EVERYMAN'S SCIENCE

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COVER PHOTOGRAPHS

Past General Presidents of ISCA

1. Prof. A. K. Saha	**(1980)**
2. Prof. A. K. Sharma	**(1981)**
3. Prof. M. G. K. Menon	**(1982)**
4. Prof. B. Ramachandra Rao	**(1983)**
5. Prof. R. P. Bambah	**(1984)**
6. Prof. A. S. Paintal	**(1985)**

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CONTENTS

EDITORIAL

BACTERIA OR BACTERIAL PRODUCTS AND CANCER

Research evidence suggests that certain species of bacteria or their toxins may have a protective or curative role in cancer. The use of bacteria or their extracts in the treatment of cancer can be traced back to more than hundred years when the American physician William Coley noticed that one of his patient suffering from neck cancer began to recover following infection with *Streptococcus pyogens.* His assembled thoughts and well planned ideas gave him the inspiration to use bacteria and their toxins to cure end stage cancers. Problems with the predictability of patient responses made him develop a safer vaccine in the late 1800's which constituted of two killed bacterial species, *S.pyogens* and *Serratia marcescens* to simulate an infection with the accompanying fever without having the risk of an actual infection. The vaccine was extensively used to treat Sarcomas, Carcinomas, Lymphomas, melanomas and myelomas. Coley's toxin which were bacterial derivatives were also thoroughly investigated for potential anti cancer activity. The early success of Coley's toxins gave way to the footholds for current advances in this field and motivated Scientists for developing bacteria based treatment alternatives for cancer. Bacteria or their products being used in cancer therapy are live, attenuated or genetically modified, Vectors as the carriers of tumoricidal agents or bacterial enzymes, toxins conjugated tumor surface antigens or ligands and spores. Anaerobic bacteria have been used successfully to target cancer tumors, delivering gene therapy based anticancer treatments.

Most of solid tumors contain regions of low oxygen or dead tissue.This environment encourages the growth of certain bacteria such as *Clostridium* family.These bacteria are the ideal agent to deliver anti cancer treatments. Spores formed by these organism can grow and multiply in favourable conditions such as dead areas inside tumors. A group of Scientists have proved that using these bacteria to target cancer tumors is effective. When *Clostridial* spores are injected into an animal they spread throughout the body but only spores that reach an oxygen starved area of a tumor germinate, multiply and become active. The effective anti-tumor activity using genetically engineered *Clostridia* in animals with tumors has been demonstrated. This type of bacterial therapy may help to destroy existing tumors and force certain types of cancer into complete remission. Since these bacteria lacked toxic proteins the side effects can be easily managed.

Although colorectal cancer is the third most common neoplasm worldwide, it exhibits low incidence in underdeveloped countries. The correlation of colorectal cancer with diarrhoea can be easily drawn if the inverse relationship that exists between the incidence of colorectal cancer and enterotoxic bacterial infections are considered. Drawing from these observations a study has introduced a hypothesis that specific peptide elaborated from enterotoxic bacteria might prevent the hyper proliferation and neoplastic development of intestinal epithelial cells associated with initiation and progression of colorectal cancer.

The lactic acid producing bacteria which are used for fermenting milk and other dairy products have anti-mutagenic and anti-carcinogenic properties.

It has been reported that dietary intake of *Lactobacillus acidophilus* suppressed DMH induced colon tumor and increased the latency of tumors in rodents. Moreover, dietary administration of lyophilized cultures of *Bifidobacterium longum* resulted in significant suppression of colon tumor incidence, multiplicity and volume.

So, bacteria show protective role in certain types of cancer. Certain agents derived from bacteria are successfully used for the management of cancer. The role of bacteria in cancer etiology and treatment is studied in detail since last few years. The integrate association of bacteria and cancer is evident in both positive and negative aspects.

In contrary to its beneficial effect, bacterial infection causes substantial morbidity and mortality in cancer patients. Etiological association of bacteria with cancer gained importance after the discovery of carcinogenic potential of *Helicobactar pylori.* Other suspected associations are *Salmonella typhi* and gall bladder cancer, *Streptococus bovis* and colon cancer etc.

The association of bacteria and cancer in both positive and negative ways usher the need to do extensive research in the field so that successful alternative therapy may be developed against cancer in future.

Dr. Manoj K. Chakrabarti

NICED(ICMR), Kolkata

"Everything must be made as simple as possible. But not simpler".

— Albert Einestein

PRESIDENTIAL ADDRESS

HIGH ALTITUDE STUDIES—MOUNTAIN PRESERVATION AND PROSPERITY

PROF. A. S. PAINTAL

I am most grateful to the scientists for electing me as President for 1984–85 and thus giving me the honour of presiding over a session that is being held in Lucknow University where I spent about 9 years as an undergraduate and postgraduate student.

CHOICE OF FOCAL THEME

The choice of this sessions' focal theme arose mainly out of the unsatisfactory conditions prevailing in the Himalayan citites and villages. It was obvious that the demand on the mountain resources and consequent exploitation had increased greatly in recent years owing to the large increase in the population of the Himalayan region itself (30% in ten years). As a result of this a dismal picture exists today both in urban Himalayan regions as well as in the rural regions. However an even worse potential danger exists in the sub-Himalayan plains where the population is also increasing rapidly and this therefore poses a threat to the Himalayan regions as it will surely tend to move into the less populated areas. It is therefore clear that if the existing conditions remain unchanged, then in the next fifty to a hundred years our high altitude regions will be subjected to such ruthless treatment and exploitation that our habitable regions will be ruined for several centuries thereafter by the greatly increase and inadequately self-disciplined population. It is therefore necessary for the whole body of scientists to look into this problem urgently.

The second reasons for my interest in this high altitudes was the fact that the present global North-South disparities are essentially disparities between the countries with temperate climates and those with tropical and equatorial climates. That climate plays a significant role in the development of nations and civilizations is well-known. Combined with a suitable political system and organisational structure, certain nations have in in the past made great advances, relative to others, dominated others and remained in a dominant position for long periods. In the absence of technological advances needed for living in temperate climates, the mediterranean climate was apparently the most suitable 1½ to 3 thousand years ago. In the last thousand years the temperate climate has proved to be the more suitable one for advancement to civilization and technology. In more recent times the ability to create the most suitable working environment has apparently been an important factor for the greater progress of certain countries. I have therefore felt that we should recognize this aspect and devote more attention to our high altitude regions which provide the most suitable climate conditions for the establishment of settlements based on highly advanced technology.

Thus we need to preserve our Himalayan legacy on the one hand and increase technologically based prosperity on the other. For both these purposes a

* General President, 72nd Indian Science Congress held during January, 1985 at Lucknow.

dynamic approach (quite different from existing attitudes) is needed and I suggest that the Government of India establishes a Department of Mountain Development for mountain preservation and prosperity. The Department would have several activities.

PREVENTION OF UNDESIRABLE CONSEQUENCES OF HAPHAZARD DEVELOPMENT

The development of any region in the Himalayas involves deforestation for construction of roads, buildings, dams, reservoirs etc. All these factors have in the past led to long-term undesirable effects consisting of rock-falls, landslides, and avalanches and it is because of this past experience that environmentalists are not keen to promote development projects in the Himalayas. It is recognized that the single most important problem in the Himalayas is deforestation arising partly from the need to fell tress for fuel but mostly for promoting the business interests of unscrupulous contractors who have in the past (and also in the present) successfully bribed their way through a week law enforcement system. Even social outcries such as that achieved by Mr. Sunderlal Bahuguna through the Chipko movement have not made a marked difference to the continutation of the evil. The Department of Environment has undertaken several projects to deal with the above problems but I think that it needs a much more intensive approach to even maintain *status quo* leave aside repair and damage that has been done during the last hundred years.

THE EFFECTS OF TOURISM

At a recent conference held in 1983 arguments were put forward for promoting tourism in the Himalayas. Undoubtedly there is a great temptation to get the maximum gains by encouraging as many tourists and trekkers as possible to the beautiful Himalayas. But in the absence of adequate precautions tourism causes much damage owing to deforestation, pressure on water and other resources and disposal of waste material. So far these aspects have not been adequately dealt with and the unfortunate results from tourist pressure are visible in the overcrowded insanitary conditions in place like Mussorie and Darjeeling.

THE EFFECTS OF INDUSTRY POLLUTANTS

There is a desire of some in the hill states to establish industries and advance technologically like certain other states in the plains. However, industries produce highly undesirable pollutants and these can cause harmful effects not only locally but also in distant places as exemplified by the acid rain in Europe. However, there is an even more serious danger arising from the pollutants entering the tributaries of our major rivers. Thus while one of the means of increasing prosperity is by introducing modern technologies one has no keep in mind the effects of pollution. If unchecked this could destroy the environment at high altitudes. At the present time it has to be accepted that because of our culture, social structure and ineffective law enforcement machinery we are at present quite inadequate to deal with the pollution generated by common modern systems and technologies. In fact the pollution generated by any common modern machine or factory in India is much greater than that allowed to be generated by the same machine or factory in Europe of America. For example take the permissable level or exhaust fumes from cars, buses and trucks. This is several orders of magnitude greater than the punishable levels in Western countries. In the capital of India itself it is quite common for a government owned and run Delhi bus to generate a thick smoke screen as it goes along and there is nothing that the law enforcement machinery has been able to do about it. Nor has it been able to do anything about the large number of smoking chimneys from industrial units in cities including the three chimneys of the Power Station in New Delhi located directly opposite the World Health Organization.

Therefore to be on the safe side it must be ensured that we establish in the Himalayas those technologies from which little or no pollution arises or the law enforcement machinery can deal with effectively.

ACTIVITIES OF THE PROPOSED DEPARTMENT OF MOUNTAIN DEVELOPMENT

The Department of Mountain Development could profitably deal with the above aspects relating to mountain development e.g. devise procedures and methods for planned development, ensure that tourism is developed along modern lines, ensure that pollution is strictly controlled. More importantly the department could co-ordinate high altitude research in various fields. It should establish an Institute of Research, design and get constructed small townships (taking the Swiss model as an example) that are particularly suitable, ensure the education and development of the local population, design and install alternate systems of energy (e.g. small hydel systems; and systems based on solar and wind energy); help in the establishment of small manufacturing units suitable for high altitudes which will not produce any pollution and develop measures to preserve the cultural heritage of the local population.

MOUNTAIN RESEARCH INSTITUTE

A large Research Institution should be established, It should have well-equipped and well-run divisions of engineering and Medical, Veterinary, Agricultural, Biological and Geological Sciences. In fact it should be a Mountain Research Institute of Technology, Medical, Veterinary and Agricultural Sciences whose main function would be research for the solution of high altitude problems. Such an Institute should not be established in any well-known city such as Simla, Darjeeling, Gauhati, Mussoorie, Naini Tal or even smaller cities but should be set up in an almost new region whee there would be facilities for the landing of small aircraft. The Institute should be actually autonomous. The initial outlay for such an enterprise would be of the order of 500 crores which would include the construction of the landing strip and other infra-structure in the new place. The figure may seem large but it is'nt so in terms of the present rising prices and it is certain that the benefits accruing from this investment will far outweigh the inputs and such benefits will become manifest in a short space of time. It is to be assumed that the Institute would have regional laboratories in other parts of the Himalayas for finding solutions to problem that are specific to those regions. For example it is easy to see that the agricultural problem will be quite different in the North-Eastern Himalayas when compared with the cold dry desert conditions of Ladakh.

WILL THE MOUNTAIN RESEARCH INSTITUTE MAKE OUTSTANDING CONTRIBUTIONS ?

The question that the layman can ask is that in view of the fact that the contributions, both discoveries and applications made by the various research Institutes have not been large and obvious it is reasonable to create another large research Institute ? What evidence is there that this Institute will not turn out to be like the others. Yes it is true that if the conditions under which the scientists have to work remain the same on the one hand and on the other hand the level of accountability expected to them also remains the same then the level of achievement will be no different from that obtaining in the average research institutes in India. Under unchanged conditions it would be a fruitless exercise to establish a Mountain Institute of Research. I would therefore recommend that in order to make it a successful venture accountability on the one hand and facilities common and special on the other must be suitably increased. The necessity to earn or acquire a parallel income must be eliminated. If these cannot be done on the excuse that one cannot have a different set of rules for one institute, then I would strongly urge that the proposed Mountain Institute not be established at all.

If one assumes that the Institute is established, as outlined above then one of the interesting points to consider in relation to the research that would be done in various fields is that much of it, if genuine, will be of value as most of it will be goal-oriented. This statement needs elaboration and I will therefore discuss it a little more in relation to the research done in India.

VALUE OF SCIENTIFIC RESEARCH DONE IN INDIA

The generation of new knowledge is valuable for mankind as a whole and it is the aim of the majority of Indian scientists to produce a new knowledge. We are not yet organised for doing good applied work. When an outstanding piece of work is published the attention of other scientists throughout the world is drawn to it and this work is cited in their own papers. If a paper contains no informations worthy of mention then it is not cited by anyone. Thus one useful but rather rough (and also at times falliable!) measure used for judging the quality of a paper published is its citedness. In a recent analysis it has been reported that the majority of papers published by scientists working in India are not cited at all and therefore the body of work leading to these papers has not served a useful purpose as far as India is concerned. It has also been pointed out that about the half the papers published in Western laboratories are also not cited. However, in the latter case it would be misleading to say that because the paper has not been cited that it does not contain any useful information for anyone. This is so because many papers contain information about a particular technology or product etc. These papers are of value for the advancement of the particular technology or product as it helps manufacture of instruments, durgs, etc., considerably. For example many of the papers on prostaglandins (a few thousand) would not have been cited but many of them would have provided useful information for the evaluation and development of various prostaglandins by the drug companies concerned who sponsor a fair amount of research work on their drugs in one way or another. No doubt similar papers that are useful for manufacturers are also published from Indian laboratories. For example in the near future a number of papers arising out of the use of nuclear magnetic resonance equipment will be published from Indian laboratories but they vast majority of them will not be cited as the work it likely to be mostly repetitive. However, the manufacturers of the equipment will benefit in any case and will also derive useful information from these papers as in the case of papers published from their own countries, but this information will be of use mainly to them and not to India. I am not here making out a cause that we in India should therefore only promote research that is outstanding but to point out a possible difference in the value of uncited work in the two different situations. However, if good work on specifically Indian problems was published, it would of course remain uncited as other scientists of the world may not be interested in Indian problems but it would be value to India. This applies to the research work already done on high altitude problems and that would be done in the proposed Mountain Institute. Thus the interesting possibility that emerges in relation to the research that would be done in various fields in the proposed Mountain Research Institute is that a large part of it, if genuineness is assured, will be value to India even if it is not cited much. That is because research in the field of high altitude does not run the risk of being repetitive, and hence of no value, as such research is being done in very few places in the world. I will now give you one example about how useful research on high altitude problems can be.

SOME ASPECTS OF RESEARCH DONE AT HIGH ALTITUDE

So far, apart from some research on horticulture, endangered species, ecology and such like projects,

the more significant research on high altitude problems has been done by certain defense organizations such as the Defense Research and Development Organization and the Armed Forces Medical Services. The research in various fields began after the brief encounter with the Chinese in the Himalayas in 1962 when it was realized how little we knew about operational factors at high altitude and man's responses when he is suddenly taken up there. The disasters we faced in the few months of 1962, fortunately made a deep enough impression to make various agencies such as the Indian Council of Medical Research, Council of Scientific and Industrial Research and the Defense organizations take an active interest in the problems and face man and machine at altitudes above between three to six thousand meters. The problems are due to two main factors, reduced atmospheric pressure and cold temperatures. I know a little about the medical research that was done and I would like to mention it briefly in order to illustrate how useful all the work done has been apart from providing new knowledge. I will use only one example and that is high altitude pulmonary oedema.

HIGH ALTITUDE PULMONARY OEDEMA (HAPO)

During the brief war with China in 1962, a few thousand soldiers were involved in operations at 3 to 5 thousand meters. Normal people become breathless when walking at these heights. However, several soldiers became breathless even at rest. They also had cough. At that time it was thought that they had infection of the lungs. It was only later that it came to be recognized that what these soldiers suffered from was in fact high altitude pulmonary oedema (HAPO). Even though the doctors did see clearly that some of them had frank pulmonary oedema they had did not label all these cases as HAPO because this entity had not been clearly recognized at that time and few were aware of its existence.

In fact the description of cases (mountaineers who had suffered from this condition) in the late fifties and documented by the well-known expert Dr. Hurbert N. Hultgren showed that physicians could not distinguish HAPO from pneumonia and they gave to HAPO patients penicillin instead of transporting them to lower altitudes. The same must have happened in the case of Indian troops in the Himalayas. Thus due to lack of knowledge a number of men were lost due to HAPO. There were also casualties due to cold injuries etc. but I will not mention them here. One cannot give a reliable estimate of the number of men who were affected by HAPO as no reliable records of the incidence of HAPO in the forward areas is available.

Troops have continued to be stationed at high altitudes after 1962 and it has thus been possible to observe the patients carefully in properly equipped hospitals run by the medical crops of the army. The research carried out mainly by the defence personnel such as the late General Inder Singh and Brigadier N. D. Menon resulted in the acquisition of valuable information. Certain lines of treatment and prophylactic measures were tried out and the research carried out earned and admiration of pulmonary physiologists and chest physicians throughout the world. As a result of this (and research done by others) it became possible to standardize and make immensely effective the treatment of HAPO as well as provide preventive measures so that today the treatment and prevention of HAPO is not longer a serious problem.

The information that became available in army hospitals has enabled new light to be shed on the mechanisms of cough. In particular the valuable report by Brigadier N. D. Menon in the New England Journal of 1965 showed that one of the important symptoms (in addition to breathlessness) of HAPO was s dry cough. This led us to re-examine the already published data on the cough produced by a chemical substance called lobeline from which we concluded that perhaps the cough produced during HAPO was due to the same mechanism as the cough produced by lobeline. In

the latter case the cough, could with reasonable certainty be attributed to the stimulation of the J receptors. It therefore seemed reasonable to expect that the dry cough of HAPO must also be due to stimulation of J receptors. In order to establish this fact we examined the records of more recent patients (for which we are grateful to the DGAFMS) and were convinced from the data that the cough must be due to stimulation of the J receptors which are normally stimulated during muscular exercise when the blood flow to the lungs increases. The most interesting feature of the new findings which were reported at the International Congress of Physiology held in Sydney in 1983 was that the dry cough produced by the stimulation of J receptors during HAPO was a common sensation which the patients had experienced earlier for example when their throat was irritated by foreign substances or in upper respiratory tract infections.

So far it had been assumed that cough was produced only when the cough receptors in the upper airways are stimulated and it therefore came as surprise to find that the common type of dry cough could also be produced by stimulation of receptors (i.e. J. receptors) at the alveolar level. Having concluded thus far it then followed that one could explain the dry cough that occurs in left heart failure leading to interstitial pulmonary oedema. Thus the dry cough in patients with previous history of coronary artery disease has become an important sign which could be useful in averting a disaster.

RELEVANCE TO BHOPAL TRAGEDY

The new knowledge obtained partly as a result of research of high altitude problems has proved to be of considerable value in the evaluation of certain patients who had inhaled air containing methyl isocyanate which had polluted the atmosphere in Bhopal recently owing to an accident in the factory. It will be recalled that the press had reported that there were many patients who in addition to breathlessness and chest pain had complained of severe muscle weakness. It was therefore confluded that methyl isocyanate must have affected the nervous system directly or that the patients had been affected by other poisonous gases. Neither of these assumptions were necessary as the muscle weakness could be easily explained by the fact that stimulation of J receptors which is intense in pulmonary oedema causes marked inhibition of muscles and this is manifested as muscle weakness in man as he needs to put in a greater effort than normal to perform the same task and this is interpreted as muscle weakness by the individual. Thus there was no need for additional concern on behalf of these patients as it was expected that the weakness would disappear with the clearance of the oedema in the alveoli.

The reflex inhibition of muscles by J receptors is called the J reflex and it is a life-saving reflex which is well-known at high altitudes. However certain trekkers disregard this muscle weakness they experience as a result of this reflex and they then end up with HAPO which the army now prevents almost totally be enforcing a set regimen. The same thing apparently must have happened in Bhopal for thousands of people who had inhaled methyl isocyanate, moved around in panic and unnecessarily worsended their condition. Had they been told to remain still so that blood flow to the lungs is not increased may lives would have been saved. Here on may recall the advice given in the Report of the Chemical Warfare Medical Committee (1918) a most distinguished committee which said that the three cardinal features of treatment after inhalation of phosgene gas were rest, warmth and administration of oxygen. Unfortunately in Bhopal rest was not ensured and there was obviously totally inadequate supply of oxygen.

ILLUSTRATIVE EXAMPLES OF OTHER RESEARCH ON HIGH ALTITUDE PROBLEMS

During the plenary sessions and the sectional meetings, the results of research on high altitude problems will be presented. A large part of the

research which is of an applied nature has been of considerable regional benefit. For example there have been advances in the selection of vegetables that grow well at high altitudes under unfavourable weather conditions. Advances have been made on growing trees at high altitudes above 3000 meters in what can be regarded as a cold desert. This has yielded rich dividends and the new techniques have been passed on to the local population in Ladakh.

Another important contribution made by the Army is that they have successfully modified the traditional "bukhari" used for heating rooms so that it will work with kerosene thus avoiding the use of wood and saving the trees. It was suggested at a recent symposium that if sufficient kerosene is made available at reduced prices to the local population, it would help reducing the felling of trees for cooking and heating the houses. Another useful recommendation was that if wheat was provided at subsidized rates it would also reduce rate of deforestation by reducing the pressure on arable land.

FUTURE PROSPECTS

There is scope for, literally, enormous amount of research and development work on high altitude problems. Past experience has shown us what we must do to preserve the grandeur of the mountains. This is bring effectively tackled by the Department of Environment and they have plants for afforestation etc. In addition extensive work needs to be done by professionally qualified people in a modern well-equipped Institue. I have already mentioned that we need to carry out research on a large variety of problems pertaining to the mountains such as medical, veterinary, agricultural, geological problems etc. Sources of power for use in the mountain must be explored in a more energetic way. We should consider whether we should endeavour to inhabit the higher altitude regions and if so how. Certainly we should carry out mineral exploration at higher altitudes e.g. above 3000 meters and find out sources of useful minerals that could be mined by modern methods. Mining at high altitudes is not a new feature as it has been done for many years in the South American Andes. We must explore not only this avenue but also other avenues for creating modern employment for the local population. It should be remembered that the preservation of our mountains will depend to a large extent on the prosperity of the local population. We could profit greatly by using Swiss models to plan and establish small industrial units in the mountains that have been such a great success in the region of the Swiss Alps.

ROLE OF DEPARTMENT OF ENVIRONMENT

Although the Department of Environment is concerned with the preservation of the environment of the whole of India, it is playing an important role in the preservation of ecological balance in the Himalayas. Their ongoing activities are many e.g. action oriented eco-development in the 15 Himalayan Universities, establishment of eco-task forces, programme for the depth study of landslide hazards, eco-development in the Himalayan foothills. They have also planned to establish a Himalayan Institute of Environment and Development with a decentralized structure consisting of a chain of centres of advanced studies along with field stations along the entire Himalayan belt. This proposed institute will therefore have mostly different functions from those that I have outlined for the Mountain Research Institute although there will be some overlap of activities.

CONCLUDING REMARKS

The talk I have given is mainly an introductory talk of the focal theme. It will be followed by contributions by highly distinguished scientists in the plenary sessions. The focal theme will be discussed in almost all the sections where you will learn about the many contributions that have been made and what can be done in the future. I am

certain that before the Congress is over a lot of valuable suggestions will have been made. At the end of it all we will be in a better position to decide whether we should have a Department of Mountain Development for the preservation of and prosperity in the mountains and whether we should have functioning under this department a Mountain Institute of Technology Medical Veterinary and Agricultural Sciences and as to where is should be located.

If the Government agress the Department itself will be set up within the framework of the Government of India. However, as far as the Institute is concerned a departure from the existing fules and regulations that exist in government organizations will be necessary. This is so because the existing system in the various institues of Science has turned out to be inadequate for, it inspite of considerable inputs our achievements are far below what we had expected. It is clear that our scientists have not been able to work in India in the way they work so effectively when they are abroad in good Western laboratories because by and large we have not succeeded in creating the appropriate working conditions. Therefore unless the conditions, under which the scientists have to work are modified and made more suitable on the one hand and the scientists are made more accountable on the other, achievements of significance arising from a broad base cannot be expected. This will apply especially to the Mountain Research Institute I have proposed. In fact the project will be a failure if it is set up under the existing conditions. Therefore unless we have the will to change, it should not be set up at all because to do so under the prevailing conditions will only add to the problems at high altitudes. But India simply cannot afford to allow things to drift for in due course, if we proceed the way we are currently proceeding, in a hundred years or so the Himalayas will be impoverished and in a very bad state. Prosperity in the mountain regions must increase in order to save them and it is therefore fortunate that attention will be focussed on them at this Congress.

As many of you know a task force is set up by the Department of Science & Technology (DST) to follow up the suggestions and recommendations arising from the Congress. In connection with last year's focal theme "Quality Science—ends and means" the DST therefore gave substantial encouragement to the setting up of a society for the improvement of the ethical standards obtaining in Indian Science. The society called "Society for Scientific Values" is still in its formative stages but I believe it will help to raise the level of what Indian scientists will expect of each other in future. Likewise, perhaps to an even greater extent, I think the DST will have an important and leading role to play in getting implemented the final suggestions and recommendations, of this Congress, which will probably have far-reaching implications and will yield great benefits.

Finally, I would like to record my gratitude to the General Secretary of the Indian Science Congress association, Prof. Archana Sharma, and the staff of the association for the invaluable help, cooperation and guidance they have given me.

BIOPLASTIC : A GREEN TECHNOLOGY

Apoorva Bhatnagar*, Amit Kr Singh and Vinod Pravin Sharma

Bioplastics have great importance and they are available in different forms. They are made from the polymers derived from biological sources. They are considered suitable for use as they rely less on fossil fuel and reduce hazardous wastes. There are enormous potential of its application in packaging technology and other allied industries.

INTRODUCTION

Bioplastics are plastics derived from renewable biomass sources *viz* starch, vegetable fats and oils etc. Plastics are synthetic or semi-synthetic organic solid materials that are used for manufacturing of industrial products. They are considered to be vital asset for humanity, often providing functionality that cannot be easily or economically replaced by other materials. Most plastics are robust and last for hundreds of years. They have replaced metals in the components of most manufactured goods, including computers, car parts, refrigerators etc and have often made the products cheaper, lighter, safer, stronger and easier to recycle.

Plastics have taken over from paper, glass and cardboard in packaging, usually reducing cost and carbon emissions. About 4% of the world's oil production is converted into plastics for use in products such as shopping bags and the external panels of cars. As oil runs out and the use of fossil fuels becomes increasingly expensive, the need for alternative sources of raw material for the manufacture of vital plastics becomes increasingly urgent. In addition, the use of carbon-based sources of energy for use in plastic manufacturing adds greenhouse gasses to the atmosphere, impeding the world's attempts to cut CO_2 emissions.

* Department of Biotechnology, Institute of Applied Medicines & Research, Ghaziabad, India.

Bioplastics are a special type of biomaterial. They are polyesters, produced by a range of microbes, cultured under different nutrient and environmental conditions. These polymers, which are usually lipid in nature, are accumulated as storage materials in the form of mobile, amorphous, liquid granules, allowing microbial survival under stress conditions. Polyhydroxybutyrate (PHB) is biodegradable polyester, which accumulates in the bodies of microorganisms. Some bioplastics degrade in the open air, others are made so that they compost in an industrial composting plant, aided by fungi, bacteria and enzymes.

BIOPLASTICS CAN BE BIOBASED, BIODEGRADABLE OR BOTH

The biobased material or product is (partly) derived from biomass (plants). Biomass used for bioplastics include stems from e.g. corn, sugarcane, or cellulose.

The biodegradable material or product is derived from renewable biomass that can be broken down in the environment by micro-organisms.

MATERIAL TYPES-THREE MAIN GROUPS

The family of bioplastics is roughly divided into three main groups :

- Biobased or partly biobased non-biodegradable plastics such as biobased

polythylene (PE), Polypropylene (PP) or Polyethylene Terephthalate (PET) and biobased technical performance polymers such as Polytrimethylene Terephthalate (PTT) or Thermoplastic polyester elastomer (TPC-ET).

- Plastics that are both biobased and biodegradable, such as Polylactic acid (PLA) and Polyhydroxy alkanoates (PHA).
- Plastics that are based on fossil resources and are biodegradable, such as Poly butylenes adipate co terephthalate (PBAT).

HOW ARE BIODEGRADABLE BIOPLASTICS MADE ?

Biodegradable plastics are plastics that will decompose in natural aerobic (composting) and anaerobic (landfill) environment by the action of naturally occuring microorganism, such as bacteria, fungi etc. over a period of time.

- Starch-based bioplastics can be manufactured from either raw or modified starch (e.g. Thermoplastic starch or TPS) or from the fermentation of starch derived sugars (e.g. polylactic acid). Common starch sources include maize, wheat, potatoes and cassava.
- Cellulose-based bioplastics are typically chemically-modified plant cellulose materials such as cellulose acetate (CA). Common cellulose sources include wood pulp, hemp and cotton.
- Lignin-based bioplastics contain wood (or lignocellulosic plant material) produced as a by-product of the paper milling industry.
- Plant proteins such as maize 'zein' can also be used to manufacture bioplastics.

HOW ARE NON-BIODEGRADABLE BIOPLASTICS MADE ?

Non-biodegradable bioplastic is a plastic derived from renewable biomass that cannot be easily broken down in the environment by micro-organisms.

- Conventional plastic resins can be made from plant oils and are manufactured using compounds extracted from castor, soya bean or oilseed rape oil. Examples include polyurethane (PU) manufactured from soya bean oil and nylon (polyamides or PAs) made using castor bean oil.
- Conventional polyethylene can be manufactured from bio-ethanol.

MIXED BIOPLASTICS

Mixed bioplastics can be both biodegradable and non-biodegradable depending on the polymers used to manufacture them. For example, a mixed bioplastic containing starch and polycaprolactone (PCL) is biodegradable, whereas a plastic containing a 1 : 1 mix of biomass and oil-derived polypropylene is not.

ENVIRONMENTAL IMPLICATIONS

The production and use of bioplastics is generally regarded as a more sustainable activity when compared with plastic production from petroleum, because it relies less on fossil fuel as a carbon source and also introduces fewer, net-new greenhouse emissions if it biodegrades. They significantly reduce hazardous waste caused by oil-derived plastics, which remain solid for hundreds of years and had open a new era in packing technology and industry.

Environmental data from Nature Works, the only commercial manufacture of polylactic acid bioplastic, says that making its plastic material delivers a fossil fuel saving of between 25 and 68 per cent compared with polyethylene. While production of most bioplastic results in reduced carbon dioxide emissions compared to traditional alternatives, there are some real concerns that the creation of a global bio economy could contribute

to an accelerated rate of deforestation if not managed effectively. There are associated concerns over the impact on water supply and soil erosion. Other studies showed that bioplastics represent a 42% reduction in carbon footprint. On the other hand, bioplastic can be made from agricultural by products and also from used plastic bottles and other containers using microorganisms.

APPLICATIONS

Biodegradable bioplastics are used for disposable items, such as films, packaging bags and catering items (crockery, cutlery, pots, bowls, and straws). They are also often used for organic waste bags, where they can be composted together with the food or green waste. Some trays and containers for fruit, vegetables, eggs and meat, bottles for soft drinks and dairy products and blister foils for fruit and vegetables are manufactured from bioplastics.

A very broad range of applications exists for bioplastics. These include :

- Medical technical products have been an important area of application for bioplastics for a long time. Implants and also stitching materials made of high purity PLA dissolves in the body during the healing process. This means a further operation can be avoided.
- PLA has quite diverse applications within the field of fibres and textiles. Bioplastics are also used in a variety of office applications. Window envelopes and diverse office utensils, adhesive and packaging tapes are examples of the diversity of application possibilities. Toys made from bioplastics provide children with fun and creative opportunities for development.
- Non-disposable applications include mobile phone casings, carpet fibres, and car interiors, fuel line and plastic pipe applications, and new electro active bioplastics are being developed into outer layers of electric pipes that can be used to cary electircal current. In these areas, the goal is not biodegradability, but to create items from sustainable resources.

MERITS AND DEMERITS

Bioplastics does have both advantages and disadvantages. The advantage of bioplastics is that organisms are able to feed on them better and faster when weather conditions are right. Thus, this allowed the bioplastics to be broken down into smaller pieces, reducing pollution in the process. With this, pollution is reduced and there will be no problem with litter or harms on wildlife.

The main disadvantage with oil-based biodegradable plastics is that when they break down, carbon dioxide is released in the process and contributes to global warming. Another disadvantage with biodegradable plastic is that degradation will take place very slowly underground, even if it disintegrates completely. Also, biodegradable plastics when mixed with normal plastics would reduced the worth of the plastic itself if it is recycled and make the recycled plastic useless.

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THE INDIAN SCIENCE CONGRESS ASSOCIATION

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

Nominations for "Asutosh Mookerjee Fellowships of ISCA" 2015-2016

ISCA has instituted 10 senior Fellowships in the name of **Asutosh Mookerjee Fellowships** in the Centenary year to utilize the services of the Life Members of the Association who are active in high quality research in their specialized disciplines but have superannuated from their service.

Objectives : The objective is to utilize the expertise of ISCA Members after superannuation primarily for research work in some R&D center/university/colleges/institute in India.

Eligibility :

(i) The fellowship is open to ISCA Life Members who have superannuated and are between the age of 65 to 70 years.

(ii) The applicant should posses a Ph. D. in science/Engineering or MD in medicine.

(iii) The fellowship is meant for those who have a proven track record as evident from their Research publications and recognition.

Number of Fellowships : The number of Fellowship to be selected each year shall be decided by the Executive Committee from the panel recommended by the Selection Committee, to be constituted by Executive Committee. Usually, the number of Scientists to be selected each year will be based on the availability of vacancies and funds available with the Association. The total number of Fellowships at a time should not be more than 10.

Tenure : The term of **Asutosh Mookerjee Fellowships** will be tenable initially for a period of three years extendable for another two years after a review of the achievement of three year's works.

Emoluments : (a) The fellowship carries an honorarium of ₹ 30,000/- p.m. such that ₹ 30000 + pension does not exceed the gross salary drawn at the time of retirement. The honorarium of Rs. 30,000 will be reduced wherever. The honorarium will be Taxable at source.

(b) Contingency grant will be ₹ 100,000/- which includes the expenditure of chemicals glasswares, stationary, part time services of a scientific assistant/secretary for typing and travel within country only.

Nominations : Nominations for the position shall be invited from the Life Members of the Association.

The nomination papers duly completed in all respects, signed, and routed through the Head of the Institution, where a scientist intends to work, should be sent to the General Secretary (Membership Affairs), so as to reach **latest by July 15, 2014**.

Announcement : The names of Fellowships thus selected shall be announced.

Activities Report and Renewal of Scheme : Fellows will submit an Annual Report of his/her research work at the end of each Calender year along with statement of expenditure for renewal and release of grant for the next year.

Contact Details : General Secretary (Membership Affairs), Indian Science Congress Association, 14 Biresh Guha Street, Kolkata 700 017, Fax 033 22872551, Phone : 033 22874530, Email : iscacal@vsnl.net, website : sciencecongress.nic.in

BIO-ART : DEVELOPING ART THROUGH BIO-SCIENCE

Sangeeta Sharma

This article deals with a new emerging branch of science, BIO-ART, a broad term for the blend of art, technology and science that is attracting artists as well as scientists. By using artistic tools on living material many innovative creations have been made, few are beneficial for human kind and few are just for the sake of entertainment. The various aspects of bio-art are discussed in detail.

INTRODUCTION

BIO-ART is a new branch of science at the junction of Art and Biology, especially ecology and life sciences, in which humans work with live tissues, bacteria, living organisms and life processes to get artistic results. The extent of BIO-ART is considered by some artists to be strictly limited to "living forms", while other artists consider it to be an art that uses the imagery of modern medicine and biological research. This bring together all traditional media, including painting, sculpture, printmaking and drawing with basic and advanced biology such as molecular and cellular genetics; transgenically altered living matter, reproductive technologies and neurosciences to convey novel ways of representing life forms. The inter-disciplinary nature of Bioart is depicted in Fig. 1. Bioart broadly refers to artworks that use life and life manipulation as the communicative medium while employing the practices of biology and the life sciences. Initially strongly associated with genetic art, bioart is an expanded term that seems to have developed in parallel with the advances in modern biology and biotechnology. It includes a variety of works that include diverse levels of manipulation, from the whole organism to the cellular and molecular level, and employ a wide range of (bio) technologies, from physical manipulation to tissue culture and genetic engineering.[1]

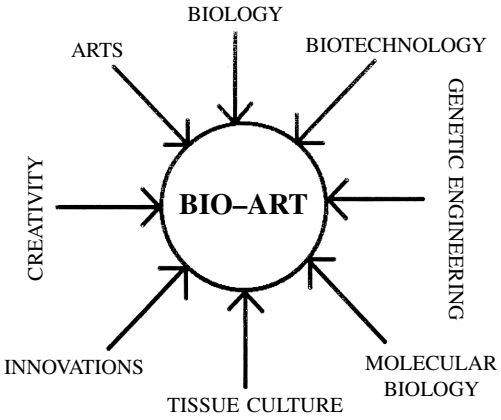

Fig. 1 Inter-disciplinary nature of Bioart

A BRIEF HISTORY OF BIO-ART

Bio-art is a relatively new development in contemporary art, still at the emergence of identity but it can be linked to two modern originators. Alexander Fleming, the discoverer of penicillin, exhibited his 'germ paintings' (images drawn by putting bacteria on paper that was pre-soaked in a culture medium and then incubated) in 1933. But, the interesting thing to notice is that it was displayed in a hospital rather than an art gallery. Later, in 1936, at the Museum of Modern Art, New York, USA, an artist, the photographer Edward Steichen

* IPS Academy, Indore (M.P.) E-mail : sangeetasharma@gmail.com

exhibited a collection of strange yet beautiful Delphinium flowers. Delphinium seeds were dosed with a chemical colchicine, a toxin that induces polyploidy (multiple set of chromosome), which resulted into beautiful and ugly mutated flowers. The selected beautiful flowers were exhibited and ugly flowers were rejected. In both of these early cases of bio-art, the mutational experiments were reductively judged in terms of their beauty.[2]

Scientist Adam Zaretsky, TROY, N.Y. once spent 48 hours playing lounge music to a dish of *E.coli* bacteria to determine whether vibrations or sounds influenced bacterial growth. He found that bacteria's antibiotic production increased, Zaretsky decided that perhaps even cells were annoyed by constant subjection to "loud, really awful lounge music." This sense of humour is a huge factor behind Zaretsky's work in the growing field of BIO-ART[3]. Responses to more recent and controversial forms of bio-art, such as the creation of transgenic mammals have gone beyond judgements of beauty in favour of more inspiring assessments.

A LABORATORY INSIDE THE GALLERY

Bioart works majorly utilizes biotechnological procedures or practices as the tools for artistic production. Menezes describes bioart as a practice of modern biology and biotechnology as the medium for artistic expression. He further states bioart as "art created in test tubes, using the laboratory as the art studio". It is important to notice that several of these works would not have been possible without access to laboratory equipment and scientific expertise. Though Do-It-Yourself culture and part-time biology is gaining attention among bio-artists, but the biotechnological protocols and practices involved in the understanding of artwork are quite costly in terms of laboratory equipment and scientific resources. Not surprisingly, if the artwork is created inside the laboratory, certain implications will emerge for the artwork to step out of the lab and move into an exhibition space[1].

BIO-ART : SAMPLES

VICTIMLESS LEATHER

The "Victimless Leather" project was introduced in 2004, to the public at Perth's John Curtin Gallery, during an exhibition that focused on the future of textiles and fashion with the controversial idea of using cells to grow "semi-living" fabric-and reactions were mixed. Immortalised mouse and human cells were used to make leather like material that is "Victimless Leather" inside a specially designed bioreactor that maintains optimal growing conditions (temperature, supply of nutrients, waste removal, etc.). A biodegradable scaffold (base that directs the growth of the cells into a three-dimensional shape) is "seeded" with the cells and after gradual degradation of the polymer, a stitch-less, coat-like structure or a miniature "leather" jacket is left behind that could fit a mouse (Fig. 2). The project is the teamwork of husband-and-wife Oron Catts and Ionat Zurr, and their research is conducted in the labs of SymbioticA.

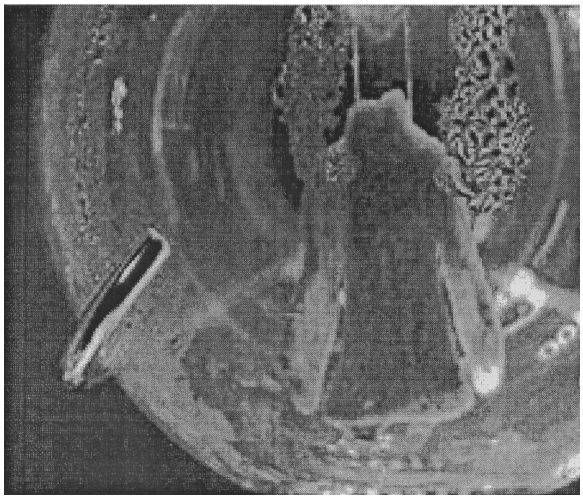

Fig. 2 Jacket grown from living tissue

It might sound absurd or even disgusting, yet Catts, SymbioticA's director, notes that, "Many people wear leather, but the fact that it is obtained from parts of dead animals seems to be accepted much more than growing semi-living cells into a miniature leather jacket-like shape."[4]

DISEMBODIED CUISINE

An Australian group called The Tissue Culture and Art Project, have chosen to turn the practice of tissue engineering into the medium of their artworks. One of their most famous projects is the 'disembodied cuisine'. They procured cells from a living frog without killing or even hurting it and grew frog skeletal muscle over biopolymer for food consumption. The climax of this project was revealed in a feast at the international biological art exhibition 'L'art Biotech' in Nantes, France in March 2003, where the little pieces of this "victimless meat" were marinated in brandy, fried and then consumed by friends and other artists[5]. The various statements about Disembodied Cuisine that Catts and Zurr have published suggest that the project aims to move meat out of the strict category of 'animal' and into an emergent category of 'semi-living,' a category that skirts the edges of the animal, plant, microbial and synthetic worlds.

TWO-HEADED ZEBRAFISH

Adam Zaretsky's in his project 'Two-headed Zebrafish-embryo' attempts initial embryonic transplant Surgery. In the project Adam Zaretsky cuts of the head of a Zebrafish-embryo and tries to attach this to another embryo. The project takes place at a MIT-lab using standard techniques and following the ethical procedures of the lab. The project raises questions about whether an artist may do the same as a life scientist and it creates a platform for debate about ethical practice in the life sciences. At first sight we seem to encounter the paradox of bioarts here again. However, Zaretsky circumvents this paradox by apparently welcoming, rather than rejecting, biotechnological innovation and the creation of new forms of life : a Zebrafish with two heads[6].

BULLETPROOF SKIN

The project artist, Jalila Essaidi, worked with the Forensic Genomics Consortium Netherlands to develop human skin with a layer of transgenic spider-silk sandwiched between the epidermal and dermal layers. Dr. Randy Lewis from Utah State University produced the silk from goats and silkworms that have been genetically modified to produce the two proteins necessary to make spider silk. The silk is harvested from the animals and woven, using special bulletproof vest techniques, into a scaffold upon which are cultured human skin cells. Two types of silk were used to manufacture skin samples: one from unmodified silkworms and one from the transgenic silk. Essaidi mounted the skins on gelatin blocks and, using a high-speed camera, filmed bullets fired at the skins. A bullet fired at a reduced speed pierced the skin woven with an ordinary worm's silk. When tested with skin manufactured from Lewis' genetically engineered silk, the skin didn't break by the bullet[7].

GFP BUNNY

The creation of transgenic life forms has proven to be the most controversial type of bio-art. A transgenic organism is one that has had foreign DNA (from another animal, bacteria, fungus or virus) inserted into its genome. Therefore, the alterations of these interspecies 'collages' are permanent and inheritable. In 2000, the Brazilian-American artist Eduardo Kac collaborated with the artist Louis Bee and two scientists, Louis-Marie Houdebine and Patrick Prunet to create a cross-species rabbit called Alba, as part of *GFP Bunny* (where GFP is green fluorescent protein). By experimenting with a rabbit, a typical family pet as well as laboratory animal, Kac deliberately provoked dialogues about the use of animals in science and about the selective breeding of domestic pets. Indeed, Kac is clear that the creation of Alba was just one part of the artwork, with another based on the public debate raised by 'her' existence[8].

CONCLUSION

Even though, the directive of bioart is not to eliminate fear, but possibly to offer a means by

which both visionary and objective ideas concerning life, nature and design can be explored and expressed. Projects like Disembodied Cuisine aim to reduce the suffering of animals that industrialized meat production causes.

Animal rights groups accused Kac and others of using animals unfairly for their own personal gain. However, many BIO-ART projects deal with the manipulation of cells and not whole organisms, such as Victimless Leather. These projects were developed precisely to highlight and problematise our relationship to non-human animals and the use of animal products in scientific processes. Like other sciences, BIO-ART also has its pros and cones, but how we use it for the welfare of human kind without deteriorating other life forms is an important aspect to be thought upon. With the practical issues and the reaction of critics and the public, it's unlikely that the Victimless Leather jacket will appear in stores anytime soon (if ever). However, the idea of using tissue engineering to grow consumer goods, be it leather or another material, could be the next frontier of biotech companies sooner than we might think.

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A STEAMING CUP OF MEDICINE : GREEN TEA

Rakesh Kumar[1] and Binita Rani[2]

Green tea is one of the oldest beverages preferred by people round the globe and at all time it has been considered as one of the most utilitarian drink providing energy and removing traces of stress to refresh and rejuvenate the mind and soul. It contains no calories – so is useful to those who want to lose weight. Today's scientific research in both Asia and the West is providing hard evidence for several wide ranging health benefits associated with drinking green tea. So, we should go ahead to formulate a newer kind of green tea mixed anti-ageing drink and enjoy the magical drink which would have myriad therapeutic and medicinal properties.

Tea is the most consumed drink in the world after water, well ahead of coffee, beer, wine and carbonated soft drinks. An accumulated number of population studies suggest that consumption of green and black tea beverages may bring positive health effects. An ancient Chinese proverb goes thus – "*Better to be deprived of food for three days than tea for one*". Of the three major beverages of the world – tea, coffee and cocoa – tea is the most popular. Tea has a long and ancient history and has been associated with man since time immemorial. The use of green tea as a beverage dates back to 3000 BC. Green tea is tea made solely with the leaves of *Camellia sinensis* that have undergone minimal oxidation during processing. Green tea originates from China and has become associated with many cultures in Asia from Japan to the Middle East. Recently, it has become more widespread in the West, where black tea is traditionally consumed.

Green Tea is one of the elements that have proved its versatility in terms of various uses to a great extent. It is one of the oldest beverages preferred by people round the globe and at all time it has been considered as one of the most utilitarian drink providing energy and removing traces of stress to refresh and rejuvenate the mind and soul. Green tea is believed to have several wide ranging health benefits now supported by recent research. The Chinese have known about the medicinal benefits of green tea since ancient times, using it to treat everything from headaches to depression. It has been used as a medicine in China for at least 4000 years. The difference between green tea and other teas is that green tea is not fermented, thus keeping the powerful antioxidants lost in the fermenting process. Green tea is not oxidized at all; the leaves are steamed, rolled and dried. Green tea has a more delicate taste than black tea. Green tea is the variety that keeps the original colour of the tea leaves without fermentation. Green tea is prepared from unfermented leaves, the leaves of oolong tea are partially fermented, and black tea is fully fermented. The more the leaves are fermented, the lower the polyphenol content and the higher the caffeine content. Green tea catechin and black tea

1. Krishi Vigyan Kendra, Lodipur Farm, Arwal, Bihar.
2. KVK, Agwanpur Barh, Patna, Bihar.
E.mail : rakesh.dt27@gmail.com

directly act on the influenza virus and inactivate it. It appears that gargling with green or black tea is very effective in preventing influenza[1].

NUTRIENT PROFILE AND ANTI-OXIDANT PROPERTIES OF GREEN TEA

One of the major goodness of green tea happens to be that, it act as a major anti oxidant, which in turn provides the body protection from the free radicals. The free radicals are the natural components which add up momentum to the ageing process and give rise to illnesses of various forms. So, the most prominent goodness of green tea lie in the fact that it helps in delaying age and save you from getting affected by different diseases. The more a person will be exposed to sunlight, pollution and smoking, more the free radicals will increase in the blood stream. Including green tea in your lifestyle will help in preventing the harmful effects and keep you young for a longer period of time. Tea is also an important source of flavonoids in the diet with levels approaching 200 mg/cup for a typical brew of black tea. The flavonoids found in green and black tea is very effective antioxidants in vitro and may therefore be active as antioxidants in the body. Green tea contains polyphenols which are thought to improve health, particularly catechins, the most abundant of which is epigallocatechin gallate. *In vitro* and animal studies as well as preliminary observational and clinical studies of humans suggest that green tea can reduce the risk of cardiovascular disease and cancer as well as beneficially impact bone density, cognitive function, dental cavities, and kidney stones. However, the human studies are sometimes mixed and inconsistent. Green tea also contains carotenoids, tocopherols, ascorbic acid (vitamin C), minerals such as chromium, manganese, selenium or zinc, and certain phytochemical compounds. It is a more potent antioxidant than black tea although black tea has substances which green tea does not such as theaflavin. In addition to this there are four primary polyphenols in green tea and they are often collectively referred to as catechins. Powerful antioxidants, catechins have been shown in recent studies to fight viruses, slow aging and have a beneficial effect on health. The principal catechin is EGCG whose composition in green tea is believed to be 100 times more potent than vitamin C and 25 times better than vitamin E as an antioxidant. The production of free radicals is the body in the main cause of many 'lifestyle' diseases like diabetes, cataract, atherosclerosis, Alzheimer's disease and skin cancer. The antioxidants in green tea fight these free radicals and therefore these diseases[2]. The main green tea benefits include helping with cancer, infections, high cholesterols issues, impaired immune function, cardiovascular diseases and rheumatoid arthritis. The components that make drinking green tea bring all these benefits are called catechin polyphenols, and inside this group there is one particular anti-oxidant that stands out among the rest: epigallocatechin gallate or EGCG. As an antioxidant, EGCG inhibits the growth of cancer cells, and also kills these cells without making any damage to healthy tissue. As it has been said, it lowers cholesterols and aids in preventing heart attacks and strokes thanks that it prevents the formation of abnormal blood clots. This component also limits the negative effects of smoking and a diet with fat. Over the last few decades green tea has been subjected to many scientific and medical studies to determine the extent of its long-purported health benefits, with some evidence suggesting regular green tea drinkers may have lower chances of heart disease and developing certain types of cancer. Green tea has also been claimed as useful for "weight loss management" possibly by inducing thermogenesis and stimulating fat oxidation.

Biochemical significance of Green tea : Green tea antioxidants are vitamin C, E, minerals, and particularly polyphenols which are the powerful antioxidants found in green tea. Polyphenols are naturally occurring compounds in green tea that accounts for its unique flavor and antioxidant

potential. Its color is due in part to chlorophyll and in part to the polyphenols in green tea. Polyphenols, main green tea antioxidant, were found to be two hundred times the antioxidant punch of vitamin E (www.antioxidantdaily.com). Green tea's antioxidant polyphenols have four types. They are epicatechin, epicatechin gallate, epigallocatechin, and epigallocatechin gallate. These four polyphenols are often called catechins as a group. Among the polyphenols found in green tea, epigallocatechin gallate or EGCG stands out. According to research, the strong antioxidant properties of green tea are mainly due to the higher concentration of EGCG. EGCG extends it protective action over the fatty acids and lipids in the brain. These fatty acids and lipids, unfortunately, are very susceptible to the effects of free radicals resulting to rapid aging of the brain. By keeping these parts of the brain fresh, EGCG helps to keep us young and alert.

Green tea can be found in the form of **"tea bags", capsules** and even **powder**.

HEALTH BENEFITS OF CONSUMING GREEN TEA

Cardiovascular Diseases

Green tea represents a promising tool for the prevention of cardiovascular disorders. The antioxidants in green tea decrease the risk of blood clots, blood pressure, blood sugar and bad cholesterol and so provide protection against cardiovascular diseases. A series of animal and human studies have highlighted the heart-friendly activity of green tea. Green tea is also believed to improve the LDL-HDL cholesterol ratio, triglycerides and fibrinogen – all blood indicators of heart disease. Green tea helps to reduce cholesterol levels. Japanese studied and confirmed that regular green tea consumption provides protection against coronary artery disease[3]. The more green tea people consume the less likely they are to have coronary artery disease. Underlying mechanisms for the heart beneficial effects of tea include vasculoprotective, antioxidative, antithrombogenic, anti-inflammatory, and cholesterol-lowering properties of tea flavonoids.

Cholesterol-Lowering Effect

Green tea lowers total cholesterol and LDL cholesterol levels and improves the ratio of HDL cholesterol to LDL cholesterol. Studies[4] have shown that people who drink green tea as a daily part of their diet have lower cholesterol levels than those who do not drink any green tea. It was observed that, on average, the more green tea that people drink the lower their total and LDL cholesterol levels were observed. In one human study, as little as 2 cups per day lowered LDL cholesterol levels by as much as 13 mg. Green tea may also help keep cholesterol levels down even when the diet is high in fat. Studies of animals fed a diet rich in lard and cholesterol found that those receiving green tea catechins had lower cholesterol levels and other indicators of heart disease risk than those that didn't receive the catechins. Researchers believe that one of the underlying mechanisms by which green tea lowers blood cholesterol levels is by reducing lipids absorption in the digestive tract and promoting their excretion from the body.

Good for Teeth

Green tea is effective and proven remedy to prevent tooth decay. It kills the bacteria that cause dental plaques and halitosis (bad breath) and increases the acid resistance of tooth enamel[5]. Green tea also contains fluoride which is good for teeth. It can kill the bacteria that cause dental plaque. It checks dental decay by inhibiting the growth of oral bacteria and so fights cavities. When used as a mouth rinse, this herbal drink reduces plaque formation. It also counters bad breath[3].

Cancer Fighting Properties

A new study published in the Clinical Cancer Research reveals how green tea works to curb the development of bladder cancer. Green tea extract inhibits the growth and proliferation of cancerous

cells, the study claims. Researchers at the University of California Los Angeles (UCLA) have found that green tea was able to target cancer cells while leaving healthy cells alone.

Liver Protection

Green tea appears to support healthy liver. Population-based study has shown that men who drink more than 10 cups of green tea per day are less likely to develop disorders of the liver. Animal studies demonstrated that green tea helps to protect liver from the damaging effects of toxic substances such as alcohol.

Stress Buster

Catechin, present in green tea removes sleepiness and works as a stress buster. If you are in need of an extra boost, then green tea with the caffeine content is a good stimulant for short time energy. The drink has got a diuretic effect and prevents rashes, indigestion and disease called beriberi. Green tea chemicals destroy harmful microbes only.

Helps in Losing Weight

There is strong evidence that green tea has fat-burning properties and promotes weight loss, especially when combined with increased physical activity and a healthy diet. Green tea polyphenols are known to promote weight loss by increasing the metabolism of fats by the liver (thermogenic effect), inhibiting lipase (fat absorption enzyme) in the digestive tract, and providing a feeling of satiety and fullness[6]. Recent high-quality study demonstrated that green tea can reduce body weight in obese persons by increasing energy expenditure and fat oxidation. The results of a Japanese study also confirm fat-burning properties of green tea. Dulloo *et al.* showed the effects of green tea extract on energy "burning" in humans[6]. It was concluded that the men who took daily doses of a green tea extract containing EGCg plus caffeine, in an amount equivalent to that found in about 3 cups of green tea, burned about 80 more calories per day than those who didn't take the extract.

New evidence is emerging that green tea can even help dieters. It contains no calories – so is useful to those who want to lose weight. Researchers have found that men who were given a combination of caffeine and green tea extract burned more calories than those given only caffeine or a placebo. Green tea is less processed than black tea and contains rich sources of antioxidants which protect the body's cells from damage.

Antimicrobial Activity

Green tea catechins have anti-bacterial, anti-viral and anti-fungal activity[7]. These include some types of salmonella, influenza virus and herpes simplex. Its bacteria-destroying abilities can help prevent food poisoning. A US study suggests a component of green tea may be useful in treating severe sepsis, an abnormal immune system response to a bacterial infection.

GREEN TEA AND INTESTINAL BACTERIA

Lee *et al.* showed the amazing effects of tea catechins was their ability to destroy disease-causing bacteria like *E. coli, Salmonella*, *Staphylococcus aureus* and *Clostridium*, especially when they reside in the digestive tract[8]. Catechins also inhibited the growth of the disease-causing bacteria, especially *Clostridium perfringens* (a common cause of food poisoning), *Clostridium difficile* (which is linked to colitis), and *Bacteroides* (which can cause abscesses if the bacteria escape from the intestines). But the gut's "friendly" bacteria, including *Bifidobacterium* and *Lactobacillus,* were relatively unaffected by the tea catechins[8].

Retarding the Development of Arthritis, Parkinson's and Alzheimer's

Green tea has the power to subdue the enzyme that ruins cartilage and thus helps you in keeping away from contracting arthritis. Alzheimer's is mainly caused due to reduction in the level of

acetylcholine in the brain. Green tea defends against the reduction of acetylcholine and aids in slowing down the process of Alzheimer's contraction. Green tea protects the destruction of brain cells thereby making the probability of contracting Parkinson's to minimal levels within our body. Parkinson's is a chronic, progressive movement disorder that causes symptoms such as tremor, slowness of movements, limb stiffness, and difficulties with balance and coordination. Researchers at Singapore's Yong Loo Lin School of Medicine and National Neuroscience Institute have recently found that drinking just 6 oz. of black tea per day may lower the risk of developing Parkinson's by over 70 percent. They speculated that the flavonoids, with their anti-inflammatory effects on the cardiovascular system, may help ward off Parkinson's by increasing circulation to the brain.

Anticlotting Effect

Green tea also appears to prevent the formation of blood clots (thrombosis). Green tea catechins produce potent antithrombotic effect by inhibition of platelet aggregation (blood clot formation).

Increased Exercise Endurance

Animal studies indicate that green tea increases exercise endurance. Green tea catechins increase metabolic capacity and utilization of fatty acid as a source of energy in skeletal muscle during exercise.

As a Beauty Aid

Many skin preparations contain green tea extracts – from deodorants to creams. Recent research suggests that green tea may protect the skin against the damage caused by ultraviolet rays.

OTHER HEALTH BENEFITS

Green tea helps to reduce the severity of rheumatoid arthritis, cataract, diabetes and impaired immune infection. It fights viruses and can help protect your joints and stave off arthritis in two ways – by reducing inflammation and by protecting against cartilage breakdown. It can even help improve joint mobility. It is believed to help boost immunity with its stimulating effect on the immune system. It acts as a herbalist for aiding in the circulation of the blood, a detoxifier for the blood and an aid in curing liver ailments. Green tea is also good for women experiencing menopause, being a good source of vitamins and minerals.

Fights Against HIV

Being an anti bacterial agent, green tea is said to prevent the HIV from getting bound to the healthy cells of your body with ease.

Improved Memory and Learning Ability

One of the important health benefits of regular green tea drinking is improved memory and learning ability. Population-based study in Japan revealed that high green tea drinking maintains cognitive function. Also, according to the results from animal studies[9, 10], green tea consumption may enhance learning and memory ability. The main components of green tea that are thought to work on improving brain function are polyphenols, epigalochatechin-3-gallate (EGCG), a very strong antioxidant. The high use of oxygen during the metabolic processes leads to the generation of a large number of free radicals (a highly reactive molecule). EGCG can penetrate the brain's blood barrier and is able to enact its antioxidative affects on the free radicals that cause damage in the brain[9, 10].

Today's scientific research in both Asia and the West is providing hard evidence for the health benefits long associated with drinking green tea. So, we should go ahead to formulate a newer kind of anti-ageing formulated drink and enjoy the magical drink which would have myriad therapeutic and medicinal properties.

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THE ARCHITECTURAL MIND AND 'ME'

Debjani Mukherjee* and Devaditya Mukherjee**

Architecture has been found to control the human behavior. Home, is part of our self-definition. People display their home as an extension of themselves. Architectural psychology focuses on the aspect of how we can design buildings better for occupants. Architect should turn on his instinctive, emotional brain and comprehend the need of the occupant and design a space that facilitates mental health positively.

Home for most people is part of their self-definition. This is why we decorate our houses, tend to our garden spaces, landscape the surrounding areas and make the entrance attractive. Apart from giving vent to the aesthetic and creative mind, these efforts are part of a public face people put on, displaying their home as an extension of themselves.

Architectural psychology focuses on the aspect of how we can design buildings better for occupants. By understanding more about how occupants experience built form, an architect should take on a more occupant-centered approach. It is this type of approach that will lead to more truly innovative architectural designs, that absorbed the ideas of the client into his own aesthetic theory and correlate it to the nature and needs of the occupant.

Peter Sear[1] observed that, 'Psychologists regularly employ architectural metaphors. They talk of structures, levels, depths, building blocks and windows to the soul. This shared language hints at an intimate relationship.' Architecture has been found to affect human behavior. Architecture can be perceived as purely functional, although some, but certainly not all can be the aesthetically pleasing, similar to the affect of any art form. It can also be an expression of cultural pride, societal passion, or national esteem[2]. Research supports the idea that architectural design and the structure of space, the number and spacing of windows, and lighting affect people. Furthermore, "architectural design has strong but modifiable effects on social behavior and users' mood and productivity and, to some extent, design features also affect health and wellbeing"[2]. According to Joye[3], "our surroundings influence not only the way we think but our intellectual development"

Gestalt psychology says that humans perceive objects as a whole that is the overall effect gets imprint in the brain, small missing out the Gestalt psychology suggests humans experience the influence of architecture as their brains have a proclivity to infer rhythm and patterns of space and structure, which influences behavior[3].

Carl Jung[4] described a building as 'a structural diagram of the human psyche.' Like art, architecture offers a vehicle for conveying our deepest thoughts. Jung rarely wrote explicitly about architecture, but demonstrated how important surroundings were to him by carefully building his own tower at Bollingen, and subsequently dedicating a whole chapter of his book, Memories Dreams and Reflections, to it.[4] The tower was 'an expression of Jung's inner world.' Jung confessed that it represented a 'psychic wholeness.'The tower became a place where Jung felt at home, a space in which he could thrive. The building climbed up from the

* Dept. of Psychology, St Thomas College, Bhilai.
** Architectural Designer, Perkins Eastman, Mumbai.
Email :

depths of his unconscious to become a shelter precise for him and his work.

Architecture has been found to control the human behavior. "The structural design or arrangement of space imposes restrictions on behavior. Doorways determine our access to a room and room dimensions restrict the kinds of behaviors that can take place inside a room"[2]. A building's interior must create the appearance of space, regardless of its actual size because space makes inhabitants believe they have the choice between interaction and isolation. Individuals report a more positive sense of control when their environment allows them to choose interaction or isolation rather than experiencing both randomly thrust upon them. The psychological effects of crowding have been associated with arousal and stress.

When individuals perceive ample space, they report feeling a stronger sense of control over their environment and are less prone to anxiety over minor annoyances, stress, and aggression. Furthermore, ample space has a pervasive effect on subjective well-being and health[5]. In a study of dormitories[6], overwhelming evidence determined the design and layout of internal space affects the stress of psychological crowding and demonstrates architectural design has a mediating effect on social behavior. Whereas crowding has been linked to aggression, social withdrawal, increased criminal acts, and inappropriate interaction, privacy is strongly correlated to less social withdrawal, a sense of control, positive mental health and task performance, and a decreased tendency to react negatively to minor annoyances[5]. Küller, Ballal, Laike, Mikellides, and Tonello[7] found the effects of light and color in the workplace had a significant influence on the mood of individuals working in the space. When individuals perceived the lighting as inadequate or too bright, their moods declined, but when the lighting was adjusted and perceived as right, their moods reached the highest levels.

As Jung said, 'I had to achieve a kind of representation in stone of my inner most thoughts and of the knowledge I had acquired. Or to put it another way, I had to make a confession of faith in stone.'[4]

Peter Sear[7] wrote, 'Le Corbusier talked about more successful projects than the ones he left us with. He spoke of 'alchemical symbolism,' the 'masculine and feminine,' and 'psycho-physiological reactions in man.'[8] Yet his buildings are widely considered to be cold, silent and lacking soul.'

These criticisms were corroborated by the Technological historian and architecture critic Lewis Mumford[9] who wrote in *Yesterday's City of Tomorrow* that, 'the extravagant heights of Le Corbusier's skyscrapers had no reason for existence apart from the fact that they had become technological possibilities. The open spaces in his central areas had no reason for existence either. Since on the scale he imagined there was no motive during the business day for pedestrian circulation in the office quarter. By "mating utilitarian and financial image of the skyscraper city to the romantic image of the organic environment, Le Corbusier had, in fact, produced a sterile hybrid.'

Criticizing the master designer is easier said than done. The end user of that space is the best critique and if he feels that there has been an integrative approach of his mental leanings with that of the architect, all controversies has to vanish.

The present study on 'Human Psyche and Artistic Wellbeing behind Personal Spaces: Housing' was carried out in various cities across India, where randomly 50 people who got their houses designed and built by an architect and a civil contractor, were interviewed. Most of the respondents stressed upon the fact that they took the pains of going for a custom made house, so that their dreams of living in a comfort zone were realized. This space being their baby, was an idea in their mind initially, and took shape just as they wanted and later residing there, is like giving birth to a baby and nurturing and raising it. But that does not mean that people who go for readymade homes, don't let their creative genes wonder out to their living areas.

It cannot be negated that the interiors also say much about the person. The house, its architecture, outside maintenance, interiors and orderliness speak a lot of the inhabitants of that space. Money, though has an important hand in all these, is a secondary factor where aesthetics and creative genre is concerned. Almost all the respondents initially made the architect aware of their personal need and likings before he embarked on the actual designing of the house. 36 people reported that they were totally satisfied and happy with the design they got from the architect. They felt that the designer was able to comprehend their need and was able to convert their vision into a spatial design. They feel positive energy and happy when at home and relaxation is maximum in that domain. Rest 10 were not too satisfied with the end result and felt the architect didn't have the vision to read their mental makeup and convert it into a home that they desired. These respondents feel mentally traumatized about not getting what they had visualized and feel helpless that they cannot do much about it without spending more money. 4 respondents primarily blamed themselves for certain mistakes that they had demanded in the design of their house and later found it not very appropriate. This creates immense agony in them even after years of residing in that house. They somehow felt the designer should have advised them forcefully and not executed such a plan.It is the architect, who after all is the trained person!

This proves that architecture is directly attached with human psychology from conscious to subconscious level. Some of the areas of architecture that the respondents found to be affecting them are:

- Building design
- Positive and negative spaces
- Colors
- Open spaces
- Openings
- Lighting- natural and artificial
- Acoustics
- Landscapes

CONCLUSION

We can say that an architect should turn on his instinctive, emotional brain, keep aside his own personal and design ego and pretend he is a 70-year old and a 10-year old. He should ask himself how the design makes him feel and behave. Does the building or landscape reduce or induce stress? Does this place make people healthier and happier? Stress is directly linked to most of the diseases, so all buildings and landscapes must work to reduce this,leading to everybody's well-being and a healthy society.

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HEAVY METAL TOXICITY

Abhijit Panigrahi

Several hazardous effects of heavy metals depicting different physiological and biochemical problems have been already reported. Various heavy metals such as lead, cadmium, zinc, mercury, copper, arsenic, gold, nickel, palladium etc. are dispersed in our dwelling environment comprising plants, animals, humans, air, water, soil etc. Heavy metals causing adverse effects are the most toxic substances to human and animals.

INTRODUCTION

In our everyday life all the creatures of the environment are continuously exposed to various metal pollution from several sources. The concept that heavy metal toxicity in experimental animals and human beings may be greatly modified and indeed modulated by the nutritional status of the animal or person is firmly rooted in a great number of reports. Toxicity of heavy metals cannot be assessed without definitive control of dietary intake and nutritional status of either the experimental animals or human subject. Extrapolation of results of animal experiment to human problems of heavy metal toxicity may be much more reliable and more satisfactory. The concept of nutritional modulation of chemical toxicity is an important subject for our study.

Toxicology is the study of the adverse and harmful effects of chemical agent on any biologic system. Toxicology embraces other scientific disciplines such as chemistry, biology, physiology, nutrition, pharmacology, pathology, immunology and medicine. It comprises many areas of service and research. Metals occur naturally in the earth's crust, and their contents in the environment can vary between different regions resulting is spatial variations of background concentrations. The distribution of metals in the environment is governed by the properties of the metal and influences of environmental factors.

The progress of evolution is a response to the ever-changing environment. Animal requirements for certain metal are a direct outgrowth of this association. The actual and potential problems of metal toxicity are often examined with too – limited knowledge by environmentalists. Experiments readily show that any compound is harmful if given in excess.

Most environmental changes of the earth are slow enough to permit living forms to adapt to the changes. In the past two decades, science, industry medicine, and agriculture have exposed man and his world to ever-increasing number of exotic chemicals represented by metal dusts and new organic chemicals. Not only the metal pollutants but non-degradable and bio-degradable pollutants also interfere with the bio-environmental processes and thereby posing a threat to the life on this planet.

Knowledge of the relationship between food and harmful material has developed scientifically in separate compartments as (i) Essential metals, (ii) Toxic metals (iii) Radioactive metals (iv) Stimulatory compounds and (v) nonreactive or

* Department of Physiology, Basirhat College, North 24 Parganas–743412, W.B. E-mail : abhi.panig@gmail.com

nontoxic metals. Now the discussion will be about toxic metal. We know the various toxic metals in nature are Cu, Ag, Au, Hg, Cd, Pb, Sn, As Sb, Pd etc. Metal and their compounds are major components of pollution and they have got an important role in carcinogenicity and teratogenicity, but all metals are not as harmful as the only mentioned above. In limited concentration many metals are even essential for the sustenance of living forms.

The contamination chain of heavy metals almost always follows a cyclic order: industry, atmosphere, soil, water, foods and human (Fig-1). Aquatic animals are sensitive to heavy metal pollution. Of them, fish is a great biomarker of metal pollution in

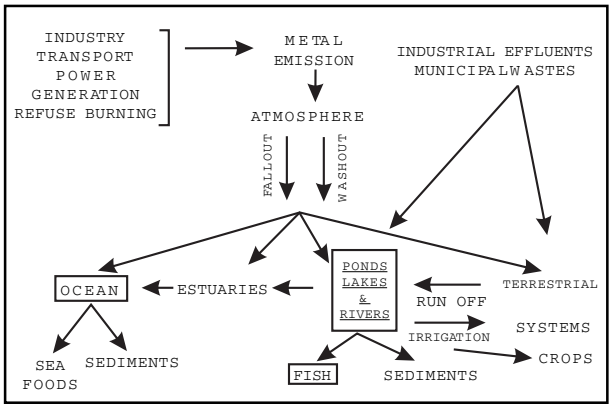

Fig. 1 : Dispersion of Metals in Environment (Water System and Land or Soil)

water. Different metals are deposited in their various organs. Fish scales exhibit the highest concentration of Cd, Pb, Cr, Ni, Zn etc. (0.888 μg/g, 0.95 μg/g, 0.30 μg/g, 0.25μg/g, and 0.63 μg/g respectively). Although toxicity and the resulting threat to human health of any contaminant are, of course, a function of concentration, it is well known that chronic exposure to heavy metals and metalloids at relatively low levels can cause adverse effects.

Metals for which there are no nutritional requirement may react with biological system to cause adverse effects. Excessive doses of nutritionally essential metals can also cause adverse effects. Excessive absorption and/or renal insufficiency or biliary obstruction lead to the breakdown of homeostatic mechanisms and to the accumulation of metals in tissue levels to cause toxic effects.

The toxicity of a metal depends on the inherent capacity of a material to affect adversely any biologic activity. Depending on the characteristics and dose, a metal may be innocuous, essential as a nutrient, stimulatory, therapeutic, harmful, or lethal. The response varies according to the environment, diet and condition of the animal, as well as the form, dosage and mode of administration of the metal or its salt. Many metals act as short term poisons or toxicants in high doses and as long term systemic poisons in low doses.

Effects of a metal can be categorized as doses that cause: (i) no symptoms or detectable effects (ii) stimulatory effects (iii) therapeutic effects (iv) toxic to harmful effects and (v) death.

The environmental quantities of all minerals and their salts must be maintained at level compatible with continued optimum health and existence.

The availability of many metals in minerals depends on the same properties, such as solubility and reactivity, that make them useful in living systems. Certain environments develop unusually high concentrations of specific elements. Alkaline salts make some streams undrinkable. The oceans are so hypertonic that they are harmful to non adapted mammals.

Continuous exposure to small quantities of metals produces cumulative effects that may result in chronic poisoning with metabolic, nutritional, and neurologic symptoms. In larger does, these salts become acutely toxic. The toxicity depends on the physicochemical properties of the salt.

POLLUTION HAZARDS

The inherent toxicity of a metal in biologic system depends on its electrochemical character

and oxidation state, its absorption and transport in body tissues, the stability and solubility of its compounds in body fluids, its case of excretion and reaction with functioning tissues and organelles and with essential metabolites. Some species of fish can accumulate high concentration of Zn in gills, Pb in liver, Cd in liver, Cu in kidney, As in kidney. It has also been reported that the acceptable limit for consumption for the metals are as follows : Pb–0.29 ppm, Zn–5 ppm, As-0.01 ppm, Cu-0.5 ppm and Cd-0.05 ppm. Toxic metals (including excessive levels of essential metals) tend to change biologic structures and systems into irreversible and inflexible conformations leading to deformity or death. For example, acute Hg toxicosis from oral ingestion of Hg Cl_2 causes severe course of nausea, vomiting and diarrhea resulting death due to circulatory failure. Chronic Hg toxicosis causes progressive renal failure with circulatory and neuromuscular abnormalities. The basic reactions are possible between metals and other biochemical constituents. This leads to a better understanding of co-ordination, chelaton ligand formation and metal interaction with proteins nucleic acids, carbohydrates and lipoprotein of cell membranes and organelles. At the cellular level, derangement of cell membrane permeability and antimetabolite activity are the effects of metal toxicity. Metal can interact wth protein leading to an allosteric effect, or with DNA or RNA to stop normal metabolism or with unknown compounds leading to a change in physiologic process and a change in behaviour and change in ecological system. More than one system is affected by each toxicant. Lead, zinc, copper, nickel, silver etc. cause pollution hazards to the marine ecosystem.

Changes in rates of the catalytic decomposition of essential metabolites, enzyme inhibition and irreversible conformational changes in macromolecular structure are some of the effects of metal toxicity at the molecular level. Complex and highly integrated activity of mitochondria should be profoundly affected by many of these metals in *vitro*. The heavy metals that presently are considered toxicological hazards in the environment include Pb, Hg and Cd. and some other metals also. Toxic heavy metals like lead, arsenic, silver, copper, zinc, chromium, mercury, cadmium etc. have been detected about the permissible levels in some rivers lakes and coastal waters of Bombay, India and other countries also because of the vast release of industrial effluents from the nearby processing industries. Surveys at the coastal waters of Bombay have revealed high content of mercury in the fish at the level of 80 – 120 μg/gm, fishes from Thane and Mumba Creek have the mercury level about 500 mg/gm due to effluents containing mercury from the nearby chlor-alkali plants and paper pulp industries. Water from Kalu river, a potential source of water supply of Bombay have shown a high content of lead, copper, mercury and cadmium. It has also reported that soil samples chosen from different sites of a cable factory of Rupnarayanpur (West Bengal) about 100 km away from the plant have shown significant amount of lead (517-2000 ppm), copper (850-1770 ppm), cadmium (16-44 ppm) and nickel (upto 241 ppm). Studies carried out indicate extensive damage to the ground water quality from effluents of electroplating wastes. High concentrations of cyanide (2 mg/L), hexagonal chromium (12.8 mg/L) have been observed in ground water of Ludhiana, Punjab; chromium of 2mg/L in ground water of Varanasi, 21 mg/L in Kanpur, U.P. have also been observed to be present. It is also reported that 80 μg of arsenic and 40 μg of lead per 100 ml of blood cause poisoning in adult and children (brain damage) respectively, small increase in mercury level can damage to aquatic life, i.e., plants (algae), and animals (fish) of which mucous secretions of gills are precipitated resulting the arrest of interlamellar spaces and the movement of gill filaments thereby preventing respiration and also metabolic upset in some organs.

LEAD TOXICITY

Lead as a toxicologically relevant element has been brought into the environment by man in extreme amount, despite its low geochemical mobility and has been distributed worldwide. Lead amounts in deep ocean water is about 0.01-0.02 μg/L, but in surface ocean water is about 0.3 μg/L. Lead still has a number of important uses in the present day; from sheets for roofing to screens for X-rays and radioactive emissions. Like many other contaminants, lead is ubiquitous and can be found occurring as metallic lead, inorganic ions and salts. It is principally derived from coal and oil.

Food is one of the major sources of lead exposure; the others are air (mainly lead dust originating from petrol) and drinking water. Plant food may be contaminated with lead through its uptake from ambient air and soil; animals may then ingest the lead contaminated vegetation. In humans, lead ingestion may arise from eating lead contaminated vegetation or animal foods. Another source of ingestion is through the use of lead-containing vessels or lead-based pottery glazes. The WHO provisional guideline of 0.01 mg/L has been adopted as the standard for drinking water (WHO, 2004 a).

The toxicity of lead and its compounds are well known and extremely documented. Exposure of man and animals to lead toxicity from the environment, food, water and inhalation of cigarette smoking is increasing. Lead is a cumulative poison that causes both chronic & acute intoxication. Chronic exposure to Pb cause its deposition and immobilization in the bone, from where lead can be mobilized following metabolic disturbances.

The G.I. absorption of Pb is increased by low dietary Ca and high dietary vitamin D. The absorption of inhaled Pb salts is rapid and complete. Pb permeates the placental barrier; Pb toxicity is related to the levels of diffusible Pb and its content of soft tissues, not to the content of Pb.

Acute Pb toxicity symptoms in man are lassitude, vomiting, headache, loss of appetite, loss of memory, uncoordinated body movements, encephalopathy, convulsion, stupor and coma. The other symptoms take a long time to appear as chronic toxicity. They are renal malfunction, anemia, brain and liver damage, joint pain, cancer, hyperactivity and general psychologic impairment. Lead toxicity in experimental animals includes reduced growth and longevity, impaired renal and reproductive function, splenomegaly, damage to hemo-poietic, central and peripheral nervous system, premature loss of teeth and reduced immune capacity. The detrimental effects in hemopoietic system are abnormal and fragile RBC, impairment in hemoglobin formation by the inhibition of the enzyme delta-ALAD in RBC by lead toxicity. Acute symptom occurs at the blood level of 100–200 μg/dl in adults and 80 –100 μg/dl in children. Chronic symptoms occur at blood level of 50–80 μg/dl.

Signs of chronic lead toxicity appears in adults are tiredness, sleeplessness, irritability, headache, gastrointestinal symptoms etc. The only clinically well-defined symptom associated with the inhibition of haem biosynthesis is anaemia which occurs only at blood lead levels in excess of 40 μg/dl in children and 50 mg/dl in adults. The activity of d-ALAD is a good predictor of exposure at both environmental and industrial levels and inhibition of its activity in children has been noted at a blood lead level as low as 5μg/dl, however, no adverse health effects are associated with its inhibition at this level. Gonadal dysfunction in man, including depressed sperm count has been associated with blood lead levels of 40-50 μg/dl. Reproductive damage may also occurs in female occupationally exposed to lead. A study on 700 smelter workers (mean blood level 79.7 μg/L) and battery factory workers (mean blood level 62.7 μg/L) indicated an excess of death from cancer of the digestive and respiratory systems.

CADMIUM TOXICITY

Cadmium is naturally present in the environment: in air, soils, sediments and even in unpolluted sea water. Cadmium is emitted to air by mines, metal smelters and industries using cadmium compounds for alloys, batteries, pigments and in plastics. This metal toxicity causes reproductive and hepatic damage, pulmonary disorder, hypertension, anemia and even prostrate cancer. This toxic heavy metal causes hazards to marine ecosystem.

ZINC TOXICITY

This toxicity occurs from metal welder, zinc containing pesticides etc. Acute and chronic doses of zinc salt can also cause hematological disorder like reduction in RBC and WBC number, Hb content and it can also diminish protein and nucleic acid content of liver, kidney and spleen in experimental animal after accumulation of that metal. Zinc pollution happens kidney problems, pain in leg, fever, vomiting and renal dysfunction, diarrhoea, pancreatitis and pulmonary fibrosis.

COPPER TOXICITY

Copper is an another toxic heavy metal which also affects blood parameters and tissue proteins and nucleic acids. Copper pollution causes mental disease, coma, anemia, pathological changes in brain tissues, liver and kidney damage, stomach irritation in human being. Copper toxicity can be dispersed from copper pickling and plating, cable factory etc. Acute and chronic treatment with acetate salt of copper (5, 10 and 20×10^{-9} mol/g) cause significant deduction in RBC number, Hb content and PCV. But plasma protein is only reduced with low concentration (5×10^{-9} mol/g) and high concentration of copper (20×10^{-9} mol/g) in a teleost, magur fish. Low, medium and high concentration of copper also diminish protein, RNA and DNA of liver, kidney and spleen of magur fish. Copper exposure suppresses specific antibody responses and increases evidence of the fish disease. It has been studied with different concentrations of copper as $CuSO_4$ (0.5 and 2.0 ppm). Low dose of copper (0.5 ppm) induce mild oxidative stress with concomitant elevation of GSH (glutathione) and ASA (ascorbic acid) content as antioxidants muscle, kidney, liver, gills of widely consumed freshwater Rohu fish. High concentration of copper (2 ppm) leads to severe oxidative stress manifested in the form of LPX and morphoanatomical alteration.

MERCURY TOXICITY

Mercury is one of the most toxic heavy metals in the environment. Man released mercury into the environment by the actions of the agriculture industry, by pharmaceuticals, as pulp and paper preservatives, catalysts in organic syntheses, in thermometers and batteries, in amalgams and in chlorine and caustic soda production. Exposure to high levels of metallic, inorganic, or organic mercury can permanently damage the brain, kidneys, and developing fetus. Low and high concentration of mercuric chloride (2 mg/kg body weight and 4 mg/kg body weight respectively) alter the testicular enzyme activity by decreasing several ATPase and by increasing acid and alkali phosphatase in adult albino rats. A single injection of all the concentration of mercuric acetate (5, 10 and 20×10^{-9} mole/g) cause reduction in red blood cell number, hemoglobin content, protein and nucleic acid content of liver, kidney and spleen of magur fish (*Clarias batrachus L*).

A glaring and fatal example of marine pollution through heavy metals was recorded among the residence on the shores of Minamata Bay in 1953 and Niigata Islands in 1965 both in Japan. Both human beings and mammals of this region were serious affected. Methylmercury chloride was identified as the causal toxin, as a byproduct of the manufacture of polyvinyl chloride resin, octanol and dioctol thalate with acetaldehyde as the initial material. Both mercury and methylmercury accumulation occurred in marine organism.

The most noted mercury poisoning was the outbreak of "Minamata Disease" in Japanese persons due to consumption of fish as food from the contaminated water. This metal causes headache,

diarrhea, blood malfunctioning, defective visions, mental retardation etc.

Permissible limits of certain heavy metals in human beings are: Ni -0.2ppm, Pb-01 ppm, As-0.1 ppm, Cd-0.003 ppm, Cr-0.05 ppm, Cu-2.0 ppm, Zn-<5.00 ppm, Hg-0.001 ppm.

CONCLUSION

Heavy metals have been proved to be toxic to both human and environment health. Owing to their toxicity and their possible bioaccumulation, these compounds should be subject to mandatory monitoring. Several suitable separation and detection methods are available for laboratories engaged daily in routine analysis of a large number of biological or environmental samples. Governments should promote harmonized data collection, research, legislation and regulations, and consider the use of indicators.

Some recommendations of the sectional committee of the section of Environmental Sciences emanating from the 98th Indian Science Congress organized by ISCA held in January, 2012 had already been taken in respect of control of environmental pollution and also sustenance of the environmental management.

It may be concluded that a holistic approach is essential for the abatement of environmental pollution. So, it is very necessary to control and reduce this pollution as much as possible so that all the living beings would become healthy in harmless environment by which our human society would be benefited much with their safe life and good health.

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LIST OF ISCA AWARDEES FOR 2013-2014

ASUTOSH MOOKERJEE MEMORIAL AWARD

No Award

C.V. RAMAN BIRTH CENTENARY AWARD

Dr. Rajendra
Vice-Chancellor, Division of Molecular Biology, Department of Zoology, Sri Venkateswara University Tirupati, A.P.

SRINIVASA RAMANUJAN BIRTH CENTENARY AWARD

No Award

JAWAHARLAL NEHRU CENTENARY AWARD

(i) **Prof. Upendra Nath Dwivedi**
Dean, Faculty of Science & Professor of Biochemistry, Lucknow University, Lucknow.

(ii) **Dr. Arun Nigavekar**
Former Vice-Chancellor,
University of Pune, Pune.

M. N. SAHA BIRTH CENTENARY AWARD

No Award

P.C. MAHALANOBIS BIRTH CENTENARY AWARD

Dr. R. Laxman Karandikar
Director, Chennai Mathematics Institute,
H1 Sipcot IT Park, Siruseri, Tamilnadu.

J. C. BOSE MEMORIAL AWARD

Prof. S. M. Paul Khurana
Director, AIB, Amity University, Noida.

P. C. RAY MEMORIAL AWARD

No Award

H. J. BHABHA MEMORIAL AWARD

Dr. G. Satheesh Reddy
Director, Research Center Imarat,
Vignyanakancha P. O., Hyderabad.

B. P. PAL MEMORIAL AWARD

Prof. P. C. Trivedi
Former Vice Chancellor, Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur (U.P.)

VIKRAM SARABHAI MEMORIAL AWARD

No Award

M. K. SINGAL MEMORIAL AWARD

Dr. Sukumar Das Adhikari
Tata Institute of Fundamental Research, Mumbai.

PROF. R. C. MEHROTRA MEMORIAL LIFE TIME ACHIVEMENT AWARD

Prof. Avijit Banerji
Retired Professor of Chemistry
University of Calcutta, Kolkata.

MILLENNIUM PLAQUES OF HONOUR

(i) **Prof. S. P. Singh**
Professor Emeritus,
Dept. of Chemistry, Kurukshetra University. Kurukshetra.

(ii) **Prof. Asim Kumar Pal**
National Fishereis University, Under. I.C.A.R. Ministry of Agriculture, Govt. of India,
New Delhi.

EXCELLENCE IN SCIENCE & TECHNOLOGY AWARD

No Award

JAWAHARLAL NEHRU PRIZE

No Award

B. C. GUHA MEMORIAL LECTURE

No Award

RAJ KRISTO DUTTA MEMORIAL AWARD

Prof. Tanya Das
Division of Molecular Medicine,
Bose Institute, Kolkata.

G. P. CHATTERJEE MEMORIAL AWARD

Dr. Mrutyunjay Suar
Department of Biotechnology,
KIIT University, Bhubaneswar.

PROF. S. S. KATIYAR ENDOWMENT LECTURE

No Award

PROF. SUSHIL KR. MUKHERJEE COMMEMORATION LECTURE

Prof. Prabir Kumar Ghosh
Director, Indian Grassland and Fodder
Research Institute, Jhansi.

PROF. ARCHANA SHARMA MEMORIAL AWARD

Dr. Satish Chandra Verma
5452/1, CAT-2, M.H.C. Manimajra,
Chandigarh.

DR. V. PURI MEMORIAL AWARD

Dr. Paramvir Singh Ahuja
Director, CSIR—Institute of Himalayan Bio resource Technology, Post Box-6, Palampur H.P.

PROF. G. K. MANNA MEMORIAL AWARD

Dr. Subodh Kumar Jain
Department of Zoology,
Dr. H. S. Gaur University, Sagar.

PROF. HIRALAL CHAKRAVARTY AWARD

No Award

PRAN VOHRA AWARD

No Award

PROF. UMAKANT SINHA MEMORIAL AWARD

Dr. Vikas Kumar Dubey
Associate Professor,
Department of Biotechnology,
Indian Institute of Technology, Guwahati, Assam.

DR. B. C. DEB MEMORIAL AWARD FOR SOIL/ PHYSICAL CHEMISTRY

Dr. Soumen Hajra
Department of Chemistry, IIT, Kharagpur.

DR. B. C. DEB MEMORIAL AWARD FOR POPULARIZATION OF SCIENCE

Dr. Narottam Sahoo
Senior Scientist, Gujarat Council of Science City,
Science City Road, Ahmedabad.

PROF. K. P. RODE MEMORIAL AWARD

Prof. G. S. Roonwal
Inter University Accelerator Center,
Aruna Asaf Ali Marg, New Delhi.

DR. (MRS.) GOURI GANGULY MEMORIAL AWARD

Dr. Mahua Gupta Choudhury
DBT Bio-CARE Women Scientist,
Biochemical Adaptation Laboratory,
Department of Zoology.
North-Eastern Hill University, Shillong.

PROF R. C. SHAH MEMORIAL LECTURE

Dr. Soumen Ghosh
Assistant Professor,
Department of Chemistry
Jadavpur University, Kolkata.

101ST INDIAN SCIENCE CONGRESS
YOUNG SCIENTIST AWARDEES FOR 2013-2014

Sl. No	Name of Section	Name of Awardees
1.	*Agriculture and Forestry Sciences*	**Kutubuddin Ali Molla** Plant Molecular Biology and Biotechnology Laboratory, Department of Botany, University of Calcutta, 35, Ballygunge Circular Road Kolkata - 700019
2.	*Animal, Veterinary & Fishery Sciences*	No Award
3.	*Anthropological and Behavioural Sciences (including Archaeology, Psychology, Education and Military Sciences)*	**Prerna Bhasin** Obesity Research Unit, Physiological Anthropology Laboratory, Department of Anthropology, University of Delhi, Delhi - 110007
4.	*Chemical Sciences*	No Award
5.	*Earth System Sciences*	**Rimjhim Bhatnagar Singh** Space Applications Centre, ISRO Ahmedabad – 15
6.	*Engineering Sciences*	No Award
7.	*Environmental Sciences*	**Divya Pandey** Department of Botany, Banaras Hindu University, Varanasi – 221005
8.	*Information and Communication Science & Technology (including Computer Sciences)*	**Malay Bhattacharyya** Department of C.S.E., University of Kalyani, Nadia - 741235
9.	*Materials Science*	**Rohit R. Shahi** Department of Physics, Banaras Hindu University, Varanasi – 221005
10.	*Mathematical Sciences (including Statistics)*	**R. Vishnu Vardhan** Department of Statistics, Pondicherry University, R. V. Nagar, Kalapet, Puducherry - 605014

Sl. No	Name of Section	Name of Awardees
11.	*Medical Sciences (including Physiology)*	**Binapani Mahaling** Department of BSBE, IIT Kanpur, Kanpur
12.	*New Biology (including Biochemistry, Biophysics & Molecular Biology and Biotechnology)*	**Vishal Acharya,** CSIR–IHBT, Palampur–176061, H.P.
13.	*Physical Sciences*	**Mohit Kumar Sharma** School of Studies in Physics, Jiwaji University, Gwalior - 474011
13.	*Plant Sciences*	No Award

101ST INDIAN SCIENCE CONGRESS
INFOSYS FOUNDATION—ISCA TRAVEL AWARD FOR 2013-2014

1.	**Manya Sharma**	**:**	Sainik School, Rewa–486001
2.	**Pranshu Nigam**	**:**	Seth Anand Ram Jaipuria School, Kanpur
3.	**Parul Uppal**	**:**	Presentation Convent Sr. Secondary School, Gandhinagar, Jammu
4.	**Harshita Agarwal**	**:**	Seth Anand Ram Jaipuria School, Kanpur
5.	**Bhavya Padha**	**:**	Delhi Public School, Jammu
6.	**V. Manaswini**	**:**	Montessori High School Mahabubabad Warangal, A.P.
7.	**Farheena Naaz**	**:**	Riverian Public School, Brahamanwal Majra, Dehradun
8.	**Neetu**	**:**	Riverian Public School, Brahamanwala Majra, Dehradun

101ST INDIAN SCIENCE CONGRESS
BEST POSTER PRESENTATION AWARDEES FOR 2013-2014

Sl. No	Name of Section	Name of Awardees
1.	*Agriculture and Forestry Sciences*	**Rajendra Lakpale** Indira Gandhi Krishi Vishwavidyalaya Raipur
2.	*Animal, Veterinary & Fishery Sciences*	No Award
3.	*Anthropological and Behavioural Sciences (including Archaeology, Psychology & Education and Military Sciences)*	1. **Vijeta Choudhary** University of Delhi, Delhi 2. **Gaurav K. Rai** Banaras Hindu University, Varanasi
4.	*Chemical Sciences*	1. **Dibakar Chandra Deka** Gauhati University, Guwahati 2. **Shah Raj Ali** Kumaun University, Nainital
5.	*Earth System Sciences*	No Award
6.	*Engineering Sciences*	No Award
7.	*Environmental Sciences*	No Award
8.	*Informtion and Communication Science & Technology & (including Computer Sciences)*	1. **Boopathy D.** Bharathiar University, Coimbatore
9.	*Materials Science*	No Award
10.	*Mathematical Sciences (including Statistics)*	1. **Rakesh K. Tripathi** Govt. Holkar Science College, Indore 2. **Reena Kumari** Indian School of Mines, Dhanbad
11.	*Medical Sciences (including Physiology)*	1. **Susmita Sil** University of Calcutta, Kolkata
12.	*New Biology (including Biochemistry, Biophysics & Molecular Biology and Biotechnology)*	No Award
13.	*Physical Sciences*	1. **Anand Kumar Srivastava** Birla Institute of Technology, Mesra Jaipur Campus, Jaipur
14.	*Plant Sciences*	1. **Geeta Sharma** University of Jammu, Jammu 2. **Anuja Koul** Sri Mata Vaishno Devi University, Katra

KNOW THY INSTITUTIONS

CENTRE FOR NANO AND SOFT MATTER SCIENCES, BANGALORE

The Centre for Soft Matter Research renamed as "Centre for Nano and Soft Matter Sciences" with effect from 1 April 2014 is an autonomous institution under the administrative control of the Department of Science and Technology (DST), Ministry of Science and Technology. DST has been providing core support to the Centre in the form of a grant-in-aid for conducting basic and applied research in liquid crystals and related areas. The Centre is governed by a Council constituted by the Department of Science and Technology (DST), Ministry of Science and Technology. Government of India.

Over the years, liquid crystal research has transformed into a truly interdisciplinary area. Traditionally the emphasis in the subject was on thermotropic liquid crystals in which physics, chemistry and engineering each played a major role. In recent times, the trend is towards lyotropic liquid crystals many of which mimic some biological systems. *In coming years the Centre plans to give a major thrust to these inter disciplinary areas (including biology) under the umbrella of Soft Matter.*

BACKGROUND

Centre of Liquid Crystal Research (CLCR) was established in 1991 by Prof. S. Chandrasekhar, FRS after his retirement from the Raman Research Institute, Bangalore in the year 1990. CLCR was registered as a scientific society in Karnataka with the objectives :

- To build a centre of excellence which will have a focus on basic science, and would also develop a bias towards technology, keeping in line with the international trends on liquid crystals materials and devices. In addition to basic research on the physical properties of the liquid crystals, the Centre will undertake projects on the application of liquid crystals.

- To undertake, carry on, develop and/or promote in every possible and conceivable manner advanced research in the field of liquid crystals and to contribute to the advancement of scientific knowledge in these subjects.
- To undertake and develop techniques for inventing or discovering new products, processes in the field of liquid crystals for the benefit of mankind in general and India in particular.

In the beginning, it was funded by an ad-hoc grant from the Department of Science and Technology, Govenment of India and from the funds made available by the Raman Research Institute Trust. The Centre was taken over in 1995 by the Govt. of India, and converted to an autonomous institution under the Department of Information Technology. In the year 2003, the Centre came under the administrative control of the Department of Science and Technology, Ministry of Science and Technology, Govenment of India.

Today, the centre is equipped with state-of-the-art equipments and facilities which are on par with the best of such facilities in this area, anywhere in the world and has carried out research on a variety of topics including synthesis and characterization of a host of liquid crystal materials. It has been active in both the basic and applied aspects of research on liquid crystals, a prominent soft condensed matter. The Centre has actively provided R&D support to BEL in its LCD manufacturing activity. BEL has been its industrial partner in a major initiative by the Council of Scientific and Industrial Research (CSIR) for new and fast LCDs. Recently CLCR has signed an MoU with M/s. Vision Multimedia Technology Ltd. (VMTL), Japan in connection with transfer of technology of a device invented in its laboratory.

AREAS OF RESEARCH

Physics

Physics of Liquid Crystals and other Soft Condensed Matter
Photo-induced phase transitions
X-ray diffraction studies
High Pressure studies
Dielectric studies
Viscoelastic properties
Electric and Magnetic field effects
Thin films
Surfaces sciences
Interfacial phenomena

Chemistry

Synthetic Organic Chemistry of Liquid Crystal materials
Calamities
Discotics
Bent-core
Dimers
Oligomers
Polymers

Facilities

Polarizing and laser scanning confocal microscopes
X-ray diffractometers with image-plate and solid state detectors
Goniometer-based display measuring system
FTIR and UV/VIS spectrometers
CD polarimeter
Fluorimeter
Impedance and high-resolution gain phase analysers
Saphire-cell high pressure apparatus
High-field electromagnet
Differential Scanning Calorimeter
Mass spectrometer
SQUID magnetometer
Elemental analyzer
Rheometer

Contact :
The Director
Centre for Nano and Soft Matter Sciences
P.B.No. 1329, Jalahalli, Bangalore-560 013,
Ph : 91-80-2308 4200, Fax : 91-80-28382044
E-mail : clcr@vsnl.com, Website : www.clcr.res.in

Conferences / Meetings / Symposia / Seminars

Tropical Ecology Congress-2014, 10th to 12th December 2014, New Delhi, India

Topics :

- Tropics and Climate change : impacts, mitigation and adaptations
- Tropical Biodiversity and ecosystem services
- Hill and mountain ecosystems in tropics
- Forest and Grassland Ecosystems
- Limnology
- Coastal and marine ecosystems
- Biotic interactions and biological Invasion
- Traditional socio-ecological systems, indigenous knowledge and adaptive management
- Socio-ecological issues in north-eastern region of India
- Tropical soils, agricultural systems and forest-agriculture linkages
- Food security and bio-prospecting
- Hydrology in terrestrial ecosystem and climate change
- Biogeochemistry
- Landscape approach to ecosystem management
- Management of degraded ecosystems

Deadline for abstracts/proposals : 30th August 2014

Contact : Dr. SC Garkoti, Congress Convener, TEC 2014, School of Environmental Sciences, Jawaharlal Nehru University, New Delhi-110067, India. Phone no : +91 11 26704015, Email : tec2014jnu@gmail.com Website : http://www.jnu.ac.in/conference/tec2014

3rd International Conference on Computer, Communication, Control and Information Technology (C3IT-2015), 7th to 8th February 2015, Academy of Technology, Hooghly, West Bengal, India

Topics :

- **Computer :** Artificial Intelligence, Soft computing, Computer Graphics, Data Warehousing & Mining, Distributed Computing, System Security, Virtual Reality, Cloud Computing, Service Oriented Architecture, VLSI and embedded Systems, Cryptography.

- **Communication :** Information Theory, Coding Theory, Mobile, Wireless and Broadband Communications, Optical Communications, RF and Microwave Communications, Antennas and Propagation, Satellite Communications, Green Communications.
- **Control :** Linear & Nonlinear Control, Process Control & Instrumentation, Drives & Controls, Intelligent Control, Industrial Automation, Controls in Aerospace, Robotics, Sliding Mode Control and related topics.
- **Information Technology :** Next Generation Networks, Ad hoc and Sensor Networks, Multimedia, Geographical Information Systems (GIS), Vehicular Networks, Information Security, Networks and Services Management, Performance Analysis, Image, Video and Signal Processing, Knowledge management, Game and Software Engineering.

Deadline for abstracts/proposals : 31st August 2014.

Contact : Convener– Academy of Technology– Aedconagar, Hooghly - 712121 West Bengal, India. +91 9432926197, Mob : + 919143229105, Mob : +91 9830312660, E-mail : conference@aot.edu.in Website : http://c3it2015.aot.edu.in/

S & T ACROSS THE WORLD

SCIENTISTS TAKE STEP TOWARD USABLE FUSION ENERGY

Scientists have taken a key step toward using fusion, the process that powers the Sun, to produce energy, according to a report Feb. 13 in the research journal *Nature*.

Fusion energy is envisioned as a way to produce virtually unlimited power to supply the Earth's needs, but no one has succeeded in devising a fusion process that gives out more energy than it takes in.

Physicists at Lawrence Livermore National Laboratory in California said they succeeded in at least releasing more energy through a fusion reaction than is absorbed by the fuel that triggers the reaction.

But that energy is still only about a hundredth of the total energy needed to set up the process in the first place, they said, most of which goes into compressing a fuel pellet where fusion takes place.

"The next necessary step would be to achieve a total gain, where energy entering the whole system is exceeded by the energy produced," the researchers said in a statement. Nonetheless, "we are closer than anyone has ever gotten" to obtaining fusion as a viable energy source, said Omar Hurricane, a researcher at the laboratory and one of the authors of the report.

The whole process took place in a space less wide than a human hair and in only the tiniest fraction of a second—150 picoseconds, to be exact.

Their process used inertial confinement fusion, which initiates nuclear fusion reactions by heating fuel pellets until they implode, compressing the fuel. The fuel consists of deuterium and tritium—isotopes, or variant forms, of hydrogen. When squeezed together, they merge creating a helium nucleus, and releasing energy along with a neutron, or subatomic particle.

The confinement squeezes the atoms of fuel "to get them running toward each other at high velocity, which overcomes their mutual electrical repulsion," said Hurricane.

The scientists said they used 192 lasers to heat and compress a small pellet of fuel to the point where the fusion reactions take place.

What made the process successful was that the scientists managed to initiate a process called "bootstrapping," a sort of vicious cycle, Hurricane said. In this, "the alpha particles [helium nuclei] that come out of that reaction start leaving energy behind and causing the temperature to go up" within the tiny chamber. "When the temperature goes up, the reaction rate goes up, and when the reaction rate goes up, you make more alpha particles."

SPACE ROCK MYSTERIOUSLY FALLS APART

NASA's Hubble Space Telescope has recorded the never-before-seen break-up of an asteroid into as many as 10 smaller pieces, astronomers report.

Fragile comets, comprised of ice and dust, have been seen falling apart as they near the sun, but nothing like this has ever before been observed in the asteroid belt.

"This is a rock, and seeing it fall apart before our eyes is pretty amazing," said David Jewitt of the University of California at Los Angeles, who led the astronomical forensics investigation.

The crumbling asteroid, designated P/2013 R3, was first noticed as an unusual, fuzzy-looking object by the Catalina and Pan STARRS sky surveys on Sept. 15.

A follow-up observation on October 1 with the W. M. Keck Observatory on the summit of Mauna

Kea, a dormant volcano on the island of Hawaii, revealed three bodies moving together in an envelope of dust nearly the diameter of Earth.

"The Keck Observatory showed us this thing was worth looking at with Hubble," Jewitt said. "With its superior resolution, space telescope observations soon showed there were really 10 embedded objects, each with comet-like dust tails. The four largest rocky fragments are up to 400 yards in diameter, about four times the length of a football field."

Hubble data showed the fragments drifting away from each other at a leisurely one mile per hour, like a slowly walking person. The asteroid began coming apart early last year, but new pieces continue to reveal themselves, as the newest images show.

It's unlikely the asteroid is disintegrating because of a collision with another asteroid, which would have been instantaneous and violent, researchers said. Nor is the asteroid coming unglued due to the pressure of interior ices warming and vaporizing.

This leaves a scenario, astronomers said, in which it is disintegrating due to a subtle effect of sunlight, which causes the asteroid's spin rate to gradually increase so that its pieces gently pull apart. The possibility of disruption in this manner has been discussed by scientists for several years, but never reliably observed.

For this scenario to occur, the asteroid must have a weak, fractured interior—probably as the result of previous collisions, the scientists added. Most small asteroids are thought to have been damaged in this way.

With the previous discovery of an active asteroid spouting six tails, named P/2013 P5, astronomers are finding more evidence the pressure of sunlight may be the primary force causing the disintegration of small asteroids—less than a mile across—in our solar system.

The asteroid's remnant debris, weighing about 200,000 tons, will in the future provide a rich source of meteoroids. Most will eventually plunge into the sun, but a small fraction of the debris may one day blaze across our skies as meteors, the researchers said.

EUROPEANS HAVE EVOLVED LIGHTER SKIN IN PAST 5,000 YEARS, STUDY FINDS

Europeans have evolved lighter skin, eyes and hair in past 5,000 years, a new study finds.

The skin changes may be a result of the body's need to produce more Vitamin D in lower-sunlight areas, although the other changes are harder to explain, scientists said.

Anthropologists at Johannes Gutenberg University Mainz in Germany and geneticists at University College London, working with archaeologists from Berlin and Kiev, reached the conclusions based on analysis of ancient DNA from skeletons.

The findings, published this week in the journal *Proceedings of the National Academy of Sciences*, suggest the changes weren't random, but were the result of natural selection—natural pressures that drive evolution, possibly including mating preferences.

The scientists compared the old DNA data with that of contemporary Europeans using computer simulations. Where the genetic changes could not be explained by the randomness of inheritance, the researchers inferred that selection played a role.

While investigating many genetic "markers" in archaeological and living individuals, Sandra Wilde of Mainz University said she noticed striking differences in genes associated with hair, skin, and eye pigmentation.

"All our early ancestors were more darkly pigmented," Wilde said. "The darker phenotype [appearance] seems to have been preferred by

evolution over hundreds of thousands of years," she added, but things must have changed in the last 50,000 years as humans began to migrate northward.

"In Europe we find a particularly wide range of genetic variation in terms of pigmentation," added co-author Karola Kirsanow, also at Mainz University. "However, we did not expect to find that natural selection had been favoring lighter pigmentation over the past few thousand years."

The signals of selection the scientists identified are, they said, among the most pronounced that have been discovered to date in the human genome.

"Perhaps the most obvious [explanation] is that this is the result of adaptation to the reduced level of sunlight in northern latitudes," said co-researcher Mark Thomas of University College London. "Most people of the world make most of their vitamin D in their skin as a result UV exposure. But at northern latitudes and with dark skin, this would have been less efficient. If people weren't getting much vitamin D in their diet, then having lighter skin may have been the best option."

"But this vitamin D explanation seems less convincing when it comes to hair and eye color," Wilde continued. "Instead, it may be that lighter hair and eye color functioned as a signal indicating group affiliation, which in turn played a role in the selection of a partner." Sexual selection of this kind is common in animals and may also have been one of the driving forces behind human evolution over the past few millennia.

"We were expecting to find that changes in the human genome were the result of population dynamics, such as migration. In general we expect genetic changes due to natural selection to be the exception rather than the rule. At the same time, it cannot be denied that lactase persistence, i.e., the ability to digest the main sugar in milk as an adult, and pigmentation genes have been favored by natural selection to a surprising degree over the last 10,000 years or so," added Joachim Burger at Mainz, senior author of the study.

"But it should be kept in mind that our findings do not necessarily mean that everything selected for in the past is still beneficial today. The characteristics handed down as a result of sexual selection can be more often explained as the result of preference on the part of individuals or groups rather than adaptation to the environment."

SCIENTISTS DEVELOP "BENDY" GLASS

Normally when you drop a glass on the floor it shatters. But in the future, thanks to a new technique, when the same thing happens the glass might just bend and become slightly deformed.

Researcher François Barthelat and colleagues at McGill University in Canada took inspiration from natural structures like seashells in order to boost the toughness of glass.

"Mollusk shells are made up of about 95 per cent chalk, which is very brittle in its pure form," said Barthelat. "But nacre, or mother-of-pearl, which coats the inner shells, is made up of microscopic tablets that are a bit like miniature Lego building blocks," he added. It's "known to be extremely strong and tough, which is why people have been studying its structure for the past 20 years."

Previous attempts to create nacre-like structures have run into difficulties, Barthelat said. "Imagine trying to build a Lego wall with microscopic building blocks. It's not the easiest thing in the world."

Instead, he and his team studied internal 'weak' boundaries or edges found in materials like nacre, then used lasers to engrave networks of micro-cracks in glass slides to create similar weak boundaries. Perhaps surprisingly, these toughen the glass by absorbing energy from an impact.

The scientists said they were able to increase the toughness of glass slides (the kind of glass rectangles that get put under microscopes) by 200 times. By engraving networks of micro-cracks in configurations of wavy lines in shapes similar to the wavy edges of pieces in a jigsaw puzzle in the surface of the glass, they were able to stop the cracks from propagating and becoming larger.

They then filled these micro-cracks with polyurethane, although according to Barthelat, this second process is not essential since the patterns of micro-cracks in themselves are sufficient to stop the glass from shattering.

The researchers worked with glass slides simply because they were accessible, but Barthelat believes that the process will be very easy to scale up to any size of glass sheet, since people are already engraving logos and patterns on glass panels.

"What we know now is that we can toughen glass, or other materials, by using patterns of micro-cracks to guide larger cracks, and in the process absorb the energy from an impact," said Barthelat. "We chose to work with glass because we wanted to work with the archetypal brittle material. But we plan to go on to work with ceramics and polymers in future."

The findings were published Jan. 28 in the journal *Nature Communications*.

(Courtesy of World Science)

THE INDIAN SCIENCE CONGRESS ASSOCIATION

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

ANNOUNCEMENT FOR AWARDS : 2014–2015

Nominations/Application in prescribed forms are invited from Indian Scientists for following Awards :

- Professor Hira Lal Chakravarty Award—Plant Sciences
- Pran Vohra Award—Argiculture and Forestry Sciences
- Professor Umakant Sinha Memorial Award—New Biology
- Dr. B. C. Deb Memorial Award for Soil/Physical Chemistry
- Dr. B. C. Deb Memorial Award for Popularisation of Science
- Professor R. C. Mehrotra Commemoration Lecture—Chemical Sciences
- Prof. (Mrs.) Anima Sen Memorial Lecture—Anthropological and Behavioural Sciences including Archaeology, Psychology, Education and Military Sciences
- Dr. (Mrs.) Gouri Ganguly Memorial Award for Young Scientist—Animal, Veterinary and Fishery Sciences.
- Prof. G. K. Manna Memorial Award—Animal, Veterinary and Fishery Sciences
- Prof. Sushil Kumar Mukherjee Commemoration Lecture—Agriculture and Forestry Sciences
- Prof. S. S. Katiyar Endowment Lecture—New Biology/Chemical Sciences
- Prof. R. C. Shah Memorial Lecture—Chemical Sciences
- Prof. Archana Sharma Memorial Award—Plant Sciences
- Dr. V. Puri Memorial Award—Plant Sciences

Last Date for Receiving of Nominations for ISCA Awards and Lectures : 2014-2015 is July 31, 2014.

For proforma of application forms and necessary information, please write to the **General Secretary (Membership Affairs). The Indian Science Congress Association, 14, Dr. Biresh Guha Street, Kolkata-700 017, E-mail :** es.sciencecongress.nic.in/iscacal@vsnl.net. The form also can be downloaded from http://www.sciencecongress.nic.in