any specified physiological function is the outcome of a well-defined and almost predetermined arrangement of component units in the spatial geometry of the cell. The slightest alteration of this arrangement, brought about either by unknown congenital factors or by artificial means, for example, injury, drugs, disease or exposure to radiations, leads to untoward disturbances in the overall activity of the collective system.

MOLECULAR BIOLOGY

Advances in our knowledge of macromolecules, particularly proteins, nucleic acids and mucopolysaccharides, have been rightly heralded as the dawn of a new era in Biology. Biology has now assumed a new dimension, and a new branch of study, namely, Molecular Biology has emerged. Scientists from diverse disciplines have joined hands in developing this new Science. It must be emphasised that studies in Molecular Biology are more a matter of tools and techniques than of the experimental material. For example, it is immaterial today whether one work with bacterial cells or with tumour or brain cells in order to obtain an insight into the molecular basis of life. Tissue culture and chemostat have made it possible to control environmental factors at will, and to keep a single line of cells going through endless cycles of growth and multiplication in synthetic media composed of comparatively simple substances. Bacterial and fungal auxotrophs may be used in investigations on the laws of inheritance and geneticists have found the technique highly rewarding. Developments in Biochemical Genetics have been so rapid that we can hope to understand, in the near future, the process by which characters like fermentability of a sugar or resistance to an antibiotic, are transmitted from the mother cell to the daughter cell in terms of nucleotides and their arrangement in the chromosomal DNA structure. Employing a variety of mammalian cells from liver, kidney, bone marrow or brain, the replication of single lines of viruses can be followed and a rational approach to the chemotherapy of virus infections is being developed.

Techniques do not make a Science, just as tools do not make a man. Nonetheless, it must be admitted that the newer techniques of Molecular Biology are revolutionising our approach to problems like cancer, heart diseases, and brain disorders, solutions for which can be found only through a better understanding of the normal processes of cell division or of the building up of macromolecular structures. Thus, a cancer cell does not apparently differ from an ordinary cell and yet it has the capacity of multiplying at a rate nearly thousand times faster than the ordinary cell. An aerobic pathogen exhibits nearly all the metabolic characters of a host cell, and yet due to some subtle difference, the pathogen is enabled to find its habitation in the host tissue and elaborate toxins. The eventual aim of Molecular Biology is to find where and why these subtle differences exist. Today we know that the activity of an enzyme protein is associated with a specific arrangement of amino acids in the polypeptide chain. We also know that the alignment of nucleotides in the DNA has much to do with the process of transmission of characters through reproduction. Perhaps the mystery of the cancer cell rests in its peculiar DNA structure driving the cell machinery to a mad frenzy of activity devoid of self-restraint which characterises the normal cell. The translation of knowledge gleaned from DNA and protein structures to the understanding of the memory process or of mental derangement in terms of the sequential arrangement of amino acids in the receptor protein and the nucleotide structure of neuron RNA or DNA is no longer a wild dream, but a distinct possibility in the near future.

THE CELL—PRIMARY UNIT OF LIFE

Within the body, the cells behave like small organisms plunged in an aerated and nutritive medium. All living cells depend absolutely on the medium in which they are immersed ; they modify this medium unceasingly and are modified by it. Despite its minuteness, each cell is a very complex organism, as it is now possible to see with the aid of newer techniques of electron-microscopy. It reveals a new world of minute structures within its wall.

One of the marvels of Cellular Biology is the toti-potential cell, the ovum. The nature of forces bound within the membrane of this single cell, so small as to be invisible to the naked eye, that leads to specialized development of parts and their organization to make so complex a structure as man, is perhaps the greatest mystery of life. To think that within a simple, quite undifferentiated single cell there is contained the pattern and the means to build along this pattern, not merely eyes, but blue and brown eyes—not merely hair, but hair that is red or black or yellow—straight or curly or kinky—hair that will begin to "fall out" at a relatively early age or hair that will retain its lustre late in life or hair that will become "prematurely" dry and grey. The same applies to colour of the human skin in different racial groups in the world including their sensitiveness to different types of light and heat radiations and development of patchy areas of hyper and de-pigmentation at different periods of life. These things are determinable at this one-cell stage as surely as is the four-chambered character of the heart—the number and distribution of acid-secreting cells in the stomach—the distribution of nerve cells and their inter-connections so that precise sensory and motor functions can be carried out—so that we can think—so that we can have aspirations and hopes—and so that we may have a conscience as well as consciousness. And finally, so that we may produce cells which have all the potentialities of the cell from which we ourselves came.

Today, Molecular Biology is focussing our attention on the structure and organisation of the cell as the basic unit—not just in health but in disease too. We are looking at cytoplasmic constituents and at parts of nuclei, and are getting interested in mitochondria and chromosomes. Just as within the atoms in physical matter, there lies a whole new world of structure, so it is with the components of the living cell. Not only structure but a force of infinite importance similar to atomic energy lies dormant inside the simple cellular components—a force which is not wild and uncontrolled but permits reproduction of the ovum again and again. What mysterious forces control its growth ? What is it that causes this reproduction to stop at the precise moment when the organism is complete ? Why does not this growth continue to make giants of us all—microbes, mammoths—mice and men alike ?

CELLULAR ORGANIZATION AND DIFFERENTIATION

The mechanism by which a mass of cells organize themselves into the outer shapes so familiar to us in the form of our functional units of organs such as the liver lobule, the nephron, etc. is still obscure. Since form is the outward expression of the morphogenic process that has shaped it, a study of the developmental processes of different organs and tissues leads us to some understanding of the levels of organisations in our body. "Embryonic development" says Weiss, "is an intricate assembly-line process in which the original material endowment of the egg is progressively transformed by chains of different and complicated interactions proceeding according to a definite inherited production schedule. This schedule has become so blue-printed by evolutionary experience that, given a standard range of environmental conditions (climate, nutrition, stress, etc.) it will lead to viable and reproductive individuals capable of passing on that pattern and schedule to successive generations". The deviations from this general

phenomenon are due to either some major initial flaw in the genetic equipment or some disruptive stress factor introduced from outside such as malnutrition or infection.

What can be considered as one of the most fascinating biological experiments of recent times is the work of Weiss and his colleagues at the Rockefeller Institute, New York, on the behaviour of multi-cellular systems in tissue culture. Suspensions of single cells of kidney and cartilage cultured in the appropriate nutrient medium yield large blocks of kidney tissue clearly demarcated against large blocks of cartilage tissue. This is apparently the first *in vitro* demonstration of the independent organization of two distinctively different types of cells into conglomerant tissues outside the animal body. Using the elegant technique of time-lapse cinematography under the phase contrast microscope, the behaviour and orientation of a mixture of epithelial cells of liver, kidney, lung, skin and eye could be followed to trace the sequence of events that happen when two cells of the like kind or unlike kind are brought together. Free single cells move around by sending out broad "mobile tongues" of protoplasm along the glass surface to which they cling normally. There is no attraction or repulsion between individuals till they actually touch each other and remain in close physical contact sufficiently long to recognize each other. Then they pull together and remain closely associated if they are of the same kind ; if not, they break away from each other till they meet cells of their own kind. By this process of trial and error, mixed populations of cells sort themselves out into large groups consisting of purely single cells of one kind or the other. In this process of sorting out tissue specificity appear to be more dominant than species specificity as examplified by the fact that liver cells of a mouse link very well with liver cells of a chick, but liver cells and kidney cells of a chick repell each other.

The discriminatory behaviour of cells described above poses a number of questions : What is the mechanism by which a cell recognizes its own kind (or class) in a mixed population (or society) ? Is there any specific attraction or repulsion centres, on cell surface reminiscent of the behaviour of seroloical reaction which are equally specific ? How do strange pairs of cells brought close to one another under compulsion, part company ? Is this reaction immutable ? Can this response be dulled or sharpened and ; if so, by what means ? Is the property of metastasis of cancer cells, by virtue of which they migrate from their site or origin and habitate inhospitable areas in host tissues, a result of a loss of this power of discrimination ? What is it that happens in parasitism which renders the host cell subservient to the metabolic demands of the parasite ?

PHYSIOLOGY OF THE ORGAN AND THE ORGANISM

Finding answers to this formidable array of questions will undoubtedly keep investigators in the fields of Life Science busy for many years to come. The complexity of the problem increases as we move from the unicellular and multicellular level of thinking towards the understanding of "Organ" physiology or the phenomena which enable groups of cells to work together as in a society to perform a particular function, e. g., the heart, blood and blood vessels constituting the circulatory system, the brain, spinal cord, and peripheral nerves, constituting the nervous system, etc.

HEART AND CIRCULATORY SYSTEM

The human heart is one of the most amazing creations of nature, infinitely more efficient than any man-made machine. It beats at a steady tempo more than 100,000 times a day, 36 million times a year, more than 2.5 billion times in the course of a lifetime of three score and ten. It is muscle, a living pump, about the size of a man's fist weighing

about three-quarters of a pound, which, in a 24-hour period performs work equal to the lifting of one ton 50 feet into the air. Every day it pumps 4,320 gallons of blood through 60,000 miles of blood vessels, a distance equal to two-and-a-half times the earth's circumference, supplying oxygen and nourishment to some 300 trillion cells in the average human body. Yet it is active only one-third of the time, resting between beats about two-thirds of the time. This is possible because of the finely tuned cardiovasculatory regulation of the human body. If all the vascular beds of the body were to open simultaneously to their full capacities, the total peripheral resistance would disappear and the cardiac output would be swallowed up, leaving no trace of an arterial pressure. In order, therefore, to permit the circulatory pumps and vessels to carry out their proper functions, most of the blood vessels of the body must be partially or even severely constricted a great deal of the time. To accomplish this, vasoconstriction must be balanced neatly against vasodilatation, with both attuned to cardiac output and to tissue needs.

The control of the degree of dilatation of the blood vessels is achieved primarily by the interplay of peripheral mechanisms. These include the effects of metabolic vasodilators, produced by muscles and other working tissues, which act directly or through axon reflexes. These local mechanisms are supplimented by a system of efferent vasodilator nerves transmitting messages from the central nervous system. When these vasodilator influences are unchecked, a state of vascular collapse and shock may ensue. Against these tendencies, a group of powerful vasoconstrictor mechanisms is available and in constant function. Their role is to reduce unnecessary blood supply to tissues. This vasoconstriction is guided by an hierarchy whereby certain favoured organs insure their own blood supply, particularly the brain, the heart and the kidney. The control of the degree and sites of vasoconstriction, depends predominantly on the action of the central nervous system and the influence of hormonal action including the permissive effects of steroids and other substances.

The normal human heart is such a sturdy organ that it hardly ever "fails" as is commonly reported, and could keep on contracting and relaxing at the same tempo for an estimated hundred years. But the stresses and strains of modern living are resulting in changes, in the internal chemical environment in which the heart pulsates, which lead to damage of the arteries feeding the heart and to the impairment of its functioning. As a result, diseases of the heart and of the blood vessels including coronary arteries have greatly increased during recent times until they have become the greatest cause of death, in all modern industrialized societies.

BRAIN AND NERVOUS SYSTEM

Man's brain, which has transformed the world and has discovered the power to destroy it, is perhaps the greatest enigma in modern Science. It took at least a billion years of evolution to create the 3-pound mass, which only in the last century has begun to acquire a dim understanding of its own nature. During the last twenty years, there have been significant new advances in our knowledge of the brain, as a result of modern neuro-physiological and neuro-psycho-pharmacological research, accompained by refinements in electronics, instrumentation techniques (Electro-encephalograph) and radioactive tracers. Brain surgery and modern electroablation and cauterization techniques are further enriching our knowledge of many hitherto obscure brain functions and its behaviour in certain types of mental aberrations. Indeed, there is a tantalizing prospect that research now under way will finally shed light on how the nervous system operates and perhaps explain what is "mind" and what are the

connecting links between man's brain and the thoughts in his head.

It is yet too early to present a complete picture of the complicated processes involved. It seems clear now that the neurons (nerve cells) that perform the "highest level of integration" are to be found not in the brain's outer layer, or cortex—as has hitherto been supposed—but deep within the brain, in the so-called reticular system, a region that is among the most ancient from the standpoint of evolution. Recognizing that the brain is being continuously bombarded, even, during sleep, with sensory impulses, the problem for Science has been to discover how the brain filters out meaningful stimuli, assigns priorities among stimuli competing for attention (ignoring them all, if sufficiently fatigued), and finally makes a decision to do just one thing at a time, out of the near-infinity of possible things to do.

According to the new hypothesis, all this is achieved by a complex interchange of nerve impulses—bearing coded information—between cortial neurons and neurons in the reticular system. One task of the cortex evidently is to assign meanings to incoming stimuli—notably to things seen, heard, smelt, tasted, and touched and to store these meanings, in some fashion, for future reference. The cortex also, it seems, transmits some sort of condensed, edited and annotated version of the flood of incoming sense stimuli into the reticular system, where the final integrating process takes place. This final integration may lead the reticular system to issue impulses that will "arouse" appropriate sensory-motor regions of the cortex to initiate a type of muscular response that has proved sucessful under similar circumstances in the past—or give more "thought" to the problem. It is perhaps too early to say whether this short account of the role of the reticular system is correct or mistaken. If correct, it goes far towards explaining the unity of the central stream of consciousness. Even so, however, it sheds virtually no light on such equally basic problems as : what, really, takes place in learning ; what is memory ; and what is intelligence and what is "learning to unlearn" (Gerard, 1961).

Up-to-date techniques are further making it possible to observe what goes on inside the living brain, man's most complex organ and in a sense his most vulnerable one. How does it all work ? What happens when something goes wrong in this socalled control center of our thoughts, emotions and actions ? Much light has recently been thrown by mental health workers and psycho-pharmacologists through the study of simple behaviour patterns in the individual and in selected groups, on the nature of intelligence, on how the brain learns, finds its satisfactions, and why, on occasion, it breaks down. It is now possible to indicate that epileptic seizures and schizophrenia—a form of madness—are primarily neuro-physiological and biochemical in origin—traceable, perhaps, to a disturbance in an enzyme system or to a harmful chemical compound substituting for a needed one—or whether the ailment is basically a malfunction in information processing peculiar to computers containing billions of switching components. There is ample cogent evidence to show that breakdowns in mental health can be improved by psycho-pharmacologic agents. "Drugs for the mind" are now available which will calm manic excitement, will alleviate severe depression, will control convulsions and so on. The "psychic energizers" or antidepressants act in a manner reverse to that of tranquillizers by deactivating an enzyme known as monoamineoxidase (MAO). The monoamineoxidase inhibitors (Iproniazid and similar drugs) have provided during recent times, an important new tool in the study of cerebral metabolism, and possibly also towards additional knowledge of the Biochemistry of emotion and other forms of mental illness. To understand the

brain with its 10 billion nerve cells working at any one instant, it will first be necessary to know more than is now known about neuro-biochemistry and neuro-pharmacology (including the role of hormones), Biophysics, the advanced Mathematics of large random ensembles, and the new science of "information theory".

THE SCIENCE OF MAN

A highly developed organism like the human being is not a mere assembly of discrete cells, tissues, organs and organ systems but an organism capable of manifesting physico-chemical, physiological and psychological activities. Man represents an integrated personality in whom all the individual activities are controlled, integrated, and coordinated by a central guiding principle. When the individual tissue breaks loose from this bond of loyalty to the common good, we have the so-called abnormal manifestation of disease. The human system has often been compared to a machine composed of intricate components. This comparison is useful as an operational concept to analyse certain functions of the body in detachment from the whole, as for example, feeding to fuelling, digestion to combustion, working of the heart to the action of a pump, etc. There the analogy stops and as we move on to organization and coordination of activities, the human system exhibits a level of complexity not attainable by any man-made machine.

The more we study man in his entirety, the more deeply we analyse his structure and physiological functions, the more impressed we are with the ancient Biblical saying that "man is wonderfully made". There is no method capable of apprehending him simultaneously in his entirety, his parts, his relations with the outer world and his reactions thereto. There is intimate coordination between each functioning part and the whole in a manner which beggars description. Even as I am standing before you delivering my Address, I am energised with electrochemical impulses, most of them quite well mediated and directional leading to some purposeful end result. Proprioceptive impulses are traversing sensory pathways from my muscle and tendons, up and across specific spinal and cerebellar pathways, and after central mediation (with all that it implies), these are modified and coordinated and returned through efferent spinal tracts to effector organs and muscles and other tissues, thus permitting me to remain in some semblance of balance. The effect of space and position upon the semicircular canals of the inner ear, as well as the effects of light upon the rods and cones of the retina with their specific and respective pathways through the eighth and second cranial nerves add to the complicated picture of maintaining this sense of balance. Simultaneously, my autonomic nervous system, controlled by set reflex patterns, is regulating all my vegetative body processes and helping me to maintain homeostasis through the release of autopharmacologic manoamine substances such as adrenaline, noradrenaline, histamine, acetycholine, serotonin, kallikrein and bradykinin. However, the superimposition of the brain with its autonomic capacities, but under potential influence by higher and finely integrated cerebral processes, may affect psychosomatically those end organs under the control of the autonomic nervous system, either for better or for worse. The headache and the neurogenic rise of blood pressure that I am having at the moment are convincing me forcefully that the "psyche" has powerful control over the "soma".

All the activities of our body on ultimate analysis, are the result of the linking, to the triumvirate axis of the pituitary, the adrenals and the gonads, of the electrochemical impulses generated in the central nervous system by the various stimuli on our sensory organs of perception. The manner in which this coordination is effected resulting in such remarkable precision and

integration has hitherto baffled our comprehension. Endocrine Physiology and Biochemistry have opened up vistas of investigation on the action mechanism of the powerful hormones secreted, by these neuro-endocrine glands. From the plethora of experimental evidence available we have just begun to learn that behaviourism, temperamental responses to external stimuli, etc. reflect very closely the interaction of these hormonal activities with the directive function of the nerves.

MAN AND HIS ENVIRONMENT

Every living thing depends intimately on its surroundings and adapts itself to any modification of these surroundings by an appropriate change. Man is no exception to this general rule but his adaptation mechanism is very much more intricate and comprehensive than is found even in the highest developed animal life.

HYPOTHERMIA

Man is a warm-blooded animal and is therefore forced to maintain his body temperature under differing climatic conditions of extreme heat and extreme cold. How far the physiological adaptive mechanisms are capable of withstanding extreme degrees of hypothermia of cooling has been recently studied with many startling new results. By 1948 it seemed firmly established that adult non-hibernating mammals would not withstand cooling to internal body temperatures below a level characteristic for each species and between 25°C (78°F) in the dog and 15°C (59°F) in the rat. This was because breathing and heart beats ceased and were not resumed when the animals were rewarmed. Observations on cases of accidental exposure and the results of Nazi experiments on prisoners of war in concentration camps suggested that 25°C (77°F) was the lethal body temperature in man.

In 1950, Bigelow and his co-workers in Toronto published a series of papers on the oxygen consumption of dogs at reduced body temperatures and on the factors involved in their survival. The brain is particularly sensitive to oxygen lack at normal body temperatures and its circulation cannot be arrested for more than three minutes without irreparable damage due to deprivation of oxygen. At deep body temperatures of 20°C, however, the oxygen requirements of the brain and other tissues are greatly reduced and the dog heart can actually be excluded from the circulation for 15 minutes without injury. Bigelow suggested that the use of hypothermia would permit intracardiac operations for otherwise incurable diseases of man and might also extend the scope of surgery on other organs.

WHAT IS DEATH ?

An even more remarkable observation was recorded in Belgrade in 1951 by Andjus. He found that 20 per cent of intact adult rats could be fully revived after cooling the surface of the body in ice until the internal body temperature reached between 0° and 2°C and until breathing, heart beats and circulation had been arrested for one hour. Golden hamsters would revive after freezing for as long as one hour in baths at –5°C. The skin and subcutaneous tissues reached a temperature of –4°C and contained much ice. There were also ice crystals in the blood and around and within the vital organs including the heart and brain. The internal body temperature reached – 1°C in many hamsters which subsequently recovered completely. The surprising results from these and similar experiments have naturally raised the problem of the diagnosis and definition of "death". We can only say that it is the *condition from which reanimation is not possible by any currently known means*. Prof. Negovski of Moscow has studied the problem of reanimation extensively and suggests a distinction between "clinical death" which is reversible and "biological death" which is irreversible. One of his recent discoveries is that

death from severe blood loss in dogs, monkeys, and even in man can be averted by reducing the internal temperature of the body to a moderate degree (about 25°C in dogs) by cooling the surface of the body. A wide variety of mammalian cells and tissues can now be preserved for periods far exceeding their normal life span in the body by treating them with glycerol or dimethyl sulphoxide or some other protective substance and then storing them either at –79°C or else in liquid nitrogen at – 190°C. The capacity to enter and remain for long periods in a state of latent life (otherwise known as anabiosis or cryptobiosis) under adverse natural conditions such as severe drought, intense heat and bitter cold may be essential for the survival of many species. This state of anabiosis might not be attainable and might not serve any useful purpose under natural or artificial conditions in man or any of the larger mammals. On the other hand, it is interesting and important to know about its occurrence in the lower animals on earth. A variety of potentially living creatures may be lying dormant on the moon or on other planets and might come to life if they were brought back to earth. Many mysteries about survival of life undoubtedly remain to be solved by those who stay earthbound.

NATURE OF SLEEP

A recent symposium in London led by Lord Adrian has given a fascinating review of this age-old problem. The current concept is that decreased activity in the reticular formation, resulting in sleep, is the result of inhibitory impulses passing to it from different parts of the brain. This is part of a larger concept, that the normal working of the brain is a balance between inhibitory and excitatory impulses. The former exists in the waking as well as in the sleeping state. (If this were not the case, we should all be epileptics). It is the alterations in this balance with resultant changes in the complex interactions between different parts of the brain, that are responsible for the many differing degrees of wakefulness and sleep. Sleep is a state of unconsciousness into which the messengers of consciousness can penetrate. Thus, there is no evidence to support the suggestion that sleep is due to accumulation in the body of some mysterious "toxin" which acts as a narcotic and so induces sleep. Neither is there any evidence that sleep is due to temporary diminished blood supply to the brain, or a lack of oxygen. In other words, the overall functional activity of the brain, is as high in sleep as in the waking state. "The need for sleep does not exist in the brain, but somewhere else in the body". The brain actually "opens up", so to speak, all of its sensory pathways during sleep.

AGEING PROCESS

With the advent of modern drugs and public health measures human mortality and morbidity have been reduced to a very large extent. Man today has a longer expectation of life and it is understandable that he would like to gow "old" without being "aged" and senile. Scientific investigations have proceeded in recent times at various levels including individuals and populations, organs and organ systems, tissues, cells and sub-cellular structures. There is evidence to suggest that body water declines in volume with age and there is a tendency for shrinkage of cell water and for a greater proportion of body water to be located outside the cells. The electrolytes located inside the cells tend to decrease. The hexosamine and collagen ratio of connective tisue is also found to decrease with age. Insoluble solids called "age pigments" have been identified in cells of various tissues of aged people. Examination of the nerve cells of the guinea pig has shown that the neuronal elements of the central nervous system accumulate "lipofuchsin" with advancement of age. Carroll Williams at the Harvard University has reported

isolation of a "hormone" which suppresses metamorphosis and thus postpones maturity in insects. Similar hormone ("juvenile hormone") has been found in mammalian tissues including human placenta.

Despite the availablity of a mass of valuable biological data, the organic problem involved in senility remains obscure and we do not know precisely as to what accumulates, or breaks down or fails to function or goes "seedy" in old age. Probably the psychic component is more important in the ageing process. Gerontologists have shown that in aged people some basic changes in the behaviours and mental capacity occur in the form of low performance on tasks requiring mental manipulation and perceptual searching. This may be related to a condition of senile change of the neurons as pointed out by Soviet physiologists.

SPACE BIOLOGY

The problems of space flight have given us recently much new knowledge on cellular and organic adaptation of plant and animal life to very different conditions of temperature, pressure, humidity and radioactivity. Already higher forms of animal life, e.g., dogs, chimpanzees, have been sent to the orbit and brought back to earth alive in space capsules fitted with modern physiological and electronic recording devices. Based on such new information, cosmonauts have also been sent to orbit and returned to earth in a healthy condition. The future holds promise of much new and exciting knowledge on physiological adaptation processes under these completely different external environmental conditions for man.

OUTLOOK FOR THE FUTURE

We have-seen thus far that the tremendous strides made by contemporary research in the Biosciences had enabled us to gain at least a working knowledge of the fundamental mechanisms involved in a number of manifestations in the panorama of life. It is now clear that life has a firm material basis and beginning, and that the process of multiplication and heredity can be explained generally in terms of the macromolecular structures of the nucleic acids and proteins. We are now in a position to look upon living creatures as beings who have evolved from simpler ancestors, who are related to their immediate progenitors and successors by inseverable bonds of heredity and who function by biochemically definable mechanisms in specific internal and external environments.

The progress of biological research on the two fronts of Neurology and Ecology has shown very clearly the closeness of the inter-relation between the neural and the psychical. Some think of mental activity and nervous activity as two inseparable aspects of one reality. A recent significant advance in the field of this inter-connection is the discovery by Penfield and Jasper (1954) that some of the deeper parts of the central nervous system "Centrencephalic system" have a hitherto unrecognized function in "alerting" the brain during waking hours. This central brain stem region together with certain parts of the thalami seem to project impulses upwards through a sponge like net of cells and fibres to the nerve cells of the cerebral cortex or surface of the brain. Similiarly, signals from the cortex return to the brain stem which becomes thus additionally important as a centre controlling the neural network of the cortex.

These discoveries have paralleled our increasing knowledge concerning the action of certain chemical substances and drugs on cerebral activity. So fast has been the progress in this field that a new branch of Neuro-pharmacology with its intimate ally, Neuro-biochemistry, has come to be established as an independent sub-discipline in Life Sciences. We know now that the activity of different groups of nerve cells can be varied in a

specific manner by the "tranquillizers" and the "hallucinogens". The current fashion in the study of brain behaviour is to pursue the subject by analogies to the "information theory" developed in telecommunication research. The prospect of this type of approach coupled with biochemical investigations on the ulterior structure of brain cells can be very exciting for the future of mankind.

Refinement of our understanding of the secretory properties of certain nerve cells of the hypothalamus has shown that the precursors of the hormones of the posterior lobe of the pituitary do not presumably originate in the pituitary gland but are produced by two groups of nerve cells in the hypothalamus, from which they pass to the posterior pituitary through a bundle of nerve cells where they are absorbed into the blood vessel. Alteration in the delicate balance of these powerful hormones is a known feature in disease and it is obvious that their mechanism should be connected intimately with the central nervous system.

Convincing evidence of the power of the central nervous system over the rest of the body can be obtained even from our everyday experience. Most of our emotive response to the environment is the result of this type of imperceptible contact with experience. Thus symbols can be potent sources of stimuli. Hearing words which bring good news or bad, seeing a ghastly or pleasant sight, smelling a good or bad odour can provide appropriate input for a variety of complex effector activity. In fact the entire phenomena of our aesthetic response to beauty whether in words, lines, colour, form, movement or shape represented by the fine arts of poetry, music, dancing, painting, sculpture and architecture is in the ultimate analysis the integration of the highest neural activity. We may also here refer in passing to the fact that some of the great works of art and great advances in thought have been made under the influence of stress factors on the central nervous system of the creators. Reaction to stress may be measured in terms of achievement or the development of fresh potentials and also in terms of the maintenance or the mental equilibrium. On the contrary it can also result in an upsetting of this equilibrium leading to physical and mental breakdown.

Man, an essentially social being, has to conform to a pattern of behaviour acceptable to his fellow beings. He has to derive spiritual nourishment from his various activities and experiences of his surroundings. He has, apart from his fundamental biological needs, to satisfy in some manner his emotional needs for love and creativity. It is apparent therefore, that threats to his ability to perform his social functions and to enjoy his legitimate share of the fruits of his labour may constitute the stress that lies behind so many states of anxiety, tension, irritability and disease. Not ignoring the genetic and biochemical mechanism and at the same time fully cognizant of other causative factors of maladjustment, we must look more deeply for all the reasons of illness in our attempt to develop a concept of possitive health. Only through a coordinated study in the domains of Life Sciences including plant and animal Biology, Physiology, Pharmacology, Biochemistry, Psychology and Psychiatry can we hope to make worthwhile contributions to Medical Science for the benefit of man.

CONCLUSION

I have attempted in the course of this address to pick out certain facets of current research in Biosciences which to my mind are going to profoundly affect our outlook on the future. We saw earlier that the influence of organization on function is well-established at the minute level of the fertilized ovum, the phage particle, the microbial cell and the sub-cellular units like the mitochondria obtained from mammalian tissues. From what little is known about the structure and function of the

human brain, it is apparent that the height of organizational complexity in evolution is reached in this organ. Up to the present time the brain has been considered as a "black box" whose functioning is magical and not reducible to intelligible terms based on physical concepts of matter and energy. Recent advances in biochemical and biophysical techniques have, however, made it abundantly clear that the brain is an electro-chemical organ which, in many respects, behaves like any other organs of the body and yet different from them in some subtle manner.

The vital difference consists in the fact that the brain is the seat of consciousness and of our thoughts and judgments. Consciousness makes it possible for man to be aware of what passes in his own mind, his symbolic abstractions, and more, it allows him to be conscious of his own personal identity ("self-consciousness"). Apparently these unique mental attributes and thought processes are also molecular and sub-molecular in nature and are dependent on minute, immeasurable exchange of energy very much like any other physiological process. By devising model systems and robots (cybernetics) based on electronic computers we have just begun to probe into the material basis of perception. When the mechanism of the human brain is better understood at the molecular level, mankind would assuredly attain a new dimension. The human brain will then be able to master itself and extend its frontiers into the unknown.

Taking it for granted that in the creation of the human brain the acme of organizational perfection has been reached, can we rest content with the belief that in us, the *Homo sapiens*, nature has exhausted her evolutionary run ? We have indeed discovered how to make certain types of acquired characters heritable in lower organisms and also to perceptibly change behaviours in higher organisms by education and instruction. "It seems unlikely", warns Hermann J. Muller, "that in respect to the human faculties of the highest importance—such as the neuronal equipment conducive to integrated understanding, foresight, scrupulousness, humility, regard, for others and self-sacrifice—modern cultural conditions may actually lead to a lower rate of reproduction on the part of their possessors than the rate of those with the opposite attributes".

This is indeed a grim warning. On account of its firm material basis, the human gene is subject to the law of entropy very much like any other form of matter. Destructive mutation leading eventually to self-immolation is its inherent property. Having become painfully conscious of this, it is our bounden duty to do something about it. With the projected plans of building space stations and launching of cosmic bases, the human spirit, tody, is preparing itself for the conquest of eternity as it were. As such, it will be cowardice on our part if we were to escape from the stark reality of our own genetic make-up and its tendency to disintegrate. The urgent need for the moment is to fit into a framework of practical eugenics, all the biological knowledge we have gathered over years of painful labour and to acquire a mastery over our own destiny.

If health and wealth are to be regarded as no more than pre-conditions of man's true progress, which is a balanced all-round movement towards a fuller realisation of the true, the beautiful and the good, the life scientist of today can advance his position and maintain that there are in organic evolution great, trends towards higher values. The seed for optimism in the future of mankind is contained in the fact that the growing emancipation of the human mind is the most significant event of this evolution. In the words of one of the greatest thinkers of modern times, Aurobindo, "if there is an evolution in material nature and if it is an evolution of being with consciousness and life as its two key-terms and powers, this fullness of being, fullness of consciousness, fullness of life must be the goal of development towards which we are tending and which will manifest at an early or later stage of our destiny".

REFERENCES

1. Carrel, Alexis, *Man, The Unknown*, Penguin Books Ltd., Gt. Britain, 1948.
2. Dixon, M. and Webb, *E. C, The Enzymes*, Longmans Green, London, 1958.
3. Gerard, R. W., CIOMS Symposium on Brain Mechanism and Learning, Blackwell Reports, 1961.
4. Glass, B., A Summary of the Symposium : "Chemical Basis of Development", Macollum-Pratt Institute, John Hopkins University, Balitimore, 1958.
5. Green, D. E., "Mitchondrial Structure and Function", Opening Address to Plenary Session. Fifty Int. Congr. Biochem., Moscow, 1901.
6. Kerbs, H. A., *Endeavour*, **16**, 125, 1957.
7. Kornberg, A., *Advances in Enzymology*, **18**, 191, **1957**.
8. Linderstrom-Lang, K. U. and Schellman, J. P., protein Structure and Enzyme Activity, *"Enzymes"*, Vol. III, p.443, Acad, Press, NY., 1959.
9. Magoun, W. H., *The Waking Brain*, Thomas, Springfield, III., 1958.

BIOPLASTIC : A BETTER ALTERNATIVE FOR SUSTAINABLE FUTURE

Darshan Marjadi* and Nishith Dharaiya**

Conventional plastics, formed from fossil fuels, are one of the important materials for the society but they are created with a process which is harmful to the environment. In order to find alternatives, a new material has been developed known as bioplastic. Bioplastis are long chain of monomes joined with each other by ester bonds. These plastics are thus considered as polyesters. Bioplastics are classified into various types. The most common is PHA (Polyhydroxyalkanoate), which remains as a carbon and/or energy storage material in various microorganism under the condition of deficient nutritional elements. There are a variety of bioplastic applications in the society and industries. This review paper is intended to provide information about alternatives to conventional plastics for the betterment of environment.

INTRODUCTION

Plastics are consumed in almost every place such as, in routine house hold packaging material, in bottles, cell phones, printers etc. It is also utilized by manufacturing industries ranging from pharmaceutical to automobiles. They are useful as synthetic polymers because, their structures can be chemically manipulated to a variety of strengths and shapes to obtain higher molecular weight, low reactivity and long durability substances. Plastics are important materials for the society not only because of their higher molecular weight and low reactivity but also for their durability and cost efficiency. Unfortunately these petroleum based plastics are not biodegradable. This result in one of the major causes of solid waste pollution through buried in landfills. They are indigestible and in many cases the animals die due to plastic blockage in the gut. Furthermore ; Plastics are often soiled by food and other biological substances making physical recycling of this material undesirable. Incinerating plastics has been one option but other than being expensive it is also dangerous ; various harmful chemicals like hydrogen chloride and hydrogen cyanide are released during its incineration[1,3].

In recent years, there has been increasing public concern over the harmful effects of petrochemical derived plastic materials in the environment. Problem of managing plastic waste on the earth is increasing very rapidly now a days, and studies have been intitated to find out suitable eco-friendly materials to minimize environmental problem.

To find alternatives researchers have developed fully biodegradable plastics, which are disposed in environment and can easily degrade through the enzymatic actions of microorganisms. The degradation of biodegradable plastic produces carbon dioxide, methane, water, biomass, humic

* Sheth M. N. Science College, Patan–384265, Gujarat
** Department of Life Science, H. N. G. University, Patan-384265, Gujarat

matter and various other natural substancs which can be readily eliminated. Due to its ability to degrade in the biotic environment, these types of material are termed as "Bioplastics."

BIOPLASTICS

Bioplastics are a special type of biological material which is degradable and eco-friendly in their chemical nature. They are polyesters produced by a range of microorganisms ; cultured under different nutrients and environmental conditions.[2] Bioplastics are mainly classified into three types : Photodegradable and Semi-biodegradable plastic. The former have light sensitive groups incorporated directly into the backbone of the polymer as additives. Due to lacking of sunlight in landfill they remain non-degraded and not used widely, while the latter can be degraded by bacteria because they attack starch easily and remaining polymer released can be degraded by other bacteria. Due to presence of starch, bacteria attack and turn off avaliability of polyethylene fragments thereby remain non-degradable.[1] The other type of biodegradable plastic is rather new and promising because of its actual production and utilization by bacteria to form biopolymer. These polymers, usually lipid in nature, are accumulated as storage material (in the form of mobile, amorphous, liquid granules) in microbes and allow microbial survival under stress conditions. This storage material is known as polyhydoxyalkanoates (PHAs), which store carbon and energy, when nutrient supplies are imbalanced. These polyesters, known as Bioplastics contain long chains of monomer which join with each other by ester bond. Bioplastics are accumulated when bacterial growth is limited by depletion of nitrogen, phosphorous or oxygen and excess carbon source is provided.

There are a variety of materials which can be utilized as a carbon source for the production of Bioplastic. Table1 summarizes different baceria, various carbon substrate used, types of polymer produces and reference.

Examples of carbon source suitable for biotechnological production of PHAs.

Carbon source (s)	Bacterial strain (s)	Polymer produced
Glucose, sugarbeet molasses	*Bacillus cereus*	PHB, terpolymer
Glucose, technical oleic acid, waste free fatty acids, waste free frying oil	*Pseudomonas aeruginosa*	mcl-PHAs
Glucose, octanoic acid, undecenoic acid	*Pseudomonas putida*	mcl-PHAs
Glucose, soybean oil, alcohols, alkanoates Palm olein, palm stearin, crude palm oil, palm kernel oil, oleic acid, xylose, levulinic acid, sugarbeet molasses	*Pseudomonas stutzeri* *Burkholderia cepacia*	mcl-PHAs PHB, PHBV
Malt, soy waste, milk waste, vinegar waste, oil	*Alcaligenes latus*	PHB
Malt, soy waste, milk waste, vinegar waste, oil	*Staphylococcus epidermidis*	PHB
Starch hydolysate, maltose, maltotetraose and maltohexaose	*Halomonas boliviensis*	PHB

mcl-PHAs : medium-chain-length polyhydroxyalkanoates,
PHB : poly (3-hydroxybutyrate),
PHBV : poly(3-hydroxybutyrate-co-valerate)

BIOPLASTIC AND SOCIAL BENFITS

What makes bioplastic especially important is that petroleum oil price is increasing tremendously and its stock will be end in the near future. It is important for the global community to have an alternative for the product derived from petroleum oil such as plastics. PHAs at least will be a solution for the most of the industries and society, which largely depend on materials made from plastic. No new inventions can escape from the limitations and drawbacks and bioplastics too have some

drawbacks. The most important drawback for PHA production is its production cost, but the good news is that the price of PHA production is decreasing, whereas, petroleum oil price is increasing constantly. As a result, the gap between the petroleum oil and PHA prices are becoming very narrow.

The first potential application of PHA polymers was recognized in the 1960s. PHA patents cover a wide range of PHAs products such as coating and packaging, bottles, cosmetic containers, golf tees, and pens[4, 5, 6]. PHAs have also been processed into fibers, for a non oven fabrics material[7]. PHAs can be used for all sorts of biodegradable packaging materials, including composting bags, food packaging, sanitary articles like diapers and fishing nets[8], biodegradable rubbers[9]. PHAs are also used to develop scaffold for tissue engineering,[10] and also posses numerous application in pharmacy and medical science.

CONCLUSION

Bioplatics have evolved into an innovative area of research for scientists around the world. This progressive development has been driven by a need for environmentally friendly substitutes for materials dervied from fossil fuel sources. In addition, recent high prices for crude oil, and the potential market for agricultural materials in bioplastics are driving an economic push toward expanding the bioplastic industry and provide better alternative for sustainable development of the future environment.

REFERENCES

1. B Johnstone, *Far Eastern Econ. Rev.* **6**, 62-63, 1990.
2. LL Madison, GW Huisman, *Microbial Mol Biol Rev.* **63**, 21-53, 1000.
3. R.M. Atlas, *Microbial ecology : Fundamentals and Applications,* **3**, 39-43, 1993.
4. J. N. Baptist January USA. *Patent* **3,** 072,538, 1963a.
5. J. N. Baptist October USA. *Patent*, **3,** 107,172, 1963b.
6. A. Webb, February, USA. *Patent,* **4,** 900,299, 1990.
7. H. Son, G. Park and S. Lee. *Biotechnol. Lett.* **18,** 1229–1234, 1996.
8. Javed A & Gruys K J. Biopolymers *Weinheim,* **4,** 53-68, 2002.
9. Van der Walle GAM, de Koning G J H, Weusthius R A & Eggnik G, *Adv Biochem Eng Biotechnol,* **71,** 264-291, 2001.
10. Simmon F & Martin D P, Welnheim **4**, 91-103, 2002.

A GREEN CANOPY NEAR BANGALORE

Nandini. N., Sucharita Tandon, Abdul Khayum and Durgesh R.*

Long spaces play a potential role in servicing the local ecology as they are the natural remedial triospheres that reduce the degree of environmental deterioration of a city. One such lung space has been identified in Bangalore.

INTRODUCTION

There is row hue and cry about global climate change and the entire world has come together to discuss about the measures to control climate change. One easy way to save the entire ecology is by creating *lung spaces*. Lung spaces play a potential role in servicing the local ecology as they are the natural remedial biospheres that reduce the degree of environmental deterioration of a city. Moreover, lung spaces are biological elements that act as carbon sinks to vehicular and industrial emissions, harvest rain water before filtering and filling it to the ground, absorb noise levels, act as sanctuary for different plant and animal species and thus play a major role in regulating the temperatures.

Bangalore city in the last two decades has seen the physical change in the surface terrain of the city. While the concrete jungle is expanding exponentially, the water sources are being invaded and destroyed. Lung spaces in the outskirts of the city act as a pace maker for this city which is slowly becoming a pool of pollutants and heat. A team of researchers from the Department of Environmental Science, Bangalore University, under the guidance of Dr. Nandini, took up the task of identifying the benefits of such lung spaces to the ecology and environment of any place.

* Department of Environmental Science, Bangalore University, Bangalore-56

Annapoorneshwari Research Foundation is one such lung space spread in a 40 acre organic farm land which is owned by Mr. Nagaraj who is an a class builder by profession. The farm, in Kodiyalakarenhalli village, Kanakpura road, Bangalore covers a big forest area in the outskirts of Bangalore. The landscape provides solace to sick and tired minds. The area has a hilly topography, a small water body and rich lush green trees. One can see and experience the totality of life and its resonance in the products of this natural boon.

The biodiversity in the entire landscape can be divided into three aranyas :

(a) **Shrivan :** This provides prosperity and is a form of tree grove. Plants grown in the farm can be classified into four major groves :

- **Coconut groove :** with about 1000 coconut trees.
- **Mango grove** with about 1000 mango trees.
- **Sapota grove** with 1000 sapota trees.
- **Areca nut groves** with 3500 trees.
- **Silver oak fencing** with 2500 silver oak tree.

Other than groves there are Neem trees, Custard apple trees, *Albezia lebac, Casurina cunninghamae*,

Pomogrenate trees and many others. All these plants with good productivity are maintained by organic farming practices. No chemical pesticides have been added. Hortisilvy culture is being followed in the farm area. The farm land is a true picture of sustainable agriculture.

(b) **Tapovan :** It is a place to contemplate and seek truth. The farm area in true sense reflects a tapovan at its full bloom. Rain water is the purest form of water so to utilize it judicially the farm area has more than two dozen rain water harvesting pits. These pits help in recharging ground water.

The farm has beautiful butterflies, unique plant species, ancient and orginal kind of soil. Also, the terrain and soil of the land have not been altered. No chemicals are added to the soil to increase its productivity rather manure is prepared in the back yard by vermi composting method and utilized in the farm area. There are about 20 vermi composting pits which are hygienic and properly covered so as to avoid mosquito breeding.

(c) **Mahavan :** It's a place where all the species of life find shelter. The farm area is a mahavan in reality where numerous microbes, plants and animals can be seen growing in harmony with each other. Farm land is nature's laboratory where so many experiments are being carried out regularly by nature to prove that co-existence between two different plants is possible. *Casurina cunninghamae* survives because of the presence of a species of mycorrhizae called frankia in its roots. The plant cannot take up any nutrient from the soil on its own. It survives in a symbiotic relation laboratory with the mycorrhizaea. Frankia supplies most or all of the host plant nitrogen needs without added nitrogen and thus can establish a nitrogen-fixing symbiosis with host plants where nitrogen is the limiting factor in the growth of the host. Therefore, actinohizal plants colonize and often prosper in soils that are low in combined nitrogen.

Seeds of custard apple act as insecticide for sapota trees. Also Custard apple and neem trees both growing together are good air purifiers and also enrich the soil.

Rows of Silver oak (*Grevia robusta*) have been planted to cut wind and prevent soil erosion and air pollution.

Following microbes were found in the soil from study area :

1. Phosphate solublising bacteria-solubilises phosphorous.
2. Gram negative rods and gram positive rods in chains.
3. Azotobacter sp.-which fixes nitrogen in soil.
4. Frankia- it is non-leguminous symbiotic nitrogen fixer.

Research findings on the farm-Annaporneshwari Research Foundation show that the farm area is like a spiritual landscape which gives relief to aching heart. The area should not be taken up for construction of any concrete jungle as these trees and green areas are the best absorbers of pollutants in the air. Every year Bangalore is witnessing a continuous decrease in rainfall, if such green corridors are reduced we would surely invite drought conditions.

Apart from reducing pollution and bringing rainfall, these trees purify the air by repelling/ killing vaious pathogens. Farm land is continuously improving the soil quality and producing rich mango, coconut, sapota and papya crops which are purely organic. It's a natural laboratory which was started 20 years back. If it is disturbed it will take another lifetime to regain such a self sustainable ecosystem.

Studies carried out show that trees are the epicenter of economical and ecological development as over a 50-years lifetime, a tree generates $31,250 worth of oxygen, provides $62,000 worth of air pollution control, recycles $37,500 worth of water, and controls $31,250 worth of soil erosion. Thus it can be easily calculated that these trees are beneficially worth many million. The farm is conserving biodiversity of all types. There are many termite hills in the area which the owner is conserving. Termite hilbs have protozoa (micro organisms) in their intestines that provide enzymes to digest cellulose. Termites and termite hills are helpful in decomposing the dried leaves fast which may otherwise take many years to become soil.

Thus open space with trees are ecological and economical asserts to any nation. We should be proud in maintaining the mother nature's purity, serenity and dignity by nurturing its speechless children and not provoke her to take revenge on us for killing the entire biodiversity.

ENTREPRENEURSHIP AND BUSINESS IN BIOTECHNOLOGY : AN OVERVIEW

B. D. Bulchandani *

Biotechnology has become an incredible technology worldwide and had been made a prime national interest by several developing as well as developed countries. Since its inception it has been projected to bring fantastic advances along with huge economic rewards, in short it promises more for less. Developing countries tend to have growing needs but scarce resources, therefore, such claims naturally appeal to those in power. The practical applications of Biotechnology extend from widely separated fields, creative minds, these ideas need to be researched and developed. Also critical testing and regulatory agency approval must be received prior to commercial production and marketing. The paper presents an illustration about the business potential in biotechnology from incubation of an idea and its transformation into a value aided product or technology through various demanding and formative steps like financing, human resource and marketing.

INTRODUCTION

In 1980 a normally reserved microbiologist by the name of Ananad Mohan Chakraborty reportedly shouted at the top of his lungs, 'I won', this out of character demenour was done to the news that the U.S. Supreme court had just upheld a ruling, awarding him a patent for the development of the first oil eating bacterical strain. It did not matter that the strain had already been to be found too fragile for use in the wild. In many ways, this court decision marked the real beginning of the commercialisation of biotechnology[1].

The message was quick and loud that the future wealth creation will be through the knowledge based industry and this knowledge era will be incomplete without biotechnology that has fascinated the entire world. Because, biotechnology involves the use of living organisms, cells or tissues or materials derived from them, the motion of ownership and exploitation of resources for projects has been and will continue to be of great importance to the development of industry.

With the expansion of biotechnological capabilities, enormous opportunities have opened up for potential commercialization. Once ideas become available, those ideas with best possibility for commercial success must be identified and converted into new or improved product, process and service, which is the essence of innovation. The innovation led growth, innovation led recovery, and innovation led competitiveness are not mere slogans but they are a hard reality of the present and the future. Beyond mere research in laboratories it includes idea incubators; technology parks; a conducive intellectual property right regime; enlightened regulatory systems ; academics who believe in not just "publish or perish" but "publish, patent and prosper"; potent inventor—investor engagement; adventure capital and passionate innovation leaders. This process involves a

* Department of Biotechnology Engineering, Sobhasaria Engineering College, Sikar-332001, Rajasthan, email;bd_bulchandani@yahoo.co.in

combination of scientific research to determine how difficult it may be to engineer the product and thorough market research to establish the likely demand for the product[2]. The business of inventing/ discovering of new products and procedures are time consuming, tiresome and often risky. From very beginning governments world wide have recognized the value of rewarding those who have invested in these daring and adventurous acts and have made technological advancements and discoveries. A patent granted by government protects investors or developers for a certain number of years and provides a legal means to ensure economic reward for creativity, research and development and above all, the perseverance and patience involved. In India, biotechnology sector is on a crossroad where on one hand it must find affordable solutions to the pressing national needs in agriculture, health and energy, and on the other hand it must be competitive enough to take advantage of the lucrative international market.

THE COMMERCIALIZATION OF BIOTECHNOLOGY

Entrepreneurial activities in life sciences started in the late 1970s and some of the notable early players were established in 1980[3]. During that year an estimated $500 million was invested by venture capitalists into biotech start up companies. In 2000, investment into the biotech industry was estimated at $ 5 billion. At present there are over 1200 companies in United States alone[1]. As with all types of business ventures there are certain unique approaches in biotechnology business. The five basic concepts in the establishment of a business venture include idea; scientific development and market research; first production of capabilities; testing, approval and marketing; and finally production.

In order for biotech products to become reality the new ideas and discoveries must be brought out of the laboratory setting into an industrial setup. Many of the outstanding discoveries orginate in public funded academic and research environments which are traditionally not business oriented, therefore, entrepreneurs with business acumen developed the concept of a biotechnology company. Market research or economic forecasting is a tricky process but is a fundamentally important corporate tool. Usually before any business venture is attempted, substantial research is done to access the feasibility of the proposed service or product. Like is there a market? Why produce something that cannot be sold ? It is critical to demonstrate a good understanding of the immediate and the future market for the products or the services to be provided[4]. Making economic forecasts that address the questions like these is central to business planning. Besides, it is also important to discuss the competition that exists and how competitive the product or service would be. Along with it a market survey must be conducted to know the strengths and weaknesses of the existing competition and in what ways the new product is superior.

The foundation of a successful business lies in a business model but the fact is that there is no universal model instead universal business principles do exists. Further considering the diversity and dynamics of the market place, the business model may have to be appropriately modified to adapt to the prevailing business climate[5]. A good business model or plan should calculate a return on investment as well as a net present value.

There are two biotechnology business models that characterize biotech companies[1] :

(i) Product development companies.

(ii) Platform technology development companies.

PRODUCT DEVELOPMENT COMPANIES

These focus on commercializing a product usually an agricultural product (including food) and the products of some therapeutic value. During last twenty five years a number of life sciences companies capitalized on new technologies to mass

produce a number of benefical, small biomolecules that had not been considered by the giant pharmaceutical companies. A sample of such companies and their products is given in Table 1. The product based biotechnology business model has certain advantages. The market for some of the products, especially therapeutic products is large and sustainable for the very fact that diseases are seldom eradicated and thus sickness persists in the population, generating a constant and perpetual need for medicine, Secondly, the business is very profitable the total margines reaching up to the range of 80-90 percent. Further, there is no or if, any, then it is only very little pricing pressure, while the patent for the product remains valid. Besides, it is very difficult for competitors to encroach because of favourable conditions for obtaining a patent for the product, this leads to protecting the huge investment of the creators of products[6].

The major disadvantage of the product based Biotechnology business model is its huge risk, the reason behind this stipulated risk is the estimation that only one out of ten companies that invest and are evaluated in clinical trials, receive approval for a new drug application. Above all the product development is characteristically of long duration i.e. from 5 to more than 10 years and is very exhaustive along with being expensive.

Table–1, Some product based companies and some of their specific products[1]

S.No.	Company Name	Product	Use
1.	Eli Lilly	Humulin Humatrope	For treatment of diabetes For treatment of growth hormone deficiency
2.	Genentech	Pulmozyme	For treatment of cystic fibrosis
3.	Amagen	Epogen	For treatment of anemia
4.	Centeon	Helixate	For treatment of hemophilia
5.	Centocor	Retavase	For treatment of myocardial infraction

PLATFORM TECHNOLOGY DEVELOPMENT COMPANIES

These focus upon making existing technology (or tools) more efficient i.e. better, faster and cheaper. Earlier, tool companies engaged in activities such as the enhancement of the delivery of existing therapeutics, currently, numerous companies have been formed not only in drug delivery but also in hot areas like gene discovery, gene therapy, proteomics, bioelectronics, and combinational chemistry[7]. A sample of such companies and their activities are presented in the Table–2. The major advantage of platform technology development companies is that it takes only a very short time for the product to reach the market the reason being that the FDA approval is often not required, since an existing and previously approved product is being improved. Secondly, the technology is not being developed from the beginning so the risk of product failure is lowered. The major disadvantage includes the risk of competition that is almost inevitable, since quality is never ending; it is likely that sooner or later some better cheaper and faster technology will emerge on the market. The adverse effects are more significant when the technology being used to enhance existing ones is not patentable[8].

Table–2, Some platform based companies and some of their specific products[1]

S.No.	Comany Name	Selected Product or Tool
1.	Rosetta	DNA Chips
2.	Perspective Biosystems	Sequencing Instruments
3.	Kiva Genetics	SNP Genotyping
4.	Aiza	Drug Delivery
5.	Millenium	Gene Discovery
6.	Xyomix	Proteomics, Protein chips

STARTING A BIOTECHNOLOGY BUSINESS

In order to commercialize an idea, it needs to be nurtured in a business culture. Traditionally, businesses are created to fulfill the needs in a society and in the process financial rewards accure

to the owner of the business. To fulfill a need a business must either add value to something by making a product or by adding value of someone by providing a service. This suggests that, for many traditional businesses, the needs existed before certain companies fulfilled them. Furthermore, biotechnology is rapidly evolving, posing a significant challenge to business based on it. There are few key aspects involved in creation of a most successful Biotech Company.

FINANCE AND CAPITAL INVESTMENT

Biotechnology companies can access capital from the same pool that other business do. A business may be financed in one of the two ways : debt financing and equity financing[6]. In debt financing the company obtain capital by securing it against an asset or group of assets. The company incurs debt through loans, bank overdrafts, and other such transactions. The lender charges interest on any outstanding balance regardless of whether the company makes or loses money. The main source of capital in debt financing is banks and other commercial lenders. Equity financing entails the element of risk, with the investor standing to lose the invested capital, should the company be unprofitable or unsuccessful[9]. Assets that may be placed at risk include plant, machinery, and stocks. The primary sources of equity capital are venture capitalists and the general public. Equity funders receive dividends only when the company has accured distributable profits. Such dividends can change over the life of the investment.

THE TECHNICAL ASPECT

Irrespective of the business model, the technology involved should be proven to be technically feasible and workable. Investors are not interested in funding scientific ideas or concepts; they will fund only what is realistic and can be commercialized for profitability. The technology may be completely developed or may be in various stages of development; therefore, it is important to disclose the technical status to the potential investors. Another aspect of interest to investors is the range of application of the technology. This will determine whether the market base for the company would be narrow or broad. Further, it is advantageous if the technology has the room for further development and expansion to include new product opportunities[10]. A caution with technology in a fast developing industry like biotechnology is the issue of patents which should be dealt properly to avoid unnecessary and costly litigations at later stages.

THE HUMAN RESOURCE

A biotechnology company thrives on quality human and nonhuman resources. As biotechnology depends on principles and concepts from several scientific disciplines it should have a compliment of qualified scientists, especially microbiologist, biochemists, geneticists, and chemists[11]. To attract higher caliber scientists, the management should be prepared to pay competitive salaries and provide other incentives. For example, being from academia, such scientists would like to publish their research in peered journals, on the other hand the company may want to keep certain discoveries secret for at least a period of time. Academics would love to have a good library resources. Some companies may offer stock option to scientists and other key staff.

Apart from scientists, a biotechnology company needs accountants, marketing personnel, public relation personnel, laboratory technicians, administrative staff, and personnel for housekeeping. Top notch personnel can be hired only if the company has adequate financial resources. Biotechnology is a very capital intensive business that depends on investors to start and sustain the operation. It is not uncommon for

biotechnology companies, especially the entrepreneurial ones, to operate in a deficit mode during the early years of existence, because during these years, the company is engaged in the development of their first products.

MARKETING STRATEGY

It is repeatedly said that the three factors to consider in establishing a new business are market, market and market. It is important to conduct market research to determine market outlets for the product, the size of the market, the distribution, the presence of competitive products, stability, profitability, and opportunities for growth[12]. Once the markets have been firmly decided upon, the company needs to plan on how to actually deliver the goods and services to the customers. This has to do with the mechanics of moving the product. The alternatives are many, but the company needs to identify the most effective and profitable ones. A product is unprofitable unless it is marketed efficiently. As part of the business, a company should try to define and develop a unique identity by which it wishes to be known in the business community. It should be unambiguous and easy for customers to associate with. It is important to be consistent in keeping the standards set in order for a loyal customer base to grow.

CONCLUSIONS

The Biotechnology has been making good progress commerically for about twenty five years and predicting where it will take us further, is difficult. A cautious examination of current prospects indicates that health care, agriculture (including the food industry) and environmental biotechnology will be the most intensively explored in the near future. The promise of biopharmaceuticals has given patients all over the world new hope to treat the most debilitating diseases, yet the vaulting cost of R & D continues to make those vital drugs prohibitively expensive. With the new millennium the sequencing of the human genome has become a reality and this land mark achievement has elicited world wide interest in Biotechnology and attracted considerable investment into the sector. As at the time of its inception, the business it still risky for those on the cutting edge of research as well as for the investors who provide the financial backing. Business executive generally believe that a successful Biotechnology business model is one that works and it should develop product or services that create increasing market share, a sustainable and increasing profit, in short it should be structured to create value.

REFERENCES

1. D. Baurgaize, R.J. Thomas, and R.G. Buiser. The Business of Bitotechnology in United Sates. In : Biotechnology Demystifying the Concept. Pearson Education, Singapore. 2004.
2. J.L. Mark, A revolution in Biotechnology. Cambridge University Press, Cambridge. 1989.
3. P.H. Abelson, *Amer. Adv. Sci.* **84**(8) : 516. 1984.
4. G. B. Rachmann, Biotechlology Start Ups. In : Biotechnology : The Science and Business Moses, V. and Cape, R.E. (Eds.) Harwood Academic Publisher, London, UK. 1991.
5. D.M. Gaythwaite, Intellectual Property and Technical Know How. In: Biotechnology, The Science and Business. Moses, V. and Cape, R.E. (Eds.) Harwood Academic Publisher, London, UK. 1991.

6. G. Acquaah, Biotechnology as a Business. In: Understanding Biotechnology. Pearson Education, Singapore, 2004.

7. F. Sharep, *Science*, **235** : 1329-1332. 1987.

8. R.S. Crespi, A Basic Guide to Patenting in Biotechnology. Cambridge University Press, Cambridge. 1988.

9. G.T. Tzotzos, and K.G. Skryabin, Biotechnology in the developing world and countires in economic transitation. CAB International, New York. 2000.

10. N. Kalaiztandonakes, and B. Bjornson, *J. Agric. Appl. Econ.* **29**(1): 129-139. 1997.

11. S. S. Brown, and M. Rowh., *Biotechnology Careers*. 2000.

12. C. E. Party, and K. O. Fugile, The Private sector and international technology transfer. 2000.

KIDNEY STONES AND GLOBAL WARMING

Murugappan, A *, and Sivaprakasam Subbarayan

According to many researchers working on 'Climate Change', climate change's impact on public health will be extensive, ruthless and affect all sectors of the public health system. A new affliction that will result from climate change has surfaced : kidney stones. Rising temperatures and increased dehydration linked to global warming will boost kidney stone rates around the world. The objective of this paper is to highlight the link between climate change and the rise in incidence of kidney stones around the world, the causative factors for occurrence of kidney stones, the socio-economic impacts, research issues and methodology to combat the disease.

INTRODUCTION

Global warming will stir up the plagues of malaria, dengue fever, hantavirus and kidney stones. It seems an odd melancholy to include kidney stones on the list of climate change-related health problems which usually run to infectious diseases and shortages of food and water. But researches predict that rising temperatures will make kidney stones more common. The real issue is that climate change cuts across so many different pathway, and kindey stones is one interesting example.

Kidney stones can be extremely painful. They are often caused by dehydration as the body is unable to flush minerals out of the system. Rising temperatures and increased dehydration linked to global warming will boost kidney stone rates around the world.

There is an urgent need to gauge the potential impact of global warming on kidney stone risk. For this, the researchers must analyze and plot prior disease incidence in world geographic regions, along with valid reports assessing global warming patterns. This would help in developing mathematical models to compute all relevant information applicable to the region under consideration.

WHAT ARE KIDNEY STONES ?

The kidney are two bean-shaped organs that are roughly four inches in length and located towards the back of the abdomen, on either side of the spine. Kidneys work by removing waste products from the blood. The waste products are transferred into the ureter (the tube that attaches each kidney to the bladder) along with excess fluids, and from there they are disposed of as urine. The sterile blood is then transferred back into the body.

There are four main types of kidney stones :

- Calcium stones are made from calcium and phosphate, or calcium and oxalate.
- Struvite stones contain magnesium and ammonia, and are often horn-shaped and quite large.
- Uric acid stones are usually smooth, brown and softer than other forms of kidney stones.

* Department of Civil Engineering, Faculty of Engineering and Technology, Annamalai University, Annamalainagar, 608 002, Tamilnadu.

- Cystine stones are often yellow and look like crystals rather than stones.

Kindey stones come in a variety of shapes, sizes and colours. Some look like grains of sand while, in rare cases, others can grow to the size of a golf ball.

The waste products are usually dissolved in the fluids that form urine but, occasionally, they can form crystals that collect around the inside of the kidney. The crystals may gather over time to form a hard stone-like lump. This is a kidney stone.

After a kidney stone has formed, it will often pass through the urinary system as it tries to be passed in urine. However, it is fairly regular for a stone to block part of the urinary system, such as the ureter or the urethra (the tube that carries urine from the bladder to the outside of the body). If this happens, you may feel acute pain in your abdomen or groin. An obstruction in the urinary system can also lead of infection, kidney injury or, sometimes, kidney collapse.

Common symptoms of kidney stones include :

- intense pain in the back or side of abdomen, or occasionally in groin,
- nausea
- blood in urine, which is often caused by the stone scratching the ureter
- cloudy or smelly urine
- a burning sensation during urination and
- fever (a temperature of 38° C or 100.4° F, or higher)

If one had kidney stones, he/she may also feel like he/she needs to urinate more often even if he/she does not need to.

The exact cause of kidney stones is unknown. They are usually formed following a build up of a substance in the body, such a calcium, ammonia, uric acid or cystine.

Certain medical conditions, such as cancer or kidney disease, can also increase the risk of developing kidney stones. This is usually due to the treatment for these conditions.

One is at a greater risk of developing kidney stones if :

- one is dehydrated or do not drink enough fluids,
- one eats a high-protein, low-fibre diet,
- one is inactive or bed-bound,
- kidney stones run in one's family.
- one has had several kidney or urinary infections,
- one has had a kidney stone previously.
- only one kidney works, and
- if one has had an intestinal bypass or a disease of the small intestine, such as Crohn's disease (inflammation of the gut).

There is also evidence that certain medication, such as aspirin, antacids, calcium and vitamin D supplements, may increase risk of developing a kidney stone.

GLOBAL WARMING AND KIDNEY STONE DISEASE

According to researchers in UT Southwestern Medical centre and UT Dallas, global warming is likely to raise the proportion of the population affected by kidney stones by expanding the higher-risk region known as the "kidney-stone belt" into neighbouring states in United States of America. Kidney-stones are more common in the warmer parts of the U.S. The Southeast is known as the "Kidney-stone belt" because of the high incidence of kidney stones in the population living in Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina and Tennessee. About 13% of men and 7% of women experience kidney stones during their lives, yet those rates can double in the "kidney stone belt". According to the U.S. National Kidney and Urologic Diseases Information Clearinghouse, about 5 percent of Americans develop kidney stones at some point, with the risk rising as men and women enter their 40s and 50s, respectively.

Dehydration (lack of fluids) in one of the risk factors linked to kidney-stone disease and global warming will aggravate this effect. It is predicted that by 2050, higher temperatures will cause an additional 1.6 million to 2.2 million kidney-stone cases representing upto a 30 percent growth in some areas of United States of America. The study shows that global warming causes a direct medical consequence on human beings. It is certain that climate change will continue and increase, and it is equally certain that increased temperatures will lead to increased kidney stone formation.

Kidney-stone disease can be caused by both environmental and metabolic problems. Little volume of urine directly enhances stone risk by increasing the concentration of stone-forming salts. They can occur from either taking in too little fluid or losing too much through dehydration.

The climate change was forecast in the study using models of global warming obtained from the Intergovermental Panel on Climate Change's 2007 Fourth Assessment Report, in which predicted temperature increases are based on expectations of future greenhouse gases.

The potential impact of global warming on kidney stone risk was gauged using two studies that reported kidney-stone rates in various geographic regions and associating regional kidney-stone rates with local mean annual temperatures, the investigators were able to derive two mathematical models relating temperature to kidney-stone risk. Both models of kidney-stone risk predicted that the current kidney-stone belt prevailing in United States of America will expand wih global warming, although the exact extent and location of the change was different. One model predicted that the increase will be concentrated in the southern half of the country, while the other model pointed to an increase in the upper Midwest. Taking into account the estimated future populations in those areas, increased temperatures were predicted to cause 1 million to 2 million more cases of kidney-stone disease.

According to Kristina Penniston, a registered dietician and associate scientist in the department of urology at the University of Wisconsin School of Medicine the Public Health in Madison, it seems entirely likely that incidence of kidney stones will increase with global warming, primarily because one of the driving forces of incidence is hydration, and with global warming people will tend to be less well hydrated.

SOICO-ECONOMIC IMPACTS

The study concluded that the increase in kidney stone cases could increase health-care costs by as much as $1 billion. This problem is not only confined to the U.S. This will also affect southern Europe, southeastern Europe, and Southeast Asia. As the treatment options in Southeast are more limited, countries in that region will certainly experience a much more severe impact on health.

When people relocate from area of moderate temperature to areas with warmer climates, a rapid increase in stone risk has been observed. This has been shown in military deployments to the Middle East for instance.

PREVENTING KIDNEY STONES

Drinking Plenty of Water

Kidney stones can be avoided by drinking plenty of water each day and avoiding getting dehydrated. It is very important to keep the urine diluted to avoid waste products forming into kidney stones.

The degree of dilution of urine can be ascertained by looking at the colour of it. The darker it is, the more concentrated it is. Urine is usually a dark yellow colour in the morning because it contains a build up of waste products that the body has produced overnight.

Normally, one should drink at least six to eight glasses (about 1.2 litres) of water each day. However, people who have had a kidney stone before are encouraged to increase their fluid intake

to two to three litres each day in order to 'flush out' waste products that can cause stones to develop.

Drinks such as tea, coffee and fruit juice can count towards your fluid intake, but water is the healthiest option and is best for preventing kidney stones. One should also make sure that he/she drinks more than the recommended daily amount when it is hot, or when exercising, in order to replenish fluids that are lost through sweating.

Changing one's diet

If kidney stone is caused by an excess of calcium, it is advisable to reduce the foods containing oxalates in diet. Oxalates prevent calcium from being absorbed by the body, so it can accumulate in kidney and form a stone. The amount of calcium in diet should not be reduced unless recommended by the medical practitioner.

To prevent developing an uric acid stone, the amount of meat, poultry and fish in diet must be reduced. Medication may also be prescribed to change the levels of acid, or alkaline, in urine.

RESEARCH ISSUES

The study conducted by the researchers in UT Southwestern Medical Centre and UT Dallas, in fact, is an eye-opener in establishing the exact link between kidney stones and global warming. Such researches have to be carried out extensively in all parts of the world. Many of the states in our country, particularly the states in northern part of our country are subject to climate extremes with cold conditions prevailing in the period November to February and hot conditons prevailing in the period March to June. Because of global warming, the maximum air temperatures at some places may reach extreme values during the hot summers and the risk of kidney-stone disease may increase further and further. In this situation, it becomes imperative to carry out a detailed investigation and derive mathematical models to forecast the risk of kidney-stone occurrence in future.

It will be quite interesting to know how global warming will impact the diet of people, because there are also many nutritional factors related to kidney stones. and climate change affects the nutrient composition of the plants that we grow and the animals that we eat. For example, fruits and vegetables are inhibitors of stones. So the question then is, will people be eating less of that as temperatures rise because these things don't grow as abundantly ? And will that then alter people's risk for stones? These are some of the important issues to be investigated.

CONCLUSION

Considering these aspects/issues, the need of the hour is to carry out interdisciplinary research involving researchers in the fields of medicine, climatology, water supply and sanitation, sociology and economics. This research must be carried out simultaneously (during the same period of time) by different groups involving different regions of the country. The findings of the studies must be debated on a common platform for exchange of views and concluding recommendations. The recommendations must be put-forth before the Ministry of Environment and Forests (MoEF) at the national level for enabling the government to take policy decisions and device strategies to combat the risk of escalation in kidney stone disease due to global warming.

REFERENCES

1. Tom H. Brikowski, Yair Lotan and Margaret S. Pearle, *Proceedings of the National Academy of Science,* USA, 2008.
2. United Nations Intergovernmental Panel on Climate Change (IPCC), Fourth Assessment Report on Climate Change, 2007
3. Alam Mozes, "Global Warming Linked to Heightened Kidney Stone Risk" *Health Day News, MSN Health and Fitness—Pain Management.htm,* 2008.

APPLICATIONS OF NANOTECHNOLOGY IN ANIMAL DISEASE DIAGNOSIS, TREATMENT AND PREVENTION

S. Parthiban*, S Raja** and H. K. Mukhopadhyay***

This article deals with different types of application of Nanotechnology in the area of disease, diagnosis & treatment.

INTRODUCTION

High-tech medical devices are creating new and excellent grounds of diagnosis, treatment and management of diseases or in a better way, of a living body, which are equally meeting with a whole new emerging range of challenges. We are moving forward day by day towards a dream world, where we want better technology for challenging dreadful diseases and appropriate therapy for human welfare. Nanobiotechnologists are working on biology's molecular toolbox in the hope of revolutionizing equipments/devices that would in turn change the whole scenario of biology fusion of useful biomolecules to chemically synthesized nanoclusters in arrangements that do everything from emitting light to storing tiny bits of magnetic data. The results in a merger that attempts to blend biology's ability to assemble complex structures with nanoscientists capacity to build useful devices for diagnosis, treatment and prevention of various diseases.

* 10/442, First cross, Thulukathamman Nagar, Murungapakkam post, Puducherry-605 004
E-mail : parthis17@gmail.com.parthis17@yahoo.co.in
** Dept of Veterinary Clinical Medicine Ethics and Jurisprudence Teaching Complex, Mettupalayam, Ragacovas, Puducherry-605 009
*** Department of Veterinary Microbiology Ragacovas, Puducherry-605 009
E-mail : mhirak@rediffmail.com

NANOTECHNOLOGY AND NANOBIOTECHNOLOGY

Nanotechnology involves tinkering at atomic levels, tweaking and controlling substances 1,00,000 times smaller than a strand of human hair, to make useful materials and devices. It involves technology at the scale of one-billionth of a meter. The term 'NANO' is derived from Greek word "Dwarf". The most widely used definition of nanotechnology is provided by the U.S. Government National Nanotechnology Research Association. According to them, Nanotechnology is defined as "Research and Technology development at the atomic, molecular levels at the scale approximately 1 to 100 nm range, to provide a fundamental understanding of phenomenon and functions at nanoscale and to create and use structures, devices and systems that have novel properties and functions because of intermediate size".

Now a look towards Biology-Billions of years of evolution have outfitted organisms of all stripes with a wealth of nanomachines, from the information storage medium of DNA to the proteins that capture sunlight and copy DNA during cell division. Merging nanotechnology with biology is known as Nanobiotechnology. Thus when both offer a helping hand to one another the outcome would surely be mind-boggling.

In the field of nanobiotechnology rather than building tiny devices atom by atom, nanobiotechnologists are working on biology's molecular toolbox in hopes of revolutionizing equipments/devices that would in turn change the whole scenario of biology. Fusion of useful biomolecules to chemically synthesized nanoclusters in arrangements that do everything from emitting light to storing tiny bits of magnetic data. The result is a merger that attempts to blend biology's ability to assemble complex structures with nanoscientists capacity to build useful devices.

PROPERTIES OF NANOMATERIALS

To visualize analytically the level, at which nanomaterial manipulation is done, we have provided some examples of biological materials in nanoscale (Fig 1).

Height of typical human	- 1.7 billion nm
Diameter of human RBC	- 800 nm
Leucocytes	- 10,000 nm
Bacteria	- 1,000 to 10,000 nm
Virus	- 75 to 100 nm
DNA (width)	- 2 nm
Atom	- 0.1 nm

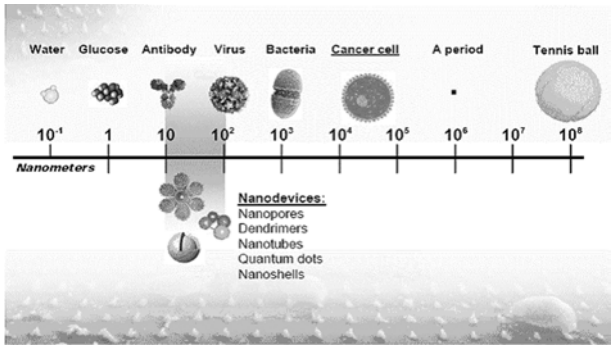


Fig. 1

Nanomaterials can have very different properties than materials at the macro level. They can be stronger, lighter, less corrosive, more porous and electrically more conductive than the bulk materials. Nanomaterials range from 1-100 nm in size, such as fullerenes, nanotubes, bucky balls, quantum dots, dendrimers etc.

- Fullerene is pure carbon molecules composed of atleast 60 atoms of carbon. Because a fullerence takes the shape of soccer ball and its inventor of a geodesic dome, which have resemblance with fullerenes, it is also referred as bucky ball.
- Nanotubes are a sequence of nanoscale C-60 atoms arranged in a long thin cylindrical structure. They are related to carbon Crystal forms-graphite and diamond. They are also called as bucky tubes.
- Quantum dots are a nanoscale crystalline structure made from cadmium selenide that absorb white light and re-emit it a couple of nanoseconds later in a specific colour.
- Dendrimers are synthetic three dimensional macromolecules formed using a nanoscale fabrication process. It is technically a polymer with a tree like structure.
- Nanoshells are atomic spheres and nanoparticles are made up of dielectric (gold sulfide or silica) core and a metal (gold) shell. They combine infrared optical activity with uniquely biocompatible properties of gold colloid. They are like spherical glass particles with an outer shell of gold with a size of about 100 nm diameter.

APPLICATIONS IN DISEASE DIAGNOSIS

1. Gold Nanoparticles

Tiny gold particles linked to DNA could detect free-floating target DNA. When the target strands bind to the gold bound complementary strands, they pack the gold particles close together that change the colour of the particle, creating a simple colour based detector for specific DNA sequences.

It could aid for rapid diagnosis of infections diseases and detection of tiny genetic mutations called single nucleotide polymorphism.

2. SERS (Surface Enhanced Raman Spectroscopy)

- Discovered by Raman in 1928 and modified by Tripp
- Works by measuring the change in frequency (Raman shift) of a near-infrared laser as it scatters off viral DNA or RNA
- Raman dye coated gold nanoparticles adsorbed with specific Abs are used in diagnosis of various infections diseases from clinical samples.

3. Atomic Force Microscopy

- Discovered by Binning in 1986, useful in identification of causative agents and lesions in the host system.
- High resolution images of virus-host events with minimal sample processing.
- Produce images in three different formats Height, Phase and Amplitude.

4. Gene Chip

- Gene chip probe are prepared and spotted on specially treated glass slides.
- RNA from sample is reverse transcripted and labelled cDNA is subjected to specific hybridization with the prepared gene chip probe.
- Results can be detected with scanning.

5. Nanofilter

- Argonide Corporation, Sanford, Florida invented a revolutionary microbial filter, capable of retaining bacterial and virus from various samples.
- Nano Ceram[8] is effective for retaining endotoxins, bacteria and virus from samples.
- These filters are useful for screening the water reservoir, and other field samples for Microorganisms.

APPLICATIONS IN DISEASE TREATMENT

Carbon Nanotubes

In the field of pharmacy smart drugs can be prepared by placing the drug or DNA within the nanoparticles like tiny fat bubbles. This enhances their therapeutic efficacy. This could have importance in target drug delivery, gene therapy, treatment and eradication of tumors.

Nanoviricides

Nanoviricide is a flexible nano-scale material approximately a few billionths of meter in size, chemically programmed to specifically target and attach a particular virus. This is designed to specifically seek and attach to a virus particle, engulfing the virus particle in the process, thereby theoretically rendering it incapable of infecting new cells. This is only the suggested or "design-goal" mechanism of action. They are designed to act as programmed chemical robots that finish their task of destroying the virus particle on their own independent of immune response.

Some Nano Vircides are being manufactured :

- AviFluCide-I^{TM}-for Avain influenza
- HepaCide-I^{TM}-for Hepatitis B
- RabiCide-I^{TM}-for Rabies
- HIVCide-I^{TM}-for AIDS

VLP (Virus like Particles)

Viruses have been used as nano containers for specific targeting applications. A subset of viruses with natural affinity have been used for receptors on tumor cell. Canine Parvo Virus (CPV) has affinity to transferrin rceptors (TfRs) for binding

and cell entry into canine as well as human cells. TfRs are over expressed by a variety of tumor cells and are widely being investigated for tumor targeted drug delivery. The natural tropism of CPV and TfRs could be harnessed for targetting tumor cells. CPV–VLPs are produced by expression of the CPV-VP2 capsid protein in a baculovirus expression system and examined for attachment of small molecules and delivery to tumor cells.

APPLICATIONS IN DISEASE PREVENTION

The important tool for disease prevention is vaccine. Nanotechnology offers a helping hand here by formation of biodegradable nanospheres that are found to give a better immune response as compared to vaccines produced by conventional methods.

Carbon Nanotubes

In the field of pharmacy smart durgs can be prepared by placing the drug or DNA within the nanoparticles like tiny fat bubbles. This enhances their therapeutic efficacy. This may have importance in target drug delivery, gene therapy, treatment and eradication of tumors. Carbon nanotubes consist of graphite sheets rolled up into tubular form.

- Single walled nanotubes : Diameter 0.5-3.0 nm Length 20-1000 nm
- Multi-walled nanotubes : Diameter 1.5–100 nm Length 1-50 um
- Made water soluble for effective use.
- Cross cell membrane gets as "nanoneedle".

ISCOMs

- Immunostimulatory complexes
- Diameter 30-40 nm
- Act as adjuvant
- Effective inducers of long lasting CMI and MI
- Activites CD4 + and CD8+ simultaneously
- Intra-nasal and Oral administration
- Equine Influenza and BHV-1

Liposomes

- Bilayered vesicles composed of phospholipids and other sterols
- Small unilameral vesicles
- Size : 25-100 nm
- Act as a Adjuvant
- Used along with BHV-1 vaccine

Gold Nanoparticles

Gold nanoparticles coated with DNA (Gene gun)

- Propelled through skin and enter directly into the cell cytoplasm and nucleus
- Delivery of DNA plasmid vaccines though gene gun is much more efficient than through needle 100-fold less DNA required to achieve equivalent immunological response.
- Efficient transformation of Langerhans cells and dentdritic cells

Polymeric Nanoparticles

PLGA (Poly-lactide-glycolide) and PMMA (Polymethylmethacrylate)

- Sustained release of antigen, with consequent prolonged stimulation of the respiratory immune system. PLGA produces higher level of virus specific antibodies than PMMA or soluble viral protein alone. Example ; BPI-3 (Bovine para influenza type 3 virus)
- Single walled nanotubes : Diameter 0.5-3.0 nm Length 20-100 nm
- Multi-walled nanotubes : Diameter 1.5-100 nm Length 1-50 nm
- Can be made water soluble
- Can cross cell membrane as nanoneedle.

CONCLUSION

- Nanotechnology is a description of activities at the level of atoms and molecules that have applications in the real world.
- Use of this technology is veterinary field has created a new horizon in disease diagnosis, treatment and prevention giving more precised results.
- Use of nanoparticles in therapy can be made by specific site directed drug delivery.
- More research in the field of nanotechnology is necessary in biological sciences.

REFERENCES

1. J. Feneque, *Science Reporter*. 10-14, 2003.
2. J. M. Nam, *Science*, **301**, 1884-1008, 2003.
3. News Focus : *Science* **298**, 2222-2223, 2002.
4. A. Rustom, *Science*, **303**, 1007-1009, 2004.
5. I. Wilner, *Science*, **298**, 2407-2408, 2002.

SHORT COMMUNICATION

MOREL TRADE IN JAMMU AND KASHMIR-NEED FOR ORGANIZED COMMERCIALISATION

Sanjeev Kumar* and Y.P. Sharma**

As more and more mushrooms are being investigated for their role as nutritional food, morels (Morchella spp.) still occupies the pinnacle position among them.

INTRODUCTION

The morels (*Morchella* spp.) belong to the class Ascomycetes of division Amastigomycota of Kingdom Myceteae. They occur in variety of habitats and their fruiting bodies are fragile to brittle, cup to saucer shaped and sessile, or stipitate having predominantly brown, yellow, cream, grey and black colour. They are well represented in India in various regions of Jammu and Kashmir, Himachal Pradesh and in Shivalik, Kumaon and Hairshi hills of Uttar Pradesh[1-2]. World over 215 taxa belong to the genus *Morchella* have been reported (Index Fungorum, 2008). In India, ten species viz. *Morechella esculenta, M. conica, M. deliciosa, M.angusticipes, M. crassipes, M. vulgaris, M. rotunda M. hybrida* (*M. semilibera*) and *M. gigaspora*, are known to exist[3]. While in Jammu and Kashmir six species of this genus have been recorded[4]. They are highly prized edible mushrooms which have been used traditionally for centuries[5].

As more and more mushrooms are being investigated for their role as nutritional foods, morels (*Morchella* spp.) still occupies the pinnacle position amongst them. Morels have a long-standing history in Indian cuisines and culture and their collection from the wild dates back centuries. Morels have been, and are now more then ever, one of the most important sources of income for rural folks and some tribal, who are involved in the collections of this commodity of commerce from the wild.

SCENARIO OF MORELS OF JAMMU AND KASHMIR

In Jammu and Kashmir, of all the edible mushrooms collected from the wild, morels (commonly called as 'Guchchi') are prime edibles with immense commercial importance and their strong demand makes them an important Non-Timber Forest Produce (NTFP). The scale of morels provides substantial monetary benefits to rural livelihoods and local traders. Morel collection, in this northern state of India, is undertaken twice in a year between March-May and August-September. Due to lucrative returns, in many villages, almost all the families are actively involved in morel collection. On an average, each individual is able to collect about 1-3 kg of fresh morels in a day and sell them in fresh or dried form to the local shopkeepers or middlemen. Incidentally, middlemen usually buy morels directly from the villagers at very low prices (Rs. 2000-3000 per kg) and further sell them to the whole sellers and customers at an exorbitant price (Rs. 5000-7000 per kg). This indicates that consumers eventually pay 2-3 times more price than the initial price at the collectors' level.

On the other hand, the official scenario of moral production is rather dismal. As per the data

* Department of Botany, University of Jammu, Jammu (J&K), 180006, E-mail. sanjeevkoul222@gamil.com. yashdbum3@yahoo.co.in

gathered from various forest divisions of the Jammu province, it is observed that moral output is not uniform in the region. In Kishtwar Forest Division, out-turn of morels production during 2003-04, 2004-05 and 2005-06 was reported to be 46.50, 35.58 and 54.21 quintals, respectively, while in Marwah Forest Division this figure stood at 10.27, 19.96 quintals during 2004-05 and 2005-06, respectively. Likewise, in Bhadarwah area, 35.00, 35.00 and 45.00 quintals of morels were extracted from the wild during 2005-06, 2006-07 and 2007-08, respectively (DFO, Kishtwar, Marwah, Bhadarwah, personal communication). However, market sale price of dried morels averages 5000-7000 per kg. this may vary enormously from time to time. The actual morel collection is expected to be far greater than that depicted by the forest department since there is visibly no control over their collection and sale. Therefore, unorganized, rampant and unscrupulous trade of this valuable commodity cannot be ruled out in the region. Although the forests are occasionally leased out on contract basis by the State forest department for morel collection and the morel gathering by others is prohibited, yet the forests are freely accessible to the local inhabitants dwelling near the forest areas for morel collection thus inflicting a huge loss to the state exchequer every year.

MORELS : THE CULINARY HERITAGE OF JAMMU AND KASHMIR

Dried morels are exported every year from India to the international markets and the State of Jammu and Kashmir ranks second in the morel trade after Himachal Pradesh with Uttar Pradesh as the third largest producer of morels in India[6]. Morels of the state have far more cachet in Indian and foreign markets due to their extraordinary flavour and taste. Widespread references and publicity of morels through scholarly articles such as 'The wedding in the family'[7] in 'The Indian Express' and 'Sarees and spice and all things nice'[8] published in 'New Strait Times' (A Malaysian newspaper) provides national and international repute to this important non-timber forest produce. Therefore, owing to the global significance and extraordinary taste and flavour of morels, it is strongly recommended that they be regarded as 'The Culinary Heritage' of Jammu and Kashmir. In addition, this NTFP can be labeled as 'Product of Jammu and Kashmir' for future trade as has been done for many other edible commodities such as fresh, dry and dried horticultural products.

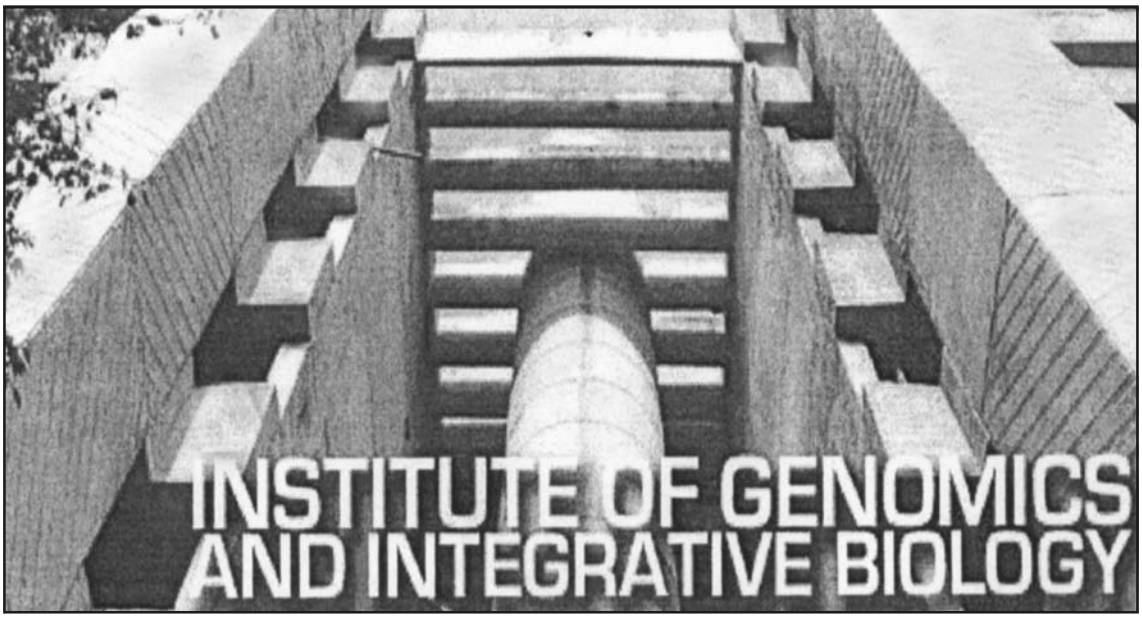
CONCLUSION

In view of the data presented in this article one can conclude that there is an ardent need for revamping and re-evaluating the morel trade in the State of Jammu and Kashmir. Opening of the morel cooperatives and nationalization of morel collection by declaring a support price to the morel produce is called for. All these regulatory measures by the State forest divisions would pave way for improving the socioeconomic status of the local populace, on one hand and state earnings on account of the morel trade, on the other.

REFERENCES

1. K.S. Waraitch, *Kavaka* **4** : 69-76, 1976.
2. T.N. Kaul, Recent developments in Morel Biology. In *Advances in Mushroom Biology and Production*, (eds. Rai, R.D., Dhar B.L. and Verma R.N.) Mushroom Society of India, Solan pp. 59-78, 1997.
3. Jamaluddin, M.G. Goswami and B.M. Ojha, *Fungi of India*. Scientific Publishers, India (1989-2001), pp. 326.
4. S.P. Abraham, *Indian Mushroom Floristic Studies*, 13-24, 1991
5. N. Pegler, *Mycologist* **17**, 174, 2003
6. O.S. Shad and T.N. Lakhanpal, *Indian Mushroom Floristic Studies*, pp. 1-3, 1991
7. M. Kapoor, A wedding in the family, *The Indian Express*, April 13. 2000.
8. M. Menon and A.A. Razak, *New Strait Times* (Malaysia), May 18, 2001.

KNOW THY INSTITUTIONS



INSTITUTE OF GENOMICS AND INTEGRATIVE BIOLOGY, DELHI

Institute of Genomics & Integrative Biology (IGIB) is a premier Institute of Council of Scientific and Industrial Research (CSIR), engaged in research of national importance in the areas of genomics, molecular medicine, bioinformatics, proteomics and environmental biotechnology.

IGIB's strengths are :

- A young and enthusiastic talent pool
- An active network with medical Institutes for clinical studies
- International and National funding support
- State-of-the-art Infrastructure

RESEARCH AREAS

I. Genomcis and Molecular Medicine

Genomics and Molecular Medicine is the major research focus of IGIB. From large collaborative projects like the Indian Genome Variation Consortium project to exploring genetics of complex disorders using a candidate gene approach several groups at IGIB are involved in studying the molecular basis of human diseases.

They focus on :

- Neuropsychiatric disorders like Schizophrenia
- Cardiovascular disease
- Diabetes and other complex disorders

II. Respiratory Disease Biology

A significant number of IGIB scientists focus on respiratory diseases using clinical, genetic, molecular and drug development approaches to tackle this challenging area.

The diseases of interest here are :

- Tuberculosis
- Asthma and Allergy
- Chronic Obstructive Pulmonary Disorder (COPD)

III. Genome Informatics and Structural Biology

IGIB has over the years built up expertise in high-throughput data analysis and genome annotation. It is participating in international efforts like the Gen2Phen Consortium for unifying genetic variation databases. Genome Informatics also forms an integral part of most other research areas at IGIB and contributes to development of tools and hypotheses. The areas where informatics has contributed to genome analysis include :

- Indian Genome Variation : analysis of genome variation data
- Next-gene sequencing, assembly and annotation
- Unfolded proteins and adhesins
- Prediction of micro RNA-target interaction
- Structural regulatory motifs in the genome

IV. Energy and Environmental Biotechnology

Scientists at IGIB are exploring the rich microbial diversity of India and developing biotechnological applications using this resource to address issues pertaining to the environment and energy crisis. Different areas that are being pursued are :

- Microbial diversity and its exploration
- Hydrogen and bio-plastic from waste
- Waste water treatment using microbes

V. Chemical & System Biology

Chemical approaches are essential in the understanding of many biological phenomena. Several research groups at IGIB have come together to utilize their varied expertise in different disciplines of chemistry and biology to address contemporary research problems that require interdisciplinary cross-talk. Research carried out at IGIB in this area involves :

- Chemical, biological and systems biology of *M. tuberculosis* and skin pigmentation
- Chemical modified oligonucleotides for biological applications
- Nanobiotechnology
- Novel immunoassay procedures
- New molecules
- Linkers for biochip development
- Peptide scaffolds and peptidomimetics
- Quadruplex—stabilizing ligands

Contact :

The Director

Institute of Genomics and Integrative Biology

Near Jubilee Hall,

Mall Road, Delhi-110 007

Phone No. 91-011-27666156/157

27667602, 27667439

Fax : 91-011-27667471

LIFE SKETCHES OF OFFICE BEARERS AND SECTIONAL PRESIDENTS OF THE INDIAN SCIENCE CONGRESS ASSOCIATION, 2010-2011

PROF. K. C. PANDEY
General President

Prof. K. C. Pandey, former Vice-Chancellor of Chaudhary Charan Singh University, Meerut, is an eminent helminthologist of the country. Born on 5th July 1943, in village Reoti, district Ballia, U. P., Prof. Pandey completed graduation from Banaras Hindu University (1959) and M. Sc. from Agra University (1961). He was awarded degree of Doctor of Philosophy (Ph. D.), and Doctor of Science (D. Sc.) by Lucknow University in 1967 and 1976, respectively.

Prof. Pandey started his academic career as a Lecturer in the Department of Zoology, University of Lucknow in 1966 and was appointed Reader (1978). He became Professor (1981) at the University of Meerut and later at Lucknow University (1991). In 1995, he joined as Vice-Chancellor of Chaudhary Charan Singh University, Meerut.

As a researcher, he worked on Fish and the taxonomy, systematics, and life cycle of Helmith parasites. His contribution to the studies of larval Helminths is a landmark in the field of fish-parasitology. He has a large number of publications in reputed journals both from India and abroad. He has published more than 175 papers and articles and authored/edited 8 books/volumes/monographs on Zoology and related subjects and supervised 36 Ph. D. students on various aspects of helminthology and fish.

Prof. Pandey has made scientific and educational trips to USA, Australia, China, Czechoslovakia, France, Germany, Japan, Malta, Thailand and South Africa. He is an active member and fellow of scientific bodies and in recognition of his contributions to Zoology in general and Helminthology in particular, Prof. Pandey has received medals like B. S. Chauhan Gold Medal, Bhalerao Gold Medal, Society of life Sciences Gold Medal, Society of Biosciences Gold Medal, and Dorab Jee Tata Gold Medal.

Besides his academic achievements, he has been an able administrator. As a Head of the Department and Dean, faculty of Science, in the University of Meerut and Lucknow he has been instrumental in introduction of several new courses and development of curriculum that is relevant to the present day need of the students. As a Vice Chancellor, Prof. Pandey took a keen interest in the development of education and in particular, gave a new dimension to the vocational and technical education in Chaudhary Charan Singh University, Meerut.

DR. MANOJ KUMAR CHAKRABARTI
General Secretary (Membership Affairs)

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

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

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

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

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

DR. (MRS) VIJAY LAXMI SAXENA

General Secretary (Scientific Activities)

Dr. Vijay Laxmi Saxena is at present Head of the Department of Zoology, D. G. College, C.S.J.M. University, Kanpur. She was appointed as Lecturer in Zoology Women's College B.H.U. Varanasi, worked in P.P.N. College, Kanpur for 3 sessions, worked as a lecturer in A.N.D. College, Kanpur and joined Dept. of Zoology, D.G. College, Kanpur in 1983 and working there till to date.

Dr. Saxena had held different posts in different organizations like General Secretary-Indian Society of Life Sciences from 2008-2010, Convener, Kanpur Chapter, ISCA from 2007-2010, Elected Executive Committee Member of ISCA from 2006-2009, Elected Council Member of ISCA from 2005-2006, Elected Recorder of the Section of Zoology, Entomology & Fisheries of ISCA in 1996-1998, Elected Member of the Section of Zoology, Entomology & Fisheries of ISCA in 1994-1996.

Dr. Saxena has received several Awards/Prizes like Women Scientist Award for the year 2009-2010, Certificate of Award for outstanding contribution for advancement of Science and Welfare, Certificate of Honour from Society of Pest Management & Environment Protection, Winner of Gold Medal award of Indian Society of Life Sciences, etc.

Dr. Saxena has research experience of 35 years and teaching experience of 28 years. Twenty six students have obtained Ph. D under her guidance. She has fifty three papers in journals of National and International repute and edited twenty books. She is a member of several professional bodies and have participated and presented papers in several National and International Symposia/Seminar and also gave Invited talks in South Korea. She has travelled worldwide i.e. Italy, Paris, Germany, Innsbruck, Malaysia, Austria, Singapore, South Korea and America, Chaired several Sessions and also as a Resource person conducted many research projects funded by U.G.C, D.S.T. and J.S.P.S. (Japanese Society for Promotion of Science). She was Coordinator N.S.S., C.S.J.M. Univ., Kanpur, organized National Integration Camp, C.S.J.M. Univ., Kanpur, participated as Contingent Leader in All India N.S.S. Republic Day Parade and Camp, New Delhi, Organized Aids Symposium sponsored by N.S.S. Regional Centre, Lucknow, organized Life Style Education Centre Workshop, organized Aids Rally and Poster Competition sponsored by U.T.A., N.S.S. Regional Centre, Lucknow, and Member of University Advisory Committee (N.S.S.) of C.S.J.M. Univ., Kanpur.

SRI NILANGSHU BHUSAN BASU

Treasurer

Born on 14th day of July, 1956, Sri Nilangshu Bhusan Basu graduated in Civil Engineering from Bengal Engineering College in the year 1977 with distinction. He completed Master's degree in Structural Engineering from Jadavpur University in the year 1983 with distinction and successfully undergone training in River Basin Management at Thames Water Authority, U. K. in the year 1989 with Commonwealth Scholarship. He is serving as Chairman of Architectural Engg. Division of Institute of Engineers, West Bengal Chapter. He is also adorning the honoured post of the Vice President at the Institute of Public Health Engineers. Presently, he is working at The Kolkata Municipal Corporation in the capacity of the Principal Chief Engineer (civil). Under the supervision of his Engineering skills a good number of infrastructure projects for the city of Kolkata have been completed successfully. 40 MGD water treatment plant at Palta, 100 MGD pressure station for clear water at Palta 100 MGD intake jetty with intake station of Palta, Networking for water mains, Booster pumping stations at Parkcircus, Bagmari, Ranikuthi, Kalighat Drainage pumping station of Southern Avenue, Automated computerized car parking system at Roudan street (over ground) at Lindsay street (underground) etc. are only a few among the large number of successful projects that he has so far undertaken. All the JNNURM projects of KMC worth Rs. 1000 crores have also formulated and is being executed in his leadership.These prestigious projects include 132 year old U.G. sewer rehabilitation of Kolkata also.

DR. TAPAN KUMAR ADHYA

President

Section of Agriculture and Forestry Sciences

Born in Kolkata on 4th September 1949, Dr. Adhya passed his B. Sc (Hons.) in Botany from Midnapore College, Midnapore and M. Sc. and Ph. D degree from University of Calcutta. He did his post-doctoral research at Bhabha Atomic Research Centre, Trombay, Mumbai. Dr. Adhya joined Central Rice Research Institute, Cuttack (Orissa) as Scientist (Microbiology) in 1977 where he is currently the Director from 2008. His research interest covers environmental microbiology with emphasis on greenhouse gas emission, pesticide biodegradation, and microbial diversity analysis with flooded rice soil as the model ecosystem. He has served as the Principal Investigator and/or Associate Investigator for several research projects. He also participated in the National Communication in Greenhouse Gas Inventory Analysis—2004 (NATCOM-2004) of the UNEP. Dr. Adhya has published more than 100 original research publication in leading national and international journals and authored more than 22 chapters in books. Dr. Adhya has guided 18 students of different universities for their M. Sc. degree and 10 students for their Ph. D. degree.

Dr. Adhya is member of several committees at national and international level including member of the Elite Panel of reviewers of WMO/UNEP for Expert Review of the Draft of the 2006 IPCC Inventory guidelines. He is associated with many professional societies and is a Fellow of the National Academy of Agricultural Sciences, New Delhi and Indian National Science Academy, New Delhi. He is the member secretary of the National Committee of the International Union of Microbiological Sciences (IUMS). He is a fellow of the Association of Microbiologist of India, New Delhi. Apart from being a reviewer of several international journals Dr. Adhya is an associate editor of the Indian Journal of Microbiology published by Springer-Verlag. He is decorated with several awards including the prestigious 'Samanta Chandrasekhar Award' (2008) by the Orissa Bigyan Academy under the aegis of the Department of Science and Technology, Govt. of Orissa and the 'Prof. G. Ramgaswami memorial award in Agricultural Microbiology' (2009) by the Assocation of Microbiologists of India.

PROF. U. C. SRIVASTAVA

President

Section of Animal, Veterinary and Fishery Sciences

Prof. Umesh Chandra Srivastava, a senior Professor in the Department of Zoology, University of Allahabad, Allahabad, has made outsanding research contributions in the field of Neurobiology, Neuroanatomy and Neurophsiology. During 36 years of his research career he has published a book and more than fifty research papers in the journals of International and National repute.

Prof. U. C. Srivastava has worked in laboratory of Neurophysiology of University of Pisa, Italy and was awarded the post doctoral degree of Doctor of Neurophysiology. The most representative investigations of Prof. Srivastava include electro-physiological investigations of the responses of reticulospinal neurons to sinusoidal tilt in the animals and also neck rotation in decerebrate cats. Convergence and interaction of labyrinth and neck inputs as well as relation between cell size and response characteristics of different size reticulospinal neurons to labyrinth and neck stimulation has been carried out. He has also traced spinal projections from mesencephalon, rhombencephalon to spinal cord by using sensitive retrograde and anterograde transport of HRP in amphibians. Prof. Srivastava has been also involved in tracing evolution of cerebral hemisphere by studying different neuronal classes in reptiles, birds and mammals. He was awarded D. Phil. degree from University of Allahabad in 1976 after completing M. Sc. (Cell Biology). He is also the Hony. Scientific Adviser of the Institute of Applied Sciences, Allahabad. He has also worked as external collaborator in the University of Pisa for 4 weeks in 1985.

So far, nine D. Phil. students have received their degrees and 8 students are working under his supervision, including a student from Libya in exchange programme. He is an elected fellow of the National Academy of Sciences India and Indian Academy of Neuroscience. He has delivered more than 50 extension lectures in last five years and coordinated seven refresher courses jointly

sponsored by the three Science Academies ; INSA, IAS and NASI. He was selected for the post of lecturer in the Department of Zoology, Cambridge University U. K. He has worked as Officer-on-Special Duty in an Honorary capacity in the National Academy of Sciences, India (1993-2008) ; and then elected as a Member of the Council of the Academy. Presently, he is an Hony. Treasurer of NASI. He is the Life Member of Several other prestigious scientific bodies and also the member of advisory boards of many reputed National and International Journals.

PROF. K. SARATCHANDRA SINGH

President

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

Dr. K. Saratchandra Singh was born on 1st March 1944, at Chingkham Lamphei, Imphal, Manipur. After graduating in Science with Anthropology as an elective subject in 1966 from D. M. College, Imphal, which was then under the Gauhati University, he passed M. Sc. in General Anthropology in 1969 from Poona University. He also obtained Ph. D. degree in Physical Anthropology from the same University.

He started his service career by joining his Alma Mater in 1970 as a Research Assistant in Anthropology, and then also as a temporary Lecturer. In 1976, he joined Government D. M. College of Science, Imphal, as Lecturer in Anthropology. Later on, he joined Manipur University as Fellow/Associate Professor of Physical Anthropology in 1984, in Department of Anthropology.

Dr. Singh is the life member of various professional organizations. Besides teaching and research, Dr. Singh also served in many other extension activities. He worked as the Co-ordinator for Monitoring Cell for the Creches of Manipur, which was sponsored by the HRD, Delhi. Worked as Secretary General (Founder) for the Manipuri Language Development Society ; as Chief of the Manipur University Employment Information and Guidance Bureau ; as member of the State Planning Board, Government of Manipur. Dr. Singh as a member of the High power Committee of the College Development Council, Manipur University. He was a member of the Tribal Cell of the Manipur University. He also worked as the President of the Medico–Legal Society of Manipur. Dr. Singh has been a member of the Executive Committee and of the Editorial Board of the Journal of Human Ecology, Delhi. He is at present one of the Council members of INCAA. Dr. Singh worked for the All Manipur Polo Association as its President and still continued to render his services as an advisor. He served as a member of the Committee for the development of the historic pologround–the Mapal Kangjeibung at Imphal city, under the chairmanship of His Excellency–the Governor of Manipur. Dr. Singh at the invitation of the Royal Queen and the Duke of Edinburgh attended the celebration function of the Public works of His Royal Highness Prince Charles, the Prince of Wales, the then Royal Patron of the All Manipur Polo Association, Imphal, on the occasion of HRH's 50th Birth Day at Buckingham Palace, London.

He has published a number of Research papers in the professional National and International journals and has also edited one book. He has supervised a number of Ph. D. Scholars.

Dr. Singh worked as a Recorder of the Anthropology and Archaeology Section of the 78th (1991) and 79th (1992) Sessions of the Indian Science Congress. At present, he is one of the members of the National Advisory Committee for the Anthropological Survey of India, Ministry of Culture, Government of India.

PROF. VINOD K SINGH

President

Section of Chemical Sciences

Dr. Vinod Singh was born on September 9, 1959 at Anantpur, a village Azamgarh of eastern U.P. He had his early education from his native place High schools and intermediate from the Wesley Inter College and B.Sc. from D.A.V. College, both in Azargarh. He did M.Sc. (1980) from B.H.U. and Ph.D. (1996) from M.S. University. Professor Singh, worked as a research fellow at University of Calgary and University of British Columbia. He later moved to Harvard University as a post-doctoral fellow during 1987-1990. After a brief stint as a senior scientist at Neurogen Corporation, USA, Professor Singh joined IIT Kanpur as an Assistant Professor in the Department of Chemistry, on December 26, 1990. He was promoted to an Associate Professor in May 1997 and to a full Professor in September 2001. For his outstanding contribution to research, IIT Kanpur recognized him with Umang Gupta Chair professorship (2007-2010).

Since June 12, 2008, Professor Singh is on deputation to work as the Founder Director of Indian Institute of Science Education and Research (IISER) Bhopal. He held an additional charge for Director, School of Planning and Architecture (SPA) Bhopal for 9-10 months. He also held a position of Chairman, BoG, National Institute of Techincal Teachers Training and Research (NITTTR) Bhopal. He is a member of Scientific Advisory Council to the Prime Minister (SAC-PM).

Dr. Singh's research interest is in the area of synthetic organic chemistry with a special emphasis on asymmetric synthesis. He has visited and given lectures in several countries. He has produced 22 Ph.D students and published more than papers in international journals. He has received various awards and honors and to name a few, Swatnajayanti fellowship award (1998), Shanti Swarup Bhatnagar Prize (2004), and J.C. Bose Fellowship (2009), etc.

PROF. ARUN KUMAR

President

Section of Earth System Sciences

Prof Arun Kumar was born at Lucknow, Uttar Pradesh in 1958. He obtained his B.Sc. in 1977 and M. Tech. (Applied Geology) in 1981 from Sir

HS University Sagar. He later joined as Research student at Department of Geology University of Delhi and obtained his Ph. D. degree in 1986. Prof Kumar joined as Assistant Professor in Department of Earth Sciences Manipur University in 1987 and was promoted to Professor in 2006. He has established GIS and Digital Image Processing lab in the department in 1995. He was one of the member of the ILTP (Indo Russian Long term Programme) and was invited from Russian Academy of Science Moscow for Seimological research. He has established many seismological stations in Manipur as well as in NE India under the Himalayan school Earthquake Laboratory Programme (HIMSELP) and North Eastern School Earthquake Laboratory Programme (NESELP) for seismic awareness among the + 10 students in schools since 2005. He joined the Indian Arctic Programme in 2009-2010 for crustal deformations measurements and its implication in isostatic rebound due to ice melting in polar region. He regularily attends number of International workshops/conferences. He is currently a member of Expert Committee constituted by Ministry of Earth Sciences Government of India (2010-12).

Research interest of Professor Kumar includes Hydrology, Seismo-tectonics, Crustal deformations, evaluation and monitoring of Natural Hazards (Earthquake and Landslides) in Manipur as well as in NE India. He has instrumented two small watersheds in Manipur for Hydro-meteorological data acquisition and their modeling, water balance estimation, drainage characteristics by GIS & Remote sensing techniques in developing grospatial database. He is involved in monitoring of earthquakes in Manipur Seismic Array. He also started the Earthquake Awarness Programme at + 10 schools level in NE India. As a part of precursory studies in a highly seismically active region in NE India, he has successfully installed 3 D fault Deformeter in a bore hole for the first time in the country in 2007 along as seismically active and creeping strike slip fault. He established one Permanent GPS stations in Imphal (IMR) and Mishmi Block of Arunachal Pradesh for geodynamic constraints for ongoing seismic phenomenon in the region. He is involved in campaign mode GPS measurements along Indo Myanmar Arc from last several years for Crustal Deformation measurements, He has produced an Atlas on Landslide Hazards and Remedial Measures of the NE India with the collaborative studies along with Defence Terrain Research Lab, Ministry of Defense for Border Road Organization.

DR. VIPIN K TYAGI

President

Section of Engineering Sciences

Born in Kharkhauda town of District Meerut in UP, Dr. Vipin Tyagi passed his intermediate from Janta Inter College, Kharkhauda, and graduation, post graduation and Ph. D. from D. N. College, Meerut.

Dr. Tyagi started his professional life as Computer Instructor in I. G. M. Industrial Training Institute, Hapur (Ghaziabad) in 1989. Later he shifted to D. N. College, Meerut. In 1999 he joined Computer Engineering department of Mody Institute of Technology and Science, Lashmangarh, Sikar (Rajsthan). He was a member of senate and Board of studies at Mody Institute of Technology and Science. Dr. Tyagi shifted to Jaypee Institute of Engineering and Technology, Raghogarh, Guna

(MP) in 2005. At present he is serving as Associate Professor in Computer Science and Engineering Department of Jaypee University of Engineering and Technology, Raghogarh, Guna (MP).

His research interests include Image Processing, Pattern Recognition and Digital Forensics. Dr. Vipin Tyagi is a recognized guide for Ph. D. He has guided a number of students for their B. Tech., M. Tech. and Ph. D. He has published a number of papers in national and international journals. He has attended many conferences and also organized conferences. He has delivered invited talks in various conferences. He is reviewer of national and international journals. He has edited a book of McMillan Advanced Research Series. He has been principal investigator of the projects sponsored by CSI, DRDO, MPCST.

Dr. Tyagi was Recorder of Engineering Sciences Section of ISCA for two years [2008-2010]. He is elected as Executive Committee member of Bhopal Chapter of Computer Society of India and IETE. He is nominated as State student coordinator of MP State of Computer Society of India. He is a Fellow of Institution of Electronics and Telecommunication Engineers and life member of quite a number of professional bodies & Societies.

DR. G. BAGYANARAYANA

President

Section of Environmental Sciences

Dr. G. Bagyanarayana is Professor, Chairman, Board of Studies Co-Ordinator, UGC SAP-III, Dept. of Botany, Osmania University and Former Head, Dept. of Botany, Osmania University (2006-2008). His area of research includes Biodiversity, Taxonomy and Systematics of Rust fungi, Powdery Mildews and Cercosporaceous Fungi. He has made a World Monograph on the genus *Melamspora* ; Biological control of phytopathogenic fungi employing antagonistic micro-organisms and botanicals (plant extracts) ; Integrated Pest Management, Biological control of weeds. Other areas of interest includes biodiversity of medicinal & aromatic plants and taxonomy, effect of Plant growth promoting rhizobacteria and phosphate solubilizing fungi on medicinal, aromatic and some important crop plants.

Dr. G. Bagyanarayana has 36 years of research and 30 years of teaching and has guided 9 students for Ph. D. degree, published 81 research papers in National and International Journals of repute, organized five National conferences and two International conferences and has participated/ presented papers in 11 International Conferences & 72 National conferences. He has authored and edited 11 books. He has been conferred with Prof. M. J. Narasimhan award and Gold Medal and Prof. B. B. Mundkur Memorial Award by Indian Phytopathological Society, Dr. Shome Memorial Award by Indian Mycological Society and Prof. Kajale Memorial Award by Indian Botanical Society.

Dr. G. Bagyanarayana is Fellow of Indian Botanical Society, Indian Phytopathological society, A. P. Academy of Sciences, Member, International Commission on Taxonomy of Fungi, H. Q. Canada, Former Vice President, Indian Society of Mycology and Plant Pathology, President, Indian Phytopathological Society, Central Zone, for two terms i.e. 1998 & 2004, Life member of National Academy of Sciences, Allahabad and several other

professional bodies. He is Editorial Committee Member and reviewer of several international and national journals.

MR. VINEET KUMAR

President

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

Mr. Vineet Kumar is IEEE Computer Society Technical Committee Member (TC-PLC) and currently engaged with largest public sector enterprise "Crompton Greaves Limited", where he works on technology understanding & solution building. He has extensive experience and knowledge of Communication technology, Protection, Control & Automation technology deliverables and has pioneered severed application engineering innovation.

He is a specialist in communication networks for Smart Grid, AMI and distribution automation applications.

Mr. Vineet was Founder Secretary of Society of Amateur Radio & Past Recorder for the Section of Information and Communication Science & Technology (including Computer Science), ISCA.

Mr. Vineet conducted series of studies/ orientations programme exploring the best ways of using communication & computing to enhance the capabilities, understanding technology innovation reaching to mass for building academic & researcher's understandings. He does technical research in the area of application engineering for diverse solutions & also work in the areas of ethnography, sociology, political science, and economics, all of which help understand the social context of the technology, both in rural and urban environments. During his 16 years of work experience, he has managed various design implementations with remote management capabilities and also strengthening linkages with various national and international organisations.

As a researcher in the area of technology innovation for the emerging third world, he has undertaken both technical and social research. He does study & support technology innovation in application engineering for diverse solutions that are designed for emerging information and communication technology (ICT) for socio economic development, as well as for whom, access to technologies remain largely out of reach.

PROF. SAMIT K RAY

President

Section of Materials Sciences

Prof. Samit K. Ray received his Ph.D. from Indian Institute of Technology, Kharagpur in 1990. Earlier he obtained his M.Sc. (Physics) and M.Tech. (Materials Science) degrees from IIT Kharagpur in 1982 and 1984, respectively. Prof. Ray worked as

a Scientist-B in Solid State Laboratory, Delhi for one year (1984-85) towards the technology development for charge coupled devices (CCDs). Since 1985, he has been at the IIT Kharagpur as a Scientific Officer (1885-1991), Lecturer (1991-1994), Assistant Professor (1994-1999), Associate Professor (1999-2004), and a Full Professor (2003-present). In between, he worked as visiting Scientist/ Professor in different renowned Institutions and Universities abroad. Prof Ray teaches various under graduate and post-graduate courses. His research interests are in the area of semiconductor nanostructures, quantum dost, photovoltaic materials, nanodevices, electronic materials, strained layer heterostructures, ultrathin and high-k dielectric films for scaled Si devices, ferroelectric thin films and plasma and ion beam processing.

At the Microelectronics Centre of Department of Electronics & ECE, Prof Ray took a key role in development of a modern microelectronic laboratory and a bipolar IC process vehicle. The developed process was used to fabricate several integrated circuit chips, e.g. Telecard chip, IIL circuits and VCO chip at IIT Kharagpur. Prof. Ray has made significant contribution in the field of silicon heterostructures and semiconductor nanotechnology useful for the next generation electronic devices, and high speed computers and communications. His work in SiGe heterostructures has run ghe gamut from very practical fields such as ULSI Si technology, to nanotechnology and Terahertz devices. He demonstrated ternary SiGeC alloy and vertical SiGe PMOSFETs for the first time using the concept of strain and bandgap engineering. These seminal work have led to a lot of subsequent research in many laboratories around the world. His current research interest is in the area of nanoelectronics and nanodevices based on Ge quantum dost/nanocrystals, quantum wells, nanocrystal memory with ultra-fast access time and high retention characteristics. He has demonstrated quantum cascade Terahertz sources and detectors based on intersubband transition in quantum wells with potential applications in imaging cancerous tissues and detecting biological warfares.

Prof. Ray is a fellow of the Indian National Academy of Engineering (INAE) and is the recipient of INSA Young Scientist Award, UGC Homi Bhabha Award, Materials Research Society of India Medal, DST BOYSCAST fellowship and CDIL gold medal of IETE. He has published more than 350 research papers in peer reviewed journals and conferences, six book chapters and co-authored a book.

PROF. SATYA DEO

President

Section of Mathematics (including Statistics)

Professor Satya Deo, a former Vice Chancellor of Awadhesh Pratap Singh University, Rewa (M. P.) and also of Rani Durgawati University, Jabalpur (M. P.) is currently a Senior Visting Professor at the Harish-Chandra Research Institute, Allahabad.

He got his B. Sc and M. Sc degrees from the University of Allagabad and Ph. D. in Mathematics from the University of Arkansas, USA in 1974 as a Fullbright Scholar. Starting his professional career as a lecturer in the University of Allahabad, he was appointed Professor and Head, Department of Mathematics, University of Jammu in 1986. He

also served University of Delhi as a Reader in Mathematics and then as Professor and Head of the Deptt of Mathematics at Rani Durgawati University, Jabalpur from 1989 onwards.

Professor Satya Deo has visited as Visiting Professors in prestigious universities. He has given several invited talks and has published more than 50 research papers in reputed journals of Mathematics. He has also published a book and has guided 16 ph.D/D.Sc research scholars.

Prof. Satya Deo was elected Fellow of the National Academy of Sciences, India (FNASc) in 1991 and was elected President of the Indian Mathematical Society in the year 2000. He was honoured by the "Distinguished Service Award" during the year 2006 by the Mathematical Association of India for his contributions to the cause of Mathematics Education and Research. He has been a member of the National Board for Higher Mathematics (NBHM) and member, Editorial Board of some Journals in Mathematics in India and abroad. He was awarded the "M. K. Singal" award by the Indian Science Congress during its 97th session at Trivandrum. He is also the Academic Secretary of Indian Mathematical Society (IMS).

PROF. AMAR K CHANDRA

President

Section of Medical Sciences (including Physiology)

Amar K Chandra earned B. Sc. (Hons.) in 1972 from Presidency College, Kolkata and obtained M. Sc. degree in 1974 from the University of Calcutta with a subject background of Physiology and specialization in Endocrinology and Reproductive Physiology. He did his Ph. D in Physiology from the same University.

He started his career as Assistant Professor in Physiology under Tripura Govt. Education Service followed by Reader in the Department of Life Science, Tripura University. He joined as Reader in Physiology of the University of Calcutta and became Professor and Head in the year 2003.

During his tenure in Tripura, he initiated epidemiological studies on the state of iodine nutrition of the people of north-east India considering its ecological/geomorphologic nature of the region. Further he continued his studied in the foot-hills of the Himalayas in Tarai-flat lands of eastern Uttar Pradesh, Sundarban Delta–an unique ecological zone of the country, in the riverine flood-prone Gangetic West Bengal and the in the Metropolitan city Kolkata. His significant contribution is that region–specific environmental factor(s) other than iodine deficiency present in food and water responsible for the persistence of endemic goiter and associated iodine deficiency disorders (IDD) inspite of supplementation of iodine through edible salt. To substantiate his findings he analyzed the suspected food and water for goitrogenic/antithyroid constituent in his laboratory followed by *in vivo* and *in vitro* experimentations with those dietary constituents with and without iodine supplementation in laboratory animals and human thyroid tissues.

Considering the exposure of environmental pollutants on health Dr. Chandra initiated studies on male gonadal disruption under the influence of heavy metals and their possible prevention by exogenous hormone therapy and antioxidant supplementation. He has also investigated goitrogenic/antithyroid and antigonadal activity of black and green tea.

The scientific contribution of Dr. Chandra were published in peer reviewed international and national journals, in Elsevier books (Academic Press) and in his edited books. He is the regular reviewer of many esteemed international and national journals and scientific periodicals. He successfully guided 12 Ph.d students under Calcutta, Jadavpur and Tripura Universities. He is the mentor of about 70 post graduate dissertation papers till date.

Prof. Chandra is the member of various academic committees of different state and central University and learned international and national scientific organisations. He is also the expert member of various committees including the project review committees. He has delivered many Memorial Oration Lectures and Invited Lectures as Guest Speaker. He is a member of the Sentate of the University of Calcutta. He is the Honorary General Secretary of the Physiological Society of India, and founder member and Vice-President of the South Asian Association of the Physiologists. Moreover, he is associated with many Physiological Societies in India and abroad.

DR. HASI R. DAS

President

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

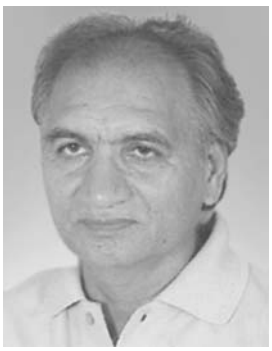
Dr. Hasi Das was born on 8th August, 1950. She graduated from Presidency College, Calcutta with honours in Chemistry in 1969. She did her M. Sc. in Biochemistry from Calcutta University. After completing her Ph. D. joined Harvard University, USA for postdoctoral research in 1977 and unveiled the role of glycan in masking cell surface antigen in malignant cells. She joined as a faculty in 1983 in the Institute of Genomics & Integrative Biology (formerly Center for Biochemical Technology) in Delhi. Presently she is a Director Grade Scientist in the same institute. She has been serving as an expert in various government and private funded projects, recruitment and assessment committees. She is the member of many professional societies and serving as the editor and reviewer of national and international journals.

Dr. Das is a leading glycobiologist in India. Her work in the Institute of Genomics & Integrative Biology revealed the pivotal role of lipopolysaccharides (LPS) in lectin mediated host-*Rhizobium* interactions that lead to infection for nodulation and developed agronomically beneficial cross infective rhizobial mutants.

During past ten years she has done pioneering work on rheumatoid arthritis (RA). Her observations on TNF microsatellites association with RA are very promising. Polymorphism in 54 codon of mannose binding lectin (MBL) gene in Indian population was shown to be protective while the same polymorphism was reported to be associated with pathogenesis of RA in other population. Her group has developed a serum-based detection kit for RA of which national and international patents have been taken. Her contribution towards searching for alternatives to modern medicines for the treatment of RA is very encouraging in bringing some new therapeutics for rheumatoid arthritis (patent pending). She published more than 60 papers in ISI journals besides couple of reviews, monographs and popular articles.

Dr. Das is the recipient of P. A. Kurup Award from the Society of Biological Chemist (India) in

2007. She was awarded by Lucid Colloids Ltd, Mumbai for Carbohydrate research in India in 2008 and honoured with Life time achievment award by the Association of Carbohydrate Chemists and Technologists in 2009 for her outstanding contribution in glycobiology and rheumatology.



PROF. VINOD RASTOGI

President

Section of Physical Sciences

Vinod Rastogi was born on 15th of July, 1949 at Hasanpur, (Moradabad) in U.P. He studied in Meerut College, obtaining B.Sc and M. Sc in Physics, both in first class. He did his M. Sc (Maths) in the first division in the year 1974 from Meerut University. He also obtained his Ph.D (1984) in Physics from Meerut University.

Dr Rastogi started his career from Meerut College as Lecturer in 1969 and then shifted to Lajpat Rai College Sahibabad (CCS University, Meerut) in July 1970, where he worked for a long time as Lecturer and Reader.

Dr Rastogi's was appointed to the position of Professor in CCS University Campus. He is also Member of Selection Committee of several universities/Colleges and Member of several Committees of UGC. Prof Rastogi has established cordial contacts with scientists of different Countires which paved the way for his international visits to various Countries.

Professor Rastogi made valuable contributions in the field of vibrational spectra of potential Anticancerous Ligands and Spectra-Structure relationship, which have heen published in rupted international journals and quoted. He has to his credit more than 100 research papers, 15 Ph Ds, 12 M Phils and 3 edited books. At present a number of students are working with him for their Ph D degree.

Prof Rastogi has attended, chaired and organized several national and international conferences. He is Editor-in-Chief of International Journal : Asian Journal of Physics and Editor of Asian Chemistry Letters. He is member of Advisory Board of Journal of Chemistry in Asia. Professor Rastogi is referee of all most all Journals of Vibrational Spectroscopy.

Professor Rastogi is Fellow of Institution of Chemists (India), and Indian Council of Chemists (Agra), Life Member of various bodies. He was elected Member of Sectional Committee of Physical Sciences several times. He was also elected Recorder (2008-2010) in the Section of Physical Sciences, ISCA. He has a very active interest in popularizing Science and written many scientific books in Hindi for school level students.

PROF. T. N. LAKHANPAL

President

Section of Plant Sciences

T. N. Lakhanpal was born on October 1st, 1944

in a remote village Haretta, in Hamirpur Distt. of Himachal Pradesh. He received his B.Sc. Hons and M.Sc. Hons degrees in Botany from Punjab University Chandigarh in 1965 and 1967 and Ph.D. Degree from the University of Delhi in 1975, on the pionerring work on cultivation of Myxomycetes and on the study of their life cycle.

He started his carrier as Lecturer in Botany at Govt. College Mandi, H.P. and moved to Hans Raj College, Delhi University in 1969. He joined the department of Bio-sciences. H.P. University Shimla in 1976 and was elected to Associate Professor and then Professor in 1982 and 1989 respectively, the position which he held till retirement in 2005. He served the university in various capacities and was Chairman of the Department and also Dean Faculty of Life Sciences. He also served as the Director, Institute of Integrated Himalayan Studies. After retirement, he was awarded Professor Emeritus-ship by the UGC for two years. He also served briefly as Visiting Professor in the department of Forest Science, Oregon State University, USA and Mizoram University, Mizoram. He is also visiting Professor in the department of Bio-sciences, Sri Sathya Sai University, Prasanthi Nilayam (AP).

Dr. Lakhanpal has been a pioneer in research on Cellular Slime Moulds, Mushrooms and Mycorrhiza. He has extensively explored the bio-diversity of various groups of fungi from N.W. Himalaya : systematics, ecology, physiology, microbiology, cultivation and mycorrhizal relationship. His group recorded many hitherto unknown species, studied their ecological distribution in selected forests, as also mycorrhizal relationship with all predominant conifers of Himachal Pradesh. The major emphasis has been on wild edible mushrooms, their ethno-mycology, and on those that enter into mycorrhizal association with different tree species. This technology has been utilized for tailoring seedlings of conifers and also of apple saplings for improved quality, quantity and establishment at degraded sites. The mushroom biodiversity is being processed into workable of monograph, three of which are already published.

Besides this, monumental work has been carried out on biology of Indian Morels (Morchella). Studies have been conducted right from traditional systematics to molecular characterization of the species of morels in North West Himalayas alongside other aspects of morel biology. Most of the edible wild mushrooms have also been analyzed for their nutritional components and nutraceutical potential of some important ones has also been investigated. Technology was also developed by his group for the cultivation of Shiitake (*Lentinus edodes*) and Milky mushroom (*Calocybe indica*).

Dr. Lakhanpal has served as President of Mycological Society of India, and Indian Mushroom Growers Association. He served as a member of QRT on mushrooms, Biodiversity Authority of India, Biodiversity Board of Himachal Pradesh. He was also Chairman RAC, Directorate of Mushorooms, Solan. He was Chief Editor of the Indian Journal of Mushrooms and was also on the editorial board of many Indian journals. He also served as recorder of Plant Sciences Section of ISCA.

Dr. Lakhanpal is fellow of Indian Phytopathological society and Society for Mycology and Plant Pathology. He was honored with Best Teacher Award by H.P. University, Shimla and Saraswati Award of Delhi University. Dr. Lakhanpal has to his credit over 175 research papers, five monographs, eight books and two edited books. He has trained a large number of M.Sc. & M.Phi students and 30 students have received Ph.D. under his supervision.

Conferences / Meetings / Symposia / Seminars

National Symposium on "Recent Developments in Diagnostics and Therapeutics Including Applications of Nanotechnology in Veterinary Medicine", 17 to 19 February 2011, Mumbai.

The symposium would include following sessions :

- Veterinary Medicine and Nanotechnology.
- Infectious and noninfectious diseases of large ruminants including Herd Medicine.
- Infectious and noninfectious diseases of small ruminants
- Companion animal Medicine including exotic pets
- Avian Medicine
- Wildlife Medicine
- Equine and Pack animal Medicine
- Ethno-veterinary and alternative Medicine
- Veterinary Nuclear Medicine/Novel drug delivery system/Laboratory Animal Medicine

Abstracts not exceeding 200 words (Times New Roman, front size-12) single spaced should be submitted online at *isvmbvc2010@gmail.com* on or **before 31st December 2010.**

Conference Secretariat and Contact person : Dr. D. V. Keskar (Organizing Secretary) Head, Department of Medicine and Pharmacology, Mumbai Veterinary College (MAFSU), Mumbai-India, Phone : 022-24131180, 24137030 Ext. 143, Fax : 022-24172301, Mobile : 09821601606 ; Email : vetkeskar@yahoo.co.in

18th Young Scientists' Conference on Astronomy and Space Physics, May 2–7, 2011, Kyiv, Ukraine

Fields :

- atomospheric studies and space geophysics
- solar physics and heliosphere
- solar System & extrasolar planets
- stellar astrophysics
- interstellar and intergalactic medium
- extragalactic astrophysics and cosmology
- high-energy astrophysics and astroparticle physics
- postitional astronomy and astronomical equipment
- computers in astronomy

Deadine for registraion–**March 10, 2011**

Contact e-mail : ysc.kyiv@gmail.com, website : http://ysc.kiev.ua

FORM IV

Rule 8

1.	Place of Publication	The Indian Science Congress Association 14, Dr. Biresh Guha Street, Kolkata 700 017
2.	Periodicity of Publication	Bi-monthly (Published every two months)
3.	Printer's Name Nationality Address	Shri Partha Pratim Hazra Indian M/S Seva Mudran, 43, Kailash Bose Street, Kolkata 700 006
4.	Publisher's Name Nationality Address	Prof. S. S. Katiyar Indian The Indian Science Congress Association 14, Dr. Biresh Guha Street, Kolkata 700 017
5.	Editor in Chief's Name Nationality Address	Prof. S. S. Katiyar Indian 7/111-E Swaroop Nagar Kanpur - 208002 Uttar Pradesh
6.	Name and Address of individuals who own the newspaper and partners of Shareholders holding more than one percent of the total	The Indian Science Congress Association 14, Dr. Biresh Guha Street, Kolkata-700 017

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

Date : 30 July 2010

S. S. Katiyar
Publisher
Everyman's Science

S & T ACROSS THE WORLD

2010 NOBEL IN CHEMISTRY

Organic chemistry has developed into an art from where scientists produce marvelous chemical creations in their test tubes. Mankind benefits from this in the form of medicines, ever-more precise electronics and advanced technological materials. The Nobel Prize in Chemistry 2010 awards one of the most sophisticated tools available to chemists today. This year's Nobel Prize in Chemistry is awarded to Richard F. Heck, Eiichi Negishi and Akira Suzuki, for the development of palladium-catalyzed cross coupling. This chemical tool has vastly improved the possibilities for chemists to create sophisticated chemicals, for example carbon-based molecules as complex as those created by nature itself.

Carbon-based (organic) chemistry is the basis of life and is responsible for numerous fascinating natural phenomena: colour in flowers, snake poison and bacteria killing substances such as penicillin. Organic chemistry has allowed man to build on nature's chemistry; making use of carbon's ability to provide a stable skeleton for functional molecules. This has given mankind new medicines and revolutionary materials such as plastics. In order to create these complex chemicals, chemists need to be able to join carbon atoms together. However, carbon is stable and carbon atoms do not easily react with one another. The first method used by chemists to bind carbon atoms together were therefore based upon various techniques for rendering carbon more reactive. Such methods worked when creating simple molecules, but when synthesizing more complex molecules chemists ended up with too many unwanted by-products in their test tubes.

Palladium-catalyzed cross coupling solved that problem and provided chemists with a more precise and efficient tool to work with. In the Heck reaction, Negishi reaction and Suzuki reaction, carbon atoms meet on a palladium atom, whereupon their proximity to one another kick-starts the chemical reaction. Palladium-catalyzed cross coupling is used in research worldwide, as well as in the commercial production of pharmaceuticals and molecules used in the electronics industry.

Heck, is an honorary professor at the University of Delaware, who now lives in the Philippines. Negishi, a chemistry professor at Purdue University in West Lafayette, Indiana, and Suzuki is a retired professor from Hokkaido University in Sapporo, Japan.

2010 NOBEL IN PHYSIOLOGY/MEDICINE

Robert Edwards is awarded the 2010 Nobel Prize for the development of human *in vitro* fertilization (IVF) therapy. His achievements have made it possible to treat infertility, a medical condition afflicting a large proportion of humanity including more than 10% of all couples worldwide.

Robert Edwards, Professor emeritus at the University of Cambridge began his fundamental research on the biology of fertilization in the 1950s. He soon realized that fertilization outside the body could represent a possible treatment of infertility. Other scientists had shown that egg cells from rabbits could be fertilized in test tubes when sperm was added, giving rise to offspring. Edwards decided to investigate if similar methods could be used to fertilize human egg cells.

It turned out that human eggs have an entirely different life cycle than those of rabbits. In a series of experimental studies conducted together with several different co-workers, Edwards made a number of fundamental discoveries. He clarified how human eggs mature, how different hormones regulate their maturation, and at which time point the eggs are susceptible to the fertilizing sperm. He also determined the conditions under which sperm is activated and has the capacity to fertilize the egg. In 1969, his efforts met with success when, for the first time, a human egg was fertilized in a test tube.

In spite of this success, a major problem remained. The fertilized egg did not develop beyond a single cell division. Edwards suspected that eggs that had matured in the ovaries before they were removed for IVF would function better, and looked for possible ways to obtain such eggs in a safe way.

Edwards contacted the gynecologist Patrick Steptoe. He became the clinician who, together with Edwards, developed IVF from experiment to practical medicine. Steptoe was one of the pioneers in laparoscopy, a technique that was new and controversial at the time. It allows inspection of the ovaries through an optical instrument. Steptoe used the laparoscope to remove eggs from the ovaries and Edwards put the eggs in cell culture and added sperm. The fertilized egg cells now divided several times and formed early embryos, 8 cells in size.

Edwards and Steptoe could continue their research thanks to the new donation. By analyzing the patients' hormone levels, they could determine the best time point for fertilization and maximize the chances for success. In 1978, Lesley and John Brown came to the clinic after nine years of failed attempts to have a child. IVF treatment was carried out, and when the fertilized egg had developed into an embryo with 8 cells, it was returned to Mrs. Brown. A healthy baby, Louise Brown, was born through Caesarian section after a full-term pregnancy, on 25 July, 1978. IVF had moved from vision to reality and a new era in medicine had begun.

Today, IVF is an established therapy throughout the world. It has undergone several important improvements. For example, single sperm can be microinjected directly into the egg cell in the culture dish. This method has improved the treatment of male infertility by IVF. Furthermore, mature eggs suitable for IVF can be identified by ultrasound and removed with a fine syringe rather than through the laparoscope.

Approximately four million individuals have so far been born following IVF. A new field of medicine has emerged, with Robert Edwards leading the process all the way from the fundamental discoveries to the current, successful IVF therapy. His contributions represent a milestone in the development of modern medicine.

2010 NOBEL IN PHYSICS

Graphene is a form of carbon. As a material it is completely new - not only the thinnest ever but also the strongest. As a conductor of electricity it performs as well as copper. As a conductor of heat it outperforms all other known materials. It is almost completely transparent, yet so dense that not even helium, the smallest gas atom, can pass through it. Carbon, the basis of all known life on earth, has surprised us once again.

This year's Nobel Prize in Physics awardee Andre Geim and Konstantin Novoselov, both professors at the University of Manchester, extracted the graphene from a piece of graphite such as is found in ordinary pencils. Using regular adhesive tape they managed to obtain a flake of carbon with a thickness of just one atom. This at a time when many believed it was impossible for such thin crystalline materials to be stable.

However, with graphene, physicists can now study a new class of two-dimensional materials with unique properties. Graphene makes experiments possible that give new twists to the phenomena in quantum physics. Also a vast variety of practical applications now appear possible including the creation of new materials and the manufacture of innovative electronics. Graphene transistors are predicted to be substantially faster than today's silicon transistors and result in more efficient computers.

Since it is practically transparent and a good conductor, graphene is suitable for producing transparent touch screens, light panels, and may be even solar cells.

When mixed into plastics, graphene can turn them into conductors of electricity while making them more heat resistant and mechanically robust. This resilience can be utilised in new super strong materials, which are also thin, elastic and lightweight. In the future, satellites, airplanes, and cars could be manufactured out of the new composite materials.

भारतीय विज्ञान कांग्रेस संस्था

14, डॉ० बिरेश गुहा स्ट्रीट, कोलकाता - 700 017, भारत

THE INDIAN SCIENCE CONGRESS ASSOCIATION

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

तार/Telegram : SCICONG : CALCUTTA
फैक्स/Fax : 91-33-2287-2551
दूरभाष/Telephone : (033) 2287-4530, 2281-5323
ई-मेल/E-mail : iscacal@vsnl.net
वेबसाइट/Website : http://www.sciencecongress.nic.in
iscacal_2004@yahoo.com

सदस्यता की शर्तें और सदस्यों की विशेषाधिकार/Terms of Membership and Privileges of Members :

संस्था की सदस्यता उन सभी लोगों के लिए खुले हैं जो स्नातक या उसके समान स्तर पर शैक्षणिक योग्यता अर्जन कर चुके हैं और जिन्हें भारत कि विज्ञान के तरक्की में रूचि हैं।

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

1. **वार्षिक सदस्य :** जो व्यक्ति नये रूप से वार्षिक सदस्यता ग्रहण करना चाहता है उसे वार्षिक सदस्यता शुल्क रू 200/- के साथ भर्ती शुल्क रू 50/-* (विदेशियों के लिए** U.S.$ 70) मात्र देने पड़ेंगे। वार्षिक सदस्यता शुल्क प्रत्येक वर्ष के 01 अप्रैल को देय हो जाएगा। जो भी 15 जुलाई के भीतर अपनी सदस्यता शुल्क नहीं अदा कर पाएगा वह उस साल के लिए अपनी वोट देने की क्षमता से वंचित हो जाएगा और/या वह उस वर्ष के लिए संस्था के कार्यालय को भी नियंत्रण नहीं कर पाएगा। एक सदस्य जो वार्षिक सदस्य शुल्क अगले साल के मार्च के अंत तक नहीं दे पाएगा उसकी सदस्यता समाप्त हो जाएगी।

   सदस्यगण अपना पेपर कांग्रेस सत्र के समय पेश कर सकते हैं। उन्हें वार्षिक विज्ञान कांग्रेस सत्र की कार्यविवरण की एक प्रति बिनामूल्य में प्राप्त हो सकती है। इसके साथ वे संस्था के रोज़नामचा ''एवरीमैनस साइंस'' भी बिनामूल्य उपलब्ध कर सकते हैं।

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

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

2. **सत्र सदस्य :** यदि कुछ कारणों से वार्षिक सदस्य अपनी सदस्यता उस वर्ष के 15 जुलाई के अंदर दोहराना भूल जाएँ तो उनकी सदस्यता सत्र सदस्यता के रूप में बिना वोट डालने की क्षमता में सीमित कर दिया जाएगा। वार्षिक सदस्य अपनी सदस्यता दोबारा अगले साल बिना भर्ती शुल्क दिए अपनी सदस्यता शुल्क को ठीक समय पर देके पुनः प्राप्त कर सकता है।

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

3. **छात्र सदस्य :** जो व्यक्ति स्नातक स्तर के नीचे पढ़ाई कर रहा है वह वार्षिक सदस्यता शुल्क रू 100/- मात्र देने पड़ेंगे। अपना नाम छात्र सदस्य के रूप में लिखवा सकता है बशर्ते उसके आवेदन पत्र पर उसके प्राचार्य/विभागाध्यक्ष/संस्थान के प्रधान के हस्ताक्षर हों। एक छात्र सदस्य को यह अधिकार दिया जाएगा कि वह अपना पेपर कांग्रेस सत्र के समय पेश कर सकें बशर्ते वह पेपर वह किसी वार्षिक सदस्य या संस्था के कोई अवैतनिक सदस्य के साथ पेश करें। उसे वोट करने का या कार्यालय को नियंत्रण करने का अधिकार प्राप्त नहीं होगा। छात्र सदस्य को विभागों के व्यवसाय बैठकों और साधारण बैठकों में भाग लेने की योग्यता प्राप्त नहीं है।

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

4. **आजीवन सदस्य :** एक सदस्य अपने भविष्य की सारी बार्षिक सदस्यता शुल्क एक बार में रूप 2000/- (विदेशियों के लिए U.S.$ 500) मात्र अदा करके पा सकता है। एक व्यक्ति जो 10 साल या उससे अधिक नियमित रूप से सदस्यता प्राप्त कर चूका है, उसे उसकी संयुक्त सदस्यता शुल्क के उपर प्रतिवर्ष रू 50/- की छूट दी जाएगी, बशर्ते कि उसकी संयुक्त शुल्क रू 1,200/- से नीचे न हों (विदेशियों के लिए U.S.$ 12.50 और U.S.$ 300 क्रमशः)। एक आजीवन सदस्य को उसके पुरे जीवन काल में सदस्यता की सारी विशेषाधिकार प्राप्त होंगे।

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

---

* भर्ती शुल्क रू 50/- सिर्फ एक नये वार्षिक सदस्य के लिए ज़रूरी है। यह सत्र सदस्य/आजीवन सदस्य/संस्थान सदस्य/छात्र सदस्य/दाता के लिए ज़रूरी नहीं है।

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

** (एक विदेशी सदस्य का अर्थ है जो भारतवर्ष के बाहर का नागरिक हो)।

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

5. **संस्थान सदस्य :** एक संस्थान जो रू 5,000/- सदस्यता शुल्क के रूप में दे वही संस्था के संस्थान सदस्य बन सकता है (विदेशियों के लिए U.S.$ 2,500)। इसमें वह बिज्ञान कांग्रेस के वार्षिक सत्र में अपने एक व्यक्ति का नाम नामांकित कर सकता है जो उनका प्रतिनिधि हों। एक संस्थान सदस्य को वार्षिक विज्ञान कांग्रेस सत्र की कार्यविवरण की एक पूर्ण प्रति बिनामूल्य में प्राप्त हो सकती है। इसके साथ वे संस्था के रोज़नामचा ''एवरीमैनस साइंस'' भी बिनामूल्य उपलब्ध कर सकते हैं ।

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

6. **दाता :** कोई भी व्यक्ति जो एकसाथ रू 10,000/- (विदेशियों के लिए U.S.$ 5000) मात्र दें वह संस्था के दाता बन सकते हैं। एक व्यक्तिगत दाता को वह सारी अधिकारें और विशेषाधिकार मिलेंगे जो एक सदस्य को उसके पूर्ण जीवन काल में प्राप्त होते हैं। एक संस्थान जो एकसाथ रू 50,000/- (विदेशियों के लिए U.S.$ 25,000) मात्र दें वह संस्था के संस्थान दाता बन सकता है, जिसे एक व्यक्ति को नामांकित करके उसे अपने संस्थान के प्रतिनिधि के रूप में विज्ञान कांग्रेस के वार्षिक सत्र में भेज सकते हैं। एक संस्थान/व्यक्तिगत दाता वार्षिक विज्ञान कांग्रेस के कार्यविवरण और संस्था के रोज़नामचा ''एवरीमैनस साइंस'' भी बिनामूल्य उपलब्ध कर सकते हैं।

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

(अ) **पेपर पेश करना :** एक पूर्ण पेपर की प्रति उसके साथ तीन सारांश की प्रति जो 100 शब्दों से ज्यादा न हों और जिसमें कोई आरेख या फर्मूला न हों, वह प्रत्येक वर्ष 15 सितम्बर के अंदर महासचिव (मुख्यालय) तक पहुँच जाना चाहिए।

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

(ब) सभी वर्गों के सदस्य जो विज्ञान कांग्रेस सत्र में भाग लेने के पश्चात लौटते समय के टिकट में रियाअत प्राप्त कर सकता है बशर्ते कि उनकी यात्रा के खर्च का थोड़ा भी भाग सरकार (केंद्रीय या राज्य), कोई कानूनी सत्ता या कोई विश्वविद्यालय या कोई नगरपालिका न उठाएँ।

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

(स) संस्था के पुस्तकालय में सभी वर्गों के सदस्य को पढ़ने की सुविधा सुबह 10,00 बजे से शाम को 5.30 बजे तक सभी काम के दिनों में (शनिवार और रविवार) को छोड़कर प्राप्त होगी।

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

(ड) समय समय पर संस्था द्वारा तय की गई मूल्य पर विश्रामगृह, सभागार आदि सुविधाओं की प्राप्ति भी सभी वर्गों के सदस्य पा सकते हैं।

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

(ई) भविष्य में भारतीय विज्ञान कांग्रेस संस्था द्वारा आयोजित परिसंवाद, सम्मेलन और वार्षिक कांग्रेस में सभी वर्गों के सदस्यों द्वारा भाग लेने के लिए अपनी-अपनी सदस्यता पत्र को लाना ज़रूरी है।

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

ध्यान दें : सभी बैंक ड्राफ्ट "Treasurer, The Indian Science Congress Association" के नाम से ही लिखा जाएँ और कोलकाता के किसी भी शाखा में देय हों। सदस्यों से यह निवेदन किया जा रहा हे कि वे अपनी सदस्यता संख्या का उल्लेख भारतीय विज्ञान कांग्रेस संस्था के कार्यालय के साथ पत्राचार के व्यक्त अवश्य करें।

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

भारतीय विज्ञान कांग्रेस संस्था

14, डॉ० बिरेश गुहा स्ट्रीट, कोलकाता - 700 017, भारत

THE INDIAN SCIENCE CONGRESS ASSOCIATION

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

तार/Telegram : SCICONG : CALCUTTA
फैक्स/Fax : 91-33-2287-2551
दूरभाष/Telephone : (033) 2287-4530, 2281-5323
ई-मेल/E-mail : iscacal@vsnl.net
वेबसाइट/Website : http://sciencecongress.nic.in
iscacal_2004@yahoo.com

सदस्यता के लिए आवेदन - पत्र / Application Form For Membership :

सेवा में/To
महासचिव (मुख्यालय)/ The General Secretary
भारतीय विज्ञान कांग्रेस संस्था/The Indian Science Congress Association
14, डॉ० बिरेश गुहा स्ट्रीट/14, Dr. Biresh Guha Street,
कोलकाता - 700 017/Kolkata - 700 017

महोदय/Dear Sir,

मैं भारतीय विज्ञान कांग्रेस संस्था का आजीवन सदस्य/वार्षिक सदस्य/सत्र सदस्य/छात्र सदस्य/संस्थान सदस्य/ दाता/ अपना नाम लिखवाना चाहता / चाहता हूँ।

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

मैं इसके साथ रू ———— सदस्यता शुल्क के रूप मे नक़द/बैंक ड्राफ्ट संख्या ———————— दिनांकित ———————— प्रचालक बैंक ———————— 01 अप्रैल —— से 31 मार्च —— तक भेज रहा/रही हूँ।

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

मैं निम्नलिखित विभाग में रूचि रखता/रखती हूँ (किसी एक में कृपया निशान लगाएं)/ I am interested in the following section (Please tick any one).

विभाग/Section

1. कृषि और वनविद्या विज्ञान/Agriculture and Forestry Sciences
2. पशु, पशुचिकित्सा और मत्स्य विज्ञान/Animal, Veterinary and Fishery Sciences
3. मानवशास्त्रीय और आचरण विज्ञान (जिसमें सम्मिलित हैं पुरातत्व-विज्ञान और मनोविज्ञान और शैक्षिक विज्ञान और सेना विज्ञान/Anthropological and Behavioural Sciences (including Archaeology and Psychology & Educational Sciences & Military Science)
4. रसायन विज्ञान/Chemical Sciences

5. भू-पद्धति विज्ञान/Earth System Sciences
6. अभियन्ता विज्ञान/Engineering Sciences
7. वातावरण विज्ञान/Environmental Sciences
8. सूचना और संचारण विज्ञान और प्रौद्योगिकी (कंम्पूटर विज्ञान सम्मिलित)/Information and Communication Science & Technology (including Computer Sciences)
9. भौतिक विज्ञान/Materials Science
10. गणित विज्ञान (सांख्यिकीय सम्मिलित)/Mathematical Science (including Statistics)
11. चिकित्सा शास्त्र (शरीर विज्ञान सम्मिलित)/Medical Sciences (including Physiology)
12. नया जीवविज्ञान (जीव रसायन, जीव भौतिकी और आणविक जीवविज्ञान और जीव-प्रौद्योगिकी सम्मिलित)/ New Biology (including Bio-Chemistry, Biophysics & Molecular Biology and Biotechnology)
13. भौतिकीय विज्ञान/Physical Sciences
14. वनस्पति विज्ञान/Plant Sciences

(कृपया टंकित करें या ब्लॉक अक्षरों मे भरें/Please type or fill up in Block Letters)

नाम/Name (ब्लॉक अक्षरों में/in block letters) : _____ _____

कुलनाम/Surname प्रथम नाम/First Name

_____

मध्य नाम/Middle Name

शौक्षणिक योग्यता/Academic Qualifications :
(प्रमाण जमा करना है/Evidence to be submitted)

पदनाम/Designation :

सम्पर्क का पता/Address of communication :
(राज्य, शहर/नगर और पिन कोड सहित/including state, city/town and pin code)

दूरभाष संख्या और ई-मेल/Phone No. & E-mail :
(अगर कोई/if any)

स्थायी पता/Permanent Address :

टिप्पणी (अगर कोई)/Comments (if any)

भवदीय/Yours Faithfully

दिनांक/Date : हस्ताक्षर/Signature

ध्यान दें : (i) सभी बैंक ड्राफ्ट "Treasurer, The Indian Science Congress Association" के नाम से ही लिखा जाएँ और कोलकाता के किसी भी शाखा में देय हों।

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

(ii) *10 अक्तूबर, 2004 के कार्यारिणी समिति के प्रस्ताव के अनुसार भारतीय विज्ञान कांग्रेस संस्था की सदस्यता के लिए आवेदन में किसी अन्य व्यक्ति के 'मार्फ़त' को सामान्यतः हतोत्साहित किया गया है। परंतु फिर भी यदि आवेदनपत्र में 'मार्फ़त' का पता दिया रहेगा तो उसमें जिस व्यक्ति का नाम दिया रहेगा उसके हस्ताक्षर भी ज़रूरी है।

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

(iii) *भर्ती शुल्क रू 50/- सिर्फ एक नये वार्षिक सदस्य के लिए ज़रूरी है। यह सत्र सदस्य/आजीवन सदस्य/संस्थान सदस्य/छात्र सदस्य/दाता के लिए ज़रुरी नहीं है।

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

(iv) सदस्यों से यह निवेदन किया जा रहा है कि वे अपनी सदस्यता संख्या का उल्लेख भारतीय विज्ञान कांग्रेस संस्था के कार्यालय के साथ पत्राचार के व्यक्त अवश्य करें।

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