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EDITORIAL

STRESS MANAGEMENT IN BIOLOGICAL WORLD : SOME THOUGHTS

As the organic world progresses through the evolutionary path, all living organisms on earth, whether bacteria, yeasts, plants, animals or humans, are encountering more and more stress from environment and changing life styles or cultural adaptations.

Despite their nearly exhaustive review of a long list of studies on stress management, the group of scientists led by S. Young in the Department of Psychology, University of British Columbia concluded that it is very difficult to lay down a uniform definition of stress management, not to speak of therapy protocols. (*J. Psychosomatic* Res., 2004, 56(1), pp.133-137)

Nonetheless, stress management has today become a necessary adjunct to human treatment schedules. The management paradigms may be different for different diseases/disabilities and for different stages of their progression. However, and particularly in this post-tsunami phase, it has become important to look at the state-of-art of the research on the etiology of different kinds of stress at the molecular level. The trends of management principles for future may gain clarity therefrom. Some examples may be attempted in support of this contention.

Bergamini and associates have pointed to the role of reactive oxygen species as one of the major players inducing severe cellular damages caused by biotic and abiotic stress (vide : *Current Pharmaceutical Design*, 2004, 10(14), pp : 1611-626). Again, Haupt and Haupt of the Hebrew University have elucidated the role of p53 tumour suppressor gene that controls cell cycle responses to stress stimuli in animal cells. One learns from their work that various approaches with the help of p53 gene therapy are currently being explored to cure stress related cancers (vide : *Cell Cycle,* July 2004). With the advancement of genomics and proteomics tools and employing genome-wide transcript profiling techniques, Syngenta group of scientists in U.K. reported in 2003 that a number of stress responsive genes have been identified at the cellular level from a variety of stress induced diseases. About a year ago, four scientists of Jadavpur University, Kolkata, India, who studied the oxidative stress level in transfusion dependent E-β and β-thalassemia patients, reported that lipophilic antioxidant vitamin-E treatment could be useful in management of these patients (vide : *Polish J. Pharmacology,* 2004, 56(1), pp : 85-96).

Anxiety disorders have been receiving focal attention these days. The recent Tsunami devastation and the unprecedented scale of trauma threafter are a wake-up call for scientists, planners and administrators alike so that stress research and management in the realm of entire biological world may be stepped up more vigorously and in a much more determined way than hitherto. Anxiety related stress management is a major issue. Some work has already been reported in the scientific literature like the work on transgenic mice revealing existence and functioning of two groups of novel genes that are involved in anxiety and stress related behaviours.

Can we attempt at exploring and fixing some commonalities of genes/molecules/mechanisms so that the issue of stress management research

may be addressed to the plant world also ? A few facts that have come to light may offer some positive thinking. Nitric oxide (NO), an important signalling molecule in animals, has been found to play a protective role in barley (*Hordeum vulgare* cv Himalaya) aleurone layers against antioxidant stress (vide : *Plant Physiology,* 2002, **129**(4), pp 1642-650). Molecules, genes etc. like functional homologues of GSH (glutathione) gene, proline and other osmolytes play important role in stress conditioning and adaptation in plants as well as higher animals. The recent thrust towards tailoring GM (genetically modified) or transgenic crops is mostly for generating abiotic and biotic stress tolerant crops. We salute the discoverers of 'Methuselah' gene (Benzer's group at Caltech ; 1998), and also of so-called 'death genes' (Lin and Wu ; vide *Plant Journal,* 2004, **39**(4), pp 612-628), whose findings and postulations have strengthened our conviction that an effective answer to various forms of stress like starvation, ageing (including plant senscence) may be found soon.

The aftermath of tsunami in the form of stress ridden human and animal survivors, crop field salinity, salinity of fresh water in the affected areas, vegetation degradation and other unprecedented disturbances in the terrestrial and marine ecosystems involving their flora and fauna calls for urgent and serious thinking in the direction of research, planning and execution of stress management, an inseparable part of disaster management. Everyman's Science may be a valuable forum for focussing on this very vital issue of today.

Prof. S. P. Banerjee

Vitality shows not only in the ability to persist but in the ability to start over.

–F.Scott Fitzergerald

PRESIDENTIAL ADDRESS

ON CHEMISTRY OF NATURAL PRODUCTS

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There are two ways of knowing : namely by statement (argumentation) and by experiment. A statement lays down, and makes us define the scope of a problem; but it neither confirms doubt nor removes it in such a way as to give one trust in the attainment of certitude, unless it arrives at the truth by way of experiment.

To the office which I have the honour to fill today, my distinguised predecessors were appointed as a testimony of their eminence in some branch of scientific research. This was the highest distinction which the Congress could confer upon them. I do not flatter myself that I have been elected your President because of the value of my direct contributions to the advancement of Science, but rather as a reward for the work which it was my privilege to perform during the early years of the Indian Science Congress, when, with the active assistance of numerous colleagues, I served as your Secretary. Perhaps for that reason I value the honour the more since I cannot but regard the Congress somewhat in the light of that in which a fond parent regards a favourite son.

It is with profound regret that I have to record the death of Sir Ganga Ram, a distinguished engineer and agriculturist. Sir Ganga Ram was elected President of the Section of Agriculture in 1922, but was prevented by ill-health from being present. His deep interest in the Congress was shown last year by his munificent gift to the University of the Punjab when he endowed a scholarship in commemoration of our meeting in Lahore. He died in London as a member of the Royal Commission on Agriculture helping to the end a cause which he had deeply at heart. He died in harness as he himself would have desired.

As the theme of the first portion of my address, I propose to give an account of the early history of the Congress. I think it is desirable that an authoritative statement should be on record since in a few years our knowledge of this may be lost. In order that you may be able to appreciate the causes which led to its formation, it is necessary we should try to visualise the position of scientific research in India in 1910-1911.

Early in the present century, it was recognised by those in authority that all was not well with university education in India, and in 1904 what may be called the Curzon Commission on University Education was appointed. As a result of the recommedations of this Commission, it was decided to raise the standard in the various universities and to introduce what are generally

* General President, Fifteenth Indian Science Congress, held during 31st January to 5th February, 1928 at Calcutta.

known as honours courses. At that time direct teaching was not undertaken by the universities which were solely examining bodies, the actual instruction being given in the affiliated colleges. To bring into effect the new courses, it was necessary to increase the teaching staffs in the various colleges, and it is clear that this Commission realised the desirability of stimulating research in the university colleges. They recognised the correctness of the view, so concisely expressed by Dr. Alexander Hill, ''Where there is no zeal for research there is no vitality in teaching.'' If we except three great names in the history of scientific research in Indian universities, I refer to our three past presidents, Sir Alfred Bourne, Sir Jagadis Bose and Sir Prafulla Ray, I do not think that I am wrong in saying that research in the universities at the commencement of the century was practically non-existent. I do not wish to infer that scientific research in India was non-existent at that date. This was very far from being the case, but research was confined to the various scientific services such as the Survey of India, the Geological Survey, the Botanical Survey, and the Meteorological and Agricultural Departments to mention only a few. From all these departments, work of the very first importance emanated, and it is only necessary for me to mention the names of Sir Ronald Ross, Sir Leonard Rogers, Sir Sydey Burrard, Sir Thomas Holland, and Sir Gilbert Walker.

It was under these somewhat uninspiring circumstances that in 1910 Professor MacMahon and I found ourselves when we were appointed to the newly created chairs of Chemistry in the Canning College, Lucknow, and the Presidency College, Madras. Coming as we did from large English laboratories, we at once felt the great lack of any scientific intercourse. Not only was there, neither in Lucknow nor Madras lack of any scientific intercourse. Not only was there, neither in Lucknow nor Madras, any scientific society, but in addition there was a complete absence of any scientific atmosphere. At the time, if we except the meetings of the Asiatic Society of Bengal, the only opportunities afforded for scientific discussion were the somewhat irregular conferences promoted by the Government of India such as—Sanitary Conferences or Conferences of Agricultural Chemists. These were purely official gatherings, and it occurred to Professor MacMahon and myself that scientific research might be stimulated if an annual meeting of workers somewhat on the lines of the British Association could be arranged. We felt that not only would the direct presonal contact and association of actual workers be of great value, but also that the general public would be brought to realise the importance and value of scientific research. We decided, therefore, to obtain the views of other scientists, and in the autumn of 1911, we issued a circular letter which is reproduced as (Appendix I) to this address.

Whilst the general consensus of opinion was favourable to our proposal to have an annual meeting, the doubt was expressed by many of those best able to judge whether the time was ripe for such an organisation. Some considered that there was not sufficient work being done in India to justify an annual meeting, whilst others suggested that, in view of the great distances, it would prove impracticable to arrange for such meetings.

We decided to proceed with our proposal, and in 1912 we selected seventeen of the foremost men of science to act as a committee to arrange for the holding of the first annual meeting (Appendix II). On Saturday, 2nd November, 1912, a conference was held in the rooms of the Asiatic Society of Bengal with the late Sir Henry Hayden in the chair. The others present were Messrs. Christie, Hooper, Kemp, Tompkins, MacMahon and myself. The actual minutes of the meeting are reproduced in (Appendix III), the most important resolution reading as follows : ''The Asiatic Society of Bengal be asked to undertake the management of a Science Congress to be held annually.''

As you are all aware progress in India is always slow, and although it had been our intention to have the first meeting in Calcutta in December, 1912 or January, 1913 this was not feasible and it was not until 17th January, 1914 that the first meeting was held with the late Sir Asutosh Mukerjee as President. The delay was perhaps not altogether unfortunate since our meeting thus coincided with the centenary celebrations of the Indian Museum. The actual meeting extended over three days and the number of papers notified for reading were thirty-one.

Whilst the number of papers which were presented to the first meeting and the attendance thereat appeared to augur well for the future, yet an examination of the authorship of the papers showed that of the thirty-one, no fewer than twenty-five were from authors resident in Calcutta or other places in Bengal. This lent support to the attitude of those critics of the scheme who suggested that distance would prevent the holding of successful annual meetings, and it had also to be borne in mind that Calcutta then, as now, was the centre of scientific research. It appeared to us, therefore, that if future meetings were to be successful, some form of government recongition was necessary so that Local Governments might be induced to pay travelling allowances to government servants. We, therefore, approached a body which is now defunct, the board of Scientific Advice, which comprised the heads of the various scientific services and we were fortunate in obtaining the enthusiastic support of two members of the Board—Sir Sydney Burrard and Sir Henry Hayden. As a result of their representations, the Government of India authorised Local Governments to permit such officers, as they might consider desirable, to attend our meetings. Not content with this, Sir Sydney Burrard also induced the majority of the Indian Railway Companies to grant concession rates to non-government servants who wished to attend. Unfortunately, owing to the war, this concession was withdrawn and in spite of repeated representations the railway authorities appear to be unable to recognise the importance of our meetings and this concession has not since been renewed. I sincerely hope that in future wiser counsels may prevail.

I feel that I should be wanting in gratitude if, before leaving this aspect of the subject, I did not take the opportunity of placing on record my great appreciation of the help and encouragement which we received in the early days from Sir Sydney Burrard and Sir Henry Hayden. The former was our President at Lucknow in 1916 and those of us who were

present on that occasion will still remember his brilliant Presidential Address; it was not our fortune to have Sir Henry Hayden in this office but I betray no secrets when I say that, it was not because it was not offered to him. With that modesty so characteristic of him, he preferred to work behind the scenes and his help was never asked in vain.

It is not necessary for me to refer in detail to our later meetings. Each year has shown a growth in the number of our members and in the number of papers contributed. It is now becoming one of our most pressing problems to know how best to deal with these papers.

May I be permitted here to digress for a moment? Without desiring to minimise the importance of the reading of papers and the discussions arising therefrom, to me the great value of our meetings has seemed to lie in the personal contact outside the lecture room. To our younger members it cannot but be an inspiration to meet and talk to the leaders of scientific thought in India. This aspect is in my opinion all too frequently lost sight of and I wish to take this opportunity of emphasising it.

The secretarial work of the Congress continued to be shared by Professor MacMahon and myself until 1921, although during the greater part of this time Professor MacMahon was absent from India on active service in France. In April, 1921, Professor MacMahon resigned and his place was taken by Professor Raman who had from the start been an active supporter. When in 1924, pressure of other work compelled Professor Raman to resign, your present senior secretary, Professor Agharkar, was appointed. To them we owe a debt which will be difficult to repay.

No account of the history of the Congress would be complete without a reference to our relations with the Asiatic Society of Bengal. I have frequently been asked to explain our relationship and I have always found it somewhat difficult to do so. In the minutes of the original committee meeting, it is recorded that the Asiatic Society of Bengal were to be asked to arrange the first Congress and this they did. In subsequent years the bonds attaching us to the Society were extremely close but there was no definite connection beyond the fact that the Honorary Treaurer and Secretary of the Society were *ex-officio* members of the Executive Committee whilst at first the appointment of the Congress Secretaries required the confirmation of the Society's Council. This loose unwritten constitution has proved to be all to the advantage of the Congress. The Society has acted as our Treasurer, it has met a large part of the cost of our publications and has undertaken much of our routine secretarial work. I think that we are deeply indebted to the Council of the Society for permitting their officials to assist us in this manner and more especially to their General Secretary, Mr. van Manen. So far as I can see the Society has not had any direct benefit from the connection whilst to us it has been of incalculable value. On financial grounds alone I do not think that without their aid we could have survived. I trust that the unwritten law which binds us to the Asiatic Society of Bengal may continue, since, to be associated with an ancient society of such standing, cannot but add lustre to our name.

It has been my privilege for nearly eighteen years to have been closely connected with

education and research and this seems to me to be an opportune time to consider how we now stand as compared with 1910 when the idea of the Congress was conceived. In 1910, as I have already mentioned, research was confined mainly to the various scientific services, in other words it was almost entirely carried out by Government servants. The condition was therefore completely different to that prevailing in Great Britain where such participation was practically unknown. As one of the results of the great upheaval due to the war, the position in Great Britain has undergone a fundamental change. The activities of the Department of Scientific and Industrial Reserch are so well-known that I need only refer to them in passing, whilst in addition, the British Government has further recognised the fundamental importance of research by the appointment of the Civil Research Committee, which may be regarded as Scientific Imperial General Staff.

During the latter years of the war and for a short time afterwards it appeared that the Government of India had at length come to recognise that it should do all that lay within its power to organise and encourage research. I am much afraid that this hope was illusory and that the impetus was due mainly to Sir Thomas Holland. With the departure from India of this great scientist and administrator, not only did advance cease but a retrograde reaction seemed to set in. Perhaps the most serious and direct blow was the curtailment of the grant to the Indian Medical Research Fund Association. Fortunately, this grant has once more been restored but it will be many years before the trained workers who were lost can be replaced. On the other hand it is with pleasure that we note an advancement in a direction new to India, namely, the formation of the research associations for the investigation of cotton and lac. The work of the Indian Cotton Committee, with which our past President, Mr. Howard has been so intimately connected, is too well-known to require elaboration, whilst the Lac Research Association has made a successful start. I have referred to these two research bodies as I consider that research conducted on these lines by independent organisations is to be encouraged in every manner possible.

Whatever may prove to be the future line of development of research in India, there can be no question that both the Imperial and Provincial Governments must continue to be deeply interested and involved. Unfortunately, the present organisation suffers from a grave disability in dealing with any scientific problem in that it no longer possesses an advisory body to whom it can refer such problems. Open as the former Board of Scientific Advice was to criticism, I would strongly commend to the authorities its reconstitution on a broader basis. There can be no question that Governments require an influential and impartial body to whom they can refer matters of scientific importance. The expense involved would be small, and the advantages to be gained are obvious.

Whilst the advance of the spirit of research in the universities can be viewed with satisfaction, I do not think that those of us who have been intimately connected with teaching for the past twenty years can look with equal satisfaction on the present position of Indian universities so far

as the general academic standing is concerned. A large number of new universities have been created and on paper the courses of study and the standard of examination would appear to be the equal of those obtaining in other countries. In actual fact this is far from being the case and it is with a due sense of responsibility that I feel compelled to say that, with few exception, the degree standard has been considerably lowered during the last few years. In my opinion the blame does not lie with those actually engaged in teaching. The recent University Acts have placed far too much power in the hands of laymen. No doubt a patient is fully aware of the qualities which he expects to find in the medical man who attends him; the contractor knows what he requires of the engineer whom he employs. This does not however justify either the patient or the contractor in thinking that he knows the correct courses of study or the correct standard of examination which will enable him to obtain the doctor or engineer he desires. Yet, if we examine the constitution of the majority of the Indian universities we find that, owing to a desire for democratic control, the real power has been taken out of the hands of the professorial staff. I am willing to grant that it is highly desirable that the general policy of the university should be regulated by laymen, but I would emphasise the necessity of debarring them from any detailed control of either courses of study or the standards of examination. These should be absolutely under the control of the professorial staff and it should be impossible for the administrative body of the university to order that the percentage number of passes in any examination should be increased as has to my knowledge happened more than once. The only result is a general diminution in the status of the degree and if this is permitted to continue, the degree of an Indian university will cease to be of value in academic and industrial affairs. Perhaps we shall see a change when there is a clearer realisation of the difference between knowledge and wisdom. It was Cowper who wrote.

''Knowledge and Wisdom, far from being one,
Have oft times no connection. Knowledge dwells
In heads replete with thoughts of other men;
Wisdom in minds attentive to their own.
Knowledge is proud, that he has learnt so much;
Wisdom is humble that he knows no more.''

Whilst it is always simple to offer destructive criticism it is not always so easy to suggest a cure, but in this case I would venture to say that it should not be difficult to raise the standard of education in the universities. The main difficulty which confornts most teachers is the large number of students, the majority of whom enter for their collegiate career not with a desire to acquire knowledge or wisdom, but to gain a degree which is a stepping stone to government employ. This factor is the real cause of the maintenance of a low standard. A simple remedy lies to hand, namely, the extension of Civil Service Examinations to all grades in the clerical departments of government. Such examinations are the general rule in other countries, and in India they are held for the higher grades, but for ordinary clerkships the primary requirement is a university degree or some other educational qualification. I would recomend that in the place of laying down an educational standard as a preliminary to employment that admission should

be by competitive examination. I am willing to admit, that the introduction of this system would in all probability lead to the formation of cramming institutions, but whatever may be the defects of these, they would liberate the universities from their present thraldom and enable them to devote themselves to their true function–the advancement of learning.

THE IMPORTANCE OF THE STUDY OF NATURAL PRODUCTS

Having completed my survey of the early history of our Congress, I will for the remainder of the time, which is at my disposal, be somewhat mere technical.

> And Nature, the old Nurse, took
> The child upon her knee
> Saying, ''Here is a story book
> Thy father has written for thee.''
> ''Come wander with me,'' she said,
> ''Into regions yet untrod,
> And read what is still unread
> In the manuscripts of God.''
> And whenever the way seemed long.
> Or his heart began to fail,
> She would sing a more wonderful song
> Or tell a more wonderful tale.

In days not so far distant, the man of Science was not a specialist. Although by profession he might be a geologist or botanist, he could maintain a very thorough appreciation of all developments in the world of Science. Thus Bacon in his catalogue of experiments to be done, which was appended to his ''*Novum Organum,*'' was able to range from a subject such as ''Fiery Humours'' to that of the ''Nature of Numbers.'' Our breadth of outlook must now perforce be much more limited, and even in the subject which we profess, it is possible only to be master of a limited portion of that subject. Deplorable as this may be, it is, I am afraid, a factor which will remain unaltered, and with the rapid development of scientific research is likely to be intensified unless the suggestion recently advocated by the Bishop of Ripon be adopted. I would plead this as an excuse, if in what follows, my language should at times be technical and difficult of understanding by those who are not chemists.

My own investigations have been concerned in the main with the study of the chemistry of natural products and as a result I have been brought into fairly close touch with such related subjects as Botany, Geology and Medicine. In the illuminating address of my distinguished predecessor, to which many of us had the privilege of listening last year, he outlined some of the beautiful methods which he has devised for probing the secrets of plant life. In comparison, the methods of the chemist may appear to be somewhat crude, they attack the position from a different angle, but one from which results of equal importance are likely to result.

One of the objects of the chemist is to separate one by one the various individual substances present in living matter and to determine their structure by analytic and synthetic methods. It is fascinating to consider the advance in our knowledge from 1806 when Serturner first isolated morphine from opium, to the present year distinguished by Barger and Harington's brilliant synthesis of thyroxine, the active principle of the thyroid gland.

The interest of the study of plant and animal products is not confined to the laboratory, but

extends into the economic world. As an example of this, I would commend to your attention the excellent work of Annett and his collaborators on the relationship of the alkaloidal content of the poppy juice to the age of the plant and to external features such as the nature and previous treatment of the soil. All true lovers of Science must deplore the circumstances which led to the curtailment of this investigation, since it is only by detailed and painstaking studies of this type, that we can pass to the many more complex ones which await solution.

I have always considered it somewhat remarkable that so little attention has been devoted by organic chemists in India to the study of natural products, most of their researches being concerned with abstract problems. It must be admitted that problems of the former type are difficult and offer little attraction to those who estimate work by quantity and not by quality. In the Quarterly Journal of the Indian Chemical Society, which is now in its fourth year, I have only been able to find nine papers which deal with the chemistry of natural products. Is it presumptuous to suggest to the organic chemists of India that they should study intensively the unique wealth of material which lies at their door, and devote less time to the study of problems of theoretic interest only?

An important advantage of this branch of research work is that it brings one closely into contact with other Sciences. In the study of plant products, contact is first established with the botanist. Without his skilled aid it is not possible to be sure of the identity of your material, and it has been brought constantly to my notice how much excellent work is lost by the lack of botanical identification of the material used in the investigation, or by its inaccurate identification. Systematic Botany is by no means simple, and it must be borne in mind that it is rarely possible to identify with certainty a piece of bark or a root. It is not alone the chemist who benefits by the collaboration; it is well-known that in many cases with closely related species herbarium identification is almost impossible. To quote what may be regarded as a classical example—no skilled observer in the field has any difficulty in differentiating the two grasses known as ''*Sofia*'' and ''*Motia*'', yet in the herbarium they are both classified as *Cymbopogon Martini,* Stapf. The distinction is of the greatest technical importance since the oil obtained from the ''*Motia*'' grass yields the well-known and valuable palmarosa oil, whilst from ''*Sofia*'' grass only a comparatively valueless and quite different ginger grass oil results. The chemical differentiation of these two oils affords no difficulty. The position is similar in the case of many other grasses, the difference between the chemical constituents being far more marked than any morphological variation. During the course of my own investigations, I have come across a number of cases of this kind, and I would like to suggest that it might be worthwhile to make a detailed botanical and chemical study of the various *Cymbopogon* grasses in which India is so rich, in order to determine whether a chemical classification would not prove to be more satisfactory than a purely botanical one, as I think that it will be generally admitted that, in spite of the laborious researches for which we are mainly indebted to Dr. Stapf at Kew, the present position is far from being satisfactory. A

study of this nature might throw some light on the question as to whether the chemical constituents of the oil derived from the same grass vary with climatic conditions and with the nature of the soil. The analysis of essential oils is now sufficiently advanced for work of this nature to be undertaken with every prospect of success.

I do not wish to claim any originality for the suggested substitution of a chemical for a botanical classification. In Australia, Baker and Smith in their remarkable work[1] on the differentiation of the various species of *Eucalyptus* have already found this to be the only satisfactory method. In this connection I would like to direct attention to the case of *Eucalyptus dives* which has been studied recently in some detail by Penfold and Morrison[2]. This tree, which is the common broad leaf peppermint, occurs in Australia over enormous tracts of country, and the oil from the leaves has become of importance owing to the occurrence in it of, from forty to fifty per cent, of the ketone piperitone, a commercial source of thymol and menthol. With the increased economic demand, it was found that certain oils said to be obtained from the leaves of *E. dives* only yielded from five to twenty per cent of the ketone. They were at first regarded as adulterated. It was, however, shown that they were genuine oils and that *E. dives* existed in at least four varieties which were morphologically absolutely indistinguishable both in the field or in the herbarium, thus differing from the grasses ''*Motia*'' and ''*Sofia.*'' At first sight, this difference might be expected to be due to soil or climatic conditions, but this does not appear to be the case, since the different varieties breed true when grown in pots. This opens up a very difficult chemico-botanical field of research, which may not be without bearing on cognate agricultural problems, but I would submit, that it substantiates my claim for the value of a chemical rather than a botanical classification in difficult cases.

In the opening remarks to this section of my address, I refered to Geology as one of the Sciences with which investigators of natural products were brought into comtact. One of the most interesting and difficult of borderline subjects is the much debated problem of the origin of the petroleum oils. During the examination of the essential oil obtained from the oleoresin of *Pinus excelsa,* which occurs in the United Provinces, it was surprising to find that the oild contained a considerable quantity of the paraffin hydrocarbon, undecane. This fact, together with the occurrence of pentane in the oil from *Pinus Sahiniana* and *Pinus Jefferyi,* both habitants of North America, not unnaturally led to the consideration of the question of the origin of petroleum, more especially since remains of the coniferae have been found in the earlier strata.

I do not propose to detain you with a detailed and historical account of the various theories which have been advanced to explain the occurrence of petroleum oils. I do not suppose that anyone now seriously doubts that they are of organic origin, a view which is supported by the fundamental fact, that the oils show optical activity. This side of the subject has been discussed by Rakusin in his book ''*Die Polarimetrie der Erdöle*''. If we accept, as I think we must, an organic origin for the oil, is it necessary to assume that all the oils have the

same organic origin? I would suggest that such an assumption is not necessary, and I would further suggest that in different areas the mother substance may have been different. According to Engler's view[3] the oils are formed from animal and plant fats, their optical activity being due to the presence of cholesterol or its decomposition products in the higher boiling fractions. Amongst other evidence he adduces in support of his theory, the fact that the optical activity is always found in the same fractions in oils from different sources. Recently Zelinsky[4] has attempted to provide evidence in support of this theory by laboratory experiments which, in my opinion, can hardly be regarded as covincing. He has shown that when cholesterol is treated with aluminium chloride, oils are formed which closely resemble the natural petroleums, and he has further shown that the same fractions of these oils and of the natural oils show optical activity. Treatment with aluminium chloride is somewhat drastic and can hardly be considered as analogous to reactions taking place in nature. Untial, therefore, the presence of cholesterol or one of its degradation products has been detected in petroleum oil, Engler's theory, attractive as it may be, cannot be considered as estalished.

Another possible mother substance has been suggested by Ormandy, Craven, Heilbron and Channon[5] in the hydrocarbon, spinacene, which has been shown by Chaston Chapman, Tsujimoto and others to be widely distributed in fish livers. The investigations of Heilbron and his collaborators would appear to leave little doubt that this hydrocarbon is a member of the terpene group, and readily undergoes polymerisation and degradation. Furthermore it is optically active. If marine animals be accepted as a source of the petroleums, I consider that this hydrocarbon may with equal probability be regarded as the cause of their optical activity and possibly with a greater degree of probability, since the quantity present would be likely to be greater than that of cholesterol.

In 1922, I was led to consider whether the mineral oils in certain cases might not have originated in resiniferous trees rather than in marine organisms. The resin-bearing trees contain potentially large amounts of material capable of yielding by simple chemical changes both alicyclic and cyclic hydrocarbons. Some support appeared to be afforded for this suggestion by the fact that in Burma large quantities of fossilised remains of *Dipterocarps* are found in strata adjacent to the oil-bearing strata. The various species of *Dipterocarpus* yield an oleoresin known as *Gurjan* balsam. In Burma, the two principal species are *D. turbinatus,* Gaertner and *D. tuberculatus,* Roxb. yielding the so-called ''*kanjin*'' and ''*in*'' oils. Not being a geologist, I consulted my geological friends but received little support for the suggestion and I was therefore extremely cautious in my published paper[6] expressing myself as follows : ''In view of the fact that the members of the coniferae have been found in the early strata, it would appear to be possible that they were, at any rate in certain areas, one of the sources of the petroleum now found there.'' This suggestion* seemed to me to be of some importance, since, if it were correct, there was the possibility that the occurrence of forests of resiniferous trees might indicate the presence

* In a discussion at the Chemical Society on the chemistry of petroleum (Chem. & Ind., 1925, 3, 168) I again referred to this suggestion.

of petroleum-bearing strata, a subject worthy of investigation by geologists.

I have, therefore, read with more than ordinary interest a monograph entitled ''The Geology of Oil, Oil-shale and Coal'' by my friend Dr. Murray Stuart, a former member of the Geological Survey of India. It would lead me too far to discuss all the interesting suggestions made by him regarding the formation of coal and oils, it is with the latter that we are immediately concerned. Dr. Murray Stuart advances strong experimental evidence for the view that it is not necessary to assume that the oils were originally formed in the strata in which they are now found, but that they may have been carried there by water being held in suspension in mud. They were subsequently deposited with this mud as a sediment. He then proceeds to suggest, after discussing the geological history of Burma during Tertiary times, that the oil now found in the Pegu strata originated in the fossil wood of the Irrawaddy system. This fossilised wood belongs almost entirely to the genus *Dipterocarpus.* During the process of silification, which he assumes may have actually taken place in the Arakan Yoma Island between the first and second phases of the Himalayan uplift, the oleoresin would be ''ejected'' from the wood and carried away with the mud by water and deposited in the Pegu strata. In so far as I am capable of judging Dr. Murray Stuart's theories, they appear to be sound, and I am prepared as a chemist to accept them as a correct explanation of the occurrence of this oil field. Professor Dudley Stamp, who has worked in Burma, is prepared to support Murrary Stuart's views allthough he does not agree with him that the Arakan Yoma Forests were the source of the *Dipterocarpus.* To quote from his most recent publication[7] ''If the chemists are satisfied as to the possibility of this material as the mother substance of the oil there seems no geological reason against the suggestion. ....But Murray Stuart's idea will hold, provided he is willing to admit derivation of his material from the north. There, in beds of the same age as the oil-bearing beds further south, vast quantities of fossil wood are found.''

Whether these theories on the origin of petroleum will prove to be correct cannot be foreseen, but I think that they indicate how interesting may be the chemical study of natural products, and how it may help in the solution of problems belonging in reality to other departments of Science.

The time at my disposal is now at an end, and I will not detain you any longer. It has been a great honour and privilege, at what will probably be my last opportunity of attending a meeting of this Congress, that I should have occupied the Presidential Chair. From after I shall watch with undiminished interest your future success.

Appendix No. I

PROPOSED INDIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Dear Sir,

The rapid expansion, during recent years, of the teaching of Science throughout India as well as the multiplication of laboratories in colleges and institutions designed for research purposes has disclosed a lack of scientific organisation which calls for the attention of all those engaged upon educational and research work in the

country. The isolated worker in India is, for the most part, deprived of the help afforded by scientific reference libraries and his difficulties are enhanced by the fact that he is removed from the European environment whence he draws in large measure his inspiration.

We feel that the disabilities under which Science suffers in India would be in part ameliorated and that an impetus would be given to research work by the establishment of some central organisation after the manner of the British Association for the Advancement of Science, whereby different workers throughout of country might be brought into touch with one another more closely. The attention of the society might be directed to every field of enquiry and to every aspect of scientific activity whether purely theoretical or applied to those numerous special problems offered by the Indian Empire and peculiar to its natural and economic conditions. The study of endemic diseases, of the conditions governing agriculture and forestry, of engineering problems in the tropics and subtropics, of the natural products of plants and of the mineral resources of the country, all these subjects call for extensive and systematic research in the laboratories with which India is now equipped. Behind this there is the larger educational problem, that of presenting to the minds of the people the aims of Science, its purpose and ideals, its value as an instrument of social and economic improvement.

The objects of the proposed society are similar to those of the British Association and they cannot be better stated than in the words which from the preamble to the constitution of that body : "to give a stronger impulse and and a more systematic direction to scientific enquiry ; to promote the intercourse of societies and individuals interested in Science in different parts of the country ; to obtain a more general attention to the objects of Pure and Applied science, and the removal of any disadvantages of a public kind which may impede its progress."

It so to be noticed that cooperation with the activities of the society would not preclude the publication of results in European periodicals nor in departmental journals dealing with particular branches of research ; its primary aim is to afford medium of communication between workers in different parts of India. Accordingly, it is proposed to establish an association which shall hold an Annual Meeting (sectional or otherwise) in the more populous Indian towns where papers might be read and discussed, the proceedings to be published in the from of an Annual Report. We invite your opinion as to the expediency of founding a society of this kind and would be glad to know whether, in the event of its successful inauguration, you would be glad to support it on the general lines indicated above. The success of the scheme naturally depends upon the extent and representativeness of the support accorded to it. We hope to arrange an early meeting in Calcutta where the details might take practical shape.

In conclusion, attention may be drawn to a most important aspect of the scheme, namely, that concerning the cooperation of Indians. We realise that the future of Science in India depends upon the adequacy of the practical training which students receive in college laboratories, and furthermore, that nothing is better calculated to increase its efficiency than the inculcation of

research as the ultimate purpose of all scientific knowledge. It is unnecessary to point out how many and varied are the problems awaiting solution or how intimately the social and economic future of India is bound up with the successful application of scientific methods to all the activities, whether agararian or industrial, of the community. We cordially invite the participation of Indian scientists, convinced in the belief that in such means as it is accorded the objects of the society shall more nearly approach fulfilment and its usefulness and permanence be assured.

The undersigned, who in response to a public demand for action are undertaking the task of arranging an informal plebiscite of the question, would be glad of the favour of your opinion, and request that replies be sent to either of the addresses indicated below

P.S. MacMahon, M.Sc. (Manc.), B.Sc.(Oxon.),

Professor of Chemistry, Canning College, Lucknow.

J.L. Simonsen, D.Sc. (Manc.),

Professor of Chemistry, Presidency College, Madras.

Appendix No. II

LETTERS TO THE PROVISIONAL COMMITTEE

Dear Sir,

As the result of proposal circularised some months ago by us advocating the establishment of a Scientific Association for India, we are in a position to state that there appears to be a general feeling favourable to the formation of some kind of scientific machinery similar to that which experience has shown to be of value in other countries. The opinions elicited are practically unanimous with regard to the necessity of a closer acquaintance on the part of those engaged in teaching with the practical needs of the country, of a more complete cooperation between Europeans and Indians in the spread of scientific culture in India, and of educating the commercial classes to its value as an essential factor of industrial regeneration.

There is, however, as anticipated, some difference of opinion as to the precise form in which such an association would be capable of performing the most useful work. After carefully considering the various opinions expressed and acting on the advice of Sir Thomas Holland, we have pleasure in inviting you to act upon a Committee with a view to arranging a Science Congress in Calcutta next cold weather.

A congress at which papers dealing with different branches of Science were read and discussed, and a public lecture of a popular nature held, would demonstrate the utility of a society of the kind we advocate, and furthermore, would afford opportunity of discussing a practical scheme for making it permanent feature in the future scientific development of India. It will be the duty of the Committee to determine the scope and constitution of the proposed association and its relations to existing societies in India. The following is a complete list of gentlemen to whom an invitation has been extended to form a Committee :

Dr. N. Annandale, *Indian Museum, Calcutta.*

Dr. Bose, C.I.E., C.S.I., *The Presidency College, Calcutta.*

Col. Burrard, C.S.I., F.R.S., *Surveyor-General of India.*

Sir S.H. Butler, K.C.S.I., *Member for Education.*

A Chatterton, Esq., B.Sc., C.I.E., *Scientific Advisor to H.H. The Maharaja of Mysore.*

B. Coventry, Esq., C.I.E., *Director of the Research Institute,* Pusa.

Major A.T. Gage, I.M.S., *Director of the Botanical Survey.*

H.H. Hayden, Esq., B.A., C.I.E., *Director of the Geological Survey.*

D. Hooper, Esq., *Indian Museum, Calcutta.*

A. Howard, Esq., *Economic Botanist of Government.*

S.W.Kemp, Esq., *Indian Museum, Calcutta.*

Surgeon-General Sir C.P. Lukis, K.C.S.I., *Director-General,* I.M.S.

Dr. Mann, *Principal, Agricultural College, Poona.*

Dr. P.C. Ray, C.I.E., *The Presidency College, Calcutta*.

Dr. M. Travers, F.R.S., *Director, Indian Institute of Science, Bangalore.*

Dr. G.T. Walker, C.S.I., F.R.S., *Director General of Observatories.*

Should you be able to act on the Committee and to take part in the proposed Science Congress, we should be glad an early reply so that the necessary arrangements might be made as soon as possible. We should also be obliged to know whether, in the event of your acceptance, you could make it convenient to be in Calcutta about the end of September with a view to convening a preliminary meeting of the Committee.

We are, Sir,
Your most obedient servants
P.S. MacMahon,
Canning College, Lucknow.
J.L. Simonsen,
The Presidency College, Madras.

Science Congress, Calcutta, 1912

Dear Sir,

A Committee meeting will be held in Calcutta on Saturday, 2nd November, 1912, in the rooms of the Asiatic Society at 11:30 a.m. to arrange the Science Congress contemplated later on in the cold weather.

The following business will be considered :

1. Election of Chairman.

2. Date of Science Congress.

Wednesday to Saturday (December 18th–21st) has been suggested.

3. Allocation of proceedings.

It has been proposed to devote three days to the reading and discussion of six papers, two in the morning of each day, leaving the afternoon free for visits to places of industrial and scientific interest. On the fourth day a popular lecture might be delivered.

4. Arrangements for place of meeting and matters connected therewith.

5. Financing of the Science Congress.

It has been proposed to charge a small admission fees, say, eight aannas per diem or one rupee for the whole series.

6. Public facilities in the cheap railway fares for visitors to the Science Congress.

If unable to be present, you would materially facilitate the proceedings by kindly letting us have your opinion on the above points in ample

time before the committee meeting in particular, with regard to :

1. Whether you would prefer the Congress to be held in January 1913,

2. any suggestion you may have concerning the most suitable subject for the public lecture, and

3. whether you would prefer some other method of financing the Congress admitting free public admission to all meetings.

We are, Dear Sir,

Your most obedient servants,

P.S. MacMahon,

Canning College, Lucknow,

J.L. Simonsen,

The Presidency College, Madras.

Appendix No. III

MINUTES OF THE FIRST COMMITTEE MEETING

Science Congress, Calcutta, 1912–1913.

A committee meeting in connection with the above was held in the Asiatic Society's rooms on Saturday, November 2nd, at 11 : 30 a.m., there being present Mr. Hayden (in the chair), Messrs. Tomkins, Hooper, Kemp, Christie, MacMahon and Simonsen.

Letters of apology for absence were received from Sir A. Mukherjee, Col. Burrard, Dr. Mann and Mr. Howard.

Mr. MacMahon explained that the proposal to hold a Science Congress arose as a sequel to proposals for the foundation in India of some general form of scientific organisation on the lines of the British Association. He stated that as the result of an informal plebescite the vast majority of those engaged in scientific word were in favour of some form of organisation on the lines proposed in the circular apended[i] although opinions necessarily differed as to the most suitable form in which it might be found most useful. The object of the Science Congress was to bring together as many of those concerned as possible with the view to ascertaining the practicability.

The proposal was then thoroughly examined by the committee and various working schemes considered. It was ultimately resolvecd to ask the Asiatic Society to undertake the management of a Science Congress annually in Calcutta similar to that proposed in the circular appended.[ii]

It was resolved that this be circulated among all members of the informal committee for signature and forwarded to the Secretary of the Asiatic Society for their consideration.

A vote of thanks was passed to Mr. Hayden for his kindness in presiding over the proceedings and the meeting then terminated.

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i. Appendix No. I.

ii. Appendix No. II.

DNA CHIPS : THE RESHAPING TECHNOLOGY OF MOLECULAR BIOLOGY

Dhanjit Kumar Das and Mohini Saini *

DNA Chip technology is a recently developed technique, widely used in biomedical research. These Chips are made on a glass slide where the message molecules (RNA) of a particular cell are attached. DNA chips are available for hybridization for detection of the expression of the gene. This technology is widely used in disease diagnosis, differences of gene expression, in drug discovery, etc.

INTRODUCTION

It is widely believed that thousands of genes and their products (i.e. RNA and Protein) in a given living organism function in a complicated way that creates the mystery of life. However, traditional methods in molecular biology generally work on a "one gene one experiment" basis, which means that the throughput is very limited and the whole picture of the genome is hard to obtain. In 1995, Patrick Brown and colleagues at Stanford University developed a new technology called DNA Chips also known as DNA microarray that attracted tremendous interest among biologists. This technology promises to monitor the whole genome on a single chip so that researchers can have a better picture of the interactions among thousands of gene simultaneously. DNA Chips are simply glass surfaces bearing arrays of DNA fragments at discrete addresses, at which fragments are available for hybridization. The theory behind the DNA Chips is fairly simple and exploits basic facts of the chemistry of DNA and RNA. An RNA molecule can bind with its DNA template, but not with DNA template whose base sequences are not complimentary to its own. A DNA Chip holds copies of most of the DNA templates contained within a particular cell. The genes being expressed by a particular cell as a group of RNA molecules, which serve as messages to the protein manufacturing machinery. In the laboratory, those RNA messages could be transcribed once more to form complementary DNA (cDNA) message molecules. A cDNA can also bind with its complementary DNA template, so when the cDNA are exposed to the DNA Chip, the message molecule recognize and adhere to the spots on the chip corresponding to their DNA templates. These message molecules have been tagged with a fluorescent dye, so when scientists look at this chip, they can see the pattern of genes being expressed at any particular time. They can also compare a spot and note that a gene is not being expressed under one particular circumstance, but it is expressed under another.

A DNA Chip is made using a glass microscope slides of 7.62 × 2.54 cm and about 1.2 mm thick. Samples of DNA in the form of spots are printed on a slide, with the help of machine called an arrayer. Most arryers have a

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high-speed robotic arm fitted with a number of pins. The arm is controlled by software that allows the user to place genes in selected areas. The pin resembles the tip of quill pins. By capillary action, each pin draws up a small amount of a solution containing the DNA for a single gene and deposits it in precise locations on a glass slide. Since the arm holds many such pins, many genes are deposited on the slide at a time. Computer keeps the record of the location of each gene on the gene chip.

There are two types of DNA chip format currently in wide use viz. (i) The cDNA format and (ii) In situ synthesized oligonucleotide array format.

The cDNA microarray is very simple and elegant array format developed at Stanford University. The array is made by robotic deposition of all cDNA contained in a cell onto a coated glass surface. Usually PCR amplified inserts from cDNA clones are arrayed. This technology allows comparison of fluorescently labelled cDNA populations from control and experimental tissues (i.e. diseased or drug treated tissues) in two colours. For this, different colours can be given to the message derived from different cells, such that the message from the control cells can be tagged green for example, whereas message from chemically treated cells might be tagged red. The fluorescently labelled messages derived from different groups of cells are mixed and hybridized with the Chip, which contain that spotted gene corresponding to that of particular cell of interest. The array is then optically scanned at two wavelengths using independent lasers to excite the two fluorescent dyes (red and green) at 632 and 532 nanometers respectively. Information from the scanner is translated into image corresponding to the two dye scanned and this is sent to a computer for further analysis. The computer produced two different pictures of the gene chip. One shows the location of all the spots in green and other picture notes the locatoin of all of the red spots. By comparing these two colours in chip, one can note the differences of gene expression between the control and experimental tissues. In Figure 1, spot number 1 shows both the colours

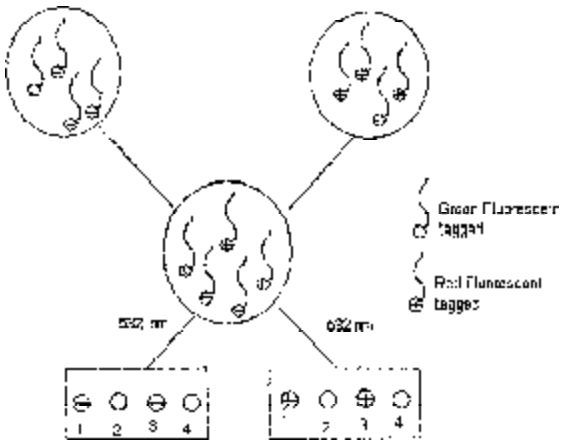

Fig. 1 : Detection of differential gene expression in control and treated cells.

means that the gene which was arrayed in this spot, expressed in both the cases i.e. both in control as well as treated cell. But in spot number 3 shows only green colour means that gene was expressed only in control cell. Likewise spot number 4, gene has been expressed only in treated cell.

The next fromat synthetic oligonucleotide array, where the oligonucleotides are either synthesized by conventional method or can be synthesized *in situ* and then immobilized on the glass surface. For this, photolithographic technique is used to synthesize oligonucleotide array. A silicon surface coated with linker molecules is taken which binds the four DNA building blocks, vis. adenine (A), Cytosine (C),

guanine (G) and thymidine (T). Initially the linkers are capped with a blocking compound that could be removed by exposure to light. The light is exposed into the chip through mask so that only certain areas of the chip become

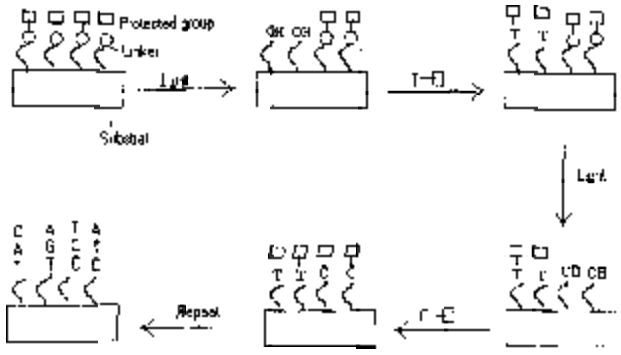

Fig. 2 : Schematic diagram representing the production of synthetic oligonucleotides array.

exposed. The chip is then incubated with one of the four bases, then it binds with the exposed areas and reapplied the block. By repeating the process with different bases according to the gene sequence could build up an array of different oligonucleotides.

Few years ago, DNA chips took to another level, by synthesizing double stranded DNA arrays accessible to proteins. Their system could allow the systematic study of DNA–proteins interaction, transforming the analysis of eukaryotic transcriptional control. In the approach, Church and colleagues displayed longer single-stranded oligonucleotide (up to 40 mers) immobilized onto the surface. To these, they hybridized 16 mers priming oligonucleotide, extending their primers with Klenow fragments, thereby converting the immobilized DNA into a double stranded form that would be accessible to study the DNA-binding proteion.

The DNA Chip technology has tremendous applications. The differences of gene expression in cancer versus normal cell line can be viewed by the DNA Chip. Oligonucleotide array have been used to measure the expression level of bacterial genes. An array of 65,000 oligonucleotide probes was constructed for detection of 100 *Steptococcus pneumoniae genes.* They are also used to study the gene expression levels in inflammatory diseases such as Rheumatoid Arthiritis (RA) and Inflammatory Bowel disease (IBD). Probes were prepared from RA tissue of IBD mucosa labelled with Cyt3 or Cyt5 fluors and exposed to microrrary consisting of cDNA targets from genes known to be involved in the disease process.

DNA Chip technology can also be used to screen individuals for mutations in the breast cancer gene BARC-1. By this technology, the mutation of p53 gene can also be detected which is responsible for lung cancer in human.

The cost of this technology at present is within the realms only on drug companies and large institutions. At present individual researchers have to rely on gaining access to chip via research institution such as the National Institute of Health and Howard Higher Institute in the United States, who are among the front runners in this technology. However, as with developments in PCR technology, it will undoubtedly become much more accessible and affordable in time to come.

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DESIGNER GENES

S. Krupanidhi*

The translated protein products of the designer genes in early embryonic life are the fundamental architectural-designers of embryo shape and organization, wherein the organ-sytems get positioned in relation to other systems. Early stages of embryonic development define the anteroposterior and dorso-ventral axis and then designer genes further co-ordinate organ-system patterning. Initially, a limited number of material gene products mainfest the morphogen-gradient. This is being followed by a sequential activation of numerous zygotic genes culminating into a phenotypic mosaic from geneotypic and clonal restriction lines.

DOES SHAPING START FROM EGG STAGE?

The single-celled, totipotent and diploid fertilized egg, is of course, not being with any definite patterned shape, in addition, the spherical circumference has low surface area and contains a complete genome from its parents. This single cell will undergo a dynamic process of embryogenesis resulting in an architecturally designed organism. Defined and best adapted to its environment, the embryo will culminate into a complete organism, a phenotypic mosaic produced from a genotypic clone. Soon the fertilized egg undergoes cleavage divisions in a predetermined manner, which ultimately makes the egg proliferate into a good many number of blastomeres, a collection of early embryonic pleuripotent stem cells. These are destined to undergo various morphogenetic movements to strategically position themselves to produce the future axis of the organism. Thus, the fertilized egg is not a simple product derived out of the fusion of male and female sex cells. Nevertheless, its stock of protein products are involved in the barricading of embryonic pleuroipotent cells.[1] Most of the fertilized egg, however, is derived from the mother, whose contribution governs the early morphogenetic movements of the blastomeres. Although, unseen morphologically a distributional dichotomy of the stock of protein macromolecules in the shapeless egg will polarize and invisibly define the dorso-ventral and antero-posterior axes of the future organism, traceable through the earliest embryonic stage namely, the blastula. Therefore, these early designer gene products are of maternal origin in the ooplasm and these determine the characteristic movements of embryonic cells initiating a cascade of embryonic gene acvtivity involved in patterning.

CONTROLLED MODIFICATIONS FACILITATE PATTERN ORGANIZATION

There are many genetic mutations now identified in developmental processes. In multiple species, a number of these mutations produce embryonic defects, namely cyclopic monster, double abdomen larva, multiple hind limbs in adult frog, *Hyla,* etc. These serve as remarkable

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examples to give insight into the parameters that shape the organism. The mechanisms of these activities will be forntier research areas in coming years as pattern formation further matures as a discipline of molecular developmental biology. The processes of development, studied by controlled modifications, that affect single components will be revealing. By transposon mediated knock-out of gene functions or knock-in of genes to rescue deficient-embryos, and amber-suppressor experiments to assess the nature of mutant forms that are naturally occurring. Gene knock-out embryos in flies are being used extensively of late to acquire the molecular evidence for the construction and making of the organism, especially where vertebrates are not favourable to mutagenic experiments.

POSITIONAL INFORMATIONAL MOLECULES REINFORCE ORGANIC EVOLUTION

The phenomenon of organic evolution elaborates that natural selection prefers the recently evolved modifications, especially those positioned in the anterior side, such as the sensory homunculus of the brain, the sense organs, and the mechanisms of cephalisation. Natural selection also favors the miniaturization and increased efficiency of organ systems, which have supported a polarized body form. For example, the lower functions of the body, such as excretory and reproductive systems, have retracted towards the posterior side. In short, transcriptional expression of the designer genes is also concomitant with the adaptations of an organism as per the guidelines of natural selection. Moreover, the dorso-ventral axis of chordates makes motor elements subservient to dorsal structures, namely the spinal cord. Thus, the network of organ systems in adult organisms follow a definite strategic positional pattern as dictated by evolutionary adaptation under the influence of positional informational molecules, which predominate early in embryonic life to define the clonal restriction lines leading to compartmentalization during the course of development (Fig. 1.)

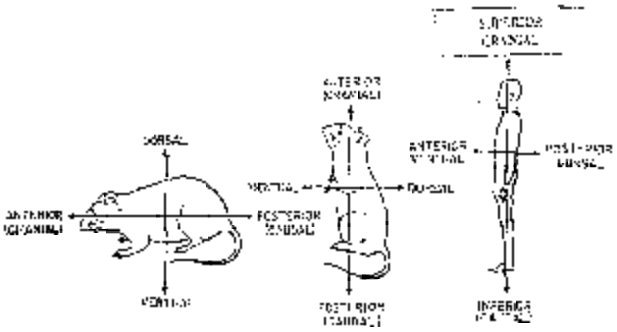


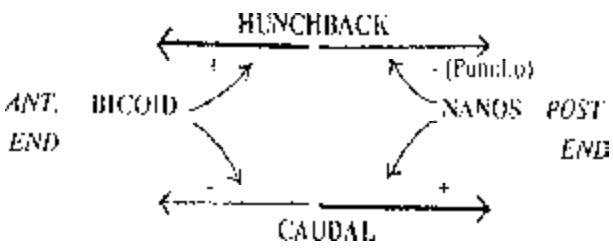
Fig. 1 : A-P and D-V axis of organisms[8]

WHAT DETERMINES A-P AXIS ?

The highly privileged portion of an organism is supposed to be the anterior end as it is in the forefront in locomotion and also an active center for the perception of events. Now, the question is that, how do the developmental events of an organisms coordinate to manifest the structures related to the privileged anterior end ? The concept of patterning has come from the observations of the embryologist, E.E. Just. He was not interested in how the bristles developed on the back of the fly, rather, he wanted to know how the fly makes its back. Since then, embryologists, geneticists and molecular biologists have been attempting to unravel the mysteries of the involvement of causative informational factors in building organisms,

particularly the fruit fly, *Drosophila,* a nematode, *Caenorhabditis elegans*[3] and mouse. Christiane Nusslein-Volhard[4] found that there are three sets of genes encoding their respective morphogens in gradients. The first, for the anterior part, the second, for the abdominal region and the last for the terminal regions at both the ends of the embryo of fruit fly, for which she was awarded Noble Prize in 1995, along with her colleague, Eric Wieschaus.

Even before the fertilized egg nucleus starts functioning, the maternal mRNA-depot, from the nurse cells of ovary, is maintained as a gradient in the cytoplasm of the egg cell. Moreover, the following four maternal gene transcripts are essential for the formation of the A-P axis, wherein : **Bicoid** and **Hunchback** gene products make head and thorax and **Nanos** and **Caudal** gene transcripts organize abdominal segments. The gradient of Bicoid protein is the highest at the anterior end and the gradient of **Nanos** protein is the highest at the posterior end. The accentuation and attenuation of one upon another profoundly demarcates the regions of their predominance such that the **Bicoid** protein inhibits **Caudal** expression, and conversely, the **Nanos** protein in conjunction with the **Pumilio** protein prevents Hunchback protein expression, whereas **Bicoid** elevates the level of **Hunchback** protein by stimulating its transcription[5, 6].



With the above gradients across the A-P axis, the stage is now set for the chain of activation of designer genes for A-P axis formation. **Orthodentcles** (otd), **Empty spiracles** (ems), **Button head** (btd), **Giant** (gt), **Huckebein** (hkb), **Hunchback** (hb), **Knirps** (kni), **Kruppel** (kr) and **Tailless** (tll) geneproducts will play specific roles (Fig.2)

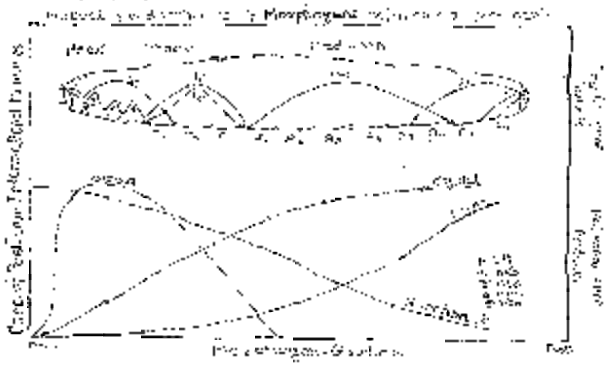


Fig. 2 : Relative dominance of Morphogens in manifesting A-P axis

WHAT MAKES THE DORSOVENTRAL POLARITY?

The hierarchal dominance of dorsal surface in relation to the ventral region throws light on how the prevalence of a gradient system produces a dorso-ventral axis[7]. Even though there is profound variation between invertebrates and chordates, with reference to functional aspects of D-V polarity, one commonality between them prevails in that their motor elements are ventral to the nerve cord.

The Dorsal protein plays a pivotal role in specifying ventral plan by its morphogen gradient which is highest in the ventral nuclei. Also, active **Spatzle** (spz) signal peptide is released on the ventral side after the forthcoming cascade of events involving the **Nudel-Pipe-Windbeutel** complex and **Gastrulation defective-Snake-Ester** genes. **Toll** (Tl) gene protein receptors

become activated upon binding with the cleaved **Spatzle** signal peptide and this coupling is produced on the ventral side alone, enabling the dorsal protein to penetrate into nuclei and activate specific target genes, namely **Snail** (Sna), **Twist** (Twi) and **Rhomboid** (Rho), whose products prompt the neighbouring cells to develop into mesodermal (ventral) derivatives. On the contrary, where there is no coupling of Toll receptor with the Spatzle signal peptide, usually in the dorsal circumference of the embryo, the translocation of Dorsal protein into the nuclei of dorsal side cells does not occur. Without the Dorsal protein, the nuclei of dorsal cells prompt the expression of **Zerknullt** (zen) and **Decapentaplegic** (dpp) genes, whose products are involved in the development of neurons positioned in the mid-ventral line, and neuroectodermal cells including portions of central nervous system and ventral epidermis (skin) (Fig.3).

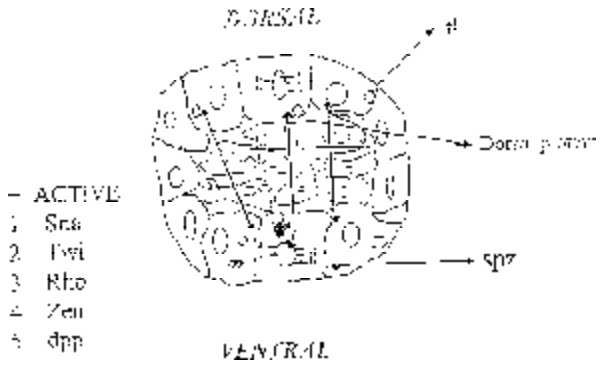


Fig. 3 : Molecular mechanism in establishing D-V axis.

WHAT ARE HOX GENES ?

Utilizing the tools and analytical approaches of molecular biology, scientists have developed techniques using hybridization probes and have found that the designer-genes, such as axis-specification genes and patterning genes are evolutionary conserved and share extensive sequence homology across species so referred as **homologous genes**. Mother nature has reused their functional theme, making use of sequence similarities in their functional domains, called **homeodomains**. Thus, the term **homeobox** gene is coined for any gene whose protein homeodomain functions as a transcriptional factor that can also be used as hybridization probe across diverse groups of species. For example, the homeobox complex of insects shows similarities with a Cephatochordate, *Amphioxus,* and this in turn shows the equivalence within the four clusters of homeobox genes of mouse and human, which are called the HOX complexes designated as HOX A, HOX B, HOX C, and Hox D, containing a total of 10 homeobox genes, called the HOX genes, Apparently, the distant phylogenetic relations among flies and mouse must not have disturbed the sequence similarities between homeotic genes, suggesting that their homeobox complexes must have been evolved from a common ancestral homeobox gene.

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DO YOU KNOW?

Q1. Which animal was cloned first?

Q2. At the time of independence what was the forest cover of India–90%, 70%, 30%, 10%.

BENCHMARKING EXERCISE IN PUBLIC FUNDED R&D ORGANISATION

H.S. Ray, Saikat Deb Acharya, Subrata K. Ghosh*

Publicy funded R & D organisations need to be more transparent about the norms followed for allocation of funds because they are more accountable and answerable. Some guidelines are provided which may help planners in this area. The paper explains how subjective concepts can be analysed for evaluation in terms of numerical grades.

INTRODUCTION

Benchmarking is an organized effort to attain some standards of perfection specially identified to serve as reference. In other words, benchmarking is a proactive exercise to change the existing methods of operation for better performance. It has been recognized as a powerful tool for manufacturing and also for the process industry to restore competitive advantages and eliminate complacency. This is not a research sort of activity. In common man's word it is the art of finding out how and why some companies can perform tasks much better than other companies and then adopt improved methods. There is no theory or formula to find out the factors for competitive advantages that are enjoyed by a leading company over others who are merely involved in providing tangible outputs using tangible resources. Benchmarking is a process which depends on mutual co-operation for a win-win game. The aim of benchmarking a company is to copy or improve upon its practices.

This is an age of quality and competitiveness, both of which need benchmarking in every sphere. A good quality product or process in the market serves as a benchmark to be achieved or surpassed for those who know that their own product or process is inferior. When they undertake programmes to improve, they are said to be benchmarking. Competitiveness for survival makes it imperative for every player in the market to emulate the front rankers.

R&D institutions traditionally existed as ivory towers housing the intellectually inclined personnel for scientific pursuits, many of these did not have direct relevance to the industry or the society. The so called 'Fundamental Work' was futuristic and was conceived frequently as potentially fruitful. However, not many of these paid dividends and scientists who worked essentially for the future were not accountable. Many scientists, of course, wrote papers for scientific journals of varying quality. Senior experts wrote reviews, overviews, recent advances and frontier areas of their fields for the benefit of others following in their footsteps and also to remain in the limelight.

With dramatic changes all around, questions are being asked for accountability of time and funds being consumed in research, their relevance and usefulness. It is well accepted that like

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science, research can also be good, bad or bogus. What criteria can be used to classify R&D is such categories ?

GOOD, BAD AND BOGUS R&D

We avoid here talking about pseudo-science such as herbal transformation of water into gasoline, cold fusion, astrology, etc. Yet even in throughly scientific, accurate and reproducible research that are reported in journals, there is a great deal which is of little relevance to society at large. Some of these are identified by the IgNobel as research that cannot and should not be repeated. The website http://www.improb.com/ig/ig-top.html lists many interesting examples of research and development of dubious value. In scientific journals there have been articles dealing with topics such as following :

- Injuries due to falling coconuts.
- Estimation of surface area of elephants based on some selected body parts.
- A pigeon's capacity to distinguish between paintings of Monet and Picasso.
- Brainwave patterns during chewing of gum of different flavours.
- Plucking of chicken feather as a measure of tornado wind speed.
- Possible pain during execution by different methods.
- Sogginess of breakfast cereal on addition of milk, etc.

Patents have been taken for washing machines for dogs and cats, for devices to translate a dog's taking into Japanese and a device to aid childbrith where the pregnant woman is strapped to a wheel rotated horizontally at high speed.

Like the preceding examples, there can be many topics which prove intellectually stimulating to the R&D scientists, but certainly they cannot be considered as good research. To be good, R&D must be evaluated in terms of its effectiveness.

EVALUATION OF EFFECTIVENESS

The investment in an R&D organisation always may not yield desired output measured in terms of money. Moreover, in case of public funded R&D organisation, the output may have to be evaluated in terms of the societal aspect and nation's emergent needs. Hence, assessing a public funded R&D organisation may have to employ a scale different from those for other research organisations. This has been discussed later.

In today's scenario, research activities are carried out more in teamwork than in individual capacity. Planning of any research work plays a very vital role. Proper planning reduces misutilisation of funds and human resources as well. Moreover, one can improve things only when one can define and measure. There is, therefore, need for clarity in thinking. Let us start with the word 'effectiveness'.

Effiectiveness E may be defined as follows :

$$E = \frac{\text{Worth (W)}}{\text{Cost (C)}} \text{ or } (W - C)$$

Worth can be valued in terms of financial benefits to an institution or social benefits which should also be measurable in monetary terms. In the case of fundamental research and/or R&D

of strategic importance there may not be an immediate gain the experts should be able to give a value in 0–10 scale. The idea is that the effectiveness is more when worth is more and cost i.e. input is less. Inputs, which would include equipment, infrastructural support, and salaries for the project, time, contingenecies, etc. can also be expressed in monetary terms.

In many institutions, expensive equipment are sparingly used in R&D work. Obviously, the effectiveness is less even if the worth of the R&D work is good. It is possible to quantify many apparently 'vague' concepts by applying similar analytical thinking.

THE BREADTH AND DEPTH OF BENCHMARKING

Benchmarking offers a wide variety of opportunities. When one talks of competitive benchmarking, then there is a thin dividing line between legitimate, public domain based information and industrial espionage (figure 1). What type of benchmarking one uses will determine ultimately what kind of information will be sought and where the source of obtaining it is going to be determined.

Strategic benchmarking : This is a process which is used for identifying world-class standards, determining gaps in competitiveness and developing strategies. This may not require visits to partners (whom to benchmark) but only some high-level studies.

Process benchmarking : This is where the bulk of benchmarking activities take place. It is about finding out how good performance is achieved to put together action plans capable of closing competitive gaps. Process benchmarking necessitates visit to partners and thorough preparation.

Performance benchmarking : This is an important process for establishing 'benchmarks' and identifying what 'stretch objectives' need to be put in place. This approach may not require company visits and is conducted through consortia studies and with the facilitation of consultants and third party involvement.

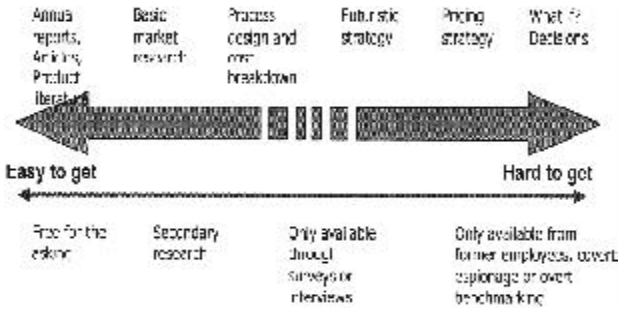

Fig. 1 : Status of obtaining information.

PUBLIC FUNDED R&D ORGANISATIONS

It is obvious that an R&D organisation will not intiate a project without assured competence. Unfortunately, many individuals continue to stick to their pet areas and dare not venture out even to related areas as they are intimidated by even the minimum levels of uncertainty. Moreover, members of the team may perceive more personal benefits only when they work in narrow areas where they are comfortable. These notions need to be changed.

Any R&D work undertaken must benefit the organise in a tangible way. Whether this is so cannot be decided by individuals or research teams but policy planners running the affairs of the Institute. Of course, the planners would take the individual or the teams' views into account.

Policy planners in government funding

agencies are increasingly focussing on mission/goal oriented projects. In the present generation of R&D, it is not enough to have scientists/institutions of repute and approval of technical merits ; there are other factors which need to be considered too. These relate to countries' priority areas, environment, socio-economic and legal factors, global considerations, etc. Thus even if funds are available for some project because of fruitful networking, it may not be advisable to take up this project. Ideally a project should ultimately lead to a potentially money earning patent, actual technology transfer, high quality publication and especially useful multipliers that ensure more projects.

The government has now introduced a Technical Audit, which is mainly done by non-technical persons specially trained to find faults. No laboratory is benefited by this audit in improving technical aspects of R&D which have to be done through benchmarking by the persons themselves. Government auditors expect that every R&D project should lead to commercial venture. In reality, studies have shown that for every 10,000 new ideas, there is finally generally only one commercial success even in an advanced country like the U.K. Obviously a great deal of research will remain in dormant stage only but each must be a building block. In fact, when we search in laboratories we find many half-baked technologies are lying like sleeping beauties for the prince of industry to come and kiss to life. Why not we have a look at all of them individually and see how many of them can be converted into money earning technology?

BECHMARKING OF PUBLIC FUNDED R&D INSTITUTIONS

It is less difficult to evaluate and grade R&D institutions than individual investigators. The factors that can be considered include the following whose relative weightages would be assigned by policy planners. These factors can be clustered into two categories–Enablers and Results. Enablers are the inputs and results are the outputs. The input factors which are to be closely related with government S&T policies, market demand with a futuristic outlook, societal aspect and nation's emergent security needs are the following :

- Institute's strategy and policy.
- Institute's resource management both in terms of human resource and physical resource.
- Process mapping with other similar but better and efficient process owners.
- Process adoption and management.
- Environmental study.
- Documentation.

To evaluate R&D institutions in terms of the above mentioned criteria, one needs some standards. In India, IISc may serve as a standard as far as publications are concerned. In some other criteria i.e. patents and technology transfer, some leading R&D laboratories may be accepted. There can be localized excellences such as biochemistry in one, waste utilization in another and, therefore, when areas are considered the standards may not be one single institution.

The other part i.e. results may be the following :

- Financial measurement in terms of colour of money i.e. percentage of funds that comes

from industry through technology transfer or through sponsored research and percentage as a grant from government house.

- Addition of knowledge in terms of patents filed and sealed (national/international), publications in the journals of high impact factor, etc.
- Government's importance, presence in electronic media and newspaper coverage.
- Recognition received by individuals and teams.
- Infrastructural support, quality of financial and administrative work.
- Investment in purchase of equipment and their status of utilization.
- Collaboration with other agencies (national/ international), quality and number of visitors to the institutions.
- Opinion of assessment committees and public perceptions.

For benchmarking, we need to identify what needs to be improved and which institution has to serve as a model and then approach the model institution for help and cooperation in that specific area. Benchmarking will not aim at emulating the other organisation per se save some aspect which serves as ideal. The Business Excellence Model (BEM) thus identifies a specific criteria and then plans to achieve and surpass the same. It is a proactive process to change the existing standards and practices using the model as Enabler to achieve improved Results.

Consider the CSIR system with thirty eight laboratories, some of which are known to excel in some specific areas. If a laboratory wishes to undertake benchmarking, it has to first fix priorities and then approach particular laboratories which are marked as models for gradual improvement through copying their methods and practices.

A critical question is whom one should copy and for what purpose. The model is assigned a reference excellence level of 100. One must be able to measure performance because, as mentioned earlier, what cannot be measured cannot be improved.

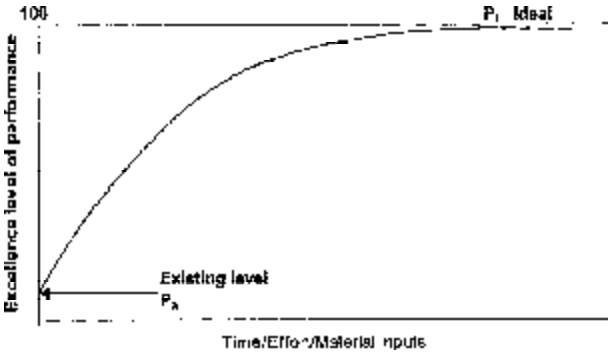

Fig. 2 : Level of excellence in performance

The level of excellence increases with inputs of time, effort and material support and the path is as shown above in the Figure 2.

It is easier to improve performance when the level is lower. However, increasing inputs are required when one goes to higher levels of excellence.

POTENTIAL FOR IMPROVING PERFORMANCE (PIP)

$$PIP = \frac{Pi - Pa}{Pi} \times 100$$

where Pi = P ideal and Pa = P actual

The performance level of the ideal performer (enabler) is to be copied provided it is situated

preferably in more or less similar situation. However, this need not be so always.

BASIC REQUIREMENTS

Some of the necessary conditions for successful benchmarking are the following :

- Knowledge of process or product to be improved before attempting to contact another company/organisation.
- Ensured management commitment.
- Identification and involvement of all those who may be affected by the project that cause for change.
- Communication flow during the project, especially with a benchmarking champion.
- Clear road maps for benchmarking projects i.e. clarification of priorities.

THINGS TO BE AVOIDED

Just looking around for improved process is a kind of tourism and awareness without commitment takes one nowhere. Benchmarking which goes beyond awareness should aviod the following.

- Do not benchmark if you lack management support.
- Do not ignore to measure people's impact.
- Do not confuse benchmarking with tourism for awareness.
- Do not ask for information which will not be supplied.
- Do not forget to determine the methodology for writing the best reports.
- Do not forget to implement.

No benchmarking project should be initiated unless there is firm decision to implement the necessary measures. Many excellent reports went to cold storage because of inadequate work on impact on people.

DO YOU KNOW?

Q3. All present day horses have come from a single wild stock, which country is the home of this original breed ?

Q4. In India which source generates maximum share of commercial energy–thermal power plants, hydroelectric project, solar devices or nuclear plant ?

BIOLOGICAL SIGNIFICANCE OF GAIA HYPOTHESIS AND ITS DIFFERENT SPECTRA

Archan Bhattacharya*

Gaia hypothesis suggests that the ecosphere is a holismic super-ecosystem with numerous interacting functions and feedback loops maintained by interaction between biotic and abiotic components. Enriched by the views of different authors, it has gone far beyond biology and has gained different spectra of thoughts. This ariticle briefly discusses some implications of the hypothesis.

INTRODUCTION

Gaia is the ancient Greek name of 'Goddess Earth'. According to Greek mythology, she maintains the balance of growth and reduction by regulating diseases, epidemics and death and simultaneously the birth of her filials and nurturing and nourishing them. Using her name, Sir James Lovelock (1969) proposed the Gaia hypothesis which says that the ecosphere is a holismic[2] (i.e., the whole is greater than the sum, synergism) super-ecosystem (the Gaian system) with numerous interacting functions and feedback loops maintained by the action, reaction and interaction between the biotic and abiotic components which maintain the ecospheric homeorhesis (evolutionary and ecological stability). Thus the biosphere (or ecosphere) is a two-in-one system[2] of living and nonliving components while Mother Gaia is the Goddess of both life and death. At heart, the hypothesis suggests that the evolution of organisms and their environment are tightly coupled as a single process through self-regulation.

In 1991, Schneider and Boston concluded that the Gaia notion is really a combination of the following five different ideas[3] :

(i) **Influential Gaia**—This simply states that the biota influence the abiotic world adjusting temperature and atmospheric chemistry.

(ii) **Coevolutionary Gaia**—This states that abiotic and biotic activities have undergone coevolution through interaction to create and sustain the biosphere.

(iii) **Homeostatic Gaia**—This says that the interaction maintains a dynamic equilibrium of the biosphere.

(iv) **Teleological Gaia**—This states that the atmosphere is kept in homeostasis by the biosphere and for the biosphere, and

(v) **Optimizing Gaia**—This says that the biospheric function creates optimal conditions for survival.

The Gaia hypothesis has attracted the attention of workers in many other disciplines and has provoked intense debates. As a result, it has gone far beyond biology. Some extensions of the hypothesis are discussed.

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BIOLOGICAL GAIA

This can be subdivided for the convenience of discussion.

(a) **Ecological Gaia or Cybernetic Gaia**

According to this hypothesis, organisms do not just passively adapt to the physical and chemical conditions, but actively interact to modify and control the physical, chemical and biological properties of biosphere. Thus biotic community plays a major role in biospheric homeostasis while biosphere is an integrated and self-regulated cybernetic (from Greek' Kybernetes : pilot or governor) or controlled system[1] (**Cybernetic Gaia**).

(b) **Evolutionary Gaia**

The hypothesis suggests that the life on Earth has not simply adapted to the conditions it encountered. The organisms began to establish control soon after the first life appeared more than three billion years ago and since then they have been weaving the web of life through their metabolic reactions. The contrary hypothesis is that purely geological (abitotic) processes produced conditions favourable for life, which then merely adapted to those conditions. Thus the evolutionary Gaia stands opposite to the conventional Darwinism and this may be called the **Gaian Darwinism.**

(c) **Conservational Gaia**

To decipher the main theme of **Gaia** hypothesis and its urge for conservation we may quote from Ted Perry :

All things are connected / Like the blood / ... ... / Man did not weave the web of life ; / He is merely a strand in it. / Whatever he does to the web, / He does to himself. According to Galley[4], we are stuck on the Earth, and it is time to think seriously about managing ourselves to avoid destruction of the only home, we have.

Some evidences for biological Gaia

(i) The Earth's surface conditions are regulated by life. Her atmosphere is maintained far from chemical equilibrium (unlike Mars and Venus) with respect to its composition of gases that determine the atmospheric chemistry and photochemistry, oxido-reduction state, alkalinity-acidity, ablbedo, temperature etc. by metabolic activities of biota.

(ii) The stratospheric ozone layer had been formed thanks of oxygen-evolving photosynthesizing cyanobacteria, then life on surface-water and land could start.

(iii) The biota on Earth have captured a huge amount of carbon in their biomass. The $CaCO_3$–shell forming organisms (coccolithophorids and forams) have continuously sedimented carbon in limestone on a long scale and also had consumed it rapily after the prehistoric events of sudden CO_2–uprise from outgassing. Thus they have lowered the CO_2 level in the atmosphere as much as one-thirtieth of which would be expected from abiological steady-state. This has lowered the green-house effect to a bio-friendly level.

(iv) The 'brown-belts' (arena of microbial activity) of soils and sediments determine the nutrient recycling and gaseous exchange. There are about 40 bioelements whose cycles are engined by both aquatic and terrestrial biota. All of these circuits have both a biotic phase and an abiotic phase, so these are called biogeochemical cycles[5].

(v) Different biological activities determine the components of different types of sediments. Microbes biomineralize different elements that are added to sediments, e. g., microbial metabolism transforms SO_4 = into H_2S that being added to iron-oxide form pyrite ores (FeS_2) ; limestone is another example.

(vi) Some ancient photosynthsizers lacking O_2-mediating enzymes, used H_2O as H^+ source and ferrous compounds as O_2 - acceptors ($4\ FeO + O_2 \rightarrow 2$ and $Fe_2O_3 + FeO \rightarrow Fe_3O_4$). The Fe_3O_4 has made large 'red bed' under the sea-bed.

(vii) The biota on Earth have performed pedogenesis. After physical and chemical weathering, biological weathering proceeds to form 'solum'. On the Martian surface, on the other hand, regolith is present on which no biological weathering could occur.

(viii) The gaseous nitrogen is available due to the denitrifiers and without biological transformations, all nitrogen would become the most stable nitrate form dissolved in oceans. If the ammonifiers would not form NH_3, the environment would become so acidic that most plants and animals would disappear. Biotransformations of nitrogen involve NO_2^-fixation (N_2 to NH_3), nitrification (NH_3 to NO_2^- to NO_3^-), assimilatory nitrate reduction (NO_3^- to organic nitrogen), ammonification or mineralization (organic nitrogen to NH_3) and denitrification (NO_3^- to NO_2^- to NO to N_2O to N_2).

(ix) Sulphur biotransforming bacteria drive the wheel of sulphur cycle through sulphate red-uction (SO_4 = to H_2S) and sulphur oxidations (H_2S to S^0 to S_2O_3 = to SO_3 = to SO_4). The Phosphorus cycle is characteristically myco-driven and mycorrhizae are very important in this respect. At least six species of ecto-mycorrhyae (eg. *Laccaria laccata*) fix nitrogen biologically. Now VAM-fungi are used as biofertilizer.

(x) A pond or a shallow lake cab establish sulphur cycle involving only bacteria. Oxidation at the surface by photo-and chemo-lithotrophs produce $SO_4^=$ and S, while dissimilatory sulphate reduction and desulphurylation lower down the water profile produces $S^=$. Lithotrophs near the surface of the pond utilize CO_2 and form organic compounds, which, after the death of lithotrophs nourish organotrophs. Such a system is called a sulfuretum.

(xi) The composition of dissolved trace metals, inorganic phosphorus, silica, nitrates and carbonates in sea–water and ocean basins are strongly influenced by marine biota.

(xii) For an example of the Gaian system one can cite the case of oceanic plankton which generate dimethyl sulphate (DMS) during photosynthesis. DMS, in mid troposphere, helps vapour concentration and cloud formation. As cloud reduces the amount of penetrating sunlight, photosynthesis becomes reduced and DMS production also is reduced. Consequently the cloud becomes thin, more light floods the ocean, DMS is formed and the process cycle continues.

(xiii) It has been said that the chemical composition of living bodies is a function of their own properties. The chemical composition composition of inert bodies, on the other-hand, is a function of the properties of medium in which they are formed.

(xiv) In any kind of autogenic succession, the former community changes the substratum in such a degree that ultimately it fails to perpetuate its life there and a latter community is established. Here biota regulate the biota and 'abiota'.

(xv) Any community is maintained at the level of carrying capacity of the esosystem by different biodemographic regulations exerted by each population and resource availability through competition, mutualism, protocooperation, commensalism, predation, antagonism, parasitism, influence to key stone species and umbrella species etc.

(xvi) The nutrient recycle pathways in a community are determined by living agents. There are four major routes for nutrient recycling or regeneration viz., (1) return by way of primary animal excretion, predominating in grazing food chains in plankton and in other communities, (2) return by way of microbial decomposition of detritus, predominating in detritus foods chains in grasslands, temperate forests etc., (3) direct recycle pathway from plant to plant through symbiotic microbes and (4) return by autolysis which does not involve metabolic energy.

SOME ENVIRONMENTAL PHENOMENA

Some examples related to environment are also discussed

(i) The photosynthetic pulse exerted by forests makes a seasonal cycle of CO_2 - concentration and dilution in Northern hemisphere and a negative feedback mechanism lies therein. During summer months, forests reduce CO_2 - concentration through increased photosynthesis and store carbon in wood and humus. In autumn, defoliation reduces photosynthesis and thus CO_2 -consumption and bacterial decay of humus releases CO_2 ; so CO_2 - concentration rises.

(ii) Methanogenic archaebacteria in municipal refuse, paddy fields and in guts of ruminant cattles produce CH_4 and thus exerct on green house phenomenon.

(iii) Nitric oxide originates from microbial processes (especially in nitrogen-fertilized soils) which has no influence at lower atmosphere, but at higher altitudes it helps the depletion of ozone layer.

(iv) Nitrate fertilizers used on soils enter our drinking water and are converted to nitrites by intestinal microflora. Nitrite then combines with haemoglobin to form methaemoglobin which interferes with the O_2 -carrying capacity of blood. The disease produced is called methaemoglobinaemia or blue body syndrome (significantly occurs at Rajasthan to take a toll of child-and live stock-lives).

(v) The Minamata disease (1953 to '60) occured due to the Minamata chemical company which discharged mercury into Minamata Bay, Hg or its salts then were converted to methyl mercury by anaerobic methanogenic archaebacteria, methyl mercury entered food chain and was bioaccumulated by fish.

(vi) Since 1980s, eight districts of West Bengal have been falling victim of arsenic pollution in drinking ground-water. Accoding to some scientists, heavy withdrawal of ground-water in those places have made O_2 entering down to arsenopyrite ($As + FeS_2$) layer associated with the aquifer, O_2 decomposes arsenopyrite to form

acid. When pH is > 4, species of *Metallogenium* and *Thiobacillus* increase the rate of degradation, when pH becomes < 4, *Thiobacillus ferrooxidance* becomes active. Arsenic dissolves into acid and leaches into aquifer[6].

APPLICATION OF BIOLOGICAL GAIA : THE ENVIRONMENTAL BIOTECHNOLOGY

Now a days, different plants, animals and microbes (especially 'steno' and rarer species) are used as bio-indicators[7] for environmental monitoring and management, for botanical exploration of underground resouces[8] , to reclaim mined wasteland[9] and to study Geobotany. They are also used to mitigate environmental pollution (bio-, phyco-and phyto-remediation). Diffierent microbes (*Bacillus thuringiensis*, *Agrobacterium tumifaciens*), fungi, nematodes, some hyperparasites, viruses etc. are used as biopesticides. Microbes are used commercially in fermentation-industries, metal-extraction (bio-leaching) etc.

AN UNSUCCESSFUL ATTEMPT TO CONSTRUCT AN ARTIFICIAL GAIAN SYSTEM

In 1991, 'Biosphere II' was constructed in the Arizona desert. The building, with a volume of 20×10^4 cubic meter and containing around 4000 species, was designed to be a self-contained ecosystem except for sunlight that would provide energy to drive the cycles O_2, H_2O, CO_2 and nutrients inside. Eight scientists entered it and it was sealed off with intention that for two years they would live there, grow their own food and be a part of the 'ecosystem'. But the Biosphere II faced various problems and in January, 1993 the mangers had to inject O_2 into the system. This failure showed our inability to mimic the ecosystem of the natural biosphere. The biological significance of Gaia hypothesis is veiled in this value.

GEOLOGICAL GAIA

According to most scientists, the primary atmosphere of Earth was formed from gases through outgassing. But the present secondary atmosphere is a biological product. Some believe that living matter actively regulates the geochemical migration of atoms and thus maintains stability of biosphere.

According to an environmentalistic view, the Gain system lies at the top of the environmental hierarchy where ecotope (an ecosystem with homologous properties that cannot be further decomposed) is the lowest level[5]. The Gaia hypothesis calls for a holistic approach to environmental management and provides a frame work for people-environment study.

OTHER GAIAS

Some ether extensions of the Gaia hypothesis are as follows.

Social Gaia

Gaianism may be successfully applied to socialism. Every big or small, human or non-human unit is integrated to form the social fabric[3] having a holismic nature and thus has inherent value to maintain the complex social system. So each unit should get honour and its fundamental rights must be admitted. Reciprocally, the integrity of Gaian system depends on the social components like cultural norms, socio-economics and political attitudes of a society towards the well being and development.

Noospheric Gaia

A term called 'noosphere'[19] (from Greek

'noos' : 'mind') refers the envelope of the Earth determined by human–consciousness (thoughts and efforts). The envelope refers to the ecosystems and societies that are interdependent and interrelated. This web of socioecosystem with consciousness is the Noospheric Gaia.

Spiritual Gaia[2]

The Gaian awareness helps a person to realize the self as an intgrated component of the 'whole' and thus the small 'I' becomes linked to Big 'I' (the 'Param' or 'Brahma' of Hinduism or the nature or ecosphere for the ecologists). Here Gaia hypothesis becomes initimate with the Deep ecology and Ecosophy or Ecophilosphy[10] and the Gandhian ecology. The Gaian - spiritual awareness may change abruptly the philosophy of life. This would transform the society and lead mankind towards sustainability with an eco-compatible life-style.

Planetary Gaia[1, 11]

On Earth, there is an Earthen-Gaian system. We may try to establish Gaian systems on other planets through our technological potential. Scientists now think about the introduction of microbial mats on Mars (if there is no indigenous 'biota') from cold, dry regions of the Earth to initiate Gaia after some transformation of Martain environment through planetary engineering to warm her, to release H_2O and to form a thick CO_2- atmosphere.

CONCLUSION

The Gaia hypothesis is yet to be formulated quantitatively and in a scientifically testable manner. At present, there are diverse inter-facing ideas embodied by the hypothesis, which has been applied to understand even planetary health and environmental and developmental issues. Analyzing the Gaia hypothesis forces us to deal with our most fundamental ideas about science and life. This stimulates mankind to care for nature, think of nature as guide for optimization.

ACKNOWLEDGEMENT

I desire to dedicate this essay to my esteemed teacher Dr. Ambarish Mukherjee who has inspired all my thoughts. I am grateful to him for his inspiration and for providing me reading materials. I also express my gratitude to all my fellow-workers in the Gaian system.

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FORENSIC ENTOMOLOGY : USE OF INSECTS IN CRIME INVESTIGATION

Devinder Singh, Meenakshi Bharti and Sapna*

Stress is now-a-days laid on scientific methods of investigation and Forensic Entomology is fast emerging as an important tool in crime solving. Interpretations made on the basis of entomological data are often very reliable and sometimes the only evidence available. Its use in India has so far remained negligible largely due to the unavailability of the required base-line data about our native insects of decay.

INTRODUCTION

Dead bodies of animals, including that of humans, are decomposed by various kinds of organisms with insects playing a predominant role. People had been observing maggots feeding upon decaying carrion but who knew that one day these so called 'natural scavengers' would act as witness to man's mud padding strategies for personal ambitions, jealousy and material gains. Practical use of these carrion-visiting insects in solving crime led to the development of a separate branch of science now-a-days called Forensic Entomology. Interestingly, when this name was not even heard of, human did use flies to solve a murder case as narrated in a Chinese story from a 13th century book "Washing away of wrongs" translated by McKnight (1981).[10]

Forensic Entomology has emerged as a major discipline with passage of time and its role in crime investigation became more and more relevant. In the developed countries, forensic entomologists are hired by prosecutors and defenders like lawyers. Some of the well-known detective agencies like FBI of USA have employed entomologists as special agents. Hundreds of research papers dealing directly or indirectly with Forensic Entomology have been published so far and this numbers is fast swelling. Large numbers of cases have already been solved in various countries of the world using entomological evidence. Several books dealing solely with this subject are now available.[11, 4, 6, 3, 7]

Exposed animal remains present a temporary and progressively changing habitat and food source for a wide variety of organisms ranging from microbes like bacteria and fungi to vertebrate scavengers. Out of these, arthropod fauna comprises a major element of the biota and insects form the most constant, diverse and conspicuous group. Large numbers of studies have shown that these six-legged creatures dominate the terrestrial as well as fresh water carrion fauna. Similar observation have been made[2] on rabbit carrion which so far remains the only study of this kind made in India.

An overwhelming majority of insects visiting carrion are flies and beetles. Members of the Dipteran families like Callphoridae,

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Sarcophagidae., Muscidae, Sepsidae, sphaeroceridae, Piopilidae and Phoridae and Coleopteran families like Cleridae, Dermestidae, Histeridae, Staphylinidae, Silphidae, and Tenebrionidae are commonly available on dead bodies. Blow files (Calliphoridae) are often the first to arrive on a dead body even within few seconds of exposure[5]. If given access, the females will oviposit on carrion within first few hours (sometimes minutes) after death. The maggots emerging from these eggs quickly invade various part of the animal body. They complete their life history on the carrion making the latter attractive for various other kinds of insects.

SCIENCE OF ENTOMOLOGY : APPLICATIONS

The science of forensic entomology is based on the analysis of these insects, which sequentially colonize a corpse as decomposition progresses, and on the rate at which the various stages of their progeny develop. This entomological information can be useful during criminal investigations in order to determine the following :

Time of Death :

There are two basic approaches to the application of entomological data for estimating the time of death. During earlier stages of decomposition, the time elapsed since death or postmortem interval may be determined by calculating the time required for a given species to reach the particular stage of development recovered form the corpse at the time of discovery. The insects involved in this approach are mostly dipterans, especially those belonging to the families Calliphoridae and Sarcophagidae. The most advanced stage of development which in turn shows the longest period of association with corpse is used to estimate the minimum possible postmortem interval. After the initial stages of decomposition are over and when the Calliphoridae and Sarcophagidae have departed, estimates are generally based on the interpretations of arthropod succession patterns.

Mode of Death :

A dead body having external injuries is more attractive to insects than one having none. So, depending upon the degree of degradation brought about by maggots, an entomologist may be able to suggest the possible mode of death e.g. strangulation or mutilation[1]. Another application is in the cases where death has occurred due to intake of drugs. A chemical analysis of the maggots found on the dead body can reveal the supecific drugs, especially helpful when no human tissues are available for sending to the laboratory for tests. During experimental studies, large number of poisonous chemicals have been recovered from maggots that fed upon animals which had died due to intake of such chemicals e.g. Cocaine, Triazolam, Oxazepam, Limemazine, Chloriprimine, Phenobarbital, Methamphetamine, Lead arsenate, Coproxamol, Amitriptyline etc.

Place of Death :

The deceased may have been killed at a place other than where the body is found. With knowledge about the carrion fauna of an area and the specific habits of species found on the cadaver, an entomologist can help to determine whether the person died at a place other than where the body has been found. Similarly, route

of transport of a dead body may also be traced by using entomological data.

OTHER APPLICATIONS :

There are numerous other special situations where entomologists can help to solve crime. If a body is found buried in soil, the entomological data can be helpful in determining the period intervening death and burial[8]. Suspects have been linked to the scene of a crime as a result of them having been bitten by arthropods specific to the vicinity[4]. Blow fly larvae found in the diapers have been used to provide information on how long children had been neglected by their parents.[8]

In order to use insects in solving crime, a detailed knowledge is required about the carrion fauna with respect to life history, habits, geographical distribution, taxonomy, morphology of immature stages, ecological succession etc. Unfortunately, we lack this information with respect to the India carrion fauna and as a result much of the valuable forensic evidence is going waste. Some initiative has already been taken in this direction at two laboratories in the country i.e. Department of Zoology, Punjabi University, Patiala - 147002 and Medico-legal Institute, Bhopal. The time is not far off when entomology will form an essential component of the routine forensic investigations in our country as well.

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SHORT COMMUNICATION

ALUS ARE RARE–A GENETIC OXYMORON ?

D. BalaSubramanian*

INTRODUCTION

Biology occasionally bewilders the practitioner. About thirty years ago, we thought we had pretty much understood the basics of what genes are, how many genes we have, what they do and how they do it. Well, genes are long stretches of the DNA molecule, assembled from four types of building blocks called nuclecotides ; the average size of a gene is some thousand or so nucleotide-long sequence of the DNA ; a gene acts of "expresses" itself through the transcription of its sequence into intermediaries called RNA which are finally translated into proteins ; a human has a few hundred thousand genes that make the body tick and these genes are packaged in units called chromosomes, to make up the whole entity called the genome. All these were written up in textbooks and biologists were dotting the 'i's and crossing the 't's, when a spanner was thrown in the works. The above numbers suggest that the total human genome would comprise a few hundred million nucleotides. But what was found ? The human genome is found to be far, far longer–about four billion nucleotides long ! A full 10-fold larger in size than expected !!

Selfish Junk

What is all that extra DNA doing in our genome, if only a tenth of it act as genes ? That answer to this 30-year-old puzzle is yet to come by. In the meanwhile, ths extra DNA has received bad press which has stuck. Nonsense, inert, non-functional, junk and garbage–these are some of the adjectives that have been used to describe it. The more polite among us have called these extra sequences as interrupted sequences or introns, as opposed to exons, namely sequences that are expressed as genes. Introns are dotted liberally and frequently along the length of the DNA chain of the genome, 'twixt and amidst the expressed gene sequences or exons'. Reading the genome from one end to the other and looking for meaningful passages, as some enzymes are required to do, so somewhat like watching a TV programme in Doordarshan, with its "sorry for the interruption" inserts and qualitatively different from other diversions such as commercials, which try to eclipse even a solar eclipse (Remember how the live telecast of the total solar eclipse of November 1995 was received by these commercials!). Commercials are exons or messages of instruction, though not germane to the main programme. Interruptions are nothings.

The nine-tenths of the genome that is not expressed has embarrassed some biologists into

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calling it junk DNA, and in a phrase that was coined by the Oxford zoologist Rochard Dawkins in 1976, "selfish DNA". This term bears some explanation since it has now moved from the wholly pejorative into the technical parlance of biology. Selfish DNA describes a DNA sequence which :

(1) has no specific contribution to make to the phenotype (or one which is expressly manifest as a form or function of the organism), and

(2) spreads by forming additional copies of itself within the genome, that is, repetitive and self-propagating.

A hallmark of a junk DNA sequence, which earns it the sobriquet "selfish", is the fact that this sequence repeats itself many times in the genome. The other interesting aspect is that microbes and lower forms of life do not have any junk DNA in them ; their genomes are spartan and to the point. Selfish DNA makes its debut in higher eukaryotes and animals, and runs riot in primates and humans. Of the several junk sequences seen in the human genome is a striking sequence called *Alu.* As sequences go, it is small–made up on only 283 nucleotides. But it repeats an incredible half a million times (perhaps closer to a million times) in the human genome! This ought to make *Alu* the most repeated phrase in the genome, somewhat like the word "the", which is claimed to be the most repeated word in any book in the English language.

This percussive and fugal repetition of *Alu* has evoked the musician in the membrane biologist David Deamer of Davis, Caliofornia to set *Alu* to music! Noting that the four DNA nucleotides contain four types of constituent bases termed A, G, C and T, Deamer decided to give each base a musical value : the notes A (the sixth note in the scale from the tonic C, or the swara *dha*) for A, G (*pa*) for G, C (*sa*) for C and E (*ga*) for T, and played the 283-nucleotide repeat sequence of *Alu* on a keyboard. It has a pleasant baroque-like air to it. In a similar vein, the Japanese-American geneticist Susumu Ohno musicalized DNA sequences, giving two musical note values to each DNA base rather than one ; the resultant music is reminiscent of that of the Polish pianist-composer Frederic Chopin. (One of the things that I intend doing, sooner or later, is to set to music protein sequences. Given the larger starting set of twenty amino acid monomers that build the protein sequence, one can assign each of them a musical value from the 22 notes of the scale in the Karnatak music *swara* and *shruti* repertoire. Protein music should sound richer and more varied than the 4-note DNA music).

Given their frequent interspersal, repetitive nature and abundance in higher animals, some have argued that "junk" sequences like *Alu* cannot be just sitting there, doing nothing. Nature, it is often said, never adds junk or wastes anything. An early suggestion was that these frequent stretches act as fillers or supports that help in the packing of the genome into its proper folding and conformation. While this idea has been thought to be a reasonable one, it has not been put to rigorous test and verified.

ALU AND AJIT WADEKAR

Drs Roy Birtten and E H Davidson of California had suggested as early as 1969 that

junk sequences play the role of regulators and co-ordinate the expression of the various genes in the genome. Sitting at various points in the genome, they might act as switches that tell which gene must be expressed when, in what time sequence and in which tissue of the body. The role is somewhat like that of manager of a cricket team who decides the batting order and the bowling order of the team, depending on the nature of the wicket, the target score to be made, time left to make the score and such other factors. This role for *Alu*-like sequences as regulators of gene expression is attractive on many counts. First, *Alu* is a "jumping gene" or a "mobile insertional element". It inserts copies of itself randomly into the genome. Yet, when we analyze the pattern of its insertion in the genomes of primates, one sees a method in this madness, or a pattern in its promiscuity. Over the last fifty million years, these insertions have occurred repeatedly and all over the genomes of monkeys and men. A close look at the pattern of divergence over these years, reveals four groups or subfamilies of *Alu*, begging a functional role for them.

What is in the sequence of *Alu* that can let it regulate gene expression? This question was posed by Drs Gordon Vansant and Wanda Reynolds of the Sidney Kimmel Cancer Center at San Diego, california. Staring at the sequence of one of the *Alu* subfamilies, they recognized a 14-nucleotide stretch that was similar to a sequence where a hormone binds ; such a binding of the hormone to this region of DNA turns on a gene placed downstream. So, does *Alu* provide an anchor point for hormone binding and control of gene expression? Enthused by this ides, they investigated *Alu* further and came up with some interesting results that they published in an issue of the *PNAS, US* (92, 8229, 1995).

THE RARE SEQUENCE

Their studies showed that the *Alu* sequence also binds to a protein which, in turn, binds to the small hormone–retionic acid. This protein is hence called the retionic-acid receptor or RAR. The scenario would be thus–RAR binds to an *Alu* sequence in the genome. The hormone retionic acid comes along and binds to RAR and effects the expression of a gene that is placed near the *Alu* ; think of the RAR as a lock on the door (the genome). The hormone fits into the lock and flicks the latch and opens the door. *Alu* is thus a RAR binding site or a retionic acid response element, RARE.

Vansant and Reynolds did another clever experiment to drive home this point. They chose an *Alu* sequence sitting close to the gene for the protein, keratin. Using molecular genetic techniques, they moved the keratin gene and replaced it with a "reporter" gene whose expression could be easily measured. The reporter gene works well with the *Alu* in tandem, but now when they delete the *Alu* sequence also, the reporter becomes inactivated, by as much as 35-folt. *Alu* regulates the reporter gene.

QED? Perhaps not all *Alu* sequences can act as gene regulators, but only those that are accessible to hormones, their receptors or other effectors that act as the key. Those *Alus* that are buried within the folds of the genome might not "see" the key and would thus be inactive, while those that can, would. And the random, repetitive

insertion and "jumping" of such junk sequences could, willy nilly, provide genetic novelty and benefits. As bob Holmes, who summarized the Vansant-Reynold result in *New Scientist* asks– "Did genetic 'garbage' spur primate evolution?"

A last word about nomenclature. Geneticists are whimsical lot, who tend to name DNA sequences and genes in quaint ways–Hox for the genes that provide homeotic development, *bride of 7* and *sisterless* for genes and mutations with the said features. *Alu* was named for the DNA fragment that is recognised and cut up by an enzyme seen in the bacterium *Arthrobacter luteus*. Worse is the abbreviation RARE ; and to identify *Alu,* which occurs in such abundance, as RARE is a classic case of mixing metaphors ; indeed it is as much an oxymoron as "fast-food chiefs" (Courtesy : William Safire).

DO YOU KNOW?

Q5. When did the last mammoths die ? 100,000 yr., 50.000 yr., 30,000 yr. or 5,000 years ago?

Q6. Amongst the following which contains the maximum level of vitamin-C, per unit weight?–tomatos, palak, onions, amla?

Q7. Choose the correct answer. The lunar shadow exactly covers the sun during total solar eclipse. This is because–(a) of a fundamental law of physics. (b) it is a happy coincidence, (c) it is an optical illusion.

KNOW THY INSTITUTIONS

DEFENCE RESEARCH LABORATORY, TEZPUR

Defence Research Laboratory (DRL), Tezpur is one of 51 laboratories under Defence Research & Delelopment Organization in Ministry of Defence, Govt of India. The establishment had its humble beiginning as "Field Laboratory", a small research cell of the then DRL (M), Kanpur on 21 November, just after the irksome Chinese aggression in October 1962. The initial charter of the laboratory was to provide storage/outdoor exposure trials for developed products under the prevailing hot and humid climate of North-Eastern Region. On subsequent development, the laboratory gained momentum with independent research & development assignments for the benefit of Defence services deployed in this strategically important region. In October 1980, it became a full fledged R & D laboratory and was renamed as Defence Research Laboratory. In continued effort towards the exigencies and need of the troops serving in inaccessible areas having severity of climate, the laboratory has dedicated for the betterment of their life and living condition. The spin-off benefit of the R & D efforts is being extended for socio-economic development of the local populace as per directive and guidance of DRDO.

Scientific team from this laboratory periodically visit the forward areas to have "on the spot" assessement of the problems faced by troops so as to evolve suitable remedial measures.

Defence Research Laboratory is situated at Solmara Cantonment, about 12 kms away from Tezpur city in the state of Assam. The technical campus spreads over 14 acres of land with three main technical buildings plus a few supporting buildings for library, workshop, cafeteria, seminar and auditorium. The seminar and auditorium halls are equipped with all modern facilities of audio-visual aids and amenities.

The major areas of R & D study being pursued by Defence Research Laboratory are :

(i) Medical Entomology. (ii) Bio-active Plants. (iii) Water Survey, Analysis & Purification. (iv) Composting Technology for Organic farming and Musroom Production. (v) Germlasm Collection for Gene Bank.

Various research establishments, colleges abnd universities are in close interaction with DRL, Tezpur for sharing knowledge, expertise and laboratory facilities for better output of the R & D programmes. Institue of Microbial Technology, Chandigarh and Vector Control Research Centre, Pondicherry are in co-operation for identification and production of entomopathogenic bacteria isolated by this laboratory. Similarly, MRC, Delhi for bioassay of plant extracts and BRL, Jorhat and DRDE, Guwalior are in constant interaction for characterization of antimalarial active compound.

MEDICAL ENTOMOLOGY

The hot and humid climate of North Eastern India is very conducive for proliferation of haematophagous insects and leeches. Mosquitoes invite a considerable attention of the Health Service for transmitting Malaria, Japanese encephalitis, Filariasis, etc. This laboratory has, therefore, taken up the issue of combating these insectvectors in this region by adopting systematic survey and integrated control measures. Significant achievements have been made on the control of malaria cases by reduction of parasitic load in more than 50 affected villages and Army Cantonments in Assam and Arunachal Pradesh.

In 1997, this laboratory maintained Sonitpur district of Assam under the operation "**No Malaria Epidemic Zone**". The studies under this operation revealed that 50% of malaria positive cases were due to the killer parasite i.e., Plasmodium falciparum. Timely survey followed by integrated control measure was adopted to arrest further transmission. The malaria cases slowly came down to the level which is known to be insignificant for malaria transmission. Thus every chance of major outbreak of malaria was brought under control.

Scientists of this laboratory surveyed all the seven states of North East India, as well as the neighbouring states like Bihar, Bengal and Andaman and Nicobar Islands to record the occurrence, distribution and species composition of vectors responsible for transmission of disease in man. Mosquitoes of this region are mainly of three types–day biter (*Aedes* spp), dawn and dusk biter (*Armigeres* spp) and night biter (*Culex* spp., Anopheles spp., *Manasonia* spp., etc). So

far, 81 species of mosquitoes have been identified by this laboratory. These are belonging to 10 genera, i.e., *Anopheles* (30 spp), *Ades* (19 spp) *Armigeres* (5 spp), *Coguillittidia* (2spp), *Culex* (15 spp), *Malaya* (2 spp), *Mansonia* (4 spp), *Minomyia* (2 spp) *Tripteroides* and *Toxorhnchites* one species each.

Infestation of watermite (*Arrenurus* spp) on *Anopheles nigerrimus, A. Philippinensis, A. ramsayi, A. vagus, Ficalbia chamerliani, Mansonia annulifera, Maindiana, Ma. uniformis, Culex bitaeniorthynchus, Cx, cornutus, Cx. malayi* and *Cx. sinensis* has been reported for the first time in India.

A mosquito bio-larvicide has been formulated taking an isolated bacteria as an active component for control of mosquito breeding. Laboratory and field evaluation of the formulation were recorded as 0.05 ppm and 0.1-0.2 kg/ha respectiveley.

BIOACTIVE PLANTS

Survey has been accomplished in different parts of NE region and a large number of widely grown medicinal plants were collected with the help of traditional practitioners, herbalists and folklore information. A herbal garden of 106 species of medicinal plants has been established with facilities for propagation and preservation. Among these, one plant most effective against malaria parasite has been identified. *In vivo* test of crude extracts of the plant on albino rats is revealing significant results in reducing malaria parasitemia in blood.

A few more medicinal plants have been identified. Preliminary screening of these plants has shown positive results against *P. vivax* and *P. falciparum* malaria parasites.

A Herbal mosquito vaporizer has been developed by formulating three essential oils. The herbal vaporiser is well accepted in users trials for its effectiveness and natural fragrance in comparison to commercial units (All Out, Good Knight etc.). It can be effectively used in rural habitat with simple modification of hurricane or kerosene lamp, where electricity is not available. A modified alcohol base formulation has also been developed which can be used as room freshner or insect repellent by topical application.

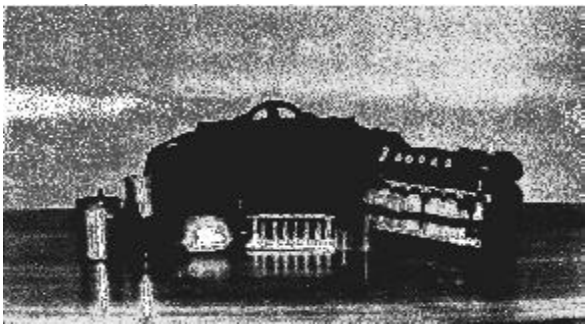
WATER POTABLE TECHNOLOGY

Extensive survey and studies have been accomplished on physico-chemical and bacteriological quality of water of North East India for assessement of potability. In many cases, water of this region does not conform to drinking water standard in respect of pH, colour and turbidity. The acidic waters are generally highly ferruginous and sometimes associated with manganese. Iron content of water in Assam, Manipur and Tripura are generally high and exceed the permissible limit manifolds. Therefore, it is recommended to have proper treatment in respect of pH, colour, turbidity, iron and manganese content for human consumption. Water of this region are generally deficient in iodine content which may result the prevalence of goiter incidence in this region. Iodine deficient is maximum in Manipur followed by Nagaland, Mizoram and Arunachal Pradesh. In view of high iron

content in underground water in some areas of the region, a special attention is required in treatment of ferruginous water.

A Water testing field kit has been developed by DRL Tezpur for the benefit of the people living in the remote areas where accessibility and scarcity of treated water prevails. Essentiality to ascertain the water quality in order to get rid of water borne diseases is a basic need. The Water Testing Field Kit can be used in field condition by a semiskilled person for testing potability of water. The kit provides water testing facilities for both physico-chemical and bacteriological parameters on accepted/rejected basis. More than 250 kits have been supplied to a number of Organizations/Institution in this region. The following tests are provided in this kit :

pH, Fluoride, Turbidity, Nitrate, Total hardness, Residual chlorine, Iron, Coliform bacteria, Chloride

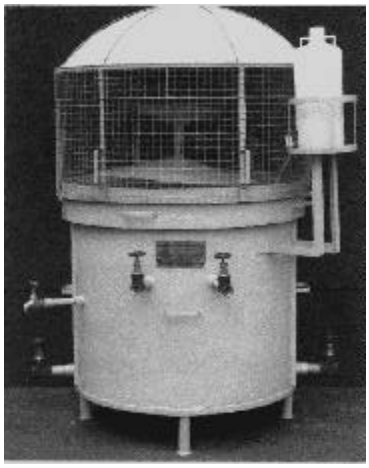


Water Testing Field Kit

DRL Tezpur has developed an improved iron removal unit. This iron removal unit made of M. S., is cylindrical in shape, consists of four chambers and have sludge/backwash outlet valves for cleaning. It has an efficient aeration system and double (upflow and gravity flow) filtration device. The various steps invloved in the unit for removal of iron are :

(i) Aeration (ii) pH adjustment (if required) (iii) Oxidation of ferrous into ferric iron by dissolved oxygen and catalytic action of iron oxide coated contact media. (iv) Precipitation of ferric iron (v) Removal of precipited iron by sedimentation, upflow and gravity flow filtration.

The output of the unit is 300 Itrs/hr and can cater to the need of small size population particularly in rural areas. Iron content of treated water through this unit is brought down to below 0.3 mg/ltr with feeding water having iron content as high as 40 mg/ltr.



Iron Removal Unit

MUSHROOM AND ORGANIC FARMING

DRL has standardized techniques for cultivation of different mushroom species and strains. Training programmes are arranged for Service personnel and local entrepreneurs. A few value added products of mushroom, viz., mushroom candy, jam, pickle etc. have been developed. A new mushroom has been developed by mycelial fusion of two different types, which is a temperature tolerant and disease resistant. It is fragile in texture and produces

less spores. A locally available wild edible mushroom has also been identified as Lentinus squarossulus. Shelf-life storage of mushroom has been standardized in terms of appearance, odour and acceptability of fruit bodies.

Huge biomass like agricultural wastes, weeds and grasses, treel leaves, animal excreta etc. are converted to compost and give back to cultivated land for improving soil fertility. An improved method of pit composting (anaerobic process), heap composting (aerobic process) and vermicomposting using local earthworm have beeni developed. These techniques can convert organic wastes successfully into valuable compost within 2-7 months depending on the nature of organic waste. The vermicomposting period can be reduced further by using microbial culture for quick decomposition and by increasing the quantity of cowdung and population of earthworm.

After 43 years of service on research and development activities, DRL, Tezpur has identified the hottest chilli of the World and it has gained core competence in two broad areas, viz., control of malaria and Studies and exploitation of natural resources of North east region.

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Conferences / Meetings / Symposia / Seminars

Date	Topic	Contact
18-19 March 2005	Naitonal Conference on **Bioinformatics Computing,** Patiala	**Dr. Deepak Grag** Computer Science & Engineering Department Thapar Institute of Engineering and Technology, Patiala 147004 Email : deepakgarg@ieee.org
March 25-26, 2005	National Conference on **Computing and Mathematical Modeling** Gandhigram	**Dr. K. Thangavel** Dapartment of Mathematics Gandhigram Rural Institute Deemed University, Gandhigram-624 302. Tamilnadu E-mail : ktvel@rediffmail.com
11-14 April 2005	**Occupational and Environmental Radiation Protection,** Boston	Harvard School of Public Health, Centre for Continuing Professional Education, 677 Huntinghton Avenue, CCPE Dept A Boston MA 02115-6093, USA Email : contedu@hsph.harvard.edu
14-17 June 2005	2nd International Symposium on **Sweet Potato and Cassava,** Kuala Lumpur	**Dr. Tan Swee Lian** MARDI Rice & Industrial Crop Research Centre P O Box 12301 50774 Kuala Lumpur, Malaysia Email : sltan@mardi.my.web
29 November-2 December 2005	Third International Conference on **Plants & Environmental pollution,** Lucknow	**Dr. R. D. Tripathi** National Botanical Research Institute Lucknow-226001, India. E-mail : isebnbrilko@satyam.net.in
19-21 December 2005	The Fifth International Conference on **Operational Research for Development,** Jamshedpur	**Prof. Janat Shah** Indian Institute of Management Bangalore, India. E-mail : janat@iimb.emet.in

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Dr. S. K. Sopory

Professor, Sr. Scientist and Group Leader, Plant Molecular Biology, International Centre for Genetic Engineering and Biotechnology, New Delhi.

S. S. BHATNAGAR MEMORIAL AWARD

Dr. P. Balaram

Professor, Molecular Biophysics Unit, Indian Instutute of Science, Balgalore.

VIKRAM SARABHAI MEMORIAL AWARD

Shri N. Pant

Member, Space Commission, Space Applications Centre, Ambawadi, Ahmedabad.

D. S. KOTHARI MEMORIAL AWARD

Prof. Samaresh Mitra

Senior Scientist, Indian Institute of Chemical Biology, Jadavpur, Kolkata.

JAWAHARLAL NEHRU PRIZE

The Science Association of Bengal, Kolkata.

THE SCIENCE-IN-SOCIETY AWARD

Dr. M. K. Bhan

Secretary to the Govt. of India, Ministry of Science and Technology, Department of Biotechnology, New Delhi.

EXCELLENCY IN SCIENCE AND TECHNOLOGY

Dr. R. A. Mashelkar

Secretary, DSIR and Director General, Council of Scientific & Industrial Research, New Delhi.

PROF. R. C. MEHROTRA COMMEMORATION LECTURE

Dr. A. V. Rama Bao

Director, AVR Research Foundation, Chairman & Managing Director, Hyderabad.

SECTIONAL AWARDS

PROF. HIRA LAL CHAKRAVARTY AWARD

Dr. Manoj Kumar Dhar

Department of Biotechnology, University of Jammu, Jammu-180006

PRAN VOHRA AWARD

Dr. Supriya Chakraborty

Scientist, Plant Virology Laboratory, Indian Institute of Vegetable Research, Varanasi.

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

Dr. Subhendu Adhikari

Sr. Scientist, Central Institute of Freshwater-Aquaculture, Bhubaneswar.

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

Shri Srikanta K. Panigrahi

Former UNEP / UNESCO Fellow, Director (Environment), Planning Commission, New Delhi.

PROF R. C. SHAH MEMORIAL LECTURE

Dr. Arindam Banerjee

Sr. Lecturer Biological Chemistry, Indian Association for the Cultivation of Science, Jadavpur, Kolkata.

Dr. V. R. Pedireddi

Scientist, Division of Organic Chemistry, National Chemical Laboratory, Pune.

PROF. (MRS.) ANIMA SEN MEMORIAL LECTURE

Prof. (MRS.) S. P. Sinha

Prof & Head, Dept. of Psychology, Dayalbagh Educational Institute, Agra.

DR. (MRS.) GOURI GANGULY MEMORIAL AWARD

Dr. D. Nagalakshmi

Asst. Professor, Department of Animal Nutrition, College of Veterinary Science, N.G. Ranga Agricultural Univ., Hyderabad.

PROF. SUSHIL KR. MUKHERJEE COMMEMORATION LECTURE

Dr. Dilip Kumar Das

Retired Emeritus Scientist of DST and ICAR, Delhi.

PROF. S. S. KATIYAR COMMEMORATION LECTURE

Dr. S. K. Arora

President, R & D, Lupin Ltd., (Research Park), Pune.

B. C. GUHA MEMORIAL LECTURE

Dr. Sujit Kumar Bhattacharya

Director, National Institute of Cholera and Enteric Diseases, Kolkata.

G. P. CHATTERJEE MEMORIAL AWARD

Prof. (MRS.) Kasturi Datta

Professor, School of Environment Science, Adjunct Professor, Special Centre for Molecular Medicine, Jawaharlal Nehru University, New Delhi.

ISCA YOUNG SCIENTISTS AWARDEES

AGRICULTURE AND FORESTRY SCIENCE

Abhijit Das

Patent Office

Govt. of India, Kolkata.

T. Damodaran

Central Aricultural Research Instt., Port Blair.

ANIMAL, VETERINARY & FISHERY SCIENCES

Tanu Allen

Toxicology Lab., Deptt. of Zoology,

Deptt. of Environment,

Ch. Charan Singh University, Meerut.

J. A. Johnson

Deptt. of Biotechnology,

Malankara Catholic College, Kaliakavilai.

ANTHROPOLOGICAL & BEHAVIOURAL SCIENCES (INCLUDING ARCHAEOLOGY, EDUCATIONAL SCIENCES)

Sudesna Chanda

Dept. of Anthropology,

University of Calcutta,

35, Ballygunge Circular Road, Kolkata-700019.

Sharuti Saini

Deptt. of Psychology,

Guru Nanak Dev University, Amritsar (Panjab).

CHEMICAL SCIENCES

Subhendu Mukherjee

Deptt. of Chemical Technology

University of Calcutta, Kolkata.

Nilesh Rane

School of Chemical Sciences

Devi Ahilya University, Indore.

EARTH SYSTEM SCIENCES

Nihar Ranjan Tripathy

Deptt. of Geology,

Banaras Hindu University, Varanasi.

Pratima M. Kessarkar

National Instt. of Oceanography, Dona Paula.

ENGINEERING SCIENCES

Deepankar Choudhury

Deptt. of Civil Engineering

Indian Instt. of Technology, Powai, Mumbai.

ENVIRONMENTAL SCIENCES

Richa Parasher

Environmental Engg. Lab.,

Deptt. of Civil Engg., I.I.T., Kanpur.

Jaysankar De

Biological Oceanography Divn,

National Instt. of Oceanography, Goa.

INFORMATION AND COMMUNICATION SCIENCE & TECHNOLOGY (INCLUDING COMPUTER SCIENCES)

Ansuman Banerjee

Deptt. of Computer Science and Engineering

Indian Instt. of Technology, Kharagpur.

MATERIALS SCIENCE

S. K. Tripathi

Deptt. of Physics, North Eastern Regional

Instt. of Science & Technology, Nirjuli (Itanagar)

MATHEMATICAL SCIENCES

Vinayak V. Joshi

Deptt. of Mathematics,

Govt. College of Engineering, Pune

R. Suresh Kumar
Deptt. of Statistics,
University of Madras, Chennai

MEDICAL SCIENCES (INCLUDING PHYSIOLOGY)

Triparna Sen
Deptt. of Genetics
University College of Science,
Technology and Agriculture
University of Calcutta, Kolkata

Sutapa Chakraborty
Deptt. of Environmental
Carcinogenesis and Toxicology,
C. N. C. I.,
Kolkata

NEW BIOLOGY (INCLUDING BIOCHEMISTRY, BIOPHYSICS & MOLECULAR BIOLOGY AND BIOTECHNOLOGY)

Shreedhara Gupta
Deptt. of Biological Chemistry,
Indian Instt. of Chemical Biology, Kolkata.

Kruti Shah
The Gujarat Cancer & Research
Instt., Asarwa, Ahmedabad.

PHYSICAL SCIENCES

Ruchi Mishra
Deptt. of Physics,
Dr. H. S. Gour Vishwavidyalaya, Sagar.

PLANT SCIENCES

V. Girija Shankar
Genetic Transformation Lab.,
International Crops Research
Instt. for Semi-Arid Tropics
(ICRISAT), Patancheru, Hyderabad

R. Uma Maheshwari
Centre for Advanced Studies
in Botany, University of Madras, Chennai

BEST POSTER PRESENTATION AWARDEES

AGRICULTURE AND FORESTRY SCIENCES

Vipin Chaudhary
R. C. A. Z. R. I., Jodhpur

Archana Srivastava
B. M. B. S. T. C., Jaipur

ANIMAL, VETERINARY & FISHERY SCIENCES

Payal Singh
A. S. College, Meerut

Mallika Chaudhury
D. R. D. O., Mysore

ANTHROPOLOGICAL & BEHAVIOURAL SCIENCES (INCLUDING ARCHAEOLOGY, EDUCATIONAL SCIENCES)

Himbala
Patna University, Patna

S. V. HITTALMANI
Karantaka University, Dharwad

CHEMICAL SCIENCES

L. R. Pandey
H. S. Gaur University, Sagar.

Garima Sumran
Kurukshetra University, Kurukshetra

EARTH SYSTEM SCIENCES

S. S. Manral,
D. R. D. O., Kochi

Babita Sharma
Kurukshetra University, Kurukshetra

ENGINEERING SCIENCE

Damodar Magdum

I. S. R. O., Ahmedabad

M. V. Bhaskar Rao

Bangalore

ENVIRONMENTAL SCIENCES

S. J. Gandhi

N. I. O. H., Ahmedabad

Subarna Bhattacharyya

Heritage Instt. of Technology, Kolkata

INFORMATION AND COMMUNICATION SCIENCE & TECHNOLOGY (INCLUDING COMPUTER SCIENCES)

H. Ravi Sankar

Central Tobacco Research Institute, Rajamundry

Chintan Naik

Shrimad Rajchandra Instt. of Management, Tarsadi

MATERIALS SCIENCE

D. P. Singh

National Physical Laboratory, New Delhi

Ashish Warrier

Sardar Patel University, Vallabh Vidyanagar

MATHEMATICAL SCIENCES

R. K. Yadav

J. N. V. University, Jodhpur

N. U. Khan

Aligarh Muslim University, Aligarh

MEDICAL SCIENCES (INCLUDING PHYSIOLOGY)

O. S. Tomer

D. I. P. A. S., Delhi

Jayashree K.,

JSS Medical College, Mysore

NEW BIOLOGY (INCLUDING BIOCHEMISTRY, BIOPHYSICS & MOLECULAR BIOLOGY AND BIOTECHNOLOGY

B. C. Narasimha Prasad

Central Food Technological Research Institute, Mysore

Savita Yadav

A. I. L. M.S., New Delhi

PHYSICAL SCIENCES

B. B. Parekh

Saurashtra University, Rajkot

Veenasangeeta Sortur

Karnataka University, Dharwad

PLANT SCIENCES

Anuradha Bandyopadhyay

Central Research Instt. for Jute & Allied Fibres, Kolkata

Tilottama Roy

R. D. University, Jabbalpur

91ST INDIAN SCIENCE CONGRESS : RECOMMENDATIONS

The focal theme of the 91st Indian Science Congress was "Science & Society in the Twenty First Century : Quest for Excellence".

SOME IMPORTANT OBSERATIONS

The Prime Minister emphasized in his address the following items from the Science and Technology Policy 2003 (presented in the 90th ISC) as the challenges for immediate action : water conservation ; recycling and desalination of sea water for use ; increased affordability and availability of reusable energy ; cure and prevention of infectious and non-infectious diseases ; improvement in the nutritional status of the poor, especially women and children ; effective use of science and technology in agriculture ; diversification of cottage and small scale industries and services in informal sector. He desired the Science Congress to annually review the progress made in implementing this policy and suggest correctives. His message was : pursue excellence, shun shoddiness, encourage public-private partnerships and streamline science administration.

Dr. Murli Manohar Joshi (the then Union Minister for Science & Technolgy) also put a strong emphasis on the pursuit of excellence. He stressed that for individual excellence to thrive, overall excellence of research and educational institutions is a must. Dr. Joshi recounted the steps already taken to achieve such goals. He urged the State Governments to provide financial support and infrastructure facility to educational institutions to revitalize them. Quoting figures from various Human Development Reports, Dr. Joshi expressed anguish on the socio-economic condition in the world despite progress in many spheres. He wondered whether the reductonist approach to science was creating a mindset that resulted in the application of science to develop the society in a fragmented manner. He emphasized the need to create a cooperative world and an egalitarian and progressive society. He felt that science needs to train the mind to see and understand the "whole".

Professor Asis Datta, in his Presidential Address high lighted the promises that biotechnology holds for the society in the area of agriculture, nutrition, healthcare and environment. He advocated tapping the strength of India by blending its rich traditional knowledge with the modern science.

The Honourable President of India Dr. A P J Abdul Kalam addressed the gathering in the evening of January 5, 2004. He opened the lecture focusing on the major challenges of providing habitat, food, healthcare, education and employment to the 260 million people in India who are below the poverty line. He called attention to the economists' suggestion that to uplift the people below poverty line, our economy has to grow consistently at the rate of 10% per annum, for over a decade. Dr. Kalam elaborated on the scientific and technological tools that we have and the quality of partnership and innovation that our scientific community can provide for achieving the desired rate of growth.

The Honourable President recounted a number

of technological breakthroughs in space technology, nuclear technology, defense technology, agriculture technology, ICT and cited the setting up of world-class institutions of IITs and IIMs in the country. He emphasized that such breakthroughs can be manifold given the reservoir of knowledge that we have in every academic institute and R & D organization, if all of them aim for technology development to the stage when it is transferred, absorbed and productionised according to the needs of people. He pointed out that for development a country has to market its products in a competitive way to other countries. To succeed in competition, high quality of product, cost effectiveness and supply in time are essential. Scientists and technologists can contribute in making these happen. The fields that he specifically mentioned for such contribution are : agriculture and agro food processing, healthcare and biotechnology, stem cell research, energy production, information and communication technology.

RECOMMENDATIONS

Participants in the 91st Science Congress during their discussions and interactions rendered useful suggestions. The same are presented here.

Excellence in Education

The area that needs attention is the empowerment of young scientists working in the universities and in national institutes. If the corporate world can have young CEOs why should science be far behind? Give freedom to young ones and they will do wonders. This process is closely linked to the training that our students receive at the university level. While several universities provide excellent knowledge base, research training in terms of experimental skills accompanied by questioning mind is inadequate. This may be nurtured through building research institutes on university campus on one-hand and having exclusive research universities on the other.

An important aspect that is less appreciated is that if one were to depict the number of students in the country enrolled from high school to university to highest doctoral degree, the picture would look rhomboidal. It should look like pyramid, with the top at Ph.D. being more selective and highly competitive. The people at the top of the pyramid should be both capable of questioning and challenging an established system on concrete basis. For achieving this, teachers should be trained to encourage a questioning mind. Teachers need to be confident about their knowledge base and understanding of science to stimulate enquiring minds. Frequent short courses and workshop for continuous up-gradation of the teachers' knowledge base is the need of the day.

-Tap the knowledge base of successful professors, technocrats and technically qualified bureaucrats. Select about 100,000 such people who have retired from their services, honour them as National Teachers. Let them choose or let the schools choose one or two such teachers. These teachers would visit the school three hours per week and transmit the excitement of their field of interest through discussion with the student of 9th and 11th standards, who are not in the immediate race for high percentage scoring. They may identify bright talents, as they are not taxed with the time bound coverage of syllabus or the examination burden. These teachers could play a role model to the students

in various schools and inculcate their knowledge in these youngsters.

-Innovation is not linked to education level, as the National Innovation Foundation has already revealed this starting fact. More such programmes need to be initiated to churn these talents.

Higher Funding for Education

-The education sector needs increased outlay in our budget and in the next five-year plan. This would go a long way to strengthen the infrastructure and provide higher salary to recruit quality teachers in schools, colleges and universities that receive federal funds. As the situation in state government-funded institutions is not healthy, legislation may be introduced that guarantees minimum outlay for education in all our forthcoming state budgets as well.

Role for Women in Scientific Excellence

-A very high priority should be accorded to the participation of women in the search for excellence in science. Only 50% of the female scientific strength of this country is currently tapped while an equal strength wait at the wings. It is seen that girls often out number boys, especially in biosciences, at the university level. A large number of girls reach the Ph.D. level. They lose out in awards and fellowships that are the measures of achievements. The age limit set for many a reward, fellowship and employment, need relaxation where women are concerned because family building, child bearing, and child rearing bring in a time lag in their career. The age limit at present results in under utilization of the trained scientific strength of the country.

Nutrition Security

-The concept of tackling deficiency through iodized salt needs to be applied in tackling malnutrition through iron fortification and protein fortification in agro-produce.

- Develop seeds with high yield capability under dearth of water and land.

- Develop crops with characters like drought and salinity resistance, fungal and viral resistance.

- Develop organic farming and food processing methods. Refine packaging storage and marketing methods. In addition crops with improved nutritional quality need developing. This will add to the nation's competitive advantage, in the short and long terms.

Science and Economic Development

The transition of products and processes from laboratory to the people requires a close co-operation of the academia and the industries. This is an essential component to reap the fruit of biotechnology and genomics. Funding agencies like the DBT, DST, ICMR, IARI and DRDO have been extensively funding research programmes. However, in this context a concerted and coordinated effort by the funding agencies with a clear roadmap is required. If the funding agencies shed the partitioning and credit-sharing race among themselves, they would be doing a great help for the scientific and technological development of the country.

The Health Sector and Biotechnology

-Develop drug in the form of vaccines, medicines and develop diagnostics to provide cost effective drug therapy to the one billion Indian as well as to compete in the world market through export.

-Launch an integrated national stem cell research programme.

-There is a need to increase health awareness among people, about infectious diseases and the importance of following the prescribed medication course, so as to reduce the problem of drug resistant strains. The media and press need to partner with healthcare services.

Plant Genome Research

-Genomic Biology Research on plants needs to be taken up on a large magnitude. Understanding plant traits in terms of specific genes and functions will be a pre-requisite for directed crop improvement.

-Genomic Biology strengthened plant breeding is essential for ensuring national food security in years to come.

Energy

-The power requirement in 2020 is expected to be thrice of the existing 100,000MW generation of power. While hydroelectric power and nuclear power if developed in a planned manner will meet a significant portion of the requirement, there is a strong case for working towards harvesting energy from space slmost 24 hours a day through out the year. That will enable sufficient power production to meet projected total requirement.

Water Management

-Find methods of redistributing water, recycling water, preventing wastage of water and rainwater harvesting in a cost effective manner while maintaining the ecological balance and biodiversity.

-Develop enconomically viable large-scale desalination plants.

Information and Communication Technology

-Develop localized Indian operating systems that seamlessly apply across general-purpose environments.

-Develop real time applications, embedded systems including smart cards, microwave ovens, washing machines, camera, cell phones to small form factor palms and PDAs.

-Develop application software for drug design, computation chemistry and physics, structural mechanics.

-Design and deploy educational courseware.

-Design and develop application server framework for middle tier business applications.

-Develop information security products based on indigenous knowledge and languages.

-Connect every college and school to Digital Library of India and to the outside world.

Space Science

-Aggressively market the proven launch systems and satellites.

-Make hypersonic reusable launch vehicle a reality within a decade.

S & T ACROSS THE WORLD

A NEW BUILDING MATERIAL

Marble slurry is generated as a byproduct during cutting of marble in Rajasthan, the state which is famous for its marble deposits. Waste is about 20% of material handled. Waste powder flows along with the water as marble slurry which leads to serious environmental degradation due to dust and contamination of ground water. Technology Information, Forecasting & Assessment Council (TIFAC), a DST division, has explored different ways to get rid of marble dust pollution. In this direction tiles made or marble dust (90%) and resins (10%) were developed by RRL, Bhopal and Macro Molecular Research Centre at University of Jabalpur. Tiles were also made from marbel dust using centre as binder. These tiles are reported to be having excellent strength properties. Specific potential product uses are marble slurry polymer composite development by RRL, Bhopal, resin bound tiles developed by Macro Molecular Research Centre, Jabalpur, road making by Central Road Research Institute, bricks by Central Building Research Institute, Roorkee, cement making by National Council for cement and Building Materials, Ballabgarh, and fired tiles developed by Central Glass and Ceramic Research Institute, Ahmedabad, However, there is need to upscale the technology and populatise these products by establishing their commercial viability.

(At News, June 2004)

GM AND NON GM CROPS

Co-existence is a devolved matter and the authorities in Wales, Scotland and Northern Ireland are responsible for developing their own policies to apply in their areas. They are reportedly working closely with Department for Environment, Food and Rural Affairs (Defra). Defra is planning consultation with inerested parties in GM crops on a range of issues surrounding co-existence and liability. These include :

(i) A proposal that farmers growing GM crops should comply with a code of practice on co-existence which has statutory backing, with the aim of ensuring that unwanted GM presence in non-GM crops is within the 0.9% labelling threshold adopted by the EU ;

(ii) Whether a threshold below 0.9% should apply in relation to organic production ;

(iii) Options for providing compensation to non-GM farmers who suffer financially because a GM presence exceeds the statutory threshold; and

(iv) The provision of guidance to farmers interested in establishing voluntary GM-free zones.

Co-existence consultation papers are expected to be published towards the year end.

(Defra, Aug 3, 2004)

BIG SHUTTLE REPAIRS

Flying foam debris from Columbia vehicles on launch in February 2003 punched a 15-25 cm opening in the shuttle's left wing, resulting in a catastrophic heating of the airframe on its

return to Earth. According to US space agency, no method of repair tested so far could withstand the 1600ºC temperature of re-entry. NASA's answer obviously lies in stopping debris damage occurring at lift-off. To that end of space shuttle fuel tanks have been redesigned. The agency believes they should no longer shed chunks of insulating foam of the size that fatally damaged Columbia. So far, NASA has complied with 5 of the 15 return-to-flight requirements set out by Columbia Accident Investigation Board (CAIB). Also future shuttles will fly with many more cameras trained on them. They will also lift off, certainly at first, in daylight. The astronauts will have the ability to repair very small cracks but anything on the scale of the Columbia gash would require them to seek sanctuary in the space station until a relief shuttle could be organized to bring them back to Earth.

(BBC News, Aug 29, 2004)

UNIQUE FLUTTER EXCITER

CSIR Defence Technology (CSIR Defencetek) has develped a novel flutter exciter to excite aircraft during flutter flight testing. Flutter is a self-sustaining oscillation that can lead to structural failure and the loss of an aircraft, and should be avoided at all cost. Flutter flight testing is aimed at demonstrating that the aircraft flight envelope is flutter free. Response measurements from deliberate excitation of the structure are used to identify and track frequency and damping values against velocity, and to identity flutter conditions without actually encountering flutter.

The flutter exciter is installed into or onto the external store, thus requiring no structural modifications to the aircraft. It has a mass of 7.5 kg, diameter of 127 mm and is 460 mm long, which makes it easy to install in a variety of external stores. The flutter exciter is pre-programmed to execute a frequency sweep and generates an oscillating rectilinear force using contra-rotating, aerodynamically unbalanced impellers. The device is driven by the air flow and the power requirement is minimal.

Defencetek provides a complete flutter prediction and aeroelastic analysis service, including ground vibration testing, finite element modelling-based structural dynamic analysis, flutter calculations and support of flutter flight tests through near real-time data analysis.

(CSIR South Africa, Aug 30, 2004)

STEM CELLS TO CURE BALDNESS

Dr George Cotsarelis and his co-researchers at the University of Pennsylvania, Philadelphia, the United States, have shown that bald mice could grow hair after being implanted with a type of stem cell. The study could lead to a cure for baldness. The project marked the first time that "blank slate" stem cells were able to induce hair growth. These cells had the ability to generate hair when taken from one animal and put into another.

The study suggested that the existing stem cells could be isolated using isolated process and reimplant them in the areas where people were bald. The study confirmed that hair follicles contained "blank slate" stem cells that gave most humans a full head of hair for life. Although they were called stem cells, they differed from embryonic stem cells. The biologists studying

regenerative qualities of hair, however, cautioned that a baldness cure was still years away.

(VATIS–Biotechnology, May-Jun 2004)

NEWS OSTEOARTHRITIS TREATMENT

A team of researchers in Bangalore has claimed to have developed a revolutionary non-invasive method for treating osteoarthritis and cancer. The technique known as Rotational Field Quantum Magnetic Resource (RFQMR) generator, said to be the first int he world, has been developed by the team from the Institute of Aerospace Medicine, IAF, and the Centre for Advanced Research and Development (CARD) after seven years of research. Using the technique, 36 patients with severe osteoarthritis were treated successfully enabling them to walk normally and climb stairs without help and pain. Similarly, and end-stage lung cancer patient was also subjected to the treatment and the results were miraculous.

RFQMR is a new machine for which an international patient is pending. RFQMR is reported to be working on the principle of alternating cell membrane potential and jamming the command and control of the target tissue cells, by altering the proton spin inside and outside the cells. The researchers are now initiating a two-year project to assess the efficacy of RFQMR, a highly specialised modality of treatment, in cancer with 40 patients. It is further claimed that the treatmen tusing the technique is not very expensive.

(PTI Science Service, July 16-31, 2004)

ANSWERS TO DO YOU KNOW?

A1. Sheep (named Dolly)

A2. 30 percent.

A3. Mongolia

A4. Thermal power plants, by far.

A5. 30,000 yr. or there about.

A6. Amla.

A7. (b) it is a happy coincidence.

LIBRARY SERVICE

The Indian Science Congress Association

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

The library of the Indian Science Congress Association subscribes the following Indian and Foreign journals. List of these journals are given below :

India

Current Science
Down to Earth
Food & Nutrition World
Indian Journal of Experimental Biology
Indian Journal of Biochemistry and Biophysics
Indian Journal of Marine Sciences
Pramana
PTI Science Service
Science Reporter

Foreign

Ambio
American Scientist
Endeavour
Interdisciplinary Science Reviews
International Studies in the Philosophy of Science
Journal of Environmental Planning and Management
Nature
Natural History
New Scientists
Policy Studies
Science
Science & Society
Social Choice and Welfare
Technology Analysis & Strategic Management
Tropical Science

In addition to those subscribed above, the following journals/newsletters are also received by the Library in exchange of the Association's journal "Everyman's Science" :

Chemecology
CSIR News
DRDO News
Environmental Awareness
Environmental Health Perspectives
Gana Darpan
Gyan Bigyan
IASSI News
INSA News
ICSSR Newsletter
Indian Journal of Physics
Indian Spices
JIMA
Journal of Forensic Sciences
Natural History (Bombay)
S & T Post
Science & Culture
Spices India
University News
WMO Bulletin
WISTA

The Library is open to all category of members of the Association as well as school, college and university teachers on all weekdays (except Saturday, Sunday and holidays) from 10.00 a.m. to 5.30 p.m.