EVERYMAN'S SCIENCE

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COVER PHOTOGRAPHS *(From the Left)*

Past General Presidents of ISCA

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

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EDITORIAL

RAVAGES OF KALA-AZAR IN INDIAN SUBCONTINENT

Kala-azar, also known as *Visceral Leishmaniasis* (VL) is caused by a protozoan parasite *Leishmania donovani* and its variant species *Leishmania infantum* and *Leishmania chagasi.* In India, the disease was prevalent much before its causative parasite was identified and was known as Dum-Dum fever, a name derived from the name of region in West Bengal where disease was widely prevalent. Interestingly, the parasite was first identified by Sir William Leishman in 1903 in the spleen of a English soldier who had died of Dum-Dum fever in Calcutta (now Kolkata), India. In the same year Donovan described similar organism in the splenic aspirate of a child suffering from a febrile illness in Madras (now Chennai), India. Later in the same year (1903), Ronand Ross named the parasite *'Leishmania donovani'*. The disease in India was generally known as Kala-azar derived from Kala-jwar (Kala= deadly; jwar= Fever). The term Kala-azar is in common use still now.

Leishmaniasis is an important tropical disease and is one of the six diseases on the list of World Health Organization Tropical Disease Research (WHO TDR). Kala-azar is prevalent in several countries in Asia, Africa and South American continent. Overall 500,000 new cases of *Visceral Leishmaniasis* are estimated to occur every year and prevalence is reported to be 2.5 million. Over 90% cases occur in five countries, namely India, Nepal, Bangladesh, Sudan and Brazil.

In India, the disease was prevalent in eastern part of the country including West Bengal, Assam, Bihar and eastern Uttar Pradesh (U.P). Sporadic cases were reported from parts of Madhya Pradesh and Chennai. The disease was known to exist in West Bengal and Assam since 1850 and several epidemics occurred upto 1940s in Assam, W. Bengal & E. Bengal (now Bangladesh), Bihar and Madras (Chennai). The prevalence of Kala-azar in India was reduced drastically as the result of DDT-spray done all over the country for malaria control under National Malaria Control and later National Malaria Eradication Programs. As the result, the disease almost disappeared during 1950 to 1970. However, there was resurgence of kala-azar in early 1970s in the state of Bihar. In 1977, more than 100,000 cases were reported in Bihar while in 1991 about 77000 cases were reported. Presently, the disease is present mainly in Bihar, Eastern U.P. and West Bengal. In Bihar (including Jharkhand), 40 out of 54 districts and 9 districts in West Bengal are affected by kala-azar. Sporadic cases are reported from Assam also.

The Indian subcontinent contributes approximately 60% of total cases in the world. In India, Nepal, Bangladesh and Bhutan, an estimated 150 million people are at risk of VL in 109 districts. There is gross under reporting in these countries and it is estimated that more than 100,000 cases of kala-azar occur in this region every year. The governments of India, Nepal and Bangladesh have signed a memorandum of understanding in 2005 to have "Visceral Leishmaniasis Elimination Program" in the region. The goal is to eliminate VL in three countries by reducing the annual incidence of VL below one per ten thousand population by 2015 or earlier. The WHO (SE Asia region) is supporting the program in this goal.

The disease is transmitted by the bite of sand flies of genus *Phlebotomus* in Old World and *Lutzomyia* in New World. The sand flies dwell in creaks and crevices in mud (Kaccha) houses and in animal sheds in poverty stricken rural and semi-rural areas.

The disease starts with fever which is irregular and is associated with malaise, headache and progressive enlargement of spleen and liver. As the

disease progresses, the patient becomes weak and emaciated and shows protuberance of the abdomen (due to enlargement of spleen and liver). Patient becomes anaemic and shows leucopenia and thrombocytopenia. The disease is usually fatal unless treated effectively with appropriate drugs.

A proportion of patients (around 20 %) who have been treated for Kala-azar develop skin lesions in the form of post kala-azar dermal Leishmaniasis (PKDL). PKDL presents with hypo-pigmented macular patches on trunk and shoulders or nodular lesions on face and arms. The lesions of PKDL have high number of parasites and are believed to be acting as reservoir of infection during the period between the epidemics. Epidemiologically, the control of PKDL is important for the control of Kala-azar.

The disease is diagnosed by demonstration of parasites (amastigotes inside the macrophages) in the bone marrow or splenic aspirates. The lymph node aspirate or biopsy and buffy coat smears from blood may also show parasites but less frequently. The newer techniques which are used in diagnosis of kala-azar include parasite antigen detection and detection of antibodies against parasite antigens and a recombinant antigen rk-39. Molecular techniques like PCR or real time PCR are also helpful, particularly in monitoring the efficacy of a treatment regimen.

The drugs available for the treatment of kala-azar are limited and all are potentially toxic. The first line drugs for the treatment have been pentavalent antimony compounds (sodium antimony gluconate) for last more than 6 decades. But the indiscriminate use of this drug has resulted in frequent treatment failures and now antimony resistance is a very serious problem in endemic districts of Bihar. The alternative drugs, amphotericin-B and pentamidine isethionate, which are also parenteral drugs are potentially toxic. A newer drug miltefosin which is given orally, is promising but its misuse may also result in resistance to this drug. The management of kala-azar is facing the serious challenge of drug resistance. In Bihar, upto 60-65% patient are reported to be resistant to antimony therapy. Amphotericin-B, though effective in most cases is potentially toxic. Liposome based Amphotericin-B, though more effective and less toxic, is a costly drug which most patients cannot afford as most kala-azar affected areas are poor, developing regions. The development of new drugs and their combination along with integrated vector management including indoor residual spray, use of impregnated bed nets and application of repellents to reduce host vector contact are essential for the control of this potentially fatal disease.

Professor M. L. Dubey
Professor R. C. Mahajan

Institution is the some of scientific knowledge.
— Aristotle

PRESIDENTIAL ADDRESS

SCIENCE AND NATIONAL WELFARE

PROF. T. R. SESHADRI, F.R.S., F.N.I.

FUNCTION OF THE INDIAN SCIENCE CONGRESS : A REORIENTATION

The Annual Session of the Indian Science Congress has been an important event for Indian Scientists. The Congress was founded more than 50 years ago by a group of scientists which included several British savants working in India. The object was to provide an occasion for research workers to meet and discuss scientific problems and exchange views. It was originally a small body consisting mainly of University teachers and scholars. Later government organisations have played an important part and a considerable number of members of the public have also become interested in Science. Thus from small meetings it has grown steadily in importance and size to its present large dimensions. There have been criticisms of its functioning; many of them are the result of misunderstanding. Still there are a number of points for the Congress to consider. At the time it was founded it was almost the only scientific society of all-India character and it also had to provide opportunities for all branches of Science to be discussed. Later specialist societies have sprung up in large numbers, not only for each major branch of Science but also for sub-divisions. Further, there are a number of Academies which have charge of Science at advanced levels. All these Academies and Scientific societies hold conventions and seminars in specialised branches. There is need, therefore, for a reorientation 'of function for this large Science Congress. Such a change has taken place with similar science organisations in other countries also; for example, the British Association for the Advancement of Science, on whose model the Indian Science Congress was founded, is now the major organisation for contact between British scientists and the British public. The annual meetings of the Association are arranged under the joint auspices of a University and a City-Council and the responsibilities are about equally divided between the Mayor and the Vice-Chancellor. It is an occasion for many special functions both in the University and in the city. I feel that we should also take effective steps to make this Science Congress more and more effective as liaison between scientists and the public. In an age of Science this becomes an essential activity for a national body. Our annual meetings should be used for discussing more fully major developments in Science and their application to national welfare; all activities which would be duplication of the work of specialist societies could be minimised. More emphasis should be placed on the Science education of the youth — school and college students. Special programmes should be arranged for them, e.g. special lectures, educational films and exhibitions. There is the question of language for Science teaching at different levels. Can we not have for this purpose a common language for our country if not for the whole world ? Equally important is the question of script. An excellent article on an ideal alphabet was published in *Science and Culture* last year by Prof. S.K. Chatterjee. It is worthy of wide study and adoption. The Indian Standards Institution could

* General President, Fifty-Four Indian Science Congress held at Hyderabad January, 1967.

also help in this matter because alphabet is of industrial and technological importance. Again there is need to discuss the Science Policy of Government and how it has affected Science, scientists and the nation; the Science Congress can provide the most suitable forum for this discussion. I am glad to state that at the initiative of our immediate past General Secretary, Dr. Atma Ram who will also be my successor as President of this Congress, this reorientation has already been initiated. I express a strong wish that it will be complete in the very near future.

I am very happy that we are meeting in this great and growing University, this important centre of learning and culture with which I have been associated over a number of years.

I wish, specially, to thank the Prime Minister for her kindness in being present with us this afternoon and inaugurating this important session. I may here recall that her illustrious father, ever since he took charge of the Government of this country as the First Prime Minister rarely ever missed the Sessions of the Science Congress. This was one of the many ways by which he showed the great value he attached to Science and its applications. It was fortunate that he learnt Science in Cambridge. All through his life he maintained a scientific outlook and worked for the progress of Science, understanding fully that it is an important tool for the welfare of the nation. We would request his worthy daughter also to follow the tradition set by him. Science can prove to be an efficient tool for the solution of many of our national problems. We all realise that we are passing through very critical times and we are faced with the problem of defence of our country and protection of our freedom. This is most important. Equally pressing are the problems of Food and Health and Education and Population Control. In ancient days people used to go to wise men and sages in times of trouble. Now they seem to look up to scientists for the necessary help. Not only technology and industry based on Science are essential but more important is the scientific approach to problems.

A few days back I received a letter from the Secretary of the Council of Scientific and Industrial Research, wherein he has mentioned that at the meeting of the Governing body of the C.S.I.R. held on 19th November 1966, the Prime Minister in her opening remarks laid stress on our achieving "self-reliance" in the context of the difficult economic and food situation, the country was facing and observed that scientists and engineers could play an important role in this matter. She added that there were certain visible gaps in research and some guidance in this respect might be forthcoming from the Indian Science Congress. She also stressed the need for securing active cooperation between Science and industry and felt that scientists should be associated with the formulation of various industrial projects from the very beginning, I am glad to recount these valuable remarks here and to request that the Indian Science Congress in its deliberations during the Session and later could bear them in mind and offer workable suggestions.

SCIENCE AND SPIRITUALITY

Though the present is an age of Science, we are not sure if all understand correctly what it implies. Different people seem to understand it differently. The villager has probably not heard about it or thinks that it is something beyond his comprehension. To many a young student, it may just mean a career. To most of the public it may mean big machines and technology, to social workers modern amenities and comforts, to industrialists a source of fortune for themselves and for the nation and to administrators an item for taxation. To some thinkers its destructive aspect, such as high explosives and Atom Bombs, is repulsive and hence it is an object of condemnation. But careful analysis shows that all these are only some products of Science, many good and many equally bad depending on individual standpoints, and they do not represent the spirit of Science. Many observers have been disturbed by the feeling that Science is antagonistic to religion; more Science may mean less of religion, less of ethics and less of true culture and all those that we associate with

the finer and higher traits of human nature. This is a very important subject and the relation of Science and religion has been engaging the attention of modern thinkers of our country from the time of Swami Vivekananda. A recent discussion is by Swami Ranganathananda who is well-known as a religious teacher and Head of the Ramakrishna Mission Institute of Culture at Calcutta. The paper entitled Swami Vivekananda's synthesis of Science and Religion was contributed to the Session of the Parliament of Religions held in January, 1964 and published in book form. Owing to a limitation of time I cannot go into the details of his excellent arguments and the volume of data he has analysed. However, I may state here a few salient points and conclusions.

Indian thought upholds both religion and Science as valid disciplines in the pursuit of truth. India's thinkers never found any contradiction between the two. The method of investigation in the field of religion is largely the same as in the positive sciences. A thorough scientific study of the facts of the inner life was undertaken by the great thinkers of ancient India; the insights which they gained were re-tested and amplified by a galaxy of subsequent thinkers. It is because of this that Indian spirituality has stood the test of time and is also fully hospitable to modern Science.

He then concludes that there is no conflict between Science and religion. Both have the identical aim of helping man to grow in spirituality, and of ushering in a better social order. Each by itself is insufficient and helpless. The combination today of the spiritual energies of these two complementary disciplines in the life of man will produce fully integrated human beings and thus help to evolve a complete human civilization. This synthesis is the most outstanding contribution of Swami Vivekananda to human thought of the present time.

It has been the conclusion of many thinkers that great movements in India have always had a basis in spirituality and her part in the harmony of nations is to play the spiritual note. The recent example of Gandhiji confirms that we have not lost the great tradition. His whole life was a grand effort to spiritualise politics. Will it not be far more easy to bring Science and spirituality together?

INTELLECTUAL AND CULTURAL VALUES OF SCIENCE

From very ancient days Science has continued to have high intellectual and cultural values. Though culture is popularly associated with certain shows, it is not easy to define, as numerous components are involved, the most important being the scientific and rational attitude of mind. Imagine what would have been the level of our ancient culture and civilization if the primary attitude of enquiry and critical assessment and search for truth at all levels, physical, mental and spiritual, was not there. In the modern context, this is forgotten and most of the cultural activities have very little of Science component in them. There is another aspect of Science and that is its importance for mental and intellectual health. All of us know how costly cricket is and all other sports including wrestling, boxing, hunting, mountaineering and travel. Sports are generally intended to foster bodily health and fitness though this is frequently forgotten and the business part and other considerations become dominant. Mind is far more important, powerful and valuable and should be kept in proper health and condition. For the purpose nothing can be better than Science, and many great people obviously took to Science for this primary attraction. Very early in the history of civilization Mathematics and Astronomy received attention. They continue to be attractive even now, though many other aspects of Science have developed similar values in recent years, for example, Particle Physics and Structural Chemistry and Molecular Biology.

THE MACROCOSM : ASTRONOMY

The study of Astronomy is also capable of providing great spiritual inspiration. It is a unique means to have a glimpse of the Infinity revealing the unimaginably vast extent of the universe we

live in. There is ample space if we could use it. Our earth and solar system form a part of a large spiral galaxy of innumerable stars that is about one hundred thousand Light Years in diameter and our Sun is placed towards the end of this system. This is an inconceivably large dimension but by no means as large as the universe made visible by long exposure photography coupled with large telescopes. In it the most distant galaxy is about a thousand million Light Years away. It is a distance difficult to conceive when we realise that light travels about 300 thousand kilometers a second. We understand how bright the Sun is, particularly in tropical countries. But the more recently studied quasars are ten to hundred times more luminous than the most luminous galaxy but they have only one times the size. This is again an inconceivably high luminosity. It is lucky that we are so far away from them. We are thereby able to live safely and study them.

If astronomy refers to the infinite macrocosm and is an ancient Science, the opposite is provided by the more recent study of Structural Chemistry dealing with the tiny microcosm. In this field during the past 100 years great advances have been made in what may be described as "seeing the unseen". Things that cannot be seen even by the most powerful microscope, have been seen and pictured by the intricate study of molecular structure, a discipline that has been systematically developed by a large number of extraordinary intellects.

THE MICROCOSM : STRUCTURAL CHEMISTRY

All of us use the terms atoms and molecules. They represent objects that are very tiny indeed. They are normally unseen and the ordinary man sees only the gross appearance of objects that are aggregates of an enormous number of molecules. The knowledge of the gross is not untrue it is only incomplete and partial and we see more and more fully when we understand the subtle details by deeper mental perception based on the effects we observe. We are steadily advancing towards fuller and fuller knowledge.

I can give one illustration. There is a valuable red substance called carotene which is present in carrot as its colouring matter and also in the leaves of plants. It is the source of vitamin A and hence is called provitamin-A. An ordinary person without serious scientific education will describe it as a red crystalline substance. He can get a magnified picture of the crystals. He could also use it for colouring foods, particularly oil and ghee; besides colour it also adds to the food value. But for a chemist it means much more. Its molecules though extremely tiny are still complex; each molecule is represented by the formula $C_{40}H_{56}$ containing 96 atoms and these atoms are arranged in a definite manner having two rings and between them a long bridge. More recent studies have given further details. Not only do the electrons in it move under the influence of light and thus produce colour but the atoms of carbon and hydrogen oscillate making a breathing in and out movement. These are too subtle to be seen by the eye, but our minds can see them based on the effects noticed in what are called spectra. We can take the spectrum not only with visible light but also with ultraviolet and infrared light. Raman spectrum provides another important method of study. Quite recently we have been using a further different method of observation; we call it "Nuclear Magnetic Resonance spectrum". This is an exceptionally powerful method and is based on the existence of spin of the nuclei of atoms. On account of this spin certain atomic nuclei e.g., protons behave like tiny magnets and make precessions in the earth's magnetic field somewhat similar to the precession of a spinning top under the influence of gravity, and this property can be used for various studies. One of the discoverers of this phenomenon, Purcell in his Nobel Prize lecture narrates as follows :

"I have not yet lost a feeling of wonder, and of delight, that this delicate motion (precession of nuclei) should reside in all the ordinary things around us, revealing itself only to him who looks

for it. I remember, in the winter of our first experiments, just seven years ago, looking on snow with new eyes. There the snow lay around my door-step, great heaps of protons quietly precessing in the earth's magnetic field".

Now in carotene we could picture not only the arrangement of atoms, the movement of electrons and the vibration of the atoms, but also the precession of the protons. This may not be the end of our vision, and we may in future see more fully.

SUB-ATOMIC PARTICLES

Subtler than the atoms are the sub-atomic particles and great advances have been made in their study in recent years. This is an outcome of our age-old interest in the nature of the fundamental constituents of matter. Our ancestors thought there existed five elements; their ideas were disproved. As Chemistry developed, a large number of chemical elements were discovered. In nature there were about 92, but more were prepared artificially and all these could be classified, and arranged in the periodic table. Earlier in this century sub-atomic particles, electrons, protons and neutrons were discovered. Thirty years ago we developed the picture of neutrons and protons as the constituents of atomic nuclei and we had the feeling that we had reached the end of the search for fundamental particles. In the final analysis, it appeared that we could reduce the world to nucleons, electrons and quanta of radiation and their interactions. But this position changed, especially after the last war; the study of cosmic radiation revealed a whole range of new particles, the mesons, baryons and antibaryons which had escaped earlier discovery because they were extremely short-lived. During the past ten years new accelerators and bubble chambers and sophisticated computing methods have increased the pace of discovery and a new world of phenomena has been revealed. The number of known particles, most of them exceedingly ephemeral, now exceeds one hundred, almost equal to that of the chemical element. Quite recently a remarkable degree of order has been found among the particles and they can be arranged in well-defined groups. The validity of the grouping has been established by the prediction of missing members and their properties and its verification. This is somewhat similar to what happened earlier with the atoms of the chemical elements and their classification.

If atomic and molecular universe gave us a picture of rotation, vibrations and precession, the sub-atomic level is a universe of rapid change and impermanence. Particles of all types are created and they are annihilated into other forms of matter and energy and they are capable of rapidly resuming their identity. Among the family of particles nucleons, electrons, and the quanta of radiation, are more familiar to us because they are the most stable at our temperatures. The idea that matter is made up of indestructible elementary particles called atoms has become untenable, and the universe that we know is subject to incessant and more or less rapid changes. This should provide an urge for the discovery and understanding of the underlying primary cause which is permanent, unchanging and indestructible and on which depend all the changing phenomena.

These scientific developments have no doubt affected our civilization and Science has become an indispensable and growing part of our culture. The achievements of Pure Science have been claimed to have the same value as music and drama, literature, sculpture, architecture and painting and should be cherished as we do our epic poems, temples and monuments and cave paintings. They are the results of the creative spirit of man and its expression. At the same time some branches of Pure Science can be economically very important in their applications, as for example Structural Chemistry in relation to dyes, drugs and insecticides.

Not long ago Pure Science cost us little. In the last century, the distinguished scientist could have accommodated all his laboratory equipment in a tray and even more recently the laboratory in

which the Raman Effect was discovered had only an annual budget of a few thousand rupees, but now Pure Science in many of its branches has become high expensive and in some cases like Particle Physics, space research and genetic code, it is so expensive that only a few rich nations with enormous resources can afford them. The danger is that even poorer ones have a tendency to emulate them with adverse effect on their national economy.

SCIENCE AND SOCIETY

From the immensity of the macrocosmic universe and the subtle intricacies of the microcosmic universe we have to come down to think of the complexities of the ordinary world of everyday life. Here arise problems of food and clothing, housing, health and sanitation, education, communication and defence. They are all of immediate importance and require all our resources and earnest attention. Their solution depends on Applied Sciences and when successful can produce health and wealth in which depend the nation's capacity to sustain pure scientific research and promote culture. This point has been frequently voiced more particularly in the course of our recent discussions with leading scientists in U.K. by our past General Secretary, Dr. Atma Ram, whose recent appointment to the responsible post of the Director-General of the C.S.I.R. has been widely welcomed. If we wish to maintain progress of Pure Science, there must be enough financial resources in the nation and they can be had only by the application of Science for production and by the development of industries. Are we fully aware of this and do we devote enough time and energy for this essential purpose? It is the rapid progress of Applied Science and technology that has revolutionised all aspects of civilized life and created the familiar activities of the modern age, an age of jet and space travel, radio and television, vitamins and antibiotics, insecticides and fungicides, novel metals, plastics and polymers and glass, and of computers. These in their turn open out new areas of work in Pure Science. The phenomenal development of the dye stuff and drug industries in pre-war Germany is stated to have given direct stimulus to the marked growth of Structural Chemistry in that country.

It is with a view to promote the application of science to technology that the large number of National Laboratories and other laboratories have been set up in quick succession in our country during the past 20 years. They have been conceived in a big way, built with great speed and well-provided with staff and equipment. But the fear has been expressed that several of them have not concentrated their capacity on applied scientific research with the result that the resources have not been brought to bear effectively in producing results of economic value. Most of the staff seem to have come with only an academic background with little experience of industry and have not been successfully oriented towards project work of technical importance. Consequently there has been an attempt to make the National Laboratories duplication of universities with the end result that both types of institutions tend to suffer.

Our national need for applied research is so great that in the present context even universities will have to focus their attention on research of this nature. Long ago the main function of a University was teaching. Research was done by enthusiasts, not always in universities but also outside in academies and in many cases by rich people in their own homes. It soon became a normal function of universities. In a democratic and scientific age, a third function is becoming more and more prominent, that is national service. In an ideal university, these functions can be complementary and need not be competitive and each can be done better because of the presence of the others. Normal research programmes are intended primarily for the training of students and for the advancement of Science including techniques and concepts. Other programmes can be undertaken as service to the State or to industry and should now be considered as a service function of the University. Since this service research in

Universities requires considerable finance which no university can afford, adequate financial help from Government and Science Research Councils is necessary to enable this function to be effectively performed.

A mistaken impression seems to persist that discoveries in Pure Science are valued more than their application to technology. There is no justification for this. In earlier years, most scientific work was really applied nature and what is called Pure Science is a later development. Achievements in either line have received appreciation; as a matter of fact practical application provides more tangible rewards. However fashions exist as elsewhere in scientific research also. Devotees of Pure Science seem to be more prone to this influence. The more abstract the subjects are the purer they can be; there are surely many interesting intellectual exercises, and there are many others that are mere repetitions and are not so interesting, but in the context of our national needs most of them may merely lead to exertion and not to worthwhile results. They can have validity and fulfilment only when they are capable of application.

SCIENCE POLICY

The spirit of India is embodied in the concept of secular state that it has adopted for its constitution. As frequently explained by most leaders it was not intended to be an irreligious state but a state which does not impose any particular religion. Another aspect is the scientific policy which the Parliament has adopted in an important resolution which gives a place of honour to Science and to scientists and seeks to involve them in all aspects of planning and development. By this India has become wedded to science and technology, not only for the purpose of the physical goods and power that they can give, but also for the scientific spirit and way of life which will solve many problems of life and society objectively without fear or favour but with good feeling and wisdom. The responsibilities of a modern welfare state are increasingly large. They are no longer merely protective, concerned only to see that wrong things are not done, and that law and order are maintained, but also developmental, increasingly concerned with the promotion of useful and constructive projects utilising all available resources. In this new and more positive role the pursuit and promotion of Science will be very much for the advantage of the nation. This places great responsibility on scientists and they have not only to work for the advancement of proper utilization of Science but also to see that scientific work and achievements are not misapplied.

Recently there have been frequent discussions on the budget allotted by Government for scientific research. Two obviously important sides of the question have been emphasised. One view is that the money allotted is not enough and compares very unfavourably with that spent by other advanced countries, and that if India wishes to have a sound base for Science and technology the expenditure on research and development should be not less than one per cent of the gross national product. The other view is that we have increased our commitments to Science fairly fast to the tune of over 100 crores of Central and States' budget excluding expenditure on research in universities, and raises the issue whether scientific potential in the country has advanced in the same rapid proportion and whether the results are commensurate with the expenditure. Since ours is a poor country with a number of rival demands like food, health and education, there is need to assess carefully at every stage whether any fresh expenditure is justified and will be fruitful. These are no doubt useful considerations to be kept in mind. The problem with the budget is a difficult one to solve and needs a great deal of objective thinking. Since there is no abundance, questions of urgency and national priorities arise. Unfortunately the cost of everything is on the increase and the cost of Science teaching and scientific research cannot be otherwise. Besides adequate increase in budget there is another way of meeting the situation. Utmost economy by all possible means and

prevention of waste in all possible forms should seriously exercise our minds, since according to the old proverb, money saved is money gained.

There is still another point which we should not overlook. Money and materials alone do not secure good research; they are only adjuncts and it is the human element behind them that does. Leadership in this context is of utmost importance. Not only in war, not only in big business and industry, but also in research there is what is known as "strategy". We have all appreciated great generals who with small armies and limited weapons have over-powered larger and better equipped adversaries. Similarly with small resources great men have built up large industries. We can ignore leadership in the field of scientific research only at the cost of the nation's security and prosperity.

In this connection the mental climate of scientific workers becomes a matter of primary importance and we do not seem to have given sufficient attention to it in our educational system. Creative Science has been claimed to be one of the greatest activities of the human mind and spirit. There is great need therefore for adequate preparation of the mind in this supreme effort. The essential steps in the training are described in *Raja Yoga,* the path of Mental Control. According to Patanjali the first step is *Yama* which includes the practice of non-killing, truthfulness, non-stealing, continence and non-receiving of gifts. Next is *Niyama* which includes cleanliness, contentment, austerity, study and self-surrender to God. These are mental and moral discplines to be strictly practised; they purify the mind and give it special powers of discrimination and dispassion. There is no doubt that a pure and strong mind sees truth clearly and the practice of Science then becomes fruitful; not only this, the proper utilisation of Science is also assured. In our traditional thinking without these essential steps further progress is not only unfruitful but dangerous. This is true even today. If there is danger in Science it can arise from the lack of this mental and moral base. Even a little of this good training can yield great results.

In the organisation of scientific research emphasis has been rightly laid on bringing together groups of scientists having complementary skills and talents and making them work in an atmosphere of mutual understanding and good will. It is however doubtful if due importance is given to the dedicated scientist who has also faith in his work and is capable of leadership. Talents differ widely among scientists. Some are narrow specialists and some others are good in human relations. But at the present time where team work is essential we need a good combination of the two capacities in a leader and it is rare indeed.

Again there is the distinction between devotees of Pure Science and Applied Science subjects. It has been felt that the distinction and delimitation are difficult and many scientists have been good in both. In general however the two aspects seem to depend on different attitudes and capabilities. If one needs men of thought who are contemplative the other needs men of action who are alert and enterprising; both types are necessary because they are complementary to each other. Not long ago the discovery and its utilisation were matters left to individual enterprise and were slow. Now they have become urgent and important because most scientists are maintained by public funds in the expectation of quick and useful results.

In a welfare state we are very much concerned about incentives. Monetary rewards have obvious limits. In the alternative our minds should be hitched to higher ideals which have no such limitations. According to the scriptures the twin ideals of every human being should be (1) liberation or uplift of the Individual and (2) the good of the World. Science is in reality an excellent means for developing the minds and spirit to achieve higher goals. If this faith could grow among scientists, their status will rise remarkably and the ancient vedic prayer which is equally the prayer of modern Science will be fully answered:

From the unreal lead me to the real
From darkness lead me to light
From death lead me to immortality.

METAGENOMICS-UNLOCKING THE MYSTERIES OF UNCULTURABLE MICROBES

Latika Bhatia

Most naturally occurring bacteria cannot yet be grown in culture and therefore cannot be analyzed by conventional means. This vast uncharacterized proportion of bacterial diversity present on this planet remains to be explored and tapped for biotechnological applications. Metagenomics studies provide us with a mechanism for analyzing previously unknown organisms. Recent advances in shot gun sequencing and computational methods for genome assembly have advanced the field of metagenomics to provide glimpses into the life of uncultured microorganisms. Novel functional genes with low homology to the known genes from culturable bacteria were identified. Hence, there is immense potential of metagenomics approach in exploration of biodiversity and its upshot in biotechnology.

INTRODUCTION

The vast majority of life on earth is microbial. Microbes run the world. It's that simple. Although invisible, microbes are essential for every part of human life-indeed all the life on the earth. It is the inherent ability of microorganisms that they utilize a variety of organic substrates and results in wide range of products through metabolic process. Owing to presence of biochemical diversity, microorganisms have been commercially exploited by fermentation industry. Microbes contribute most of the photosynthetic capacity to planet. In recent years, use of microbial inoculants as a source of bio-fertilizers has become a hope for most of countries, as far as economical and environmental viewpoints are concerned. Microbial enzymes have gained much popularity. Production of primary and secondary metabolites by microorganisms is possible only due to involvement of various enzymes. Virtually all ecologies rely on the intricate biochemistry of microbial life to sustain themselves. Our mutualislic relation with gut microbiota influence maturation of immune system, modulate response to epithelial cell injury, affect energy balance, and support biotransformation that we are ill-equipped to perform on our own, including processing of xenobiotics[1].

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MICROBIOMICS

Microbial communities live in extreme environments, at temperatures, pressures and pH levels in which no other organism can survive. Extreme environment such as polar region, acidic and alkalophillic springs and cold pressurized depths of the ocean are colonized by microbes which have developed countless strategies for survival. There are countless biochemical transformations that are mediated by microbial genome. Microbial communities have adapted through countless individual generation and billion of years of environmental changes[2]. Given the enormous number of microbes and their vast metabolic diversity, the accumulation of mutation during the past 3.5 billion years should have led to very high

levels of genetic and phenotypic variations. The worldwide oceans are teeming with microscopic life forms. Normal cell counts of $>10^5$ cells per ml in surface sea water predicts that ocean harbor 3.6×10^{29} microbial cells with total cellular carbon content of $\approx 3 \times 10^{17}$g. Communities of bacteria, archaea protists and unicellular fungi account for most of the oceanic biomass. These microscopic factories are responsible for 98% of primary production and mediate all biogeochemical cycles in the ocean.

Globally, termites are extremely successful group of wood degrading organisms and are therefore important both for their roles in carbon turnover in the environment and as a potential source of biochemical catalyst for efforts aimed at converting wood into biofuel. Only recently have data supported any direct role for the symbiotic bacteria in the gut of termites in cellulose and xylan hydrolysis[3]. Our body-surfaces are home to microbial communities whose aggregate membership outnumbers our human somatic and germ cells by at least an order of magnitude. The vast majority of these microbes (10 to 100 trillion) inhabit our gastrointestinal tracts, with the greatest number residing in the distal gut, where they synthesize essential amino acids and vitamins and process components of otherwise indigestible contributions to our diet such as plant polysaccharides. The human distal gut microbiome is estimated to contain ≥ 100 times as many genes as our 2.85-billion base pair (bp) human genome. Therefore, a superorganismal view of our genetic landscape should include genes embedded in our human genome and the genes in our affiliated microbiome, whereas a comprehensive view of our metabolome would encompass the metabolic networks based in our microbial communities[4, 5].

WHY METAGENOMICS ?

To understand the biochemical processes of life it is often easier to study them in a simple system (like microorganism) instead of complex one (like humans). Microorganisms have many of the same properties as more complex organisms such as amino acid biosynthesis. The genetic and biological diversity of microorganisms is an important area of scientific research. The genetic diversity (taxonomic or phylogenetic) is commonly measured by molecular genetic methods. Biochemical (physiological) diversity is measured in the laboratory with pure or mixed culture. Unfortunately, scientists are able to grow less than 1% of all microorganisms observable in nature under standard laboratory conditions. This leaves scientists unable to study more than 99% of the biological diversity in the environment. The estimate that less than 1% of the prokaryotes in most environment can be cultivated in isolation has produced a quandary : what is the significance of the field of modern microbial genomics if it is limited to culturable microbes? Until recently this limitation meant that the genome of most microbial life could not be dissected because more than half of the known bacterial phyla contain no cultured representatives, and the archael kingdoms are likewise dominated by uncultured members. Bacteria may be recalcitrant to culturing for diverse reasons-lack of necessary symbionts, nutrients, or surfaces, excess inhibitory compounds, incorrect combinations of temperature, pressure, or atmospheric gas composition, accumulation of toxic waste products from their own metabolism, and intrinsically slow growth rate or rapid dispersion from colonies.

Metagenomics is a novel approach of examining the microbial world that has potential to transform modern microbiology and to revolutionize understanding of the entire living world[2]. The emergence of culture-independent and metagenomic techniques has however provided us with the tools to determine the full extent of the uncultured microbial diversity and allowed access to the biochemical pathways within these uncultured microorganisms. Metagenomics is the study of the

pooled genetic complement of a given environmental sample, and analyses can be either sequence driven or function driven. Melagenomics is also referred to as environmental and community genomics. It provides a second tier of technical innovation that facilitates study of the physiology and ecology of environmental microorganisms. According to Kevin Chen and Lior Pachter, metagenomics is the application of modern genomies techniques to the study of communities of microbial organisms directly in their natural environment, by passing the need for isolation and lab cultivation of individual species. Metagenomics treat the microbial community as a single dynamic entity. It explores the nenome content of the community and leads to analysis of changes in content and expression as a function of site, time, and various states of perturbation, e.g., progression towards and regression from disease following treatment.

In metagenomics total genetic material is collected and sequenced from an environmental sample, rather than from individual isolates. "What you're really doing is trying to infer the properties of microbes within complex microbial communities enmasse," says Ed DeLong, a professor of civil and environmental engineering at the Massachusetts Institute of Technology.

APPROACHES TO METAGENOMIC ANALYSIS

Metagenomics is employed as a means of systematically investigating, classifying and manipulating the entire genetic material isolated from environmental samples. This is a multi-step process that relies on the efficiency of four main steps. The procedure consist of (i) the isolation of genetic material, (ii) manipulation of genetic material, (iii) library construction, and the (iv) the analysis of genetic material in the metagenomic library. The clones can be screened for phylogenetic markers or "anchors." such as 16S rRNA and *recA*, or for other conserved genes by hybridization or multiplex PCR or for expression of specific traits, such as enzyme activity or antibiotic production, or they can be sequenced randomly.

The starting material is a mixture of DNA from a community of organisms that include bacterial, archaeal, eukaryotic and viral species at different levels of diversity and abundance. In some projects, sample collection may be confounded by the presence of limited amounts of DNA or the presence of contaminating DNA or other compounds that interfere with DNA extraction. The word metagenomics was coined to capture the notion of analysis of a collection of similar but not identical items, as in meta-analysis, which is an analysis of analysis. Cells can be broken open using chemical methods such as alkaline conditions or physical methods such as sonication. DNA free from cell is separated from rest of the sample by methods of density centrifugation, affinity binding and solubility/precipitation. One method of building metagenomic libraries from the soil involves physically separating the bacteria from the rest of the soil matrix before lysis to minimize contamination with numerous inhibitors of the enzymes that are used for cloning that are found in soil. The use of subtractive hybridization (hybridization of the community DNA to immobilize or labeled copies of eukaryotic DNA, from which the unbound bacterial DNA can be separated), or separation based on GC content, will also in theory allow enrichment of bacterial DNA at the expense of eukaryotic DNA.

Once the DNA is collected, it is manipulated in second step, so that it can be used in the model organism. Genomic DNA is cut up into smaller fragments using restriction endonuclease. The fragments are then combined with vectors containing selectable markers. Cosmids or BAC (Bacterial Artificial Chromosomes) libraries are constructed. BAC vectors help for cloning large fragment of DNA up to 100 kb. which contain several gene arranged in the precise order in which

they are found in the genome they come from. If the gene for 16S rRNA is found in one clone, the bacterium it comes from can be identified and the neighboring gene can be sequenced. Conventional vectors having the capacity to hold 3 kb of DNA can also be used. This is a shot-gun approach. It clones the entire genome in form of a library of random genomic clones i.e. without identifying them. Accordingly, DNA fragments can be sequenced without previous screening. This allows the discovery of novel genes regardless of their origin. The drawback of this method is that it requires massive sequencing to analyze the thousands of clones generated from a single sample and that it is difficult to reassemble genome from many small fragments.

Without very extensive sequencing coverage of an environmental samples, the less abundant numbers of low diversity bacterial communities will probably not be represented in any given data set. With more complex communities enormous amounts of DNA sequence data will be required for assembly of even the most abundant number. Metagenomics project will require new-throughput, lower cost sequencing technologies. For example the pyrosequencing technology developed for the 454 Life Sciences Genome sequencer FLX eliminates the need for library construction (in other words, the community DNA can be sequenced directly, without first being cloned into a laboratory host) can generate more than 100 million base pairs of DNA sequence in a single run. Other technologies with similar throughputs are expected from, for example Helicos, Intelligent-Bio-Systems and Complete Genomics.

The third step is to introduce the vectors with the metagenomic DNA fragments into the model organism. Aside from *E. coli*. several bacterial hosts are being developed to serve as a vehicle for gene cloning in metagenomics. *Streptomycetes* are of much promise because they are easy to grow in the laboratory and are useful for expression of genes from other actinomyceles. Another well developed bacterial system for heterologous gene expression is *Bacillus subtills* which is a better system than *E. coli* for the expression of extracellular protein. The availability of heterologous gene expression system for archea is limited, although there are well developed gene manipulation systems for the eukaryotes.

The transformed cells are then grown on the selective media so that only the cell carrying vectors will survive. These samples of cells containing all the metagenomic DNA samples on vector are called metagenomic libraries. If metagenomic libraries from two or more different communities are available, they can be used to compare the relative abundance of genes with given function and these can be related back to particular condition in each environment. Tringe *et. al.*, has been compared the libraries from the metagenome of Sargasso Sea and that of whale fall community in Antarctica. Sargasso sea is a well characterized region in Atlantic near Bermuda that has usually low nutrient level, but here the resources are more regularly mixed by turbulence. On contrast whale fall ecology develops when died whale falls to the bottom of the ocean. Comparing the two metagenomic libraries from these two different communities, they found that the gene for chemotaxis were over represented in the whale fall communities.[6] Reason behind it was that chemotaxis was important for bacteria to find and move towards the episodic whale fall in the bottom of the ocean; whereas in Sargasso sea these genome were less expressed.

The fourth and final step in the procedure is the analysis of DNA from metagenomic libraries. The expression of DNA determines the physical and chemical properties of organisms so there are many potential methods of analysis. The chemical properties of the expressed metagenomic DNA can be examined by performing chemical assay on products created by the model organism. This would investigate whether the model organism gained an

enzymatic function that it is previously lacking such as use of an unusual nutrient source for growth under conditions that limit normal nutrient availability. A typical metagenomic analysis involves several subsequent rounds of the procedure in order to definitively isolate target genes from environmental samples and to effectively characterize the information encoded by the sequence. The information gained from the metagenomic procedure provides information regarding the structure, organization, evolution, and origin of the DNA and can be used in scientific application for the benefit of society and the environment.

RECENT PROJECTS OF METAGENOMICS

(1) To date sequence-based metagenomic analyses of marine microbiota have attempted to describe; 'who is there?'; 'what are they doing?'; "who is doing what?" and what evolutionary processes determine these parameters?' Recent conceptual and technological advances have allowed the increased use of sequence guided metagenomic investigations of the marine environment[7]. Diversity and the abundance of free-living marine microorganisms have been described using 16S rRNA based analyses and total metagenomic analyses from a variety of different marine environments such as in ocean surface waters, mesopelagic waters, the deep sea, water columns and sea subfloor sediments. The microbial diversity of marine invertebrate associated organisms has also been investigated including marine corals and marine sponges.

(2) Human microbiome has significantly enriched metabolism of glycans, amino acids and xenobiotics; methanogenesis; and 2-methyl-D-erythritol 4-phosphate pathway-mediated biosynthesis of vitamins and isoprenoids. Thus, humans are superorganisms whose metabolism represents an amalgamation of microbial and human attributes. This metagenomics analysis begins to define the gene content and encoded functional attributes of the gut microbiome in healthy humans. Future studies are needed to provide deeper coverage of the microbiome and to assess the effects of age, diet, and pathologic states (e.g., inflammatory bowel diseases, obesity, and cancer) on the distal gut microbiome of humans living in different environment[8].

(3) Metagenomic study of the marine planktonic microbiota in which surface (mostly marine) water samples were analyzed as part of the *Sorcerer II* Global Ocean Sampling expedition. These samples, collected across a several-thousand km transect from the North Atlantic through the Panama Canal and ending in the South Pacific yielded an extensive dataset consisting of 7.7 million sequencing reads (6.3 billion bp). Though a few major microbial clades dominate the planktonic marine niche, the dataset contains great diversity with 85% of the assembled sequence and 57% of the unassembled data being unique at a 98% sequence identity cutoff. Using the metadata associated with each sample and sequencing library, new comparative genomie and assembly methods were developed[9].

(4) Interrogation of microbial metagenomic sequence data collected as part of the Sorcerer II Global Ocean Expedition (GOS) revealed a high abundance of viral sequences, representing approximately 3% of the total predicted proteins. Cluster analyses of the viral sequences revealed hundreds to thousands of viral genes encoding various metabolic and cellular functions[10].

CONCLUSION

Metagenomics analyses microbial communities as systems that have functional properties that go beyond those of individual genes or individual microbes. The application of metagenomics based approaches has provided new challenges and has allowed the discovery of novel functions, an appreciation of the great diversity of microorganisms, and the introduction of the controversial ideas regarding the concept of species,

genome and niche. Metagenomie projects are complex hence the establishment of collaborative scientific team, both domestic and international will be encouraged. Therefore, metagenomics study is something like a metaorganism, and understanding such an entity requires a system-biologic approach.

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SOME REMEDIES TO MINIMIZE THE POLLUTION DUE TO E - WASTE

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As software gets more demanding, hardware needs to keep pace. The Government department, Local Authority, Private Sectors are involved with large software providers and they find it most economical to replace their equipment after every few years with new one. With the average of 3 years lifespan of computers, the environmental pollution and human health has become a serious issue. Now a days, it is the demand of time to either reuse or recycled the e-waste. Some toxic substances like lead, cadmium, mercury are dangerous to human health. In this paper, we have made an attempt to suggest some remedies, which is helpful to reduce this pollution and also human health problems due to the hazardous substances available in electronic waste materials.

INTRODUCTION

E waste or Waste Electrical and Electronic Equipment (WEEE) is the term used to describe old, end-of-life or discarded appliances using electricity. It includes computers, consumer electronics, mobile phones, household appliances, cooling appliances etc. E-waste contains both valuable materials as well as hazardous materials that require special handling and recycling methods. It contains over 1000 different substances, many of which are toxic and potentially hazardous to environment and human health, if these are not handled in an environmentally sound manner. E-waste is a big toxic ocean. To save the nation from this, proper awareness is highly needed among all. Further it is a duty of every living being to save the nature from these dangerous breakdowns.

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There is an estimate that the total obsolete computers originating from government offices, business houses, industries and household is of the order of 3 million nos. Manufactures and assemblers in a single calendar year, estimated to produce around 1200 tons of electronic scrap. It should be noted that obsolence rate of personal computers (PC) is one in every two years. The consumers finds it convenient to buy a new computer rather than upgrade the old one due to the changing configuration, technology and the attractive offers of the manufacturers. Computer waste is generated from the individual households ; the government, public and private sectors ; computer retailers ; manufacturers ; foreign embassies ; secondary markets of old PCs. etc.

To prevent the environment from e-waste, it is better to recycle or reuse or dispose off in landfills or incinerators. The reuse and recycling of e-waste reduce the hazardous effects on the environment. Recycling and reuse also boosts energy and resource conservation. However, the cost of recycling is

very high but it is better to prevent pollution and safe guard the environment instead of burning and landfilling the e-waste.

Disposal off e-waste in landfills contaminates the ground water and soil. The toxic chemicals present in the electronic equipments purge away into the land over time or it may release into the atmosphere. These hazardous substances contaminate ground water, lake and wells and pollute the environment.

HAZARDOUS WASTES

Here we consider the computers as e-waste. It contains various substances and chemicals, which are toxic and create serious problems for the environment as well as human health.

Lead : It is present in glass panels and gaskets in computer monitors, solder in printed circuit boards and other components.

It causes damage to the central and peripheral nervous systems, blood systems, kidney and reproductive system in humans. It also affects the endocrine system, and impedes brain development among children. Lead tends to accumulate in the environment and has high acute and chronic effects on plants, animals and microorganisms.

Cadmium : It is found in SMD chip resistors, infra-red detectors, and semiconductor chips. Also some older cathode ray tubes contain cadmium.

Toxic cadmium compounds accumulate in the human body, especially the kidneys.

Mercury : Thermostats, sensors, relays, switches, medical equipment, lamps, mobile phones and batteries uses Mercury. It is also used in flat panel displays.

The Mercury causes damage to organs including the brain and kidneys, as well as the fetus. The developing fetus is highly vulnerable to mercury exposure. When inorganic mercury spreads out in the water, it is transformed to methylated mercury which bio-accumulates in living organisms and concentrates through the food chain, particularly via fish.

Hexavalent Chromium/Chromium VI29 : Chromium VI is used as corrosion protector of untreated and galvanized steel plates and as a decorative or hardener for steel housings.

Chromium VI can cause damage to DNA and is extremely toxic in the environment.

Barium : Barium is a soft silvery-white metal that is used in computers in the front panel of a CRT, to protect users from radiation.

Short-term exposure to barium causes brain swelling, muscle weakness, damage to the heart, liver, and spleen.

Beryllium : Found on motherboards and finger clips, it is used as a copper-beryllium alloy to strengthen connectors and tiny plugs while maintaining electrical conductivity.

Exposure to beryllium can cause lung cancer. Beryllium also causes a skin disease that is characterized by poor wound healing and wart like bumps. Studies have shown that people can develop beryllium disease many years after the last exposure.

Phosphor and Additives : The coating on Cathode Ray Tubes contains phosphor.

This is a serious hazard posed for those persons who dismantle CRTs by hand.

REUSABLE SUBSTANCES FROM E-WASTE

Although e-waste contains many toxic substances, some materials which are non hazardous can be reused for other purposes:

Copper : It is costly material and can be reused easily. It is found on PCB's, on IC's of motherboard,

on RAM chip, on SMPS, on the internal circuit of keyboard, on the cables and connectors.

Aluminum : It is found on the heat sink, SMPS, CD ROM drive, floppy drive, R/W drive, cells, and on the hard disk.

LED (Light Emitting Diode) : It comes in various colors like red, green, yellow, white. Generally it does not get worsen/worthless, and thus can be reused.

Peripherals : Metallic parts of the printers like iron or fiber rod, printer head, cartridge, CD's, pen drive, cabinets can be reused. Keyboards can be remolded.

Silicon : It is found on transistors, IC's and printed circuit boards.

REMEDIES

The lifespan of computers are only 3 to 4 years due to the advancement of technology. The user replaces the system instead of changing it's parts. The above mentioned toxic substances are available in the computers, which are very hazardous for health and environment. So, it is dangerous to either burn or landfill the e-waste, because in both the cases, it pollutes the environment.

Today, the e-waste has becomes a serious problem. Thus either it has to be recycled or reused or disposed off. Recycling can be defined as the assembling, developing, promoting or buying of new products, which are prepared from waste materials. But some toxic substances cannot be recycled, because it affects the human health and environment as well. Burning the e-waste into incinerators leads to formation of harmful gases due to the hazardous substances present in it. If these harmful substances can be disposed off with some chemicals then it will reduce the pollution of environment and also reduce the problem of human health danger with some extent. These are listed here :

Cadmium : Cadmium containing material increases the pollution to considerable extent due to its toxicity. If it is released to the atmosphere in ionic form then it is directly absorbed in human body. Cadmium oxides and carbonates are the non toxic material and thus the pollution due to cadmium can be prevented by simple aerial oxidation by using manganese oxide (MnO) as catalyst.

$2Cd^{++} + O_2 \longrightarrow 2CdO$

$2Cd + 2O_2 \longrightarrow Cd_2O_3$

Mercury : It causes high toxicity to human organs and tolerable limit of mercury pollution is very low. Mercury is absorbed by body in any form and has a high tendency to accumulate in the body organs. Some alkyl derivatives of mercury like methyl mercury are highly toxic. Mercury easily forms Nitrates and Chlorides, which are ionic in nature. In ionic state also mercury is absorbed by human body but ionic mercury can be excreted by kidneys and other organs thus lowering the toxicity level. Therefore, it is always safe to burn such mercury rich materials in presence of oxidizing agents like concentrated nitric acid (HNO_3) or even potassium iodide (KI) which easily converts ionic mercury to nitrates and iodides. Mercury is more dangerous due to its two oxidation states Hg^{+}, Hg^{++}.

$Hg^{++} + 2HNO_3 \longrightarrow Hg(NO_3)_2 + H_2$

Hexavalent Chromium : Colored materials contains high amount of chromium in the form of chromaplates and other electronic materials. Chromium can be easily eliminated from water or even soil by treating the material with carbon dioxide under pressure. Chromium carbonates are easily formed and thus the risk of mixing chromium with water and soil can be reduced.

$$Cr^{+++} + 3O_2 \xrightarrow{CO_2 + \text{Water}} Cr_2O_3$$

So it is always convenient to burn chromium containing electronic devices in presence of carbon

dioxide in moist condition (carbonic acid burning). Of course burning of acid may increase the air pollution.

Barium (Ba^{++}) : Barium and its compound have tendency to aggregate forming macro particles and therefore barium dose can be obtained from air and water as well. Due to this the tolerable dose limit can exceed very easily. Barium containing material can be destroyed or disposed by burning the material in airtight compartment and the products are allowed to release to atmosphere through micro filters (Sinter). It is also advisable to burn such barium containing material to form ash which after dissolution in water forms a floggy mass or it can be removed by simple chemical treatment of ash solution with dilute sulphuric acid (H_2SO_4).

$Ba^{++} + H_2SO_4 \longrightarrow BaSO_4 + H_2$

Lead : When lead is disposed with sodium carbonate then all metals gets easily converted to their oxides or carbonates which are soluble to water. The majority of the metals are non toxic.
$Pb^{++} + Na_2CO_3 \longrightarrow PbCO_3 + 2Na^+$

PROJECTION OF E-WASTE IN INDIA

From the data collection for last four years from three metro cities Delhi, Banglore and Mumbai, the expected e-waste for year 2010, 2011 and 2012 is calculated.

Year/Cities	Mumbai	Delhi	Banglore
2006	7900	9520	9100
2007	9000	10300	9600
2008	9850	10750	9800
2009	11000	10800	11500

Table 1 : E-waste generated in last four years in three metro cities

On the basis of last 4 years data, we calculate the expected e-waste for next 3 years, represented in Fig 1.

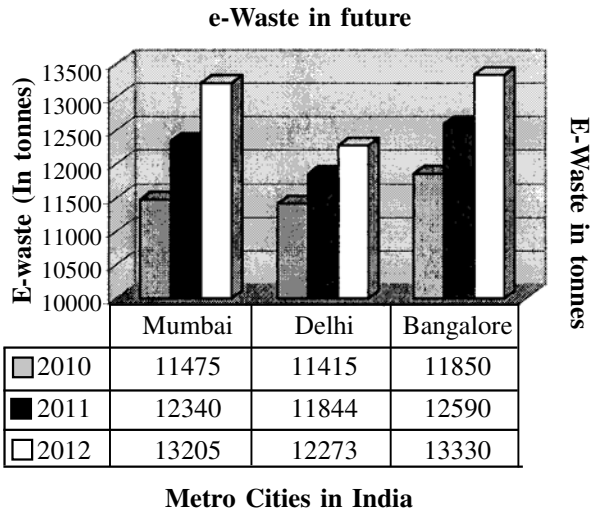

Fig 1: Estimated e-waste in future years

CONCLUSION

The e-waste is one of the fastest growing waste streams in the world. From the Fig. 1, we notice that day-by-day, it is generated with alarming rate. There must be awareness between the users and manufacturer of electronic products. It is the moral responsibility of producer and distributor of electronic product to manage the e-waste.

Electronic products contains both toxic and non toxic substances. Some substances like copper, aluminum, iron which are non toxic can be reused easily. The more hazardous substances like lead, cadmium, mercury can be disposed off with other chemicals, so that the resulting gases or substances are not dangerous for human health and also help to reduce the pollution due to waste material.

E-waste is a big toxic ocean. The projection of trend calculated in this paper warns the need of proper action for E-waste management that must be taken soon; otherwise India would have to pay a huge price for it. To save our nation from this, "A proper awareness" is highly needed among all. Thus the objective of this paper is to provide suggestions of some recommendations for minimizing pollution of environment and human health problems.

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MISS: MICROBIALLY INDUCED SEDIMENTARY STRUCTURES

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A new category of primary sedimentary structures named "Microbially Induced Sedimentary Structures (MISS)" formed by the interaction of microbes with sediments and physical agents of erosion, deposition, transportation or deformation, are the latest interests of scientists studying evolutionary biology. The structures form when microbial mats are preserved in the sedimentary geological records.

INTRODUCTION

Archean Earth history is very difficult to reconstruct. Until recently, only bacterial cells preserved in chert (fine-grained silica-rich microcrystalline, cryptocrystalline or microfibrous sedimentary rock that may contain small fossils), microborings (microendolithic cyanobacteria, green and red algae, fungi and foraminifers), and stromatolites (from Greek *strôma,* mattress, bed, stratum, and *lithos*, rock) provided the few clues to ancient life. Noffke and his colleagues in 2001 hosted a new category of primary sedimentary structures that they termed "Microbially Induced Sedimentary Structures" (MISS).[7] These, siliciclastic (MISS) are providing vital information of evolutionary mechanisms of major life forms on this earth. MISS rise from the interaction of photoautotrophic microbial mats with physical sediments in siliciclastic, shallow-marine habitats.

Sand is present everywhere on this Earth and their deposits are one of the oldest sediments of Earth. Irrespective of all evolutionary changes that took place on Earth during its time travel the moving waters remained the same for at least three billion years. Benthic prokaryotes, which are bacterial microbes found at the floor of the sea, are known as the constructors of the stromatolites. Sediments on the ocean floor are not just accumulations of minerals but are reservoirs of benthic microorganisms which is an integral, highly complex cosmos. Stromatolites are reef-like boulder heads and are the most important things which have preserved original term of life. Stromatolites are magnificent geological features, layered, branched, and full of preserved energy.

The microbes form thin organic coatings, around individual sediment grains called as biofilms, or they grow to thick, carpet-like layers called microbial mats that cover many kilometers of tidal, lagoonal and continental shelf sediments. Both biofilms and microbial mats contain abundant amounts of extra polymeric substances (EPS). EPS are highly adhesive mucilages in which the bacteria are embedded. Microbial mats are indeed 'mats'. These coherent, organic layers can be lifted from the sediment, rolled up and carried away like a carpet.

Under microscopic examination these microbial mats show innumerable distinct microorganisms that form a dense and comprehensible network.

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The main mat-constructing microbial group is photoautotrophic cyanobacteria. Because of the large sizes of their filaments, and their blue-green colour, cyanobacteria were formerly termed 'blue algae' or 'blue green algae'. Stanier *et. al.* in 1977 nevertheless detected that the algae in fact are prokaryotes, not eukaryotes[9]. Prokaryotes include *Bacteria* and *Archaea*, microbes without a nucleus and generally without cell organelles. Eukaryotes include protista such as algae, fungi, and all multicellular plants and animals. Eukaryotes have a nucleus and various cell organellae.

STROMATOLITES AND MICROBIAL MATS

Microbial mats and biofilms have a significant influence on how sediments respond to the hydraulic dynamics of waves and currents. For a long time microbial influences on marine sediments were

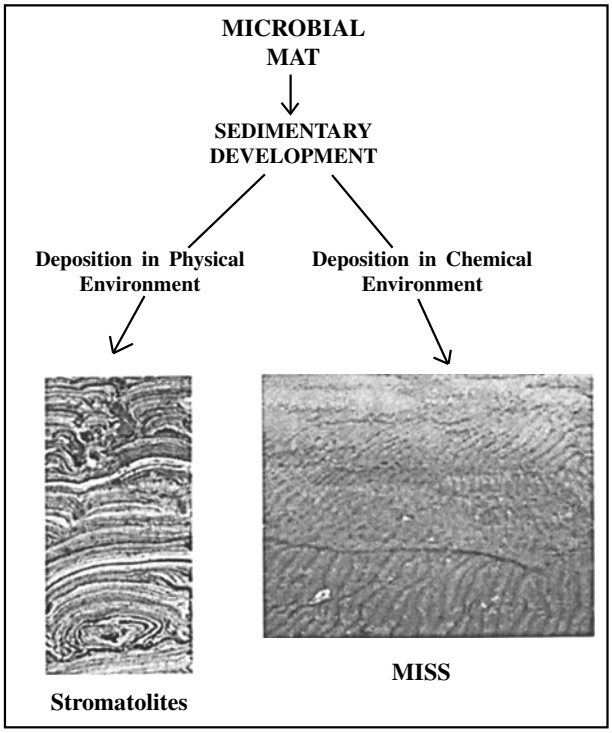

Fig 1 : *Stomatolities and Microbially Induced Structures*

generally understood as biogeochemical processes resulting in the formation of stromatolites. These rigid, reef-like build-ups are composed of a stack of layers which can be seen in vertical section through the stromatolite. These layers derive from *in situ* precipitation of carbonate or silica minerals. This precipitation is generated by the metabolism of biofilm and mat-forming microbiota, which is an characteristic feature of chemical marine environments (Fig. 1). Stromatolites, similar to sturdy coral reefs, are important for geologists and

Fig 2 : *"Mycrobially Induced Sedimentary Structures" on rocks showing "Ripple Marks"*

biologists. They constitute solid rock units that can be preserved easily. Stromatolites are found abundantly in the fossil record, and they allow insight into Earth's earliest life. However, biofilms and microbial mats do not always form stromatolites and specially in today's modern times. Stromatolites are found mainly in the tropics, where carbonate minerals precipitate from seawater and cementation takes place. Benthic microbiota also colonizes cold-water oceans, where the sea floor is composed of sandy deposits. Sand is redrafted by waves and currents. This interaction between moving water and sediment is termed 'physical sediment dynamics'. In such physical environments, chemical precipitation of minerals does not take place, and stromatolites do not build up. However, microbenthos still leaves traces in the mud and sand.

Characteristically, traces are made by macroorganisms such as worms, clams and polychaetes that inhabit marine sediments. The animals burrow through the sand, graze on the seafloor surface, or tunnel vertically downward in search of a suitable environment. Burrows, grazing traces and tunnels are found as trace fossils in

consolidated sedimentary rock. However, traces are left not only by worms and clams, but are also left by benthic microorganisms. Like macroorganisms, microbes respond actively to the hydraulic displacement of their muddy or sandy substrate. Prokaryotes react to physical erosion, and to deposition of sand, and their active migration leaves traces behind. This microbial-physical interaction contrasts with biogeochemical processes. The MISS structures form counterparts to stromatolites that occur in carbonate settings. The structures, like traces and trace fossils, occur in modern sediments as well as in fossil sedi-mentary rocks. Most important, MISS do not resemble stromatolites.

Recent research documented that the structures have the same significance for the interpretation of Earth history as stromatolites. Stromatolites occur since early Archean times, and witness the existence of biofilms and microbial mats for at least 3.4 Ga years. MISS show the same distribution through time, and record that microbial mats were present in tidal flats, lagoons, and continental shelves throughout Earth history. The oldest examples are reported from the 3.2 Ga old Moodies Group, South Africa. Both stromatolites and MISS occur until today. However, modern stromatolites are restricted to rare and very small scaled habitats, such as the famous Shark Bay in Australia. In contrast, modern microbial mats that form MISS are distributed worldwide. They fringe the oceans like a blue-green seam and constitute one of modern Earth's largest ecosystems. Conveniently, microbial mats can be monitored everywhere along sandy beaches. The microbial- physical processes that form the MISS can be measured and quantified. The study of microbial mats and MISS in the present environment enables geobiologists to draw conclusions about fossil microorganisms in ancient oceans. This comparison of modern with ancient environments is termed the 'actualistic principle'. Geoscientists say "The present is the key to the past". Geobiological research essentially calls for the comparison of modern with ancient life and environment. The study of MISS therefore is setting the direction for this developing discipline.

The academic correct definition of MISS is: Microbially Induced Sedimentary Structures. MISS are primary sedimentary structures that arise syndepositionally from the interaction of biofilms and microbial mats with the physical sediment dynamics in siliciclastic aquatic environments. Biostabilization counteracts erosion; baffling and trapping responds to deposition of sediment; and binding and growth take place during latencies (the time periods of no or low sediment reworking). Nearly all biotic-physical interactions overlap in the formation of MISS. Whereas primary mineral precipitation does not play any role in the formation of the MISS, secondary mineral accretion induced by the decay of the microorganisms assists in the preservation of these structures. In thin-section, the macroscopic MISS must include microscopic textures that are related to, have been caused by, or represent ancient biofilms or microbial mats. MISS occur from the early Archean to the present, and allow conclusions about the continental shelf and tidal flat environments. MISS are significant indicators for narrow facies zones in marine settings. Sixteen types of MISS are generally recognized which can be grouped into four categories. What are the four categories—name them. The classification is based on result of growth, biostabilization, binding, baffling, and trapping.

Fig 3 : *Stomatolities which resulted from Algal mat.*

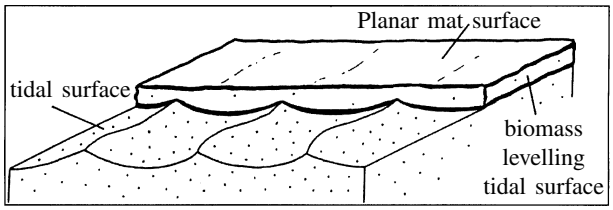

Fig. 4 : *Diagrammatic sketch showing leveling of ripple marks on a tidal surface by a cyanobacterial mat. The biomass grows preferentially in deeper parts of the rippled relief. Further growth of the biomass forms a planar mat surface over time.*

SIGNIFICANCE OF 'MISS'

Just like a complex food web, microbial mats are communities of micro-organisms in which each member depends and is depended on by others in the community. Within microbial mats an amazing array of energy harvesting strategies are seen, and virtually every way in which energy can be extracted from the environment can be found in microbial mats, often over vertical distances of only a few millimetres. Yet, while the active mat community may extend just a few millimetres deep into the sediment, its chemical impact, via buried and decaying biomass, may influence the sediment for decimetres and even metres beneath the surface. Identification of the actual participants in a mat-forming microbial community is hardly ever possible in the terrigenous clastic rock record.

Mats possibly also played an important role in biological evolution. For example, one of the plausible explanations for the demise of many Ediacaran organisms is that their ability to anchor themselves to the substrate with holdfasts was degraded concurrent with the rapid decline in microbial mat coverage at the Proterozoic-Phanerozoic transition. With the advent of burrowers, microbial influence extended deeper beneath the sediment surface, but contiguous biofilms were more difficult to sustain. This may have shifted the balance of sedimentary biofilms towards those that form as microbial coatings around individual grains, such as oncoids and 'algal biscuits'. Abundance of mat-related structures in shelf sequences also implies *in-situ* production and preservation of organic carbon. Conceptual models for sedimentary carbon burial and source rock formation in the Precambrian have to take this significant difference to the Phanerozoic into account. There is also a growing interest in terrestrial microbial mat systems and in the freshwater microbes that produce stromatolites.

Due to the large contribution of microbial life to the global biomass, atmosphere hydrosphere chemical cycles are strongly influenced by microbes. For example, close to the depositional site, ammonification, denitrification and sulphate reduction of microbial sediment leads to a rise in alkalinity of ambient water. Microbial mats also play an important chemical role in the reductive fixing of metals like iron, manganese, gold and uranium. Thus, the trace element geochemical signatures of sedimentary rocks may be misinterpreted if the former presence of microbial mats goes undetected.

Aside of their utility for palaeoenvironmental reconstructions, mat-induced structures can also serve as important palaeogeographic indicators and have potential for refining techniques of basin analysis in Precambrian strata. The impediment to erosion caused by prolific mat growth may be a key factor that encouraged vertical stacking of highstand systems tracts in the Precambrian. At a smaller scale, mat growth reflects a low rate and the discontinuous nature of sedimentation, and partly controls bedform evolution. Establishing an interest in microbial mat structures in siliciclastic sediment is, therefore, laden with the possibility of elucidating a wide range of geological phenomena. Fossil microbial mats, or stromatolites, attest to the existence of water or moisture in which microbial life thrived, and constitute the oldest and most

pervasive evidence of life on Earth. Therefore they also figure prominently in our attempts to identify life on other planets.

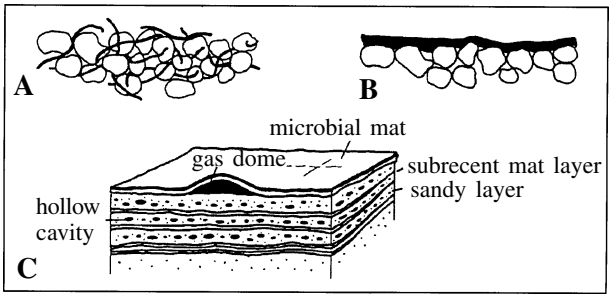

Fig. 5 : *Sedimentary grains are interwoven by cyanobacterial filaments, and fixed in their position. The organic meshwork either increases the resistance of the organic-rich sediment against erosion or permits flexible deformation. B) Reduction of the surface roughness of the sandy deposits by the smoothing mucous-rich cyanobacterial cover (black). Smoothing of the sedimentary surface means reduction of frictional forces, which increases the stability against erosion. C) Dense mat layer seals the sediment and intrasedimentary gasses become entrapped. The gas pressure increases over time and generates hollow cavities within the sands.*

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APTAMERS-POTENTIAL APPLICATIONS IN DIAGNOSTICS AND THERAPEUTICS

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Nucleic acid aptamers have attracted intense interest and found wide applications in a range of areas. Using an efficient selection process, randomized oligonucleotide libraries can be rapidly screened for aptamers with the appropriate binding characteristics. This technology has spawned the development of a new class of oligonucleotide therapeutic products. This article highlights the potential of aptamers in diagnostics and also focus on pitfalls and future prospects of this technology.

INTRODUCTION

For a long time, nucleic acids were considered mainly as linear carriers of information, whereas most cell functions were ascribed to protein molecules possessing complex three-dimensional structure. Apart from their role in the evolutionary archives of life, the use of DNA and RNA as natural ligands in evading cellular defense mechanisms was first discovered in the late 1970's with their application in antisense therapy. Analysis of transcription, splicing and translational mechanisms has shown that specific interactions of proteins with certain RNA sites are of tremendous importance in gene regulation and expression. The immense combinatorial variety of nucleic acids and their ability to form diverse secondary and tertiary structures made possible the directed search for nucleic acids exhibiting peculiar properties. Advances in genomic and proteomic technologies have led to the development of elaborated methods for nucleic acid evolution in the laboratories and which could be used to obtain RNA or single stranded DNA capable of exhibiting catalytic activities. These synthetic nucleic acids capable of exhibiting catalytic activities are called aptamers (Latin : *aptus* = suitable, adjusted)[1].

Aptamers, discovered around 1995, are short 50-100 base long, single stranded oligonucleotides capable of recognizing a wide variety of target molecules, and bearing a group of characteristics important for the development of novel diagnostic and therapeutic strategies. Aptamers are obtained *in situ* by direct selection from combinatorial oligonucleotide libraries by a method called as SELEX (Systematic Evolution of Ligands by Exponential enrichment) in which several rounds of selection are being carried out in order to pick the sequences that bind to a target molecule. In each round, the oligonucleotide library is incubated with the target molecule followed by the selection of those oligonucleotides which bind with the target molecule and finally these oligonucleotide sequences are amplified using PCR. As a consequence, the combinatorial library is enriched with the sequences exhibiting the increased affinity to the target molecule. The chief advantages of SELEX for biotechnology applications are its technical versatility and applicability to a wide array of target molecules, while the chief stumbling

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block is the widely held bias that nucleic acids are too large, too expensive, and in the end too synthetically cumbersome to serve as drugs or assay components[3].

Aptamers have been shown to bind to proteins, peptides, nucleic acids, polysaccharides, small organic molecules (amino acids, nucleotides and other metabolites), virus particles, whole cells and tissues. These small single-stranded nucleic acids are claimed to act as mimics of antibodies in that they can recognize molecular targets with high specificity and are able to carry therapeutic agents, radioisotopes, directly to solid tumour masses or to individual cells that may metastasize with greater efficiency. The main advantage of aptamers is their *in vitro* selection process, contrary to the biological systems used by the antibodies. To produce antibodies, the induction of an immune response is necessary. By isolating aptamers *in vitro* an aptamer can be produced for any target molecule. Another complication for *in vivo* production of antibodies is that the antibodies can only work under physiological conditions. This restricts the range of applications and functions of antibodies. Aptamers, on the other hand, can be optimized for any condition. Aptamers are also stable at high temperature and they can be regenerated easily after denaturation. Aptamers are in general more stable than antibiotics and have a longer shelf life[5].

Aptamers are high–affinity and high specificity ligands. Recent development of automatic aptamer selection allows simultaneous selection of aptamers to a great number of different targets. Owing to such characteristics, aptamers are widely used in basic and applied fields of investigations. Aptamers have been used for investigation of mechanisms of interactions of proteins with nucleic acids. In the case of proteins, *in vivo* recognizing specific sequences of nucleic acids, SELEX allows a researcher to reveal natural sequences of RNA or DNA recognized by the protein. Analysis of three-dimensional structure of aptamer-protein complexes is used for structural investigation of the RNA and DNA binding sites of target proteins. Highly efficient and specific inhibitors of target proteins can be obtained on the basis of aptamers. Similar inhibitors can be used both in fundamental research and for creation of new drugs such as various cell surface receptors, growth factors, hormones, enzymes, toxins and proteins of viruses and pathogenic microorganisms can serve as targets. Several drugs are being investigated on clinical trials based on aptamers. These oligonucleotides can also serve as new inhibitors for different proteins by performing a directed search for molecules, competing with the aptamer-inhibitor for binding to the protein target and thus interacting with the same site of the protein as the original aptamer[6].

Aptamers have been widely used for detection of different target molecules for diagnostic purposes. It has been demonstrated that aptamers might replace antibodies in methods of ELISA, fluorescent hybridization *in situ* and Western blotting. Aptamers are employed for measuring concentrations of various metabolites and protein factors, for detection of toxins, revealing different types of cells and tissues, and cells of pathogenic microorganisms. They can also be used for affinity purification and identification of target molecules.

The most promising application of aptamers is that of microchip development incorporating a great number of aptamers that can be used for simultaneous analysis of many target molecules. Presently, there are some aptamer-based microchips available which can analyse growth factors in human blood. It has been proposed that in future, there will be a development of aptamer-based microchip that could analyse for the expression of a greater number of different human cell proteins, which might be of huge importance for development of methods for diagnosis of different diseases as well as for fundamental research. Microchips based on high-affinity aptamers would be very attractive in the future as the aptamer identification process is

very rapid that can be performed on an automated platform. Aptamers can be immobilized at a definite density at precise locations on a solid surface with existing technologies used to generate DNA microchips. Moreover, homogenous preparations of aptamers are readily available from chemical synthesis. Microchips based on aptamers are robust and are expected to have a long shelf life. The formation of irreversible cross-linking between aptamers and proteins is highly specific and provides another dimension of specificity in addition to the specificity provided by affinity. This dual specificity provided by cross-linkable aptamers eliminates the need for secondary ligands specific for each protein for detection. In the near future, aptamer microchips are expected to play a dominant role in the area of proteomics that not only will facilitate better disease management by analyzing the expression of proteins by patients but also help discover new therapeutics by target validation. Aptamers may also be useful in more direct methods that do not require immobilization. For example, fluoresceinated aptamers can be detected in a flow cytometer. A novel application of fluorescent aptamer detection is with the use of quantum dots. The ability of different quantum dots to emit at different wavelengths whilst excited at the same wavelength could offer a solution for multiple analyte detections in solutions[3].

Aptamers have become increasingly important molecular tools for diagnostics and therapeutics. In particular, aptamer-based biosensors possesses unprecedented advantages compared to biosensors using natural receptors such as antibodies and enzymes. Aptamers with high specificity and affinity can in principle be selected *in vitro* for any given target, ranging from small molecules to large proteins and even cells, thus making it possible to develop a wide range of aptamer-based biosensors. These oligonucleotides, once selected, can be synthesized with high reproducibility and purity from commercial sources. Since aptamers often undergo significant conformational changes upon target binding, this characteristic offer great flexibility in design of novel biosensors with high detection sensitivity and selectivity[7].

An unexplored area of aptamers is in sensors based on electrochemical detection. Aptamers, being polyanionic, may be attractive for sensing the changes in conductance in the presence and absence of target binding. An interesting area of nucleic acid research is the understanding of the principles behind the charge transfer within the DNA helix. Although this research is still in infancy, it has great potential in the area of molecular sensing. The application of nanomaterials provides a novel approach to develop label-free, high sensitivity aptamer based sensors. Recently, a single-walled carbon-nanotube field effect transistor device has been fabricated to monitor aptamer-protein-binding processes[7].

Another class of aptamers that has been recently developed is that of peptide aptamers. These are artificial proteins where inserted peptides are expressed as part of the primary sequence of a structurally stable protein, called the scaffold. This is achieved by the insertion of oligonucleotides encoding the peptide into existing or engineered restriction sites in the open reading frame encoding the scaffold. The peptide displayed can be isolated from random libraries or can be amino acid sequences taken from previously identified proteins whose biology requires further characterization. Peptide aptamer technology has the advantage over existing technologies that the reagents identified are designed for expression in eukaryotic cells. This allows the construction of molecular tools that allow the logics of genetics, from knockouts to extragenic suppressors, to be applied to studies of proteins in tissue culture cells[6].

Aptamer-Facilitated Biomarker Discovery is an emerging technology for biomarker discovery. AptaBiD, as it is often called, is based on multi-round generation of an aptamer or a pool of aptamers for differential molecular targets on the

cells which facilitates exponential detection of biomarkers. It involves three major stages which includes differential multi-round selection of aptamers for biomarker of target cells followed by aptamer-based isolation of biomarkers from target cells and mass spectrometry identification of biomarkers. The important feature of the aptamer-based- biomarker technology is that it produces synthetic affinity probes (aptamers) simultaneously with biomarker discovery. In this technology, aptamers are developed for cell surface biomarkers in their native state and conformation. In addition to facilitating biomarker identification, such aptamers can be directly used for cell isolation, cell visualization, and tracking cells *in vivo*. They can also be used to modulate activities of cell receptors and deliver different agents (e.g., siRNA and drugs) into the cells[9].

The therapeutic potential of aptamers lies on some of the issues that apply to more conventional pharmaceuticals. Firstly, aptamers must interact tightly and specifically with their targets. The large size and surface area of nucleic acids is a decided advantage, in that they can potentially form many more interactions with targets than can smaller molecules. The large size of aptamers gives them multiple opportunities to discriminate between epitopes on related proteins, and aptamers have been shown to distinguish between even closely related targets, and aptamers must be able to not only disrupt the function of a particular target, but also inhibit or modify the metabolism associated with that target.

Some of the most obvious problems linked with aptamer technology have already begun to be solved while natural oligonucleotides are relatively unstable in sera or within cells, chemically modified nucleic acids have been shown to be nuclease-resistant. Similarly, researchers have begun exploring the pharmacokinetic properties of aptamers, but these are still largely unknown. Even if the aptamers can be made bioavailable, their size and hence cost of production remains problematic. Fortunately, many aptamers can form tight and specific interactions with their targets via domains of only 30 to 40 nucleotides. While these 10 000 to 15 000 Dalton molecules are still orders of magnitude larger than a conventional drug (approximately 200 to 800 Daltons), advances in synthetic methods may soon allow their economical synthesis. Finally, while the specificity of aptamers for their targets may ward off the systemic side effects often associated with pharmaceuticals, this same specificity may encourage the evolution of metabolic or viral resistance. In fact, many of these potential problems serve to highlight unique advantages of aptamers relative to conventional drugs or even other biopolymers. The fact that nucleic acid shapes are largely determined by relatively simple secondary structural motifs implies that aptamers can be readily engineered. Disulphide cross-links can be introduced into nucleic acid secondary structures and thus provide a large increase in thermal stability without compromising structural integrity. Structure-forming helices in aptamers have now been successfully replaced with disulphides and other compact chemical structures. Similarly, aptamers have been stabilized against exonuclease degradation by simply adding nucleotides bridged by phosphorothioate linkages to their 5' and 3' -termini. The selection process itself can potentially be geared to anticipate and overcome problems associated with delivery and bioavailability. Aptamers selected for their ability to bind to complex targets, such as cell lines or organs, could potentially be used for tissue-specific delivery. Aptamers selected to interact with coated pits or for the ability to localize to specific organelles might provide another layer of sophistication for drug targeting[10].

While the prospects for aptamer therapeutics remain uncertain, it is likely that selected RNA and DNA molecules will find use in diagnostic assays. Like antibodies, aptamers that react with a variety

of targets can be selected. Like antibodies, aptamers have high affinities and specificities for these targets. Aptamers are smaller and less complex than antibodies, however, and consequently may be easier to manufacture and modify. Thus, it is not unreasonable to speculate that the large markets associated with immunodiagnostics will see an increasing challenge from kits based on nucleic acid shape recognition.

The discovery of aptamers whose affinity and specificity parallel those of antibodies is expected to have a future impact on diagnostics. It is also likely that existing diagnostic formats may change according to the need to better harness the unique properties of aptamers. Aptamers have an unleashed potential to circumvent limitations associated with antibodies and are waiting to be utilized in practical settings where their performance could be compared directly to the antibiotics. Aptamers can be raised against toxic, small or otherwise poorly immunogenic antigens. They may circumvent problems with biopolymer denaturation during storage, and are ultimately cheaper than antibodies. The passage of aptamers from experimental novelties to research investigations should be accelerated by the identification of large numbers of aptamers recognizing large numbers of targets, and this radiation of aptamers may turn on the automation of aptamer selections. Just as monoclonal antibody facilities exist in many major corporate and academic research settings, it is possible that aptamer facilities will now begin to be set up. These facilities may reasonably be expected to include a robotic workstation that starts with purified targets or even target mixtures, and returns populations of binding species that can be quickly characterized by automated sequence acquisition and analysis. The selected aptamers can then be used to quantitate, localize, or inhibit proteins, even proteins whose function is unknown. As research tools, aptamers may eventually contribute to nascent efforts in functional genomics, providing ready-made inhibitors of the multitude of new genes identified by Genome projects[8]. The high affinities and specificities of aptamers for their targets originally suggested that aptamers might be good drug leads. Proofs that aptamers can specifically inhibit biomedically relevant proteins and modify cellular metabolism augur well for future drug development. Recent advances in the chemical modification of nucleic acids suggest that one of the major barriers to use, stability, can be overcome. If, however, aptamers are to be used as pharmaceuticals, methods of mass producing and delivering modified oligonucleotides will have to be developed; these methods will in turn be dependent on better defining the pharmacokinetic properties of oligonucleotides. The introduction of aptamer-based diagnostic tools is more likely in the near future which would require the development of simple methods for the detection of aptamer- target complexes.

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LANGUAGE AND THOUGHT : THE CHICKEN AND EGG SYNDROME

Lakshmi Krishnan* and Debjani Mukherjee**

The question with language and thought is, which comes first? Does language shape thought or vice-versa? From a psychological viewpoint, Piaget asserts that thought exists without language; whereas Chomsky, from the linguist's point of view, stresses the influence of language on thought. After studying the thought processes of young children under controlled conditions, this paper tries to arrive at a balanced conclusion vis-à-vis the above question.

For many centuries it was considered that language is the source of the expression of human thoughts and ideas. Ralph Waldo Emerson[1] wrote, "Thought is the blossom, language the bud." However, psycholinguists in the 20th century started grappling with some new questions. Thoughts and ideas, even when not spoken out aloud, need to be expressed in some way within the mind itself. When we think, we may not be speaking to others, but we are speaking to ourselves. In most cases, a human being "speaks to himself" in the language where his comfort level is highest, and this is usually, though not necessarily, the mother tongue. But what about those who do not know any language? For instance, babies in the pre-speech stage cannot speak, but surely they also have thoughts and ideas in their minds; their minds do not remain blank until they acquire speech skills. Likewise is the case of deaf and dumb people. Though they cannot hear or speak verbal languages, they must surely have ideas in their minds. Helen Keller became blind and deaf when she had an attack of meningitis at the age of one. She could not hear or speak any verbal language and only when she was about seven years old did she learn to communicate her thoughts by pressing signs into the palm of her tutor Anne Sullivan. Those were not the days of hearing aids or even of Braille or sign language. Yet it is beyond credence that a fertile and intelligent mind like hers could have been a vacuum until she learnt to communicate ideas! The question with language and thought is, as with the chicken and egg, which comes first? But be that as it may, language is a uniquely human gift and plays a big part in our experience of being human and it is worthwhile attempting to understand its role in shaping our mental construct.

Does language shape thought, and if so, to what extent? Does it influence the way we think, the way we live, the way we see the world, the way we interact with other human beings? Well-known critic Elaine Showalter[2], analysing the difference between the writing of men and women, says that language plays an important role in the cultural construct of a person. Patriarchal social conventions allow lesser and more limited linguistic territory for women, which reflected in their writing and ideas too, till in later years more and more women broke relatively free of these conventions resulting in the enrichment of ideas in women's writing.

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It is an unresolved controversy whether language is merely a tool for expressing our thoughts or whether it actually shapes our thoughts.

Piaget[3] the famous psychologist and known for his research on cognitive psychology, is quite definite about the relationship of language to concept formation. He is of the opinion that there is no need for language to precede the acquisition of concepts. Before the child learns to speak, he is already using symbolic thought in which one object stands for another. A child that opens and shuts its mouth while working out how to open any box for example a lunch box or a matchbox is representing one action by another even if he cannot speak. Language is only one of the symptoms of this level of development, not the cause. Some use of symbols is found before speech occurs, and some use of non-language symbols co-exists with speech. Language is only part of the child's development and does not play a crucial role. Its only major difference from other symbolic systems is that it is not personal and idiosyncratic but is shared with other speakers of the language. The proof of the minor role of language comes from studies of deaf and blind children. Their conceptual development is delayed by between one and four years. Yet in the end they acquire more or less the same concepts as the normal child in spite of their language handicap. So language only greases the wheels, it does not drive them. Piaget's advice for the teacher seems to be that language must not be treated in isolation but as part of the general development of the child; the teacher must not expect to influence conceptual development very greatly through language teaching.

From the point of view of the linguist, Noam Chomsky[4] is far from convinced that language is simply part of the growth of symbolic thought. In a recent lecture he dismissed this with the remark that 'Since only the vaguest of suggestions have been offered, it is impossible at present to evaluate these proposals.' Most of those studying child language at the moment agree with him that the dependence of language acquisition on more general learning processes is not proven. Many aspects of language development appear to have no parallels in other areas of development. Syntactic structure has peculiarities of its own. For instance, early in the development of speech the child forms sentences by combining two different types of words, usually known as 'pivot' and 'open'. Examples of this are sentences such as 'Ball there', 'Spoon fall' and 'See Doggy'. Why he should do this and how this leads on to more complicated structures is as yet uncertain. Yet this stage is found in a variety of languages and may perhaps occur in all human languages. As a developmental stage it seems unique to language. The linguist's advice to the teacher is then to be wary of subordinating language to concept as this will not teach those aspects of language that are unique.

Though there are differences between these two approaches, there are also similarities. They both recognise that language acquisition is not the same thing as the development of concepts. They differ over the degree of independence they grant to language. Piaget sees language as essentially no different from other uses of symbolic thought. Chomsky sees language as having its own specific qualities not shared by other aspects of development. The difference between concept and language has been shown in several experiments. In our effort to validate this theory, we found that children are able to discriminate spatial relations at an earlier age than they can understand the language that describes these relations.

Working with a group of children in the nursery age group (4-6years), we showed them different geometrical shapes placed in different positions to each other. For example if they were shown a picture of a triangle inside a square, they could pick out a matching duplicate picture much easier and quicker than if they were given a verbal order "Show me a picture of a triangle inside a square."

In another example, some of the children were instructed verbally, "Throw the ball into the bucket." The others were shown manually what they had to do. No verbal instructions were given to this lot. It was found that the children who received the visual example comprehended and performed the action much quicker than those who received the verbal instructions. Thus we found that concept precedes language.

The way in which languages differ from one another may give credence to the belief that language does indeed shape thought. Lera Boroditsky[5], in her essay "How Does Language Shape the Way We Think?" gives the interesting hypothetical example. Suppose we want to say, "Bush read Chomsky's latest book." Let's focus on just the verb, "read." To say this sentence in English, we have to mark the verb for tense; in this case, we have to pronounce it like "red" and not like "reed." In Russian you would have to alter the verb to indicate tense and gender. So if it was Laura Bush who did the reading, you'd use a different form of the verb than if it was George. In Russian you'd also have to include in the verb information about completion. If George read only part of the book, you'd use a different form of the verb than if he'd diligently ploughed through the whole thing. Boroditsky also conducted a test on speakers of English and Russian languages and came up with interesting results. In English, there is only one word for the colour "blue", whereas in Russian there are two distinct, separate words "goluboy" (light blue) and "siniy" (dark blue). Boroditsky's data shows that Russian speakers are quicker to distinguish between the two shades of blue than English speakers who were much less sensitive to subtle differences in shades. To take a broader example, we can consider the fact that in some languages (like English) inanimate nouns take a neuter gender, while in other languages (like Hindi), all nouns, whether animate or inanimate, are classified as either masculine or feminine. A chair, for example, is neuter in English but feminine in Hindi. Would that make a difference in the way the speakers of both these languages think?

It is probably too simplistic to find an answer to the question as to whether language shapes thought or vice-versa. A more realistic and balanced conclusion would be that both language and thought are complementary to each other. It is possible to develop concepts without verbal language and communication can be done through symbols also, but for the most effective and powerful expression and communication of ideas, there can be no better tool than the verbal language. Expressing and communicating effectively will in turn facilitate further development of ideas.

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APPLICATIONS OF GREEN FLUORESCENT PROTEIN

Anju Kumari[2], Rakesh Kumar[2*], K. K. Kapoor[1] and P. K. Sharma[1]

Green Fluorescent Protein (GFP) was first isolated in the early 1970s for experimental use from Coelenterates or the Pacific jellyfish, *Aequorea victoria*. GFP has since become a favored biomarker in the photophysical analysis of molecular biology and ecology because of its strong intrinsic visible fluorescence and the feasibility of fusing it to other proteins without affecting their normal functions.

INTRODUCTION

Microorganisms are exploited in many areas of environmental biotechnology, including bioremediation, biocontrol, and plant growth enhancement. Increasingly, Genetically Engineered Microorganisms (GEMs) are being constructed for these environmental applications. To assess product efficacy and potential risks of release of GEMs into nature, specific and sensitive monitoring methods are required. Traditional techniques for assessment of microbial numbers and metabolic activity generally lack the specificity required for monitoring of GEMs. Therefore, novel molecular biology based techniques such as DNA probing and marker gene tagging have recently been developed as specific methods to identify and quantitate populations of specific microorganisms in the environment. One of the most promising markers is the *gfp* gene, encoding the Green Fluorescent Protein (GFP). An advantage of GFP is that, unlike other biomarkers, it does not require any substrate or additional cofactors in order to fluoresce.

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GFP OCCURRENCE AND STRUCTURE

GFP is a fluorescent protein isolated from coelenterates, such as the Pacific jellyfish, *Aequoria victoria,* or from the Sea pansy, *Renilla reniformis.* Its role is to transduce the blue chemiluminescence of the protein *aequorin* into green fluorescent light by energy transfer. In GFP, the fluorophore originates from an internal Ser-Tyr-Gly sequence which is post-translationally modified to a 4-(*p*-hydroxybenzylidene)- imidazolidin-5-one structure. The fluorophore itself is a p-hydroxybenzylidene-imidazolidone. It consists of residues Ser65-*dehydro* Tyr66 - Gly67 of the protein. The cyclized backbone of these residues forms the imidazolidone ring. The fluorescence is not an intrinsic property of the Ser-Tyr-Gly tripeptide.[1] The amino acid Sequence Ser-Tyr-Gly can be found in a number of other proteins as well. This peptide is neither cyclized in any of these, nor is the tyrosine oxidized. None of these proteins has the fluorescence of GFP. The fluorophore is generated by a sequential mechanism in an auto-catalytic process. No co-factors or enzymatic components are required. The reaction is initiated by a rapid cyclization between Ser65 and Gly67 to form an imidazolin-5-one intermediate which is followed by a much slower rate-limiting oxygenation of the Tyr66 side chain by O_2 on a timescale of hours. Gly67 is required

for formation of the fluorophore, no other amino acid can replace Gly in this role.

GFP APPLICATIONS

The gene for GFP has been isolated and has become a useful tool for making chimeric proteins of GFP linked to other proteins where it functions as a fluorescent protein tag. It has been expressed in bacteria, yeast,, slime mold, plants, drosophila, zebrafish, and in mammalian cells. Since the *gfp* gene is eukaryotic in origin, it was first necessary to develop optimized constructs for expression of *gfp* in bacteria. Chalfie *et. al.* (1994) revolutionized the used of *gfp* gene as maker in bacteria by cloning and expressing it in *E.coli* [2]. A number of GFP variants with spectrum of fluorescence ranging from yellow, blue, orange, red and green have been developed by site directed mutagenesis. The use of the reporter gene *gfp* allows reporter activity to be examined in individual cells. Because the reporter activity is cellular fluorescence conferred by the production of a Green Fluorescent Protein (GFP), Fluorescence Microscopy can be used to generate spatial information on biosensor cells *in situ,* and Flow Cytometry can be used to quantify the fluorescence of individual cells recovered from a habitat.[2] Additionally, unlike the reporters β-galactosidase, β-glucuronidase, and ice nucleation proteins, GFP is not known to be produced by organisms indigenous to terrestrial habitats; thus, it can be used without background reporter activity by the indigenous microflora. GFP is very stable; this provides experimental flexibility when evaluating reporter activity following an induction event.

GFP cassette has been described with *gfp* under the control of a strong constitutive promoter like *npt, cam* and *tac* promoters with an optimized ribosome binding site. A number of broad host range plasmid, suicidal plasmids and transposon cassettes have been developed for introduction of *gfp* gene into different hosts. Several Tn*5*-based transposons containing either a promoterless *gfp* gene or a *gfp* gene expressed from a broad-host-range promoter have been generated for use in tagging diverse bacterial species.[3] The *gfp* genes have been used in gene expression studies in eukaryotic organisms, constructing transgenic animal and transgenic insects. Some of the applications are as :

Colonization studies

In both natural and managed ecosystems, plant-associated bacteria play a key role in host adaptation to a changing environment Interactions between plants and beneficial bacteria can have a profound effect on crop health and yield and soil quality. The ability to colonize roots has been considered the major factor that determines inoculum efficacy both for crop yield enhancement and for disease control. This has led to an emphasis on selection of plant-beneficial bacteria that are rhizosphere competent and can also colonize internal tissues. GFP tagged bacteria have been used to study the colonization by symbiotic, endophytic and phytopathogenic bacteria.[4,5]

Whole cell biosensor

Microorganisms are increasingly being used as specific and sensitive sensing devices for measuring biologically relevant concentrations of pollutants. These biosensors rely on analysis of gene expression, typically by creating transcriptional fusions between a promoter of interest and a reporter gene, and the extent of reporter gene expression serves as a measure of the available concentration of a pollutant. The gene for Green Fluorescent Protein (GFP) is increasingly being used to construct whole-cell biosensors because it allows for *in situ* assessments of bioavailability, although it has not been used extensively as a reporter for measuring biologically relevant concentrations of pollutants, iron, water, sucrose and lead availability.[6,7]

Detection of VBNC

Culture-based techniques are most commonly used to determine viable counts in dairy products,

but they have the limitation that they are unable to enumerate Viable But NonCulturable (VBNC) organisms. VBNC organisms may potentially be capable of causing infections and may contribute to food spoilage. Direct analysis of microbial cells based on vital staining and combined with analysis by Microscopy or Flow Cytometry can provide an alternative approach to culture-based methods for determining the total and viable counts of bacteria. Gene expression using *gfp* gene fusion has been used for assessing viability in both culturable and nonculturable cells.[8]

Gene transfer

Horizontal gene transfer is an important adaptive mechanism for bacteria that may result in increased genetic variation by bringing together genes from different genetic backgrounds. Genes can be horizontally transferred between bacteria by conjugation, transduction, and transformation. Studies on conjugation have primarily been conducted using disruptive techniques limited to detecting transfer to the culturable fraction of the community by growth of recipients on selective media. The culturable bacteria are typically less than 1% of the total number in marine environments. By using a nondisruptive system based on the Green Fluorescent Protein (GFP) to detect plasmid transfer, problems with culturability can be circumvented.[9]

Quorum sensing

In recent years it has become apparent that bacteria coordinate their interaction and association with higher organisms by intercellular communication systems. In gram-negative bacteria, one type of communication system functions via small, diffusible *N*- Acyl Homoserine Lactone (AHL) signal molecules. Such quorum sensing regulatory systems operate allows bacteria to sense and express target genes in relation to their cell density. Several methods to detect the presence of AHL have been described. A number of bacterial sensor systems such as the pigment-developing *Chromobacterium violaceum* and *luxAB* and *lacZ*-based systems have been described. Although these methods are very useful and highly sensitive, they do not allow for detection at the single-cell level or at the local environment. Bacterial AHL sensors that signals the presence of AHL molecules by expressing a reporter Green Fluorescent Protein (GFP) have been developed which indicate the presence of AHL in the environment.

In medicine

Another powerful use of GFP is to express the protein in small sets of specific cells. This allows researchers to optically detect specific types of cells *in vitro* (in a dish), or even *in vivo* (in the living organism). Genetically combining several spectral variants of GFP is a useful trick for the analysis of brain circuitry and as sensors of neuron membrane potential, tracking of receptors on cell membranes, viral entry and the infection of individual influenza viruses and 'lentiviral viruses, etc. It has also been found that new lines of transgenic GFP rats can be relevant for gene therapy as well as regenerative medicine. By using "high-expresser" GFP transgenic rats display high expression in most tissues. Through its ability to form internal chromophore without requiring accessory cofactors, enzymes or substrates other than molecular oxygen, GFP makes for an excellent tool in all forms of biology.[7,10]

CONCLUSION

In cell and molecular biology, the GFP gene is frequently used as a reporter of expression. In modified forms it has been used to make biosensors, and many animals have been created that express GFP as a proof-of-concept that a gene can be expressed throughout a given organism. The GFP gene can be introduced into organisms and maintained in their genome through breeding, injection with a viral vector, or cell transformation. To date, the GFP gene has been introduced and

expressed in many bacteria, yeast and other fungi, fish (such as zebrafish), plant, fly, and mammalian cells, including human. Martin Chalfie, Osamu Shimomura, and Roger Y. Tsien were awarded the 2008 Nobel Prize in chemistry on 10 October 2008 for their discovery and development of the Green Fluorescent Protein.

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EMOTIONAL INTELLIGENCE : THE VEHICLE TO WELL-BEING IN RELATIONSHIP PERSPECTIVE

Nilanjana Sanyal* and Manisha Dasgupta*

The present "celluloid" era is marked by "me-only" orientation coupled by materialistic strivings to achieve "excellence" in varied spheres of life, to make the self "glorified", thereby paying minimal heed to the needs of the others. Competition, jealousy coupled with other negative emotions, self-insufficiency serve as "piercing and attacking edges" to have their toll on interpersonal relationships in the long run. As such, the depth, genuinity and serenity of relationships are getting eroded at fast pace. It is Emotional Intelligence (El) which serves as a "catalyst" in making individuals aware of the emotional planes of themselves as well as others, and helps foster healthy relationships, which naturally calls forth well-being in the long run. The present chapter is an attempt to highlight the significance of El in relational context so as to help keep our relationships "green".

The present era of globalization is marked by perfectionistic orientation coupled by materialistic strivings to achieve "excellence" in varied spheres of life. People are increasingly focussing on the avenues to attain the "ideal standard" in the rat-race of unhealthy competition. As such, the relationship-platter is increasingly becoming brittle, with its enmeshed threads getting torn apart ruthlessly, owing to underlying prejudices, bigotry, conspiracies, unhealthy competitive-spree and the like. Hence, the dire necessity to realize the danger of the alarming situation and mending itself by adopting appropriate measures to re-instill happiness and well-being in the long run. The present chapter is a humble attempt to understand the significance of Relationship Science in the context of long-term well-being of individuals, with Emotional Intelligence (El) serving as an important catalyst in the process.

GREENING OF RELATIONSHIP SCIENCE

Relationship Science is emerging to be an integrating force within psychology[1]. This is because close relationships are the essential units of human existence. The desire to establish and maintain intimate ties with others is considered by some to be a basic motive[2]. The success and failure of interpersonal relations have a profound impact on one's life satisfaction[3], psychological well-being[4], and physical health[5]. Besides, many studies have documented that a troubled relationship, especially a distressed marital or family relationship, is the most common problem of those seeking psychotherapy[6].

In fact, the tissue of a relationship is the oscillating rhythm of influence observed in the interactions of at least two people. This rhythm is displayed in regularities in their interaction pattern, and the goal of relationship science is to identify

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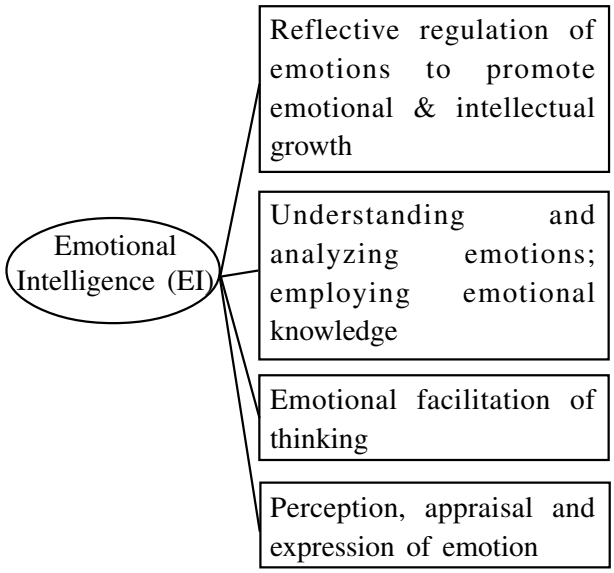
the causal conditions responsible for that rhythm. Relationships are inherently temporal rather than static. A relationship itself is invisible; its existence can only be discerned by observing its effects. The oscillating rhythm of a relationship emanates right from the time of conception through birth with the development of attachment with the significant care-giver within the initial few months of life followed by its reverberations in different spheres (owing to generalizations)[7]. Attachments first develop in terms of object-relations with a part-object (i.e., the mother's breast) followed by the perceptions of the mother as an "object", and then as a "person", to be generalized later on to other individuals with which the child interacts[8]. In fact, the crux of one's relationship-web essentially depends on the quality of infantile reverberatory-connection with significant members[9].

The "yacht" of interpersonal relationships is steered properly by the catalyst of Emotional Intelligence, by balancing the fusion of head and heart[10]. It paves the way for thoughtful reflection that essentiates the development of empathy, respect, reciprocity and acceptance of the "significant other", which serve as the key pillars of healthy relationship.

EMOTIONAL INTELLIGENCE : THE KEY TO STEER RELATIONSHIPS

Emotional Intelligence (EI) is the integration of emotion and reason that results in a whole that is greater than the sum of its parts. It essentially depends on the optimum blend of affection and cognition that determines how people make sense of their emotional experience and how they use it.

EI serves as a highlight factor in establishing and maintaining relationships[11]. In fact, an interpersonal relationship is conceived of as a developing process of interdependent functioning characterized by recurrent patterns of interaction, the rules governing those patterns of interaction, and the relatively enduring emotional, cognitive and behavioural dispositions of the people involved toward the people and involved in the relationship. Every relationship has emotional and cognitive aspects that continue between interactions and contribute to its persistence[12]. The dynamic fabrication of emotional intelligence is expected to have the following constituting elements :



Hence, the mental processes included in Emotional Intelligence are :

- Appraising and expressing emotions in the self and others,
- Regulating emotions in the self and others, and
- Using emotions in adaptive ways.

EI may be related both to characteristics that build relationships and to the quality of those relationships. Four building blocks of relationships where EI comes to play an important role may be

- empathy,
- the ability to self-monitor in social situations,
- good social skills and
- cooperation.

The corresponding important indices of relationship quality may be affiliation, close affective ties and a satisfactory close partnership."[13]

Thus, in any relational context, individuals need to start the process of recognition by attending to their bodies. They need to be able then to symbolize what they feel, first to themselves and then, when appropriate, expressing this to others. People need to be able to say to themselves, "I feel". Having acknowledged their emotional experience, people then need to begin to understand those feelings. The mind needs to symbolize bodily felt experience in words, to synthesize the neuro-chemical cascades that wash over into conscious experience and symbolise them into personal meanings.

Thoughtful reflection on emotional prompting is a crucial part of Emotional Intelligence. This is where conscious thoughts play its crucial role. A schematic representation of personality in relation to EI may be understood as :

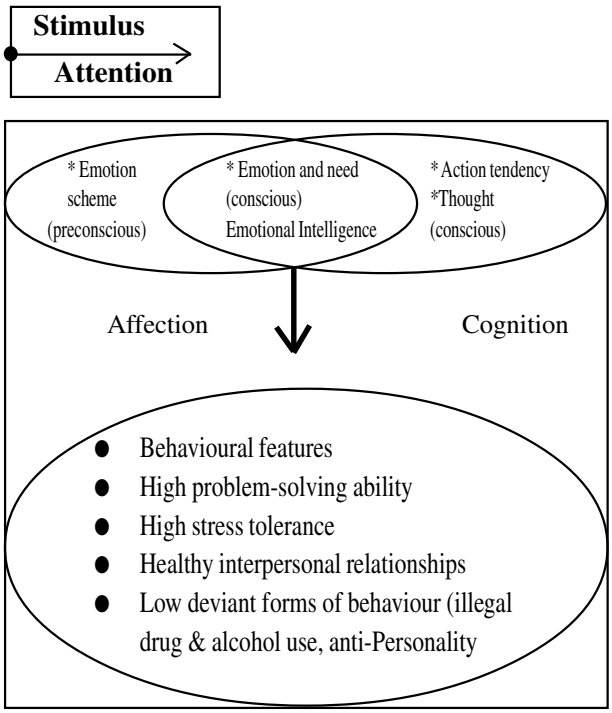


Fig. 1 *: Schematic representation of personality in relation to Emotional Intelligence*

Hence, it appears that El plays a crucial role in mending relationships so as to instill a sense of well-being in the long run, which is of chief focus in the final fold of the chapter.

EMOTIONAL INTELLIGENCE AS AN AVENUE TOWARD WELL-BEING IN RELATIONAL CONTEXT

EI enables individuals to have effective regulation of affect within themselves and others, thereby contributing to well-being. Thus, the emotionally intelligent person is often a pleasure to be around and leaves others feeling better, by means of the reverberatory impact of "contact therapy". It reflects a focus on positive psychological and social functioning, personal strengths and mental health[14]. As such, EI enables one to transcend the path toward personal growth by a continual process of "working through" one experiences in the canvas of relationships. Thus, the chief features of well-being, fuelled by El in relationships include the development of :

- self-acceptance ;
- personal growth ;
- sound purpose in life ;
- environmental mastery ;
- autonomy ;
- positive and healthy relations with others ;
- sense of generativity ;
- coherence and integration of personality ;
- mindfulness.

CONCLUSION

Thus, to draw the curtain close, it can be said that relationship platters are the most essential social-emotional commodity for all of us. To live happily and healthily, and help others to live the same way, we ought to have the "cloaks" of close and satisfying relationships. The sense of happiness with the root of belongingness creates the context of our sense of well-being. In this, the creator is behaviourally conceived to be emotional intelligence the new arena of cognition-emotion blended element of mind. It is this emotional intelligence (EI) which serves the crucial role of a mediator in making relationships meaningful and essential to

their mental and physical well-being. As such, it is the catalyst which helps in keeping one's relationship-web optimally functional, to bring forth feelings of happiness, well-being, and contentment with a generativity-rimmed outlook as resultants on the whole.

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SHORT COMMUNICATION

STORY ABOUT VACCINES

Malika Pal*

This article is a collection of the Interesting Facts associated with the development of Vaccines.

Everybody knew that milkmaids are beautiful. There were plenty of nursery rhymes and stories about their divine beauty and flawless skin. People thought that this is a gift from God to them since they do a dirty and tedious job of cleaning a cow and milking them, then supplying it. In this way they work as angles and so God has given them the gift of beauty. But one village doctor from Berkley, Gloucestershire England set out to find out truth behind the myth.

This man was Edward Jenner. He observed the life and working of the little milk maids and saw that when the girls begin their work in cow shed they do fall sick and have skin rashes, but these rashes are mild and soon disappear. This was commonly called cow pox. These girls never suffered from Small pox.

Small pox is a dangerous disease that was very common in Europe in 18th century. Hundreds of people suffered and about 40% of them died every year due to this disease. 1/3rd of all babies born never reached age of three. In this disease small water filled pimples appear on the skin including eyes. They burst when ripe; the water which comes out from the pimples spreads more infection. The pimples left permanent marks on the skin, which looked very ugly. Pimples formed on eyes damaged the eyes leading to blindness. Since it spreads through direct contact, it spread easily in damp and cold climate of Europe.

However, milk maids were resistant to this dreaded disease. Jenner had an idea; he first injected an 8 year old boy named James Phipps with materials removed from cow pox rashes from hands of milk maid Sarah Nelmes in May 14th 1796. After six weeks the boy was exposed to the pus from small pox patient, but the boy did not develop small pox. This experiment confirmed his belief that germs of cow pox disease gives protection against the disease of small pox. So if somebody suffers from cow pox once he will never suffer from small pox or the person becomes immune to small pox. Edward Jenner made his report public in 1798 after experimenting on 23 more persons. By 1801 about 1,00,000 people were treated in Europe. But people were still doubtful about the procedure and took a little time to accept the treatment.

VACCINE IN AMERICA

The first American known to be vaccinated was Daniel Oliver Waterhouse. He was five years old when his father Benjamin Waterhouse, a Boston doctor obtained cow pox germs from Europe and infected his own son along with two servants in July 8th 1800. They were later exposed to small pox germs and found to be immune to it. Such daring and dramatic demonstrations proved the value of this type of treatment and people gradually begin to accept it.

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In 1805 Napoleon Bonaparte made vaccination compulsory for all French soldiers. In Russia the first child vaccinated was renamed as Vaccior and was educated by the state as he was considered as national treasure. Since the material used came from cow it was known as vaccination as Latin for cow is *Vaccina* and the name vaccine was given by Louis Pastuer to any preparation of weak germs that was used to immunize against any infectious disease. Today small pox vaccine is made from viruses grown on the skin of calf or sheep or eggs.

Edward Jenner died in 1823 as a satisfied man but didn't knew that both the diseases, cow pox and small pox are caused by virus. His perfect observations and confidence lead him towards a new method of treatment and ensured secure future for generations to come. Today children are vaccinated against diphtheria, measles, mumps, whooping cough, rubella, polio, tetanus etc. Since October 1977 not a single small pox case was reported throughout the World.

FORMIDABLE PASTUER

Now lets talk about failure. Most of us dread this word and do not like to discuss it or admit it. But imagine a situation when you fail to prove what you have strongly stated it's bad isn't it ?

Think how will you handle the situation and see how Louis Pastuer did it..... Louis Pastuer in 1880 claimed that he had isolated certain germs that caused cholera in chickens. In those days people thought that diseases were caused by evil spirits.

The concept that germs cause disease was unheard of. So he was asked to demonstrate his findings . Pastuer was confident of his findings so he accepted the challenge. He injected few healthy chickens with cholera germs, but to his dismay the chickens remained healthy. It was a huge set -back for Pastuer. Dishearten but Formidable, Pastuer began to review each step of his experiment. By doing so he found that the germs he used that day were not fresh, they were old and stale germs, which did not cause disease.

He repeated his experiments with a little modification. He took two sets of chickens, 1st set consisted of chickens that remained healthy during the first demonstration and 2nd set consisted of fresh chickens. Both sets were injected with fresh germs. But this time too everything was not OK.

Only chickens of 2nd set developed cholera and died but others remained healthy. It was a mystery only he could solve and he did it beautifully.

He explained that the chickens that had received weak germs from old cultures had developed immunity in their body against the disease. So when they received the actual dose of powerful germs during the 2nd experiment they remained healthy. This was similar to the use of cow pox germs by Edward Jenner in 1798 to develop immunity for small pox.

It was later accepted that when a body is exposed to weak or weakened germs, it develops immunity against the disease, as these weak germs stimulate production of antibodies in the body of the host.

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KNOW THY INSTITUTIONS

BERHAMPUR UNIVERSITY

Berhampur University is one of the prominent universities in Orissa. It has been accredited by National Assessment and Accreditation Council (NAAC) with a rating of B^+. The university was incepted in 1967 with the mission to provide the benefits of Higher Education to the people of South Orissa, to foster socio-economic growth of the region and to study, preserve and enrich the culture of South Orissa. The university has completed 37 years and has carved for itself a place of pride in the academic map of the country. University of Berhampur is a permanent member of the Inter University Board of India and Sri Lanka as well as that of the Association of Common Wealth University of London.

HISTORY

Berhampur University was established in 1967, inaugurated by Dr AN Khosla, the then Governor of Orissa and the first Chancellor of the University. The University was shifted to its present site known as Bhanja Bihar, named after the celebrated poet of Orissa Kabisamrat Upendra Bhanja. The university is known as a symbol of glory and prosperity for the people of South Orissa.

EDUCATIONAL STREAMS

The university has achieved great distinction in the academic world due to the qualitative and quantitative production of M. Phil., Ph.D., D. Litt. and D. Sc. degrees. Berhampur University Orissa presents M. Sc. in Biotechnology / Bioinformatics,

PG Diploma in Disaster Management, M. Tech. in Computer Science, Master in Business Economics and M. Tech. in Electronic Information Systems. The Harihara Mardaraj Distance Education Center at Berhampur University Orissa works with the motto of providing education at the door step of the students and presents opportunities to join under graduate, post graduate and professional courses extensively. The university has the record of holding seminars and conferences every year apart from organizing weekly seminars in the departments. Several UGC sponsored Refresher Courses/Orientation Programmes/Summer Institutes are conducted in the university for the benefit of the university and college teachers.

FACILITIES

Learners at Berhampur University can avail of the RP Padhi Library that comprises a large volume of books and journals on diverse areas. Subscription facility is available for news paper and journals. Computer center, Cultural club, Athletic club, Shopping complex and Health center are other facilities at Berhampur University Orissa.

Faculties/Departments

Faculty of Science

Computer Science
Marine Science
Physics
Chemistry
Botany
Zoology
Mathematics
Electronics

Faculty of Arts

Political Science
Industrial Relations and Personal Management
History
Economics
Home Science
Oriya
English
Mass Communication
Linguistics

Faculty of Business

Commerce
Business Administration

Faculty of Law

Law

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Conferences / Meetings / Symposia / Seminars

1. World Congress for Man and Nature, "Global Climate Change and Biodiversity Conservation, 11th to 13th November, 2011, Haridwar, Uttarakhand, India.

- Global Climate Change
- Biodiversity Conservation
- Environmental Management
- Sustainable Development
- Mathematical Modeling
- Global Warming and Economics
- Environmental Statistics
- Energy Efficiency
- Medicinal Plants
- Natural Resources
- Forestry
- Water Conservation
- Environmental Biotechnology
- Disaster Management
- Environmental Education
- IT Application in Environmental Conservation
- Environmental Technology
- Environmental Economics
- Environmental Laws and Policies
- IPR & Sustainable Development
- Eco-tourism
- Aquatic Ecology
- Aspects of Pollution & its control
- Ayurvedic Science
- Climate Change & Quality Management
- Environmental Protection
- Alternative Energy and its Resources
- Climatology
- Geospatia Technologies
- Remote Sensing & GIS
- Green Energy Technologies
- Food Resources
- Industrial Emission
- Wildlife Science
- Nanotechnology & Conservation
- Human Ecology & Global Climate Change
- Decision making system & EIA
- Environmental Science in Veda
- Biodiversity in Veda

For Paper submission guidelines visit : www.wemanu.com

Online Submission : @:wemanu2011@gmail.com, @:wemanu2011@hotmail.com

Abstract Submission : 15th August, 2011, Acceptance Notification : 30th August, 2011, Paper Submission : 30th September, 2011

Contact : Prof. D. R. Khanna, Executive Director, World Congress for Man and Nature, Department of Zoology & Environmental Science, Gurukula Kangri Vishwavidyalaya, Haridwar-249404, Uttarakhand, India.

2. International Conference on Nano Science, Technology & Societal Implications, 8th to 10th December 2011, Bhubaneswar, Odisha, India

The International conference on NSTSI 2011, aims to build a three day platform where the concerned researchers/academicians/engineers/administrators from diverge regions of the world would converge to share their knowledge, expertise and research ideas. The papers are solicited in the following (but not limited) areas :

- Science in a nanoscale.
- Nanotechnology address to Climate Change and pollution free energy.
- Nanomaterials
- ICT and Nanotechnology
- Nanotechnology in Diagonsis and Treatment of Diseases, Health matters & Nanomedicine.
- Nanofabrication & Characterization Technology.
- Nano and Quantum Computing — Prospects & Challenges.
- Nanobiotechnology.
- Fusion nano : Bio-inspired or bio-oriented nanotechnology and nanostructures and those combined with information technology.
- Post Nano : Next generation process.
- Nanophotonics and Nanoelectronics
- Nanotechnology : New ideas & Trends for Human Capacity Building.
- Nanotechnology and Socio-Economic Trends
- Environmental & Health Risks of Nanotechnologies : The Debate
- Nanotechnology : The Power to Solve Poverty
- Socio-Economic Limits for a Win-Win Nanotechnology
- Problem-Solving : Public Private Partnerships on Nanotechnology
- Market and Development in Nanotechnology
- Application of Nanotechnology in Agriculture

Contact : International conference on Nanoscience, Technology and Societal Implications, Department of Physics C.V. Raman College of Engineering, Bidyanagar, Mahura, Janla, Bhubaneswar, Odisha, India, Pin - 752054, E-mail : nstsi11@cvrce.edu.in

S & T ACROSS THE WORLD

PLANTS TEACH HUMANS A THING OR TWO ABOUT FIGHTING DISEASES

Avoiding germs to prevent sickness is commonplace for people. Wash hands often. Sneeze into your elbow. Those are among the tips humans learn. But plants, which are also vulnerable to pathogens, have to fend it alone. They grow where planted, in an environment teeming with microbes and other substances ready to attack, scientists note. Now, researchers are learning from plants' immune response new information that could help them understand more about humans' ability to ward off sickness and avoid autoimmune diseases.

In the latest issue of the journal *Science,* Texas AgriLife Research scientists report their findings of a "unique regulatory circuit" that controls how a plant turns on and off its immune sensor. "Plants and animals live out their lives mostly in good health, though they may have been subjected to a lot of pathogenic mirobes," said Dr. Libo Shan, AgriLife Research plant molecular biologist and lead author for the journal article. "Scientists all around the world have been interested in how a healthy host can fend off invasions of pathogens and turn off the defense responses promptly once the intruder risk factors are decreasing.

The research team found a "unique regulatory circuit" in which BAK1, a protein involved with cell death control and growth hormone regulation, recruits two enzymes—PUB 12 and PUB 13—to the immune sensory complex and fine-tunes immune responses. Basically, the surface of plant cells has sensors that sense microbial invasion. One of the best understood plant receptors is FLS2, found in the common laboratory plant Arabidopsis. FLS2 could sense the bacterial flagellin, which is a part of the flagellum, or tail-like projection on cells which help it to move. When FLS2 perceives flagellin, a series of "evolutionary conserved immune responses" is activated to fend off baterial attack, Shan said. But the immune response can not stay activated or the plant will stop growing and producing.

"To avoid detrimental effects of long-lasting immune activation, plant and animal hosts need a way to switch the activation off," she noted. "How that can be has been a mystery to scientists."

The team discovered that the flagellin perception recruited PUB 12 and PUB 13 to the receptor FLS2 complex. Those two enzymes could add a biochemical signature tag, ubiquitin, to the FLS2 receptors which inform cells to degrade the immune senors, she added. As a result of these actions, immune signaling decreased.

Knowing how immune signaling works may help researchers devise ways to help plants and animals—including humans—regulate their immune systems.

Shan said the mechanism her lab discovered is very broad in that it can be found in both plants and animals. "We needed to understand the mechanism so that we can regulate it better," she said. "The host needs to know when the signal is triggered (to fight off a pathogen). Then the immune response needs to go quickly up and then back down when it is no longer needed." Shan believes that this ability could lead to cures, rather than medical relief, from an assortment of ailments including allergies and autoimmune diseases.

"Plants have figured out how to survive in terms of disease and pest resistance," she added. "And what we lean from them at the molecular level might help us understand animal pathogens better."

(ScienceDaily, June 17, 2011)

HARNESSING ELECTRON SPIN : TOWARD A NEW BREED OF COMPUTERS THAT CAN PROCESS DATA USING LESS POWER

Physicists at the University of Arizona have achieved a breakthrough toward the development of a new breed of computing devices that can process data using less power.

In a recent publication in *Physical Review Letters,* the physicists propose a way to translate the elusive magnetic spin of electrons into easily measurable electric signals. The finding is a key step in the development of computing based on spintronics, which doesn't rely on electron charge to digitize information. Unlike conventional computing devices, which require electric charges to flow along a circuit, spintronics harnesses the magnetic properties of electrons rather than their electric charge to process and store information.

"Spintronics has the potential to overcome several shortcomings of connventional, charge-based computing. Microprocessors store information only as long as they are powered up, which is the reason computers take time to boot up and lose any data in their working memory if there is a loss of power," said Philippe Jacquod, an Associate Professor with joint appointments in the College of Optical Sciences and the Department of Physics at the College of Science, who published the research together with his postdoctoral assistant, Peter Stano. "In addition, charge-based microprocessors are leaky, meaning they have to run an electric current all the time just to keep the data in their working memory at their right value," Jacquod added. "That's one reason why laptops get hot while they're working." "Spintronics avoids this because it treats the electrons as tiny magnets that retain the information they store even when the devices is powered down. That might save a lot of energy."

To understand the concept of spintronics, it helps to picture each electron as a tiny magnet, Jacquod explained. "Every electron has a certain mass, a certain charge and a certain magnetic moment, or as we physicists call it, a spin," he said. "The electron is not physically spinning around, but it has a magnetic north pole and a magnetic south pole. Its spin depends on which pole is pointing up."

Current microprocessors digitize information into bits, or "zeroes" and "ones," determined by the absence or presence of electric charges. "Zero" means very few electronic charges are present; "one" means there are many of them. In spintronics, only the orientation of an electron's magnetic spin determines whether it counts as a zero or a one. "You want as many magnetic units as possible, but you also want to be able to manipulate them to generate, transfer and exchange information, while making them as small as possible" Jacquod said.

Taking advantage of the magnetic moment of electrons for information processing requires converting their magnetic spin into an electric signal. This is commonly achieved using contacts consisting of common iron magnets or with large magnetic fields. However, iron magnets are too crude to work at the nanoscale of tomorrow's microprocessors, while large magnetic fields disturb the very currents they are supposed to measure.

"Controlling the spin of the electrons is very difficult because it responds very weakly to external magnetic fields," Jacquod explained. "In addition, it is very hard to localize magnetic fields. Both make it hard to miniaturize this technology." "It would be much better if you could read out the spin by making an electric measurement instead of a magnetic measurement, because miniaturized electric circuits are already widely available," he added.

In their research paper, based on theoretical calculations controlled by numerical simulations, Jacquod and Stano propose a protocol using existing technology and requiring only small magnetic fields to measure the spin of electrons. "We take advantage of a nanoscale structure known as a quantum point contact, which one can think of as the ultimate bottleneck for electrons," Jacquod explained. "As

the electrons are flowing through the circuit, their motion through that bottleneck is constrained by quantum mechanics. Placing a small magnetic field around that constriction allows us to measure the spin of the electrons."

"We can read out the spin of the electrons based on how the current through the bottleneck changes as we vary the magnetic field around it. Looking at how the current changes tells us about the spin of the electrons." "Our experience tells us that our protocol has a very good chance to work in practice because we have done similar calculations of other phenomena," Jacquod said. "That gives us the confidence in the reliability of these results."

In addition to being able to detect and manipulate the magnetic spin of the electrons, the work is a step forward in terms of quantifying it. "We can measure the average spin of a flow of electrons passing through the bottleneck," Jacquod explained. "The electrons have different spins, but if there is an excess in one direction, for example ten percent more electrons with an upward spin, we can measure that rather precisely."

He said that up until now, researchers could only determine there was excess, but were not able to quantify it.

"Once you know how to produce the excess spin and know how to measure it, you could start thinking about doing basic computing tasks," he said, adding that in order to transform this work into applications, some distance has yet to be covered. "We are hopeful that a fundamental stumbling block will very soon be removed from the spintronics roadmap," Stano added.

Spintronics could be a stepping stone for quantum computing, in which an electron not only encodes zero or one, but many intermediate states simultaneously. To achieve this, however, this research should be extended to deal with electrons one-by-one, a feat that has yet to be accomplished.

(Science Daily, June 21, 2011)

GOLD NANOPARTICLES HELP EARLIER DIAGNOSIS OF LIVER CANCER

Hepatocellular carcinoma is the most common cancer to strike the liver. More than 5,00,000 people worldwide, concentrated in sub-Saharan Africa and Southeast Asia, are dignosed with it yearly. Most of those afflicted die within six months.

A big obstacle to treatment of liver cancer is the lack of early diagnosis. Current techniques, including ultrasound, CT and MRI scans, spot tumors only when they have grown to about 5 centimeters in diameter. By that time, the cancer is especially aggressive, resisting chemotherapy and difficult to remove surgically.

Now a research team led by Brown University reports some promising results for earlier diagnosis. In lab tests, the team used gold nanoparticles ringed by a charged polymer coatinng and an X-ray scatter imaging technique to spot tumor-like masses as small as 5 millimeters. The approach, detailed in the American Chemical Society journal *Nano Letters,* marks the first time that metal nanoparticles have been used as agents to enhance X-ray scattering signals to image tumor-like masses.

"What we're doing is not a screening method," said Christoph Rose-Petruck, Professor of chemistry at Brown University and corresponding author on the paper. "But in a routine exam, with people who have risk factors, such as certain types of hepatitis, we can use this technique to see a tumor that is just a few millimeters in diameter, which, in terms of size, is a factor of 10 smaller."

The team took gold nanoparticles of 10 and 50 nanometers in diameter and ringed them with a pair of 1-nanometer polyelectrolyte coatings. The coating gave the nanoparticles a charge, which increased the chances that they would be engulfed by the cancerous cells. Once engulfed, the team used X-ray scatter imaging to detect the gold nanoparticles within the malignant cells. In lab tests, the nontoxic gold nanoparticles made up just 0.0006 percent of the cell's

(ScienceDaily, June 22, 2011)