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EDITORIAL

Biodiversity is an oft-discussed topic today. The scientific world is seriously debating issues like increasing risks leading to shrinking of biodiversity, conservation of natural biodiversity for posterity and harnessing the various streams of rich/enriched biodiversity to provide the basic biotic resource so essential for sustenance of the human race.

A number of basic issues continue to remain puzzling. On the one hand, it is claimed that depletion of biodiversity is essentially due to cruel and selfishly motivated human interference and, on the other, the human race depends one way or the other upon great many diverse forms of plant and animal species for its existence. Again, considered from the angle of organic evolution, life forms (species/genera) make their appearance in the nature of various ecosystems and ecological complexes. It is equally true that a good many of those ancient life forms became extinct with the passage of time, also as a result of onward march of evolution. Even today, while we are witnessing alarming increase in the list of endangered species, we also learn about new species of plants and particularly of animals being discovered in one or the other corner of the globe. Further, viewed in the context of burgeoning human population, ever increasing emphasis on structuring of modernistic human habitats having all the ingredients of various hues of consumeristic society, natural ecology-sustaining land and water areas are getting increasingly reduced or disturbed to accommodate the demands for housing, industrialization and urbanization. These very land and water areas were once home to richly diverse flora and fauna whether cultivated or wild, original or migrated, primitive or progressive.

Indian agricultural scenario itself is a grim reminder of the extent of depravation that good many major crops like rice have undergone in terms of land races and traditional old varieties. This genetic diversity (i.e. biodiversity) is fast vanishing, giving way to newer and fewer high yielding varieties.

Indiscriminate deforestation for fuel and human settlement purposes has caused severe erosion of various biological forms whether from plant or animal kingdom. A similar stark reality is witnessed in the case of aquatic and marine flora and fauna whether higher or lower order plants, planktons, fish species, sharks, whales or others. Other ecosystems and ecological complexes, for example, desert or mangrove ecosystem, present almost the same picture.

A number of other important issues are also being taken into consideration while expressing concern for biodiversity. Despite all pressure on biodiversity for human sustenance, expansion of agriculture, industry etc., it is again true that biodiversity is an indispensable resource for our existence, for cultural diversity and for preservation of knowledge traditions built up and perpetuated for ages among various communities of mankind.

Even today, biodiversity ensures discovery and extraction of new drugs not only for use as human or animal medicines but also as biopesticides for agricultural and domestic use. Furthermore, we have now entered into the era of practical application of biotechnology, not only for developing gene related protocols to harness existing biodiversity in improvement of human,

animal and plant health, but also for arresting erosion of biodiversity and for further enrichment of biodiversity spectra.

The greater the genetic diversity among farmed crops or animals, the less will be the chances of economic loss due to insect pests or pathogens, since the diversity spectrum of such crops or animals will act as buffer. At least, their protection against pandemics can be thought of in the context of such wide spectrum of genetic diversity.

Thanks to the timely realization by the various world bodies including the United Nations, the scientists of different disciplines and their fora and the serious minded NGOs, the issue of conserving and even enriching the biodiversity, particularly of the tropical countries, is coming into focus more and more sharply. Therein lies the salvation of the human race and the guarantee to saving of diverse cultures and knowledge traditions.

Prof. S. P. Banerjee

Rudeness is the weak man's imitation of strength

—Eric Hoffer

PRESIDENTIAL ADDRESS

ANTHROPOLOGY AND INDIA

J.H. HUTTON, *C.I.E., M.A., D.SC., F.A.S.B., I.C.S.

Your Excellencies, Ladies and Gentlemen,

My first duty is the pleasant one of welcoming you here today and of thanking the Indian Science Congress for the distinction conferred on me by its invitation to preside over its activities at its twenty-second meeting. When I accepted that invitation, not I confess without some compunction, I had not foreseen that this meeting would have the honour of being opened by H.E. the Viceroy, and was likely to be of additional importance as inaugurating the constitution of a National Institute, or Academy, of Sciences for India. I need not recapitulate that part of the address of the distinguished physicist, your twenty-first President, which explained and justified the proposal for a National Academy of Sciences put before you by him a year ago. It is enough to remind you that the Indian Science Congress marked its coming of age by appointing a committee to draft proposals for the institution of a body which should perform for India some of those functions which the Royal Society discharges with regard to Science in the United Kingdom. These proposals, in accordance with your instructions, are to be laid before your General Committee and this session. The committee which you appointed through your General Committee was to be constituted of the following persons—the outgoing and incoming Presidents of this Congress, seven representatives of nine scientific societies, eight representatives of nine scientific departments of Government, the Director or other representative of the Indian Science Institution, Bangalore, one representative of the Editorial Board of *Current Science*, Bangalore, and five members representing the General Committee of your Congress. This committee was given power to coopt other members and did in fact so coopt five representatives of five scientific societies and institutions and seven distinguished scientists in their personal capacity. The societies and individuals comprising this commitee were drawn from nineteen different places in all parts of India, from the eight major provinces (exclusive of Burma) and from three of the major Indian States, while the members representing the scientific departments of Government were mainly Europeans whose duties took them to all parts of India and who are strictly representative of none. Obviously a committee so composed could rarely, if ever, meet in full, and the General Committee of the 1934 Congress must have realized that when appointing it; nevertheless the meetings held were representative of five provinces, and of the 15 members who prepared the original draft for the rules and objects of the National Society to be created, four were representatives of your association, five of various learned societies, six of

* General President, Twenty-second Indian Science Congress, held from 30th January to 5th February, 1935 at Calcutta.

scientific departments of Government. Further, this committee had at its disposal the materials collected by the Editorial Board of *Current Science*, which had issued a questionnare to obtain the opinions of Indian Scientists of the formation of the proposed Academy, and the majority of the scientists who expressed their views on the subject approved "of the idea of seeking State aid to start an entirely new organization which would be run more or less along the lines of the Royal Society of London, the details of the constitution, as also the process of initiation of the Academy, to be decided by a committee to be appointed for the purpose". Such a committee you had appointed with instructions to take the necessary steps to bring the Academy into existence and to draft a constitution to be submitted for the approval of your General Committee at this Congress. The nature of the institution to be thus brought into existence was broadly indicated in a resolution of your General Committee. Seven meetings of the Academy Committee were held, at the first of which it was decided to determine in advance the number of Foundation Fellows to form the Academy and then to consider its constitution, as it was clearly desirable to have the constitution of the Academy approved by those, who were to form it, before the draft was submitted to the Indian Science Congress. Arrangements were therefore made for the allotment of fellowships to the various Sciences and for the selection of the persons to fill them. It was decided that the question of the location of the Academy's headquarters must be postponed for the decision of the Foundation Fellows, and part of the set of rules drafted by Professor Meghnad Saha was also considered. Before the second meeting could take place, however, the work of the Academy Committee, as revealed in the copy of the minutes sent to absent members, was adversely criticized by Sir C.V. Raman, himself one of those members, in a presidential address to a conference of South Indian scientists at Bangalore. This was followed by his taking the unexpected step of registering a society as the "Indian Academy of Sciences" at Bangalore, thus involving your Academy Commitee in a sort of comic imbroglio more suited to the dignities of the two Kings (or was it mayors ?) of Brentford than to those of the scientists of India. Your Academy Committee, however, went on with its work and ultimately came to an agreement with the Bangalore Academy, the terms of which involved the subsitution of the name "National Insitute of Sciences of India" for "National Academy of Sciences of India", and some minor verbal changes in the draft of the aims and objects of the proposed body. The Indian Academy of Sciences, Bangalore, has in its turn made certain necessary changes in its memorandum of association and constitution, and the present position is that the body brought into existence by the Indian Science Congress will cooperate with the three existing bodies of Academy status in different parts of India and with such other academics of sufficient status as may be formed in the future.

Your Academy Committee have carried out their work under extremely difficult circumstances, and I would recommend you to accept, if you possibly can, the recommendations put forward with the report which they are presenting to you and which contains a full account of all that is necessary to your General Committee in reaching a decision. In coming to such a decision your General Committee will no doubt have the advantage of not being composed entirely of scientists. The instiution of an Academy is not an

act that demands of itself any specialized scientific knowledge. It is true that the scientific method of approach may be of no little value in forming a judgement on any problem; at the same time we have, as scientists, to beware of valuing ourselves and one another too highly, and of supposing that because a man knows very much about one subject he is therefore the more fitted to express an opinion on others. Very often it may be the other way round, for in these days of specialization a scientist is apt to become "a man that knows more and more about less and less", so that his opinion upon subjects outside his field of special study is not necessarily of special value. Knowledge and judgement are two different things and do not by any means always go hand in hand, and there is always the possibility that a scientist's tendency to be wrapped up in his special subject may warp his attitude to outside issues of a more general nature. Scientist or layman, however, we have before us in the institution of this national scientific body the common intention that it must be fitted to pursue those purposes and ideals, which Professor Meghnad Saha so ably put before you last year, for the conquest of error, for the advancement of Science and for the good of India.

I never realized, nor came near to realization of the vast field that there is in India for the organized efforts of Science until the Census of 1931 put me into a position in which I could hardly overlook it. The first essentials of Sociology and accurate statistics, and most of the few statistics available in India are obtained by crude methods and give results which are insufficiently exact. We know for instance that the population has increased but we can only guess at the causes; we cannot in India as a whole be certain of where or when the increase took place beyond locating it over a period of 10 years. In Madras alone was the registration of births and deaths sufficiently accurate for the population of 1931 to be determined approximately before the couning took place, and even then we cannot be sure that the accuracy was not an accident. How far the variation of fecundity in different parts of India is due to environment, heredity or social customs we have no means of knowing since detailed local studies are wanting. Mr. Porter in Bengal has embodied in his Census Report for that province an interesting speculation on the future growth of the population of Bengal; but the figures on which it is based being limited to seven enumerations are not enough to warrant our taking it as more than a speculation. Even so it leads us at once to the urgent need of a greater application of Science to matters of rural economy. It is probably true enough that improved methods of agriculture can so increase production that the population of this country is not in immediate danger of outstripping its potential food supply. But I say potential advisedly. It is very clear that in other respects the position is serious. The vast majority of India's population live an agricultural life not only by force of circumstances but by deliberate preference, and under their existing conditions of ignorance and of absence of capital, the population attempting to live by agriculture is likely to become, if it has not already done so, much too numerous for the land to support. The subdivision of holdings which are insufficient to maintain their owners, must tend to reduce the economic output from their land while the increase of cultivators and in particular of landless agricultural laborers calls for an increasingly high return from the land. In limited areas, and to a limited extent, some relief is afforded by seasonal industries (such as cotton in Central India) which enable the agriculural population add to the income

derived from land; in other areas cottage industries give similar assistance, but the extent of these reliefs is entirely inadequate to the need, and there is an obvious call for a great extension of part-time industries in which the cultivator can find employment when he is not required on his fields. To give one instance, it is probable, if not certain, that the application of scientific methods of breeding, feeding and selection could double the outturn of silk in India without any increase in the number of cocoons, and could at the same time enormously improve that quality of the silk. Indeed, for at least one Assam tribe the silkworm provides not only clothing but an article of food, as the pupa is much relished and reserved as a delicacy for favoured guests. But without seeking to popularize this use of the silkworm, the extension of silk producing, on scientifically improved methods as a cottage industry might make India easily the premier silk-producing country in the world.

Further, although at present there may actually be enough food in quantity to prevent the great majority of cultivators from going hungry, it is becoming increasingly apparent that their diet is very often extremely badly arranged. A very great deal of the disease in India is deficiency disease due more to a badly chosen diet than to actual scarcity of foodstuffs. This point is well-bought out, for instance, in Mr. Yeatts' Census Report on Madras where he emphasizes the researches of Sir R. McCarrison on the causes of blindness in India, indicating that the widespread prevalence of keratomalachia is due to a diet deficient in fat-soluble vitamins. It is likely also that leprosy, to take another instance, is encouraged by deficiency diets. Sir John Megaw again, in his paper on *Population and Health in India*, tells us that in India, although three meals daily is more common than two, "malnutrition due to unsuitable diet is the rule rather than the exception". Here then is one practical task for doctors and health officers : that of prescribing a suitable diet within the means of the very poor conformable to the local products available in the neighbourhood. An example of what can be done in this way may be seen in Mr. Mukherjee's report on the Census of Baroda, 1931, where Dr. F.P. Antia and Mr. F.S. Kale give a food survey of the principal castes in the State. I would at this point put in a word of warning against those enthusiasts for reform and improvement whose zeal is greater than their knowledge. It is perhaps partly because the results of intemperance are so obvious and easily appreciated that the advocates of temperance are apt to be fanatic extremists, though I have known some who tempted one at times to recall Samuel Butler's caustic comment on the Puritans who "compound for sins they are inclined to by damning those they have no mind to". My point is that home-brewed beers form a very important element in the diet of the more primitive tribes and castes of this country. Not only does the very moderate amount of alcohol in these brews supply for certain purposes the want of sugar, which in many of their environments they cannot obtain, but the recent researches of Col. Chopra on vitamins have shown that the home-brewed beers of India contain many very valuable vitamins, and there is consequently a serious danger that propaganda or legislation directed to the suppression of the use of these liquids may result in the spread of deficiency diseases, and add one more tally to the lamentable tale of damage done by well-meaning but ill-informed tampering with customs that are disapproved by the reformer but are in fact useful adaptions of environment on the part of the ones to be reformed.

Unfortunately however it is not only rural economy which calls for the aid of the scientists, the rural call is it true, the more urgent, not only because there are more than eight countrymen for every single townsman in India, but because the rural population is infinitely the more conservative; it is therefore in much greater need of that "new outlook on life", the necessity of which is admirably emphasized by Sir John Megaw, in the paper which I have already cited, with a telling quotation from the concluding chapter of the Report of the Royal Commission on Agriculture. Such a new outlook is easier for the townsman to acquire, for in exchanging a rural for an urban life he comes into daily contact with new ideas and new ways of living. Unfortunately these ways of living are in some respects no improvement on the old. The Indian village, at any rate in northern, western, central and parts of southern India, often on a constricted site which cannot be expanded on account of the need of land for agriculture, is apt, to be congested to a highly insanitary degree; but in towns this condition is often incredibly accentuated, and while 26% Bombay's 1,161380 inhabitants live under conditions of the grossest overcrowding, 74% of that population live in one-roomed tenements at more than 4 persons per room. Buildings of one story predominate in India towns, which makes the figures of congestion, when the population for a given area is compared with congested population in Great Britain, appear lower than they really are, but where, as in Cawnpore, tenement buildings are used, the congestion is almost incredible. One chak of the Anwarganj ward to Cawnpore contains a density of 786,560 persons to the square mile, a figure untouched by the worst of the metropolitan boroughs of London. Obviously there is a need for scientific planning in the outlay and growth of all developing urban areas if a repetition of this sort of scandal is to be avoided. It was a matter of considerable surprise to me to find that in many parts of India the existence of a town with a large and concentrated population was regarded as an occasion for pride and complacency. A large town appears much rather to me as a source of fear and repulsion. It is true that the work of such men as Sir Raymond Unwin have shown that there is no need for this, but nevertheless such parts of India as Assam, Malabar, and Eastern Bengal, where any close concentration of population is the exception, appear to be the more fortunate for that, and India has a wonderful opportunity of profiting by the experience of Britain and avoiding, by careful and scientific planning while her industries are still in their infancy, any further concentration of industrial population in congested areas.

I have referred to these points of rural economy, of diet and of town planning merely as instances of matters in which Science may and should be utilized and directed for the benefit of the community; there must be many more which will no doubt be discussed by the various sections of this Congress, much more fruitfully than by me. There are however, certain aspects of my own special subject to which I propose now to direct your attention. India offers a vast field to anthropologists and opportunities such as exist nowhere else in the world, forming as she does a veritable museum of living physical types, of social organizations, cultures and religious beliefs. From the point of view of physical anthropology there is a vast amount of work to be done. India contains, in forms that are anatomically distinguishable, elements derived direct from the negrito races which constitute probably the oldest type of human being anywhere surviving. These elements are no doubt few and

rare, limited to the Andamanese, rapidly alas becoming extinct, and to one or two of the remoter jungle tribes of the south of India. Similarly there are to be found survivals of that other eastern negroid race, the Melanesian. These survivals are more easily to be traced in culture than in anatomy, and it is not unlikely that the typical appearance of the Melanesian race itself is the result of hybridization. Nevertheless evidence is to be found of affinity in physique between some of the Assam hill tribes and the races of Papua and New Guinea, and it is pobable that such affinities occur again in some other parts of India. On the other hand, the physical type which Col. Sewell has conveniently labelled Proto-Ausraloid is widespread in India and Burma. This race possibly represents an early branch of the brown race of the south-east Mediterranean which migrated eastwards at a very early date and has been modified by environment to produce a markedly different type. On the other hand, it may be connected with some of the recent finds in Palestine, which Sir Arthur Keith appears to regard as related to surviving types of man. These views are not necessarily mutually exclusive. This race is represented most strongly in the lower castes and in some of the aboriginal tribes particularly of southern India. These races have been followed by others whose order of coming is more difficult to determine. One race of invaders, probably likewise moving from north-west to south-east, must have brought in the Mon and Munda language and possibly the keeping of sheep. Like their predecessors they seem to have formed definite connections overseas and to have moved on from India to Indonesia as the succeeding races did afterwards. It was perhaps after their coming that the Paroeean or Mongoloid races began to come down from the north-east, particularly in eastern India and Burma, but whether they ever penetrated far into India except at a much later date is doubtful. There is a suggestion of the Mongoloid about many tribes, in the Madras Agency Tracts, for instance, but it is not clear that this element did not come in from the east by sea together with the returning wave of speakers of Mon languages which certainly came back from the east westwards into Assam. In 1930 Mr. J.P. Mills and myself published in the Journal of the Asiatic Society of Bengal an account of some stone funerary urns found in the North Cachar Hills, which were then, as far as we could ascertain, unique. Since that date groups of very similar urns, used for an obviously identical purpose, have been discovered by Mdlle. Colani of the Ecole Franfaise d'Extrême-Orient in Tonkin in Indo-China, so that the Khasi-Synteng group in Assam can now be connected with the Far Fast culturally as well as linguistically.

And here is a point at which the geologists can help us. I have suggested elsewhere that a wave of immigration into India from east or south was caused by the subsidence of the mass of the Indian Archipelago. There are tradition among the hill tribes of Assam. Burma, Easern India and the islands themselves which seem to me to point to a great volcanic cataclysm and a submergence of land under the sea which drove them to escape into the hills and ultimately to migrate; Messrs. Peake and Fleure, in that admirable series *The Corridors of Time*, have pointed out that if the coastline of the Indian Archipelago be extended to the hundred fathom line a great land mass appears which very nearly joins the Asiatic continent to Australia, and that some such reconstruction is necessary to account for the early occupation by man of the Australian continent; Molengraaff and Weber in

their work on the Zoology of Indonesia have pointed out that the distribution of the species of freshwater fish in the islands suggests land continuity up to a comparatively recent date. The suggestion I made of the migration of certain tribes as the result of a volcanic upheaval and submergence met with quite definite disapproval at the hands of the geographers to whom I propounded it last year in London, but since then I notice that Corbett and Pendlebury in their work on the butterflies of the Malay Peninsular have been led independently to a precisely similar conclusion to that reached by Molengraaff and Weber when working on the fish; I think I am justified therefore in stirring up the geologists to re-examine the possibility of the subsidence of Indonesia after its occupation by man, and at what is, geologically speaking, a recent date.

Whatever the provenance of the Mongoloid element in India, however, its physical influence appears to have been very small, and the mean bulk of India's population would appear to be of Mediterranean origin, and it is possible to show much evidence for a continuity at a very ancient date of both race and culture from south-eastern Europe through Asia Minor, Syria, Mesopotamia and Iran to India. Into this population brachycephalic elements have entered probably coming both in the form of an admixture with the civilized Mediterranean and also in the form of a definite brachycephalic migration which has affected certain areas in India, of which Bengal is one, very much more strongly than others. It is possible that this latter brachycephalic element brought in the Pisacha or Dardic branch of the Aryan language, a purer form of which followed with the dolichocephalic Aryan invasion of about 1500 B.C. This difficult question I have discussed at greater length elsewhere, and I do not pretend to regard the position advanced as conclusively proved and estabished. What I do urge is that the question of race in India is one which calls for very careful and detailed examination by trained anthropologists on the lines recently adopted by Dr. Guha of the Zoological Survey and those workers who have been assisting him. The method of working by the coefficient of racial likeness is laborious and involves an amount of mathematical calculation which is more laborious even than the taking of the measurements, but results of permanent value cannot be obtained without the initial labour, and this should be extended to all parts of India and to every tribe and caste. It should also be supplemented by a corresponding analysis of the blood groups of such castes, since it is possible, if not probable, that these may give no less important indications of relationship than anthropometrical measurements. You have in India in the caste system a most valuable opening for approach which is denied to other countries where racial mixtures have gone on in a far more promiscuous way than they have in India. I do not suggest of course that caste is any necessary criterion of race. I fell certain that it is not, but it has divided up the population into endogamous groups which must have very greatly retarded and restricted the extent of miscegenation, and investigation is urgently called for before that system begins to break-down under modern conditions. Meanwhile that same system afford opportunities for the study of human genetics not found elsewhere; it also opens up an approach to the study of the effects of environment on physique, since if castes which can be shown to have had a common origin and to have kept their strain pure, but which are now domiciled in different parts of

the peninsula, are found to differ physically, the differences may be examined to see how far they can be traced to climatic or to other environmental causes.

In prehistoric Archæology there are any number of sites awaiting excavation, and it seems highly probable from finds that have been made in Bihar that the Mohenjodaro civilization not only to the Indus valley but to the valleys of the Jamuna and the Ganges as well. We do not yet know the meaning of the ideographs used by the people of the Mohenjodaro civilization, nor what was the language used. It seems likely that it was a Dravidian tongue, but it might conceivably have been a Munda one. A mere reference of Munda is enough to remind one that our serious lack of knowledge of the distribution of this language shows how great is the necessity of linguistic research in southern India. Sir George Grierson's great work on the languages of India did not include the province of Madras, and we have no knowledge whatsoever of whether any trace of the Munda or Mon linguistic family exists south of the Godavari river or not. I suspect myself that such traces will be found in the uplands of Mysore, but that is a pure guess. An extension of the linguistic survey to the whole of south India is urgently needed; meanwhile we cannot tell whether the Munda speakers ever penetrated to the south or not, nor what traces, if any, survive of any of the languages that must have preceded Dravidian there. But we ought not to be content with mere linguistics. There is a branch of research in which so far as I know very little indeed has been done in India, but which if taken up comparatively is likely to lead to valuable results. I refer to the symbolism of dreams. Such work as has been done on this subject in Europe tends to show that the symbols of dreams are of universal application. Thus to dream of the loss of a tooth foretells the death of a relative in all parts of the world; most often, but not necessarily, it refers to a maternal relative, which is perhaps in itself significant. Now Freud makes a suggestion that the dream symbols used by the "subconscious" to avoid the censorship of the "ego" may be the survival of a symbolic language in use by the human race before any language, as we understand the word, developed. It seems not unlikely that when primaeval man got beyond the stage of chattering, squealing, and grunting in different tones of voice, he communicated by means of a very limited vocabulary in which one word or symbol had to serve all sorts of different meanings connected only by some real or supposititous similarity in the objects named. The suggestion is an interesting one, and I would recommend a comparative research into the dream symbols of various castes and tribes as one which might throw some light on the preexistence or otherwise of such a symbolic proto-language, and which would at any rate test the claim which has been made that dream symbols are of universal application. It has to be borne in mind of course that conventional interpretations of dream symbols may bave been communicated, at a much later stage in human evolution, from one people to another in the manner in which folktales have spread all over the world, and that the diffusion or universality of conventional interpretations of dreams, is not necessarily relevant to the hypothesis put forward by Freud, in which the symbol is used by the subconscious self in cases in which the ego disapproves and suppresses the use of a more easily recognized vehicle of expression. Here the interpretation is not available until supplied by psychologists.

In the study of folklore proper only a beginning has been made in India, and a vast deal of material is disappearing very rapidly under the influence of missions and of the general change in the manner of living which is being brought about by the opening up of communications generally. Dr. Bake, a Netherlander, has recently been working at Indian folk-music and has shown as what *can* be done by a enthusiast, while Bengal has set an example to other provinces in a revival of folk-dancing.

Turning to religion we find in India beliefs and practices which seem to have survived from a very early date in human history like flies preserved in lumps of Baltic amber.

Thus traces are easily found, not only in tribal beliefs, in which the principle is sometimes specifically formulated, but in folk religion as distinct from orthodox dogma, all over India of a belief that life is a finite and material substance. It is this belief in the transferability of life, so to speak, that underlies the practices of head-hunting and human sacrifice, though in the case of the later the ideas of propitiation and expiation have doubtless entered later at a sophisticated stage when the original idea which gave rise to it had begun to fade. It also underlies many funeral practices in this country which are arranged with a view to the transference of the life-matter to the crops, whereby it is again consumed by human beings and used for the propagation of fresh individuals by the begetting of offspring. Elsewhere I have pointed out that the same idea appears to be the basis of the practice of temple prostitution. Now I suggest that this idea of life as a material substance arose very early in human pre-history. Primitive people to this day have great difficulty in expressing anything but a concrete idea; primitive languages are apt to contain no words for abstract ideas. Clearly the inference is that at a primitive stage of thought only concrete things can be conceived of, and the first man who reflected upon the difference between a dying body and a dead one conceived of that which had left the body as some material substance which had leaked out of it, which is very much how the Karen states the case at this day. This view of the nature of life is not only common throughout India in tribal religions but may be traced in Hindu philosophy. The Vedanta conception of the soul with its successive sheaths is probably one instance, and a more concrete one is to be found in Manu's condemnation of the Teli and his relegation of him to an out-caste position on the ground that he is a destroyer of life by crushing the oilseed for the extraction of oil; hence the distinction in Bengal between the Teli who cushed the seed, and are therefore outside the pale, and the Tili who merely traded in it without having committed the sin of destroying life. Another instance of the way primæval things survive in India is perhaps to be found in the common prejudices in regard to red ochre. When arranging for the numbering of houses in the 1931 census I found that red ochre was a desirable pigment to recommend because almost all over India the use of red ochre is regarded as fortunate, and while people are likely to object to numbers tarred or painted on their houses, the affixing of numbers in red ochre was regarded as more lucky than unsightly. I do not know the cause of this, and I do not know that anyone knows why this superstition attaches to red ochre, but it struck me at once that it might well be a survival of some belief that was obviously at work in the old stone age. It is clear from many prehistoric finds that palæolithic man treated the bones of the dead with red ochre and

the find at Offnet of a large number of heads so treated without the appropriate skeletons suggests that the use of ochre may have at one time been associated with the practice of head-hunting or with that of a separate disposal of the head in burial, a practice still popular in parts of the hills of Assam, where it was once more prevalent than it is now, in parts of Burma, of Indonesia and of Melanesia.

I have said enough to indicate I think the enormous field there is in India for anthropological research. What is most wanted at present is the organized collection of facts, of facts, that is, uncoloured by any preconceived ideas. Facts once collected and put on record can be interpreted at any time, while premature interpretation is too apt to predetermine the actual facts collected, and all the time precious material is disppearing at a rapidly increasing rate. The tremendous change which motor transport has introduced into India has only just begun to be felt, but the general improvement in means of communication is indicated by a rise in 1931 in the figures of every form of road transport except those of palki-bearers, who show a not very remarkable decrease, and a rise in the figures of persons employed in the construction of means of road transport, and a corresponding rise of over 300% in the figures of owners, managers and employees connected with mechanically driven vehicles. This change is having an incalculable effect on country districts, and you must expect to find that an incredible quantity of traditional belief and custom will disappear in a generation. Change has been fast enough in Britain. I can remember as a child taking part in more than one Easter egg-rolling. and you may search very far before you can see one there now-a-days, and I can remember watching the performance of what must have been one of the very last bands of the old folk sword-dancers before the artificial revival of folk-dancing; but in this country I have seen whole village entirely abandon their ancient customs in the course of a few years, and there are no written records by which the rising generation of such villages can have any knowledge at all of the practices of their own fathers. It is therefore to the collection of the existing material of folk tradition before it is lost that this generation of Indian ethnographers is called, and I would further urge that intensive work on a limited area is far more valuable than extensive work which necessarily involves generalization. That can always be done later. Local diffrences are often very great and the minor differences found from district to district may be of great significance. Different areas with different environments need different treatment, and it seems to me that we suffer much too much already in India from too much centralization, and too much generalization in every form of activity.

The question is likely to be asked what, if any, is practical value of a study of Anthropology. I offer no categorical answer to that question, but I do offer a few instances in which its practical value is sufficiently obvious. Thus in Africa the substitution of Indirect Rule for the older system of direction administration is the immediate result of applied anthropology. Indirect Rule is an educative system and its objective is to evolve by a natural process an indigenous system of administration which shall conform to civilized standards without jettisoning what is good and environmentaly suitable in the native systems which Direct Rule must completely obliterate. To quote the Report of the Kenya Land Commission—"The

principle is that it is better to take the native customs as they stand and build from them as a basis, that to rely upon some novel but imported pattern which would not be understood—" Such a principle involves of course not only the knowledge of what is but of what has been; the knowledge of the origin and *raison d'etre* of customs and belief, since no complete understanding of these is possible without the knowledge of how and why they came into existence and developed as they did. The experiences of Africa have an important bearing on the administration of the more primitive parts of India, and it would probably be wise in our administration of tribal areas to look for light not from the east but from the dark continent. *Semper aliquid novi Africa adfert,* and although the system of Indirect Rule has lately incurred much criticism and may in some cases have been carried too far, we have had only too little of it in India. Anthropologists have been accused, incidentaly by Mr. Jayaker, of wishing to create for their own edification living museums of people whose sophistication is retarded to their disadvantage. In point of fact this criticism is most unjust. What the anthropologist does seek to do is to apply his acquired knowledge and experience so to modify contracts between primitive and advanced cultures that the former may not be, as they so often have been ruthlessly extirpated by the latter, a process invariably accompanied by the decimation, if not annihilation, of the races whose culture is destroyed.

At the same time the answer to any question as to the practical value of anthropology must obviously depend to some extent of the circumstances under which the question is asked, and in the case of this country I would suggest that, apart from any administrative question, Anthropology may be able to provide a solution to certain problems of very great importance to the people of India. India shows a marked contrast to Europe in that the number of males exceeds the number of females; various explanations have been sought in differences of climate, differences of race, or differences of social custom, but no one has yet studied the subject so thoroughly as to be able to offer us any convincing explanation of the phenomenon. Again, it is for the anthropologist to consider and determine not only its causes but what will be its results. It is both, contended and disputed that in-breeding leads to an excess of masculinity. If that be true (and there are wighty opinions on that side) then the caste system is likely to be one factor in producing this excess of males. If so, will such an excess have a good result or a bad one? In the former case caste is clearly an insitution to be cherished; in the latter case we ought to do all in our power to encourage intercaste marriage. Here is a problem for the examination of anthropologists, a research problem of very great practical importance. It is not so much for the anthropologist to say whether or not an excess of males is a bad thing, as to determine the causes and consequences of such an excess; to say whether the observance of caste is a factor therein and whether intercaste marriages end to produce a more even balance of sexes. An enquiry of his kind should not be an impossible matter in a town like Calcutta. Sir John Megaw, in a much discussed paper read last February before the East India Society, emphasized "the urgent need for the people of India to adopt a new outlook of life". Such a new outlook can, I claim, be supplied by Anthropology, which should teach us to "see life steadily and see it whole". Life is very largely

governed by custom and prejudice, and often so rigidly that these factors amount to tabus for tabu in its broader sense is no foible confined to savages but an attitude of mind which they share with the most civilized, and which is common to all religions which depend on any hierarchical organization or any schematic creed. Untouchability as observed in India is a precise instance of tabu. Tabus when they arise, may be admirable and even necessary, but like all religious dogmas tend to survive long after the necessity has declined and their moral justification has vanished, a survival which is often to the moral, social, or economic detriment of the comunity which holds then. Many instances of this might be given but it will be enough here to mention a tabu on the planting of rice in certain Naga villages. Where agricultural operations are carried out vry largely by the work of the community acting together, it is obviously necessary to control the inception of successive stages, and to maintain their control a tabu is laid upon sowing and upon transplanting before the controlling official gives the word by an inaugural ceremony. Otherwsie there would be a tendency for those whose field has completed one stage with the help of their neighbours to go on to the next instead of helping the rest of the community to achieve a similar completion first. The successive operations of the agricultural year are therefore all governed by a series of ceremonies and tabus, the inauguration of which has been fixed at the time which experience has shown to be most suitable in the environment. So strong has the respect for these inaugural tubus become, that people migrating from one area to another have frequently continued to refer to the village of their origin for the dates of the cremonies to be preformed in their new village, and have thus perpetuated an agricultural calendar which is not suited to the changed environment, and although they themselves recognize that at their new and, for instance, lower and warmer altitude an earlier sowing or transplanting would be advantageous, they prefer from religious or superstitious reasons to retain the dates suited to the village of their origin and to suffer considerable economic damage as a result. Similarly the system of *tabu* was probably essential to the authority and position of the Maori chiefs, but so strong was the prohibition on touching one that a case is on record of a chief who was rescued by a missionary on the point of suffocation from a fish-bone stuck in his throat which none of his people could remove on account of that tabu.

Now the reason why tabu, useful in origin, is carried to an extreme which is merely damaging is that it has a definitely religious sanction, and all religious sanctions tend to be not only dogmatic but extremely rigid. This rigidity is no doubt a quality necessary to their enforcement in the first instance and to the survival of their initial inconveniences. At the same time its ultimate effects is to take such injunctions as, for instance, "what God has joined let no man put asunder" and "thou shalt not commit adultery", and interpret them so stringently as to make them prohibitive of divorce or the remarriage of widows under any circumstances at all, giving us a stone for bread.

Professor Haldane has recently drawn attention to the fact that human morality is usually relative. He refers to that father of modern Science Aristotle, who, he says, "saw clearly enough that right and wrong are usually quantitative. Thus according to the amount of risk taken in a given situation, conduct is judged to be cowardly, cautious, brave or rash. There is an optimum somewhere between

two extremes just as there is an optimum temperature for a growing plant". He goes on to point out that the principle is "perfectly familiar in Science, as when a substance exhibits new properties with rising temperature, or an aggregate of many similar molecules displays characters not found in a single one." The conclusion he draws is that a human code of ethics must be plastic and capable of adjustment of changes in the economic structure of society, and a code which is rigid is a dangerous anachronism. It is however, the tendency of all hierarchical codes to aim at rigidity regardless of environment. It is just that spirit which, to use to more of Professor Haldane's illustratoins, induced British bishops in the early XIXth century to vote in the House of Lords against a bill to abolish the penalty of death for stealing by children under 16, and in this XXth century to oppose the legitimization, by the subsequent marriage of their parents, of children born out of wedlock. It is the same spirit which is abroad in India opposing changes in the marriage laws or the entry of exterior castes into temples. Because a mediæval widow must burn with her husband or live celibate till her death, her remarriage is still discountenanced; because a thousand years ago it was considered advisable to marry off a daughter before she reched puberty therefore it is a sin not to do so today. There is ample evidence that the relative proportions of the sexes at certain ages differ in India from those in Britain largely on account of the great mortality among girls who are married and caused to bear children before they are physically fit for it. Yet the Sarada Act is virtually a dead letter and the interval between its passage and its taking effect was used to perpetrate an enormous increase in infant marriages, not only among Hindus but also among Muslims and Christians. A careful investigation into the causes of death in childbirth in Madras showed that in 6% of all confinements the mother was under the age of 15, and if any one needs light on the excessive mortality among Indian girls aged between 15 and 30 he has only to turn to the Report of the Age of Consent Committee and the horried volumes of evidence attached. Clearly there is need for the new outlook referred to by Sir John Megaw, particularly in the more rural parts of India.

Another end which I believe that Anthropology can further, is that of a better understanding between nations and races. Nor do I refer merely to the very obvious need of a mutual understanding between Britons and Indians. Misunderstandings exist no less between different racial and social elements within India and are in just as much need of liquidation. It is a commonplace that to know all is to understand all, and clearly a knowledge of the characteristics and genius of an alien race as determined by their composition, their history and their environment is likely to make it easier to allow for points of difference and to appreciate by-standards that are other than our own. The increasing ease and rapidity of communication is causing the world to shrink with a speed which is very disconcerting,and unless we can learn to put up with, as neighbours, peoples and nations that were merely names to the bulk of our forefathers, we shall find it an uncomfortable place to live in. Change is proceeding at a pace that rapidly increases as it goes along, *vires acquirit eundo*, and although in India it has been extraordinarily slow in the past, it is already very much faster and may become extremely fast in the near future. The geographer Ptolemy writing nearly two thousand years ago referred to the Nagas and placed them on his maps

approximately where they are today, but though the name remains, he would no longer recognize their country as the realm of the naked, though this change has been taking place only in the last few years, and may not yet be regarded as complete. But nearly everywhere in rural India the last 20 years has witnessed a tremendous change in the standard of living and a very rapid introduction of new ideas and new practices. *Tempora mutantur et nos mutamur in illis*, "times change, and we to fit them", may still be true, but for a great many of us the change is becoming too rapid to be at all comfortable, and there is real danger that the more backward may be entirely destroyed by failure to adapt themselves to the changed environment. What the anthropologist seeks to do is to control their contacts with a more sophisticated civilization in order that they may have a reasonable chance of adapting themselves to a changed environment and escape that complete destruction by disease and vice that contact with civilization has brought to so many people of comparatively primitive economic culture. The object is not to chain the individual to his existing environment, but by giving him the opportunity to adapt himself to changes at his own rate, to enable him to control his environment by the development of his own culture. The attempt to "civilize" has generally meant an attempt to make in a hurry a perfectly good savage into an unsatisfactory or useless imitation of an inferior Bengali or an inferior European, unsuited to the surroundings in which he finds himself and able only to subsist as a parasite on society if he can be found what Nagas describe as a "sitting-eating job". It is against this process in any of its many forms that anthropologists seek to take precautions, and it may be claimed that at least in Africa they have effected something, and I am one of those who think that it is still not too late in parts of India and Burma, and that we can do no greater harm to people who have a culture of their own already adapted to their environment, than to filch it from them, before they have any means of appraising comparative values, by the substitution of another, unsuited to the environment and disguised under the insidious pretext of "uplift", when so often merely substitutes new tabus for old, while leaving the attitude of mind, the outlook on life completely untouched. The only case I know of in which the mere museum-of-exhibits policy could be justified is that of the Andamanese, who are probably so far removed from the conditions of modern life and from any qualifications for sharing it, that it is to be doubted whether adaptation is at all possible without completing the destruction of what is left of them in the process. Fifty years of contact with the penal settlement in Port Blair has already reduced their numbers from over three thousand to a mere 450. A strict isolation is probably their only chance of survival, and they really ought to be preserved from extinction if only as scientific specimens of a type of human being elsewhere long vanished from the face of the earth.

Finally, Anthropology like any other Science is worth pursuit for a sake of knowledge alone. Great advances have been made in those Sciences which give us knowledge of our environment. Geologists can tell us the composition and history of the earth and astronomers penetrate yearly further into space. Great advances have likewise been made in the Sciences such as Chemistry and Physics which give us control over material substances and physical force—but the merest beginning has been

made in those Sciences which give us knowledge of ourselves, a knowledge without which we can never hope to control the destiny of our race. The Sciences of Anthropology is the first step towards the acquisition of such knowledge. It has taken man about a million years to reach his present state of existence, and Sir James Jeans estimates that the earth will remain habitable for a million times that period again. What the human race will be like if it survive to such an aeon, is clearly beyond the imagination of man, but one thing may be taken as certain and, that is, that it will need all the knowledge it can have of its past and its present, of its nature and composition, and of the controls, if there be any, of its own development, if it is to succeed in adapting itself to the changes inevitable in so great a period of time. It is impossible to say what trifle may not lead to important discoveries, or that knowldege of no practical value to one generation may not be invaluable to the next. Meanwhile much material of great importance to anthropolosists is disappearing all too rapidly, and we must search for knowledge and for truth while there is yet time. A philosopher of old has told us that Truth is great and shall prevail. Gentlemen, that philosopher was very clearly one great optimist, but even though we may see small sign of the prevalence of Truth in our generation it is all the more our duty as scientists to do all that in us lies to make her paths straight.

DO YOU KNOW?

Q1. What is a cloche ?

Q2. What does an actuary do ?

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MICROBIAL CELLULASES FOR INDUSTRIAL APPLICATION

Ashish Vyas, Deepak Vyas and K.M. Vyas

Research on cellulases and related hydrolases is mainly confined to animal feed, food application, brewery and wine industry. The last fifty years of research witnessed progress in isolation, purifying, characterizing and elucidating the mechanism of action of cellulases from microbes. Recent use of these enzyme in textile, laundry, pulp and paper industries have given a new spurt for screening of new microbes having extremophilic, alkaliophilic and thermotolerant properties for novel industrial applications.

INTRODUCTION

Enzymes are considered to be the catalytic machinery of living systems. Mankind has harnessed the enzymes since the dawn of human civilization. Enzymes are remarkably effective catalyst, responsible for the thousands of coordinated chemical reactions involved in biological processes of living systems.

Enzymes are usually intra-cellular in nature but there are certain enzymes which are extra-cellular in nature. The major part of enzymes is produced by GRAS (Generally Recognized As Safe) status microorganisms given by Food and Drug Administration (FDA) as industrial enzymes like cellulases. Only a limited number of all known enzymes are commercially available and more than 75% of industrial enzymes are hydrolases. About fifty industrial enzymes are available and their number increases steadily. Probably the first application of cell free enzymes was the use of rennin isolated from calf stomach in cheese making. Rennin is a aspartic protease which coagulates milk protein and has been used for hundreds of years by cheese makers. Rohm in Germany produced the first commercial enzyme preparation in 1914. This trypsin enzyme, isolated from animals' degraded proteins was used in detergent. It proved to be so powerful that the original small packet size made the German housewives suspicious so that the product had to be reformulated and sold in larger packages. The real breakthrough of enzymes occurred with the introduction of microbial proteases into washing powders. The first commercial bacterial (*Bacillus* sps.) protease was marketed in 1959 and became big business. Novozymes company in Denmark started manufacturing it and major detergents manufacturers started to use it around 1965.

Presently, the enzymes are commonly used in many industrial applications and there is a great demand for stable highly active and specific enzymes. Godfrey and West[1] have in 1995, estimated that world sale of industrial enzymes would be > 1.0 billion US dollars, while world market for industrial enzymes is expected to be in the range between 1.7 to 2.0 billion dollars by the year 2005. Research on Industrial enzymes cellulases, hemicellulases and pectinases started

* Lab of Microbial Technology, Department of Botany, Dr. Hari Singh Gaur University, Sagar (M.P.) 470 003

early in 1950's in relation to enormous potential to convert lignocellulose to glucose and soluble sugar, animal feed followed by food application[2–10]. Cellulose is the most abundant and renewable biopolymer on earth. An estimated synthesis rate of cellulose is approximately 4×10^{11} tonnes/year. Cellulose has been used by man for centuries; however its enormous potential as a renewable source of energy was recognized only after cellulose degrading enzymes or cellulases have been identified. The potential use of different microbial enzymes is presented in **Table–1**.

TABLE 1 INDUSTRIAL USE OF ENZYMES

1. Amylases	Detergent industry Juice clarification
2. Cellulases	Detergent industry Juice clarification Textile washing Ensilage additives Feed additives Retting additives Production of single cell protein (SCP) in solid state fermentation (SSF)
3. Glucose oxidase (GOD)	Glucose analysis in biological sample
4. Lipases	Leather industry Dairy industry (cheese making) Modification of butter fat Detergent Industry Pharmaceutical industry
5. Proteases	Detergent industry
6. Pectinases	Juice and Pulp industry Juice clarification Enzymatic debarking Production of oligouronides
7. Xylanases	Bleaching in paper industry (clarification) Feed conversion efficiency of animal feed
8. Phytase	Animal feed application

The research on cellulase is mainly concentrated on using this enzyme in food, animal feed, textile, fuel, chemical industries, waste management, medical/pharmaceutical industry, protoplast isolation, genetic engineering[11–14] Cellulases have tremendous importance in improving the nutritional quality of fermented food for livestock's, improving the rehydrability of dried vegetables and soup mixtures, production of cello-oligosaccharides, glucose and other soluble sugars from cellulosic waste.

However, even after last 30 years of research, their application has not yet been economically feasible due to cost of these enzymes and lack of their required efficiency. The cellulase system in fungi is considered to comprise of three hydrolytic enzymes—(i) the endo (1, 4)-β D-glucanase (Synonyms : endoglucanase, endocellulase, carboxymethycellulase [EC 3.2.1.4], which cleaves β-linkages at random, commonly in the amorphous part of cellulose, (ii) the exo-(1, 4)-β D-glucanase (synonyms : cellobiohydrolase, exocellulase, microcrystalline cellulase, Avicellase [EC 3.2.1.91], which releases cellobiose from either the non-reducing or the reducing end generally from crystalline parts of cellulose ; and (iii) the β -glucosidase (synonym cellobiase [EC 3.2.1.21], which releases glucose from cellobiose and short chain of oligosaccharides[15]. Cellulase producing microbes are isolated from wide variety of decomposing substrates, manure, compost, rotting leaves, laboratory waste[16]. The research on

cellulases in early and late 90's has taken a new spurt in using these enzymes in entirely new industrial application as mentioned below in details.

CELLULASES IN DETERGENT INDUSTRY

Cellulases have been parts of detergent since early 90s. Industrial enzymes used in detergent till now mainly constituted proteases, amylases, lipases or detergent additives. Recently, Hoshino[17], Barbesrgaard[18] reported the addition of cellulases, remove cellulose microfibril, which are formed during washing and use of cotton based cloths. This can be seen as colour brightening and softening of the material. The mechanism of cellulase action as detergent is different from other detergent enzymes that act directly on soil and dirt on the cloths. Endoglucanase component of cellulolytic complex acts at the amorphous region of fabric resulting in loosening of fibrillar structure of the cotton cloths, which in turn help in the removal of soil and dirt from these regions. Schulein[19] pointed out that this mono component enzyme formulation of fungal endoglucanases is required in low quantities and does not show action over crystalline region of cotton fibres. Hence, cloths are not damaged even after repeated washing cycles.

CELLULASES IN TEXTILE INDUSRIES

Cellulases have become third largest group of enzymes used in the textile industry. Biostoning and Biopolishing have been the best known current textile applications of cellulases. Cellulase offers an ecofriendly approach replacing the harsh chemical for fabric finishing. The concept of Biostoning was first introduced in Europe in 1989 and in USA in 1990. Denim garments and blue jeans are currently very much popular and nearly 800 million pairs of jeans are produced worldwide every year. In denim fabrics, the indigo dye is mostly attached to surface of yarn and to most exterior short cotton fibres. When these jeans are repeatedly washed, they show a washed down aged effect. In textile mills, the indigo warp was heavily sized with starch, and the denim fabrics are woven into very tight structure. This made them extremely sturdy and long lasting material, but rather stiff and uncomfortable to wear initialy. Hence the aged or faded jeans became very popular. In 1970's & 80's industrial laundries developed method for production of faded jeans by washing garments with pumice stones, which partially removed the dye revealing the white interior of the yarn, leading to the faded, warn or aged appearance. The use of pumice stone for providing faded appearance was also observed to have some problems like rapid wear and tear of washing machine, large number. of second class garments, unsafe working conditions and environmental pollutions, etc. In mid-1980s, microbial cellulases provided a perfect alternative for stone washing, later known as biostoning. During biostoning process, cellulases act on the cotton fabric and break off the small fibre ends on the yarn surface, thereby loosening the indigo, which is easily removed by mechanical abrasion in the wash cycle. In view of the vast potentialities of this business, R & D Deptt. of various enzyme manufacturing companies are actively formulating various cellulolytic preparations. Cavaco-Paulo[20] however reproted that cellulases rich in endoglucanases component are important in the process of biostoning'.

CELLULASES IN PULP AND PAPER INDUSTRY

Pulp and Paper industry is one of the largest users of biomass today. Paper manufacturing is one of the largest industries. Cellulases and related hydrolases have been used in the pulp and paper

industry for different purposes. Cellulases and xylanases are used in new paper modification of coarse mechanical pulp and hand sheet properties in the biomechanical pulping[21]. Cellulase and hemicellulase mixtures have been used for the modification of fibre properties with the aim of improving drainage, beatability and runnability of paper mills[22, 23, 24]. In such treatment, the enzymatic treatment was performed either before or after beating of pulp.

The application of cellulases in the de-inking has been intensively studied in both laboratory and pilot scales. The process of de-linking finds its rationality that large amount of laser printed papers and photocopies paper are wasted from number of offices. Toner or ink is a resilient, plastic polymers with embedded carbon black that are fused to fibres and do not disperse readily. These residual ink decreases the brightness, and the toner particle creates a conspicuous background on paper. Toners remain as large, flat rigid particles that separate poorly from fibres during flotation and washing stages. In paper recycling, the costly dewatering and disperson step followed by additional flotation and washing are required to improve the de-inking of paper.

Microbial cellulases mainly from *Aspergillus niger, Tricoderma viride, Penicilum* spp., *Humicola* spp. and *Fusarium* spp. have proved to be quite useful in the process of deinking. Micro-organisms producing acid cellulases can work well with acid sized sulfite paper whereas with alkaline sized papers, it is preferable to use cellulases with neutral pH optima. Gubitz[25, 26] however reported the pure endoglucanases from *Gloeophyllum sepiarium* and *Gloeophyllum trabeaum* were successful in de-inlink operation. There has been report that application of alkaline active cellulases is useful in de-inlinking processes.

Cellulases work in several ways to enhance de-inking. They might reduce the hydrodynamic drag to increase the filtration and flotation rated during paper recycling or they might also decrease the specific surface area of the fibres and thereby reduce the interaction with contaminants. In flotation de-inking process, cellulases simply shave fibres from ink particles where fibres will settle down and ink particles will adhere to the air bubble in much better way experiencing much lesser drag from interaction with water thus, the ink particles can be carried to the top of the tank much easily and can be separated.

CELLULASES IN PLANT AND FUNGAL PROTOPLAST ISOLATION

Cellulases and related hydrolases were also used in production of plant of fungal protoplast by solubilization of plant and fungal cell walls. These protoplasts can then either be fused to produce hybrid cells having desired characteristics or used for transformation with DNA. Generally, cellulase of *Trichoderma viride, Penicillum pinophillum* were used for this purpose.

GENETIC ENGINEERING OF CELLULASES

Microorganisms generally produce low levels and multiple forms of cellulase and therefore workers have gone for isolation, cloning and expression of cellulase genes. Cellulase genes from fungi, bacteria and actinomycetes have been cloned, expressed and recombinant enzymes have been purified and characterized[11]. Number of genes responsible for cellulolytic acivity have been isolated and identified from various micriobial sources[27] **(Table 2)**. These genetic engineering techniques can pave the way to produce hybrid

strains capable of producing either one or all cellulase components at high levels.

TABLE 2 : CELLULASE GENES OF DIFFERENT MICROORGANISMS

Enzmes	Genes (s)	Source
Endo-b-1,3-glucanase	*bglH*	*Bacillus subtilis*
Endo-b-1,4-glucanase	*end1*	*Butriovidrio fibrisolvens*
Endo-b-1,4-glucanase	*cenA*	*Cellulomonas fimi*
Endo-b-1,4-glucanase	*cenA*	*Clostridium thermocellum*
Endo-b-1,3-1.4-glucanase I (EGI)	*(EGI) +egl1*	*Trichoderma reesei*
Endo-b-1,3-1,4-glucanase III (EGIII)	*egl1, egl3, egl4, egl5*	*Trichoderma reesei*
Exo-b-1,4-glucanase	*cex*	*Cellulomonas fimi*
Exo-b-1,3-glucanase I + II	*EXG1/BGL1*	*Saccharomyces cerevisiae*
Cellobiohydrolase	*CEL3*	*Agaricus bisporus*
Cellobiohydrolase	*Cbh1*	*Aspergillus aculeatus*
Cellobiohydrolase I (CBHI)	*Cbh1*	*Trichoderma reesei*
Cellobiohydrolase I (CBHI)	Cbh2	*Trichoderma reesei*
Chellobiohydrolase	*cbh1*	*Phanerocheate chrysosporium*
Cellobiohydrolase	*cbh1*	*Penicillium janthinellum*
b-glucosidase	*Bgl1*	*Aspergillus aculeatus*
b-glucosidase	*Bgl*	*Bacillus circulans*
b-glucosidase	*BglA, bglB BGlC*	*Cellulomonas bizotea*
b-glucosidase	*BGL2*	*Saccharmycopsis fibuligera*

CONCLUSION

The progress in biotechnology of cellulases and related hydrolases has attracted world-wide attention because of its use in laundry detergent, textile washing, pulp and paper industry, protoplast isolation and genetic engineering. The present and future research on cellulases will now be focussed in producing high yield of thermostable alkaline and acidic enzymes with improved catalytic efficiency and broad substrate specificity with site directed mutagenesis of cellulase genes are being attempted to achieve these ends. Research on exploiting the existing and new cellulases should also be aimed at future approaches.

REFERENCES

1. T. Godfrey. Textiles In : Godfrey T, West S, Editors, Industrial Enzymology, 2nd Ed., London, MacMillan Press, pp. 360-71, 1996
2. M. P. Coughlan, : *Biochem. Soc. Trans* : 405-6, 1985.
3. Ashish Vyas ; Deepak Vyas and K. M. Vyas *J. Sci. and Indust. Res.* **64** : 281-286, 2005
4. M. Mandels, *Biochem. Soc. Trans*, **13** : 414-15, 1985
5. E. T. Reese & M. Mandels, Rolling with the time : Production and application of *Trichoderma reesei* Cellulase, Annual Report of Fermentation Processes 7 : pp. 1-20, 1984.
6. A. Chesson Supplementary enzymes to impove the utilization of pigs and poultry deits, In : Haresign W. Cole DJA, editors. Recent advances in animal nutrition, London : Butterworths, pp. 71-89, 1987

7. S. Thomke ; M. Rundgrean & K. Hasselman. The effect of feeding high viscosity barley to pigs. In Proceeding of the 31st meeting or European Association of Animal Production, Commission on Animal Production, Munich, Germany, p. 5, 1980

8. A. G. J. Voragen *Fruit Processing* **7** : 98-102, 1992

9. A. G. J. Voragen ; R. Heutink and W. Pilnik, *J. Appl. Biochem*. **2**, 452-68, 1980

10. A. G. J. Voragen ; H Wolters ; T. Verdonschot-Krocf ; F. M. Rombouts & W. Pilnik, Effect of juice releasing enzymes of Juice quality, In : International Fruit Juice Symposium, The Hague (NL), May Zurich : Juris Druck Verlag, pp. 453-62, 1986

11. P. Beguin and J. P. Aubert. *FEMS Microbiol. Rev*., **13**, 25-58, 1993

12. M. P. Coughlan *Biochem. Soc. Trans.* **13**, 405-406, 1985

13. M. P. Coughlan & L. G. Ljungdahl, The properties of fungal and bacterial cellulase with comment on the production and application. In : Biotechnology and Genetic Engineering Reviews, Vol. 3 (Russel, G. E., editor), Inter science, New Castle upon-Tyne, pp. 39-109, 1985

14. M. Mandels, *Biochem. Soc. Trans.*, **13**, 414-415, 1985

15. M. K. Bhat and S. Bhat *Biotechnol. Adv.* **15**, 583-620, 1997

16. Ashish Vyas and Deepak Vyas, *J. Basi and Appl. Mycol.* **1** (2), 183-185, 2002

17. E. Hoshino and I Susumo Enzymes in detergency Marcel Dekker, 9, 149, 1997

18. P. O. Barbesrgaard ; G. W. Jenson and P. Holm. Detergent Cellulases, U. S. patent No. 4, 435, 302, Nov. Industri A/S Denmark, 1984

19. M. Schulein and K. Levering. Fungal cellulases composition containing alkaline-CMC endoglucanase and essentially No. cellobiohydrolase United States Patent No. 5691178, 1997

20. A. Cavaco-Paulo ; J. Cortez and L. Almeida *J. Soci. Dyers & Colour,* **113**, (7/8), 218-222, 1998

21. M. Akhtar *Holzfor Schung*, **48**, 199-202, 1994

22. P. Noe, J Chevalier, F. Mora and J. Comtat, *J. Wood Chem. Technol.* **6**, 167-84, 1986

23. J. C. Pommier, J. C. Fuentes and G. Gama, *Tappi* J. **72**, 187-91, 1989

24. J. C. Pommier ; G. Goma, J. C. Fuentes, C. Rousset and O. Jokinsen *Tappi*. J., **73,** 197-202, 1990

25. G. M. Gubitz, S. D. Mansfield, D. Bohm and J. N. Saddler *J. Biotechnol.*, **65**, 209-215, 1998

26. G. M. Gubitz, S. D. Mansfield, D. Bohm and J. N. Saddler. Effectiveness of two endoglucanases from *Gloeophyllum* species in deinking mixed office waste paper, Int. Conf Biotechnol Pulp Ind, 47th, C, 135-138, 1998

27. L. R. Lynd, P. J. Weimer, W. H. Zyl and I. S. Pretorius, *Microbiol & Mol Biol Rev*, **66** (3), 506-577, 2002

INTELLIGENT TEXTILES

Inderpal Rai *

Intelligent textiles represent the next generation of fibers, fabrics, and articles produced from them. These can be described as textile materials which act by themselves. This means that these may keep us warm in cold environments or cool in hot environments or provide us with considerable convenience, support, and even fun in our normal day-to-day activities, for example, through the incorporation of electronic devices or special colour effects. One of the main reasons for the fast development of intelligent textiles is their importance to the military industry. This is because they are used in different situations such as extreme winter condition, uniforms that change color so as to improve camouflage effects, communication and monitoring of soldiers at warfront.

INTRODUCTION

Intelligent textiles are not confined to the clothing sector only they are becoming increasingly prominent, for example, as biomedical and other engineering materials. It is quite likely that the future developments of intelligent textiles outside the clothing industry may prove to be of real value. Intelligent textiles provide ample evidence of the potential and enormous wealth of opportunities still to be realized in the textile industry, in the fashion and clothing sector, as well as in the technical textiles sector. Intelligent devices will, within the next few years, significantly regulate our day-to-day lives, and many of these devices will be in textiles and clothing.

According to its response tetiles can be divided into the following groups

- ***Passive smart materials***, which can only sense the environmental condition or stimuli,
- ***Active smart materials***, which sense and react to the condition or stimuli,
- ***Very smart materials***, which can sense, react and adapt themselves accordingly, and
- ***Intelligent materials***, which are capable of responding or being activated to perform a function in a manual or pre-programmed manner.

This article discusses how some intelligent textiles work.

INTELLIGENT TECHNOLOGY

A line diagram of intelligent functoning is as follows :

Trigger or stimuli ® Sensing + Processing + Actuation ® Controlling ® Response or Action

The sensors provide a nerve system to detect singals. The processor analyzes and evaluates the signals. The actuators act upon the detected and evaluated signal either directly or from a central control unit. The materials used are photosensitive

* Dept. of Home Science, JNV University, Jodhpur, Rajasthan 3420011

materials, fiber optics, conductive polymers, thermal sensitive materials, shape memory materials, intelligent coating materials, chemical responsive materials, microcapsules and micro- and nano-materials.

We are inspired to mimic nature in order to create clothing materials with higher levels of functions and smartness. Cloning silk fibers was a first step. The question that arose was could the skin–an intelligent material-be mimicked ? The skin has sensors that can detect pressure, pain, ambient conditions, etc. and can intelligently function with environmental stimuli. Intelligent textiles are materials and structures that sense and react to environmental conditions or stimuli, such as those from mechanical, thermal, chemical, electrical, magnetic or other sources. Intelligent textiles are no longer a science-fiction fantasy. For example, there are in the market self-cleaning carpets, memory-shaped and environment-responsive textiles, and anti-insomniac micro-fibers. These "intelligent fabrics" have come about through advances in nano-and micro-engineering-the ability to manipulate and exploit materials at micro or molecular scale. At the nanoscale, matericals can be "tuned" to display unusual properties that can be exploited to build faster, lighter, stronger and more efficient devices and systems.

NANOTECHNOLOGY APPLICATIONS IN INTELLIGENT TEXTILES

The textile and clothing industry, normally seen as a 'traditional industry', is an important part of the European manufacturing industry and gives employment to over two million people. Increased competition, specifically from Asia, and the proposed abolition of all import quotas for textiles and clothing in the EU, United States, Canada and Norway already is forcing the industry to restructure and modernize. Significant restructuring has taken place over the last decade, however, there is a general recognition that producing traditional apparel products may no longer be sufficient to sustain a viable business, and the EU textile industries may have to move towards more innovative, high quality products in order to differentiate themselves and compete. Already, nanotechnology is being used to improve the function ability of many consumer products. Nanotechnology improved products rely on a change in the physical properties when the feature sizes are shrunk.

Multifunctional Textiles

The use of Nanotechnology is allowing textiles to become multifunctional. For instance, Plasma technology is being used to modify the top nanometer layers of textiles, allowing them to be made antibacterial, fungicidal and water repellant. Other areas of interest include heat resistant and mechanically resilient work wear, ballistic protection, sensors and camouflage.

Protective Work Wear

W. L. Gore & Associates 'Gore-Tex Work wear' which applies Nanotechnology and Dupont's Teflon to produce an anti-static membrane for protective clothing against bad weather and electrostatic discharges.

Freshness You Can Wear

Nanoparticles have been used to provide the controlled release of fragrances, biocides and antifungals on textiles, leading to the expression, 'Freshness you can wear'. Ciba Specialty Chemicals

(CSC) is modifying fibers on the basis of nanocontainer microcapsules that prevent bacterial growth by releasing antimicrobiotics. The same technology is used to absorb odors.

Improved Moisture Absorption

Kanebo Spinning Corp of Japan has produced a polyester yarn with thrity times the ability of normal polyester to absorb moisture. The yarn, suitable for use in undergarments, has twenty layers for containing moisture and oil content. The layers have a total thickness of fifty nanometers. Toray Industries, Inc. of Japan has developed a fabric containing bundles of ultrafine nanometer nylon threads that allow superior moisture absorption properties.

Intelligent Sensor Textiles

They will look like typical military equipment, such as tents or camouflage nets. The electronic wires and sensors woven into the fabric will perform the complex procedure of listening for the faint sounds of distant vehicles being deployed by the enemy. Within the fabric, the sensors and their connecting wiser will communicate with one another to create patterns of information. This information can then be translated by computer software into image that will enable soldiers to determine the location of detected sounds. The military already has sound detection systems that rely on radio waves, but communication via radio waves can alert an adversary to a military unit's location. The e-textiles system being developed produces no detectable energy and also requires less power than radio-wave-operated systems. Fabrics can be woven with sensors that can detect chemicals, pick up satellite singals, and perform other feats.

Wearable Computers

The generic concept of wearable computers is a small CPU in a fanny-pack connected to a cumbersome headgear that holds a display screen at eye-level. Because the wires and sensors in e-textiles are woven into the fabric, wearable computers could be constructed much like normal-looking shirts or hats or other types of cloth apparel. These computers wouldn't connect users to the Internet or send and receive e-mail, but would perform specific functions necessary to the wearers. Wearable computers constructed of e-textiles ofter context awarences. They can be designed to be aware of the user's motions and of his surroundings. Sensors called accelerometers can detect changes in speed and direction. There are visual sensors that can project images to tiny displays clipped to eyeglasses. An e-textile shirt for a blind user might include tiny vibrating motors that would provide cues about approaching objects.

Medical and Aesthetic Applications

Nanoscale titanium dioxide (TiO_2) coatings give fabrics antibacterial and anti-odor properties. These have special properties, which can be activated in contact with the air or UV light. Such coatings have already been used to stop socks smelling for instance, to turn airline seats into super stain-resistant surfaces, and applied to windows so they clean themselves. Dressings for wounds can now incorporate nanoparticles with biocidal properties and smart patches are being developed to deliver drugs through the skin. Successful experiments have been conducted to grow human nerve cells on circuit boards. This paves the way for brain implants to help paralyzed people interface directly with computers.

Intelligent Clothing for Elderly

Scientists are developing clothes for the elderly that can monitor chronic illness through body temperature, blood pressure, heart rates, breathing and even the way they walk. They dream of garments that can trigger paralyzed limbs to move and that can smooth the motions of patients with Parkinson's Disease or Multiple Sclerosis. Intelligent textiles or "electro textiles" can be described as an amalgamation of two seemingly different fields of textiles and electronics in order to create a new generation of textile structures with electronic capabilities.

Health Monitoring vest has been developed for the elderly that can automatically measure and record vital signs, such as heart rate, temperature, and blood pressure. If doctors can evaluate symptoms during normal, everyday activities, then they can make better decisons and more precisely target and monitor the treatment. The development of intelligent textiles are soon going to mix and match sensors, processors, and communications devices that plug into knitted or woven garments made from cotton, polyester, or blends. The garments will be threaded with conductive polymer and metallic fibers that will serve as data buses and power lines. These devices will have the look and feel of typical garments and, after the attachments are unplugged, can be tossed into the washing machine.

New Vision

Intelligent fabrics and textiles will be exploited to enhance functionality, form, or aesthetics. MP3 players–the mass gadget of the moment–will disappear and instead become integrated into one's clothing. MP3 jackets, based on the idea that electrically conductive fabric can connect to keyboard sewn into sleeves, have already appeared in shops. The textile and clothing industry has been one of the first to exploit Nanotechnology in quite straightforward ways. Many developments are appearing in real products in the fields of medicine, defence, healthcare, sports and communications.

CONCLUSION

Intelligent textiles are not confined to the clothing sector : they are becoming increasingly prominent, for example, as biomedical and other engineering materials. These developments will be the result of active collaboration between people from a whole variety of backgrounds and disciplines : engineering, science, design, process development, and business and marketing. If technology is going to be increasingly part of clothing and skin, there needs to be some serious thinking about what it means for us as humans in future.

Further Reading & Resources

1. Jim Thomas, Nanotech, *The Ecologist*, February 2004.
2. Jim Thomas, Nanowatch, *The Ecologist*, May 2004.
3. Louis Theodore, Robert G. Kunz, *Nanotechnology : Environmental Implications and solutions* ISBN : 0-471-69976-4
4. Tushar Ghose, Abdelfattah Seyam, and Anuj Dhawab : *Electronic Textiles : The Evolution and Future*, College of Textiles, NC State University, RALEIGH, NC 27695, U. S. A.
5. 'Functional textiles'—www.empa.ch
6. 'Nanotechnology sees payoff in consumer markets'—www.centredaily.com
7. Textiles Intelligence (www.textilesintelligence.com)

CAPACITANCE RELAXATION PHENOMENA IN CARTILAGINOUS MEMBRANE

P. Shaw * T. K. Basak ** N. C. Ghosh *

The Cartilaginous membrane of human body comprises of lipoproteins. In presence of electrical stimuli the lipid constituents of the cartilaginous membrane undergo spatial orientation due to hydrophobic interaction of the lipid bilayer. The experimental findings are indicative of the spatial complexities of the lipid bilayer which may be expressed through relaxation phenomena associated with the orientation of the polar heads of the constituent lipids which were extracted from human cartilaginous membranes. The relexation phenomenon is linked intimately with the proliferation of cells in human bodies under normal and abnormal growth. It has been found that the frequency response characteristics of the lipid bilayer are significant in respect of detecting normal cell and malignant cell present in mammalian cartilage. For normal cell, there is no relaxation jump but in malignant cell there is positive relaxation jump depending on the age at which malignancy occurs.

INTRODUCTION

Cancer is an uncontrolled and purposeless growth of tissues that is irreversible and persists even after the stimulus that produces it, has been removed. It is a disorder of cellular growth in which the cells are no longer subject to the restraining influences normally controlling their behaviour. The fault causing this disorder within the cell itself affects the membrane for which variation in relative capacitance of the lipid bilayer embedded in the membrane influences the capacitance relaxation properties.[1] Human beings of all ages develop cancer, and a wide variety of organs are affected. In different organs and at different ages this differs widely, in youth often being rapid and in middle age slow. However, this phenomenon may vary from patient to patient even when they arise in the same organ. The role of lipid protein interaction is significant. This phenomenon has been illustrated in the experimental findings (Figs. 3 & 4) of malignant membrane which shows distinct monotonic jump of capacitance relaxation. This jump in respect of relaxation phenomenon is however absent in normal membrane which is illustrated in Fig. 5.

During recent years, it was assumed that the factor causing cancerous growth was normally present in all human cells, but that it remained inactive or 'repressed'. To the naked eye and to examining hand, it customarily presents itself as a tumour. Literally, this word means no more than a swelling and the lipids are confined within a membrene with a similar orderly arrangement. But in this context, it can be defined as an abnormal mass of tissue, the growth of which exceeds and is uncoordinated with that of the normal tissues and which continues to grow in the same way after the cause which initiated the progress has been removed. Tumours may be benign or malignant. Benign tumours remain local, they grow slowly and do not threaten life recept by reason of their size of by compressing the tissues round about it.

* Dept. of Physics, ** Dept. of Electrical Engineering, Jadavpur University, Kolkata-700 032

Cancer was first regarded simply as tumours or swellings which grew causing destruction and ulceration of normal tissues in their vicinity. It was finally recognized that the basic difference between the cancer cell and the healthy cell lay in a defective mechanism controlling growth and that this defect was irreversible and transmitted to all the progeny of the malignant cell. There are no constant marks which distinguish the cancer cell from the normal cell. Most of the malignant tumours develop in continually renewing tissues. The mechanism responsible for invasion is complex. It seems probable that the malignant cells form some substance which damages or actually destroys healthy cells in their neighbourhood, enabling the cancer to thrust its way between them. This may well spread by infiltration. Cancer cells have some power of spontaneous movement and will break off easily from the principal mass of the tumour because they lack the adhesive properties of healthy cell. Sometimes they will burst their way through the thin wall of a vein, become detached and swept along in the current of circulating blood until they come to rest in some distant organ. Here they will anchor, establish themselves, and continue to divide and multiply until they form a colony of the main cancer and the surrounding lipoproteins here also be affected which reflect a remarkable change in the relevant relative capacitance-frequency curves[2-17].

METHODS AND PROCEDURES

For measurement of relative capacitance at constant low voltage level (100 mv) and over the frequency range of 100Hz to 1.0 KHz, different techniques have been employed for corroboration of satisfactory evaluation of the relative capacitance with relaxation for the membrane. The measurements were carried out for six subjects out of thirty three ranging from 20 to 75 yrs of age for both male and female having malignancy and for those of the remaining subjects without malignancy (Fig. 2). The extracts were prepared by dissolving cleaned (by distilled water) lipoproteins in 15ml acetone and kept in the laboratory at room temperature (about 25°C) during the phases of the experiment. The system developed and described here uses the technique of passing a constant low voltage (100 mv) through the electrodes dipped in the lipoproteins extract separated by a small distance 1.5 cm). The data were recorded during measurements with the help of a programmable HP 428A Precision LCR Meter (Fig. 1). The measurement cells consisted of glass vessels and the electrodes immersed in it are made of Ag/AgCl.

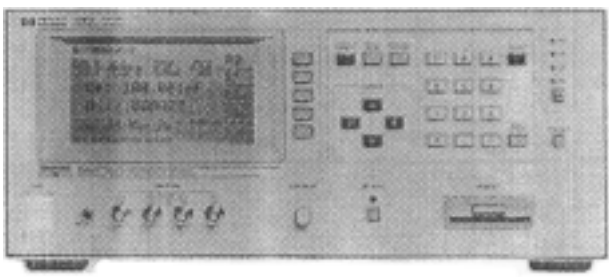

Fig. 1 Precision LCR Meter (HP 4284A)

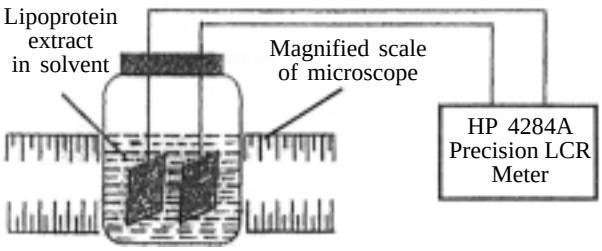

Fig. 2 Schematic of experimental setup (2-electrode system) in impoprotein extract

MEASUREMENTS AND DATA ANALYSIS

The experiments were performed in lipid solvent for which specific amount of lipoprotein was dissolved in acetone. The voltage level for measurement was kept low around 100 mv at a room temperature which was maintained around 25°C and the frequency range was kept wide from 100 Hz to 1.0 KHz. The experimental readings were used to determine the associated relative capacitance according to the relation, given below :

$$C_{rel} = \frac{KC_1}{C_2}$$

Where K is a constant which depends on lipoprotein extract. C_1 and C_2 are the capacitances of the solvent and the lipoprotein extract in solvent respectively.

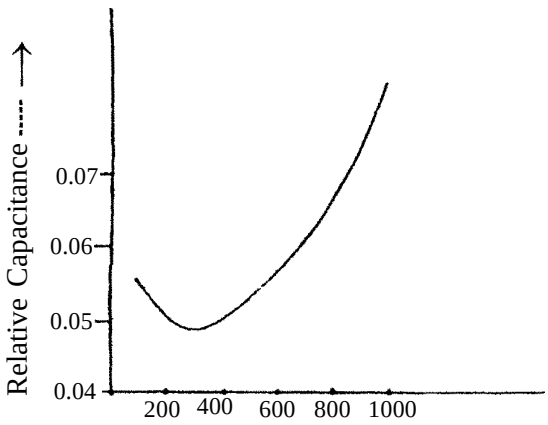

Fig 3 : Typical capacitance relaxation phenomena for abnormal (cancerous) membrane for lower age group (below 50 years)

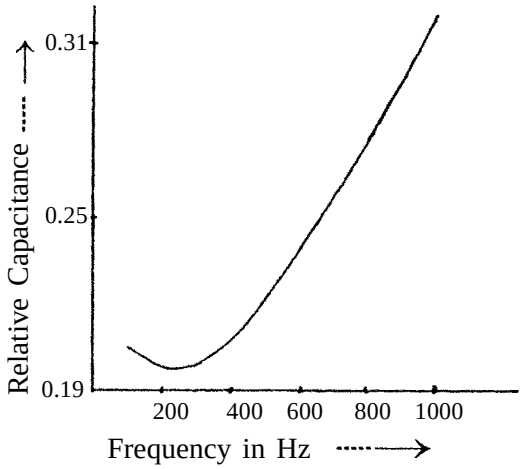

Fig 4 : Typical capacitance relaxation phonomena for abnormal (cancerous) membrane for higher age group (above 50 years)

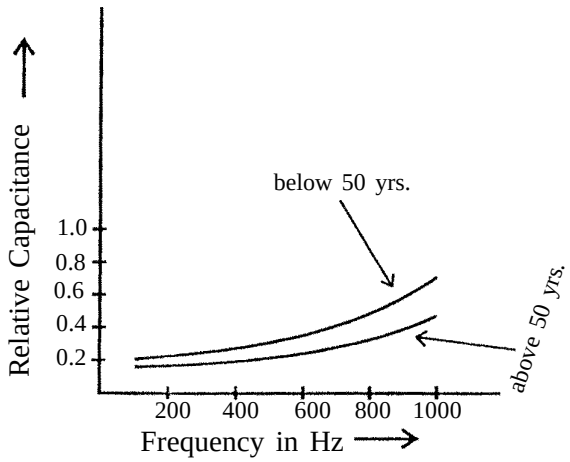

Fig. 5 : Capacitance relaxation for normal membrane (below 50 yrs. and above 50 yrs.)

DISCUSSION

Early treatment of cancer requires timely detection of this disease in human body. In the present work, it was found that six subjects out of thirty three showed typical capacitance relaxation phenomena associated with relaxation jump in case of malignant subjects. For establishing the conformity of the results, the specimen of

membranes for normal and malignant subjects were collected from diagnostic laboratories. The membrane of the subject comprises of lipoproteins. The main constituent of which is the phospholipids. The phospholipids play an important role in membrane structure. The hydrophobic linkage of the polar heads of the lipid bilayer undergoes spatial orientation concomitant with polarization in presence of electrical stimuli in lipoprotein solvent, for which specific capacitance across the lipid bilayer undergo changes. This is due to orientational polarization of the lipid constituent of the membrane. The data obtained from the different experimental setups are indicative of the spatial complexities of the lipid bilayer which may be expressed through relaxation phenomenon associated with the orientation of the polar heads of the constituent lipids which were extracted from human bodies[11, 15]. The parameters describing orientation of the hydrophobic linkage have been explored in the present investigation. It has been found that the frequency response characteristic of the lipid bilayer are significant in respect of detecting normal cell and malignant cell present in human bodies. The frequency range was kept from 100 Hz to 1.0 KHz above which the results were not satisfactory for monitoring the relaxation jump. The relaxation phenomenon described above is linked intimately with the proliferation of cells in human bodies under normal and abnormal growth. The experiment has been designed in such a way that the investigation for detecting normal cell and malignant cell in human bodies is indepedent on electrode system and the nature of the solvent. For normal cell, there is no relaxation jump but in malignant cell, there is positive relaxation jump on the age at which malignancy occurs.

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REFERENCES

1. D. F. Sargent. *J. Membrane Biol.* **23**, 227-247, 1975
2. M. De Rosa, S. De Rosa, A Gambacorta and J. D. Bu'lock. *Phytochemistry*, **19**, 249-254, 1980
3. U. Dumzendorfer, N. Katopodis, A. M. Dnistrion et al : *Invest Uron* **19**, 194-196, 1981
4. Sir Ronald Bodley Scott (editor) : Cancer-The facts, Oxford University Press, 1981.
5. A. Gliozzi, R. Rolandi, M. De Rosa and A. Gambacorta, *Biophys', J.* **37**, 563-566, 1982
6. N. Katapodis, Y. Hirshaut, HL Geller et al : *Cancer Res*, **45**, 5270-5276, 1982
7. AM. Dnistrian, MK Schwartz, N. Katopodis et at : *Cancer*, **50**, 1815-1819, 1982
8. A. Gliozzi, R. Rolandi, M. De Rose and A. Gambacorta, *Biophys. Acta* **735**, 234-242, 1983
9. A. Gliozzi, R. Rolandi, M. De Rose and A. Gambacorta, *J. Membrane Biol*, **75**, 45-56, 1983
10. M. De. Rosa, A. Gambacorta, B. Nicolaus, B. Chappe & P. Albrecht, Biochim. *Biophys. Act*. **753**, 249-256, 1983

11. M. De. Rosa, A. Gambacorta and B. Nicolaus, *J. Membrane Sci*, **16**, 287-294, 1983b.

12. G. N. Reddy and S. Sha, *IEEE Trans Biomedical Engineering*, **31**, 291-302, 1984

13. A. Gulik, V. Luzzati, M. De Rosa and A. Gambacorta, *J. Molec. Biol*. **182**, 131-149, 1985

14. H. P. Schwan,-'Dielectric properties of cells and tissues in interations between electromagnetic field and cells'. A. Chiabrera, C. Nicolini and H. P. Schwan-EdsNewyork, Plenum, 1985.

15. A. Gliozzi, S. Bumo, T. K. Basak, M. De. Rosa and A. Gambocorta, *System Appl. Microbiol*, **7**, 266-271, 1986

16. R. Pething and U. B. Kell.- *Pess, med. biol.* **32**, 8, 1987

17. S. Saha and W. A. Paul, *IEEE Trans on Biomedical Engineering*, **39**, 12, 1298-1304, 1992

18. N. C. Ghosh, P. Shaw, T. K. Basak and K. Bhowmick-Organisation of cartilage membrane-Proceedings of National Symposium on Cellular and Molecular Biophysics (March 17-19, 1994).

19. P. Shaw, K. Bhowmick, N. C. Ghosh and T. K. Basak-IEEE Engineering in Medicine & Biology Society 14th Conference of the Biomedical Engineering Society of India) New Delhi, **3**. 99, 1995

20. Murray Robert K, Granner Daryl K. Mayes Peter A. Rodwell Victor W-(editors) : Harper's biochemistry, 25th ed. Mcgraw-Hill, 2000.

21. P. Shaw N. C. Ghosh and T. K. Basak, Proc. 89th Indian Science Congress. Lucknow, 2002.

22. P. Shaw, T. K. Basak and N. C. Ghosh, Proc. 90th Indian Science Congress, Bangalore, 2003.

23. P. Shaw, T. K. Basak and N. C. Ghosh, 91st Indian Science Congress, Chandigarh, 2004.

DO YOU KNOW?

Q3. What is topiary ?

Q4. Apart from being a device to kill prey and offer defense what is the use of poison ?

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CAMEL : A UNIQUE SPECIES IN HOT ARID DESERT ECOSYSTEM

Champak Bhakat * and M S Sahani

Camel can tolerate high temperature, solar radiation and water deprivation and subsists on poor quality, thorny, vegetation. Camel hair is having great economic importance for its better utility as pure camel hair blends with other fibers in rural cottage industry. Camel milk has comparatively better keeping quality and medicinal properties. Camel hide and bone can also be used for making various types of consumer goods including fancy decorative items. Camel dung is a good organic manure and fuel. Draught use of camel carting is profitable and advantageous over bullock carting for small farmers. Camel is also gainfully utilised riding, racing, ploughing for livestock. Camel's meat, marketing camel as draft and game animal are of economic importance.

INTRODUCTION

As crop yields are low in hot arid desert because of recurrent drought, the farmers of this region rely heavily on livestock enterprises for their sustenance. The livestock should be compatible with crop cultivation instead of competing with it for land and water resources. Camel rearing enterprise fits well such requirements. The abbreviation of CAMEL may be expanded as 'C'-Carrier, 'A'-Arid zone, 'M'–Multipurpose, 'E'–Ecofriendly, and 'L'—Livestock. The camel is a useful component of desert ecosystem where the flora of usually marginal land can hardly meet the requirement of human food and energy. It possesses many unique qualities, which make it distinctly superior to other livestock. This "Ship of the desert" uses various adaptive mechanisms on hot arid sand dune. For instance, cattle in the central desert of Australia with daily temperature of 40°C, is reported to have died without water in four days while camels survive for more than 15 days in the same environment. It has been estimated that a well-fed camel could carry some six months energy on it's back while cattle are unlikely to carry on more than two-three months, if run out of food. Camels are able to sustain up to 20 to 22% loss of body weight during severe famine conditions, whereas other livestock like cattle and buffalo cannot sustain beyond 10 to 12% loss in body weight[1]. Camel population of the world is 19.32 million and that of India is 1.03 million[2]. Indian camel population is mainly confined to north-western states viz : Rajasthan, Gujarat, Haryana and Punjab (93.12% of the total) with highest density (70.13%) of camel in eleven arid districts of Rajasthan[3].

The scientific utilization of bio-energy camel is given on the next page :

* Camel Management Unit, National Research Centre on Camel, Bikaner–334001, Rajasthan. E mail : bhakat@scientist.com,

Draught use :

The comparative study between camel and bullock carting systems[4] reveals that pay back period is almost double in case of bullock carting as compared to camel carting, whereas Benefit Cost Ratio is $\frac{3}{4}$ th time higher in case of camel carting. Due to short pay back period and higher benefit cost ratio, camel carting is profitable and advantageous over bullock carting for small farmers. Indian camel can carry a load of 1.5 to 2 tons for 4-6 hours covering a distance of 30-40 km on two and four wheel cart without showing signs of distress[5]. It can work for 4 hrs at a stretch and 6 hrs with 2 hrs rest in between.

Ploughing use :

Camel can produce upto 1.16 hp energy during ploughing covering one hectare in 11 hours and can plough 500 sq. meter/hour at a depth of 16 inch. It can plough continuously for 3-4 hrs covering an area of 3000-3200 Sq meter[6].

Riding use :

The slender riding camel can cover up to 100 km/day at an average speed of 15-20 km/hr over long period and stocky pack dromedary camel can cover 20-25 km/day at an average speed of about 5 km/hr and can carry burden of 200 kg on its back. The camel can travel 950 km in 29 days and can cover distance ranging from 24 to 70 km/day at an average of 43 km/day in a camel safari across the desert of Rajasthan[7].

Racing use :

Camel racing in the Gulf and certain Arabian countries is an important cultural event which emphasizes the Bedouin traditions. The long limb length enabled the pacing gait to maintain even at high speeds. This gait would, therefore, appear to allow grater mechanical efficiency and therefore, speed around 9-10 m/sec to be maintained despite relatively low oxygen availability. There is a better race potential in Jaisalmeri than Bikaneri breed of camels and the female is having better endurance than male[8].

Defence use :

The camel corps contributes an important wing of Border Security Force of the Indian Para Military services and used for patrolling purpose in the desert belt of international border.

The various aspects of scientific utilization of camel products and byproducts are given below :

Camel Hair :

The camel hair products are an important source of additional income. The handicraft articles made up of camel hair, provide work to rural women in the field of grading of hair, tops preparation, spinning of hair, weaving, embroidery with 100% speciality and blending with sheep wool, goat hair, cotton and other products. Camel hair is widely used in rural cottage industry of Rajasthan and Gujarat for preparation of common utility items viz : blankets, bags, mattresses, ropes, floor rugs, etc. The researches on camel hair blends with wool, silk waste and polyester have shown encouraging results. Blended products are prepared with sheep wool, goat hair and cotton. It is worthwhile to blend camel hair with polyester, wool or silk waste. It has been estimated that a camel hair fabric of 620 gm weight will be as warm as a pure wool fabric of 900 gm weight. The hair of dromedary camels are durable, strong and have low conductivity. The camels of Bikaneri breed of 2-3 years of age produce higher annual

hair yield as compared to other age groups and breeds[10]. Annual hair production of camel is depicted in **Fig 1**. The fineness of hair of Indian camels ranges from 25 to 40 micron. The proportion of medulated fibres ranges from 50 to 80%. The fibre length ranges from 5 to 7 cm. The vegetable matter contents are from 4 to 5%. The pH is 7.02. The single fibre tenacity is better than wool which ranges from 15 to 17 gm/tex. The camel hair and wool blend, polyster blend and silk waste blend have good commercial prospects. The blend slivers exhibit strength of 11 to 19 gm/text.

Camel Milk :

Camels can produce sufficient quantities of milk without any supplementation, both under extensive and semi-intensive management conditions. The composition of camel milk is comparable to that from other domesticated animals. The keeping quality of camel milk is very good and the milk is a rich source of vitamin C. The calculated average lactation length is 305 days. The average daily yield varies from 3.5 to 4.5 liters. The camel milk contains per kilo about 2930.8 KJ of energy and about 35 gm of proteins[10]. The total daily energy requirement of a man can be met by 4 kg camel milk and his entire protein requirement by 1.75 kg camel milk. It has, therefore, considerable potential to combat malnutrition of people in arid desert land. The camel milk contain fat 2.9% to 3.5%, SNF 8.2% to 14.3%, lactose 3.4% to 5.8%, protein 3.5% to 4.6%, ash 0.7% to 0.9% and water 81.4% to 87.0%.

Camel Meat :

It is not a common practice to eat camel meat in India, although it is used in substantial quantities in several other countries. Dressing percentage of camel carcass ranges from 40 to 60%. Camel meat contains about 22% protein and only 1% fat. It has been estimated that an average carcass weighing 210 kg would yield 10 kg fat, 160 kg meat and 40 kg bones and would thus yield 35 kg protein and 9973125 KJ energy which will be sufficient to meet the protein requirment of about 35 people[10]. The optimum age for camel slaughter is around 3-4 years.

Camel Hide :

Recently camel hide is used for making various type of leather goods and fancy items of public interest viz : shoes, sandals, purse, bag, stool cover, rope, jewelry box, toys and various decorative items, etc. In earlier era, camel hides were utilized to make containers for storing and carrying water, oil and ghee, etc. This hide is well suited for application of colour and in Rajasthan there is a tradition of making elaborately painted small container (*kuppi*) by using camel hide. It has good export potential.

Camel Bone :

Camel bones are important raw material for the manufacture of jewelry in some parts of the world. In India, since ivory has been banned, it has often been replaced by camel bones. Of late, camel long bones are used for making fancy and decorative items. It has same potentiality as ivory but less costly. Camel bone is also used as bone-meal and fertilizer.

Camel Dung :

Dung ranks as an important byproduct. Camel dung is good source of organic manure and dry dung is also used as fuel. For pastoralists inhabiting in barren territories, it can be the most important source of fuel. This dung can be sold by camel herd owner for good price. Camel breeders used to compensate the landowners by cash or by providing

camel dung for overnight stay on their fields. Brick factories are also using camel dung as fuel.

Camel as Game Animal :

In recent times, the use of camel as a game (polo) animal in the Gulf countries and certain Arabian countries gained enormous importance. Very big amount of money is involved and the ecomonic importance of camel as game animal has increased tremendously. Camel safari is very much popular among tourists. In India, camel dance, use of camel in marriage and other social programmes have a great socio-cultural importance.

Camel Marketing :

Animal husbandry nevertheless plays a vital role in the economy of India and contributes more than 60% of the GDP of the region. Camel marketing through livestock fairs in western Rajasthan has opened new avenues for farmers. Marketing of camel is considered an important trade in Rajasthan where it is widely used as draft animal. Camels are mostly marketed at big animal fair such as at Nagour, Pushkar, Tilwara, Phalodi and Gogameri in Rajasthan.

CONCLUSION

Camel is a unique and important component of the desert ecosystem because of its adaptation in behavioural, anatomical, and physiological functions. It is very essential to adopt scientific management practices to get efficient utilization of camel resources round the year for different purposes.

REFERENCES

1. M. S. Sahani, S. C. Mehta, *Proceding of National Symposium on livestock bio-diversity* 11-12 Feb 2004, NBAGR, Karnal, Haryana : pp 13-20, 2004.
2. FAO, Production Year Book, Rome Italy, 2002.
3. N. D. Khanna, A. K. Raj, S. N. Tandon. *Ind. J. Animal Sciences*. **60**, 331-337, 1990.
4. C. Bhakat, M. S. Sahani, *Ind Animal Research*, **36**, 1-6, 2001.
5. A. K. Rai, S. Raghvendar : *Animal News*. Scotland U. K. **24**, 11-13, 1994
6. A. K. Rai, N. D. Khanna, A. K. Roy, Annual Report, NRCC, Bikaner, India, pp, 7-8, 1991.
7. N. D. Khanna, A. K. Rai, and N. Sharma, *Drought Animal News* Scotland, U. K. **24**, 13–15, 1996
8. S. Raghvendar, M. S. Sahani, Annual Report. NRCC, Bikaner, India, pp 7-9, 2000.
9. C. Bhakat, S. C Mehta and M. S. Sahani. *Ind Animal Sciences*, **72**, 275-276, 2002.
10. R. T. Wilson *Sudan Tropical Animal Health and Production*, **10**, 19-25, 1984.

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JATROPHA–A BIO-DIESEL FOR FUTURE

Avijit Dwary and Mahadev Pramanick *

The present article discusses the potential usefulsess of Jatropha oil. Jatropha (*Jatropha curcas*) belonging to family *Euphorbiaceae*, a perennial plant produces seed with 31-37 per cent of oil, which can be combusted as fuel without being refined. This fuel known as bio-diesel, can be produced by the process of "transesterification". Jatropha plant is grown in marginal and poor soil with minimum cultural practices or in waste lands with low fertility, rockiness, shallowness of soil. Besides higher cetane number, the oil reduces emission of carbon-monoxide by 44 per cent, sulphates by 100 per cent and ozone forming potential by less than 50 per cent. Through Jatropha cultivation, not only bio-diesel can be obtained but also a tremendous opportunity will be there for employment generation in an agricultural country like India.

INTRODUCTION

In April, 2004. a Mercedes Benz-C220 CDI car traveled over 10,000 km of stretches on Indian roads throughout Rajasthan, Gujrat and some southery states. The car manufactured in Daimler-Chrysler's Pune plant, was being run not on petrol or diesel but on Jatropha Methyl Ester (JME), a fuel made from the seed extract of a wild plant named *Jatropha curcas* that grows in wasteland. The test was conducted by Central Salt & Marine Chemicals Research Institute (CSMCRI), a Bhavnagar based CSIR Institute. The journey has, obviously, far reaching implications.

Jatropha is a perennial plant belonging to the family called *Euphorbiaceae*. It is termed as Physic-nut or Purging nut in English, Ratanjyot in Hindi, Kattamanakku in Tamil, Jepal in Gujrati and Kanana-randa in Sanskrit. The centre of origin of the crop is Mexico and Central America. It has been introduced to Africa and Asia by the Portuguese as an oil yielding plant and is now cultivated throughout the world. In India, Central and Western parts like Gujarat, Rajasthan, Madhya Pradesh, Maharashtra and Southern states like Tamil Nadu and Andhra Pradesh are the leading states producing jatropha. The plant which flowers during the rainy season, produces yellowish green flowers in racemose inflorescence. The average ratio of male and female flower in the inflorescence is 29 : 1. It is a small tree or shrub with smooth gray bark, which exudes whitish coloured watery latex when cut. Normally the plant is 3-5 meter in height but upto a height of 8 meter has been found under favourable conditions. The fruits are 2.5 centimeter long, black and 2 to 3 halved. Fruits mature by September-October when the capsule changes from green to yellow in colour. It has nearly 420 fruits and 1580 seeds per kg. respectively.

Jatropha, a highly drought resistant species, is adapted to arid and semi arid conditions. It can

* Department of Agronomy, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal

be grown in low to medium rainfall areas (300-1000 mm/annum). It occurs mainly at lower altitudes (0-500 m) with average annual temperature above 20°C but can grow at higher altitudes. It grows on well-drained soil with good aeration and is well adapted to marginal soils with low nutrient content.

THE BIO-DIESEL

Jatropha, the wonder plant, produces seeds with 31-37 per cent of oil content, which can be combusted as fuel without being refined. It bears a clear smoke-free flame. In the CSIR Institute (CSMCRI) Jatropha Methyl Ester (JME) fulfilled most Euro-4 emission norms in its non-blended form. Bio-diesel's phosphorus and sulphur contents were found to be lower than those of fossil diesel and its cetane number, a measure of ignition quality was higher than the standards required in some developed countries. The oil gave the car a mileage of 15.5 km per litre in test condition and about 13.5 km per litre in normal condition, which was at per with the mileage from the fossil diesel. Using a base price of Rupees 6 per kg. for jatropha seed and a standard yield of one litre of JME from 3.5 kg. of jatropha seed, the scientist have calculated a rough price of Rupees 24 per litre of bio-diesel, comparable to fossil diesel. From the second year after planting, the plant starts yielding but maximum yield can be obtained from the fifth year onwards of planting up to 40-50 years. From one hectare of land around 3.5-3.75 tonnes of oil can be obtained.

For maximum efficiency, the Triglycerides of oil is converted into methyl ester by the process of 'transesterification'. Bio-diesel is methyl ester formed by transesterification of the oil with methyl alcohol to produce Bio-diesel and Glycerol. The reaction is catalysed by sodium hydroxide (NaOH). The simplified reaction is– 100 kg unrefined oil + 24 kg methyl alcohol + 2.5 Kg NaOH = 100 kg Bio-diesel + 26 kg glycerine.

Besides higher cetane number, the oil reduces emission of carbon-monoxide by 44%, sulphates by 100%, unburnt hydrocarbon by 68% and the ozone forming potential of Bio-diesel is 50% less then the fossil diesel. The neat Bio-diesel was also tried in a high-powered non-automobile engine without modifying the Engine with satisfactory result. Transesterification process also gives by-products like glycerine and oilcake. The oilcake is a good source of organic manure which contains about 38% protein. Some cost of transesterification can be met by selling oil cake and glycerene on an attractive price.

As Jatropha is grown well in marginal and poor soils with minimum cultural practices, the crop is to be planted in wastelands with low fertility, rockyness, shallowness of soil, salinity, alkalinity and swampyness. Several organizations are now initiating Jatropha plantation in wasteland. Indian Oil Corporation and Indian Railways have recognized Bio-diesel as a natural and viable alternative to petroleum diesel, considering it's benefits to society. Research efforts at R & D center at IOC, Faridabad, and the Indian Railway's Loco works at Perambur, near Chennai, stand at the forefront in this endeavour. Being the largest consumer of diesel, the Indian Railways has started a drive to produce Bio-diesel for its captive consumption. The lead in this regard, has also been taken by the Kharagpur Division of the South Eastern Railways. Already, the Division has planted 2 lakh Jatropta trees in 110 hectares of unutilized lands, most of which lie but between Kharagpur and Nimpura. A few months ago, the Northern

Railways had test run the Delhi-Amritsar Janasatabdi Express on the Jatropha oil blended Bio-diesel, which was churned out by Indian oil Corporation.

However, making Jatropha plantation commercially viable would warrant the involvement of not only scientists but also economists and visionaries because a cycle of demand and supply needs to be created. Experts believe that over 30 million hectare of a total of 130 million hectare of wasteland in India can be brought under Jatropha cultivation, if an integrated approach is followed. On an average, one hectare of land yields 7.5 tonne of Jatropha seed or 2.5 tonnes of oil from which JME can be prepared. Gujarat, Rajasthan, Chhattisgarh, Andhra Pradesh, Haryana, Tamil Nadu are some of the states where planned Jatropha cultivation has taken place. At present, about 10 lakh hectare have been brought under Jatropha plantation, which could rise to 40 lakh hectare in the next year. If 10 million hectare of land in India is brought under Jatropha and other bio-fuel cultivation like Karanja. Jojoba, Kusum, Mahua, Neem etc. it can produce about 4 million tonne of oil equivalent to one tenth of countries requirement.

The increasing consumption and depletion of reserves in the globe clearly shows that the end of the "Fossil Fuel Age" is not very far away. We have to be alert about the danger that may ruin the total economy of our country. Through Jatropha plantation, we can not only get bio-fuel but some other additional advantages such as erosion control of soil, increase in soil quality, promotion of women, job opportunities among the rural and tribal masses and also poverty alleviation in rural areas and renewable energy production. A cheap eco-friendly fuel may still be years away but the plant seems to hold the key to India's spiraling fuel inadequacy.

An agricultural country, like India, will greatly benefit by changing over to energy from biomass. But Jatropha alone cannot provide the entire energy equal to the petro-diesel energy produced in the nation. Naturally, bio-diesel development ought to be a distributed and decentralized activity and is likely to be labour intensive, offering work opportunity to the unempolyed. However, harvesting and collection of plant seed oil from various sources, without demands of the non-energy users, requires a well coordinated public policy. Vigorous support from various departments and particularly from agricultural scientist is required for cultivation of energy crops for bio-diesel production.

BIODIVERSITY-MACRO AND MICRO : TO BE NANO OR NOT TO BE !

Christian Ulrichs[1], Inga Mewis[1], Arunava Goswami[2]*, S. D. Chatterjee[3], S. P. Banerjee[4], Sujit Adhikary[2], Atanu Bhattacharyya[2]

Biodiversity is one of the simplest term to understand in the world of science and conservation management, yet it seems to be an unreachable goal to many. Why so ? Diversity of organisms at the macro level, biomolecules at the micro-level and nano-biomolecules at the meso-biological level are yet to be mapped. It is high time that we gain serious and deeper understanding about the various modern issues of biodiversity. This article is an attempt to decipher many facets of this complex multi-disciplinary subject and to highlight trecent dataset and promises of biodiversity research worldwide.

GETTING A MEASURE

The term 'biodiversity' is a simple derivative of 'biological diversity'. Biodiversity is the sum total of all biotic variations from the level of genes to ecosystems (e.g., species, genetic and ecological diversity). The challenge comes in deciphering a measuring unit of such a broad concept in ways that are useful. To proceed in depth with the study of biodiversity, we need to pin the concept down[1]. We cannot even begin to look at how biodiversity is distributed, or how fast it is disappearing , unless we can put units on it. However, any attempt to measure biodiversity quickly encounters a problem in that it is fundamentally a multidimensional parametric function. Figure 1 explains the concept in a simple way. Study of particular facets of biodiversity has led to rapid growth of science, exciting and sometimes controversial discoveries[2,3]. Phylogenetic and time dependent data are shedding light on the ecological and evolutionary processes that have shaped current biodiversity. There is no doubt that human interventions and modernity are destroying this diversity at a rapid rate, resulting in an outcry for *ex-situ* and *in-situ* mega-conservation efforts of biodiversity hotspots. A vital question now being asked all over the world is how badly this loss affects ecosystem functioning and modalities. Sample A contains more diversity than sample B as it contains three species in comparison to two species in sample B. But there is less chance that two randomly chosen individuals will be of the same species in sample B than in sample A.

Cause and ethics

The most striking feature of Earth is the existence of life, and the most striking feature of

1 Humboldt-Universität zu Berlin, Institute for Horticultural Sciences, 14195 Berlin, Germany,

2 Biological Sciences Division, Indian Statistical Institute, Kolkata 700 108, Email : [agoswami@isical.ac.in],

3 Dept. of Agriculture, Writers Building, Kolkata 700 001,

4 Retired Faculty, Calcutta University, Kolkata 700 019

* Corresponding author

life is its diversity in complexities, forms, sizes and shapes. Biodiversity has long been a source of wonderment and scientific curiosity, but is increasingly becoming a source of concern[4]. Human domination of Earth's ecosystems is markedly reducing the diversity of species within many habitats worldwide, and is accelerating extinction. One of the more pragmatic questions raised by these threats to biodiversity is the extent to which this loss of biodiversity matters ; that is, are stability, productivity and other aspects of the functioning of both managed and natural ecosystems dependent on biodiversity ? There are strong reasons to hypothesize, as Darwin and Elton did earlier, that biodiversity might impact ecosystem processes. But ecology is no longer a discipline in which natural history observations and simple verbal logic hold the key. A 1993 book edited by Schulze and Mooney has rekindled interest in the potential effects of biodiversity on ecosystem processes, where hypotheses are now tested against the results of field experiments, mechanistic theory and quantitative field observations[5].

Sample A

Sample B

Fig. 1

Global patterns

Biodiversity, the variety of species, is distributed heterogeneously across the Earth. Some areas are flooded with biological variation (for example, some moist tropical forests and coral reefs), others are virtually devoid of living organisms (for example, some deserts and Polar Regions) and majority of the earth surface falls somewhere in between. Determining why these differences exist has long been a core objective for ecologists and biogeographers[6]. It will be a continuing, an important, and to many an impressive challenge for scientists in days ahead. Indeed, past decade has seen an enormous explosion of research documenting broad-scale (geographical) spatial patterns in biodiversity, and an explanation for the observations and their implications. Twofold interests drive this field of research. First, it

provides an opportunity for improvements in the available data and analytical tools, the former resulting mostly from extensive collection of existing specimen and species occurence records. The establishment of dedicated distribution-mapping schemes, and the use of remote-sensing technology (to measure vegetation and other environmental variables) will be useful for this mapping effort. Second, it generates concern over the future biodiversity. Thus the resultant need is to determine its current status, to predict its likely response to global environmental change, and to identify the most effective schemes for *ex-situ* and *in situ* conservation and sustainable use[7].

Consequences of altered biodiversity levels

Humans have extensively altered the global environment, resulting into changes of the global biogeochemical cycles, transforming land and enhancing the mobility of biota. In the past three centuries, fossil-fuel combustion and deforestation have increased the concentration of atmospheric carbon dioxide (CO_2) by 30% (with more than half of this increase occurring in the last 40 years). The concentration of free methane, CFC and other gases that contribute to climate warming has doubled. In this century these greenhouse gases are likely to cause the most rapid climate change that the Earth has experienced since the end of the last glaciation 18,000 years ago and perhaps a much longer time. Nitrogen for fertilizer and other human activities has more than doubled the rates of terrestrial fixation of gaseous nitrogen into biologically available forms. Agricultural and urban system run off of nutrients have increased several-fold in the developed river basins of the earth, causing major ecological changes in estuaries and coastal zones. Humans have transformed 40-50% of the ice-free land surface, changing prairies, forests and wetlands into agricultural and urban systems. Human interventions directly or indirectly interfere about one-third of the net primary productivity on land and fish harvest that use 8% of ocean productivity. We are currently using 54% of the available fresh water, with use projected to increase to 70% by 2050. Finally, the mobility of people has transported organisms across geographical barriers that long kept the biotic regions of the Earth separated, so that many of the ecologically important plant and animal species of many areas have been introduced in historic time[8].

Search for a general biodiversity-stability relationship

A long-term study to define experimentally the relationship between diversity and stability in plant communities was started by David Tilman in 1982. The experiments were done in four grassland fields of US (Cedar Creek, Natural History Area, Minnesota). This vast area was divided into over 200 experimental plots, and researchers gathered information on species richness, community biomass and population biomass over a time scale[9]. The results of this and other extensive studies show that diversity within an ecosystem tends to be correlated positively with plant community stability (that is, decreased coefficient of variability in community biomass). At the same time, population variability affects biodiversity minimally. Two mutually non-exclusive, hypotheses called the averaging effect and the negative covariance dominate the basic arguments for a positive relationship between diversity and stability for primary producers at the community level. Briefly, these two hypotheses argue that species richness in diversity increases community stability because diverse plant communities respond differentially to variable background inputs. The differential responses of populations add up, through time, to give climax community dynamics. Therefore, within an ecosystem, diversity tends to be correlated positively with ecosystem stability. This correlation does not necessarily relate to population-level stability. Much work is still

required to determine the driver of the diversity—stability positive relationship. However, it seems that community-level stability is dependent on the differential response of species or functional groups to variable conditions (e.g. climate, soil, other plant communites etc.), as well as the functional redundancy of species that have important stabilizing roles[10].

Conservation of biodiversity at the micro-and nano-scale : a new trend !

The screening of tropical plant derived products for novel pharmaceuticals, agricultural and other industrial products is in the news nowadays. Biologically derived nano-particles (e.g., nanosilica produced by phytoplanktons, experimentally derived natural nanoparticles in acidophillic fungi, VAM, bacteria and some plant extracts etc.) have very recently joined the show. The study of role of bio-nanoparticles in the physiology of the plant and animal world opens the gateway for the exciting new areas of bio-nanotechnology. The search madness is slowly gripping the world, once envisioned in the term of 'mesophysics', by physicist, Feynman. With the adoption of UN biodiversity convention resolution, major efforts are underway to scan the tropical countries' flora and fauna at the macro (species level), micro-(DNA, RNA, genes and biomolecules, secondary metabolites of plant and animal origin) and nano-biomolecule (biomolecules of the 10^{-8} meter range) levels. The convention has highlighted the effort of the researchers from the industrialized and developing countries to carry out investigations into the existing flora and fauna of the world with an attempt to attract industrial investment in this area, which in turn will stabilize the rapid loss of biodiversity. This mammoth effort needs support from international research communities[11].

Conservation in macro-, micro and nano levels—a campaign for biodiversity

Macro-and micro-organism biodiversity conservation signals a cultural phenomenon these days. We, naturalists, have a visceral desire to conserve not only the organisms as such but also the habitats of these organisms. 'Wilderness' might have many meanings. So, let the 'biodiversity' carry the load. Conserve 'biodiversity' and you preserve species richness, habitats and opportunities for living-all three in a go.

REFERENCES

1. Etienne RS, Latimer AM, Silander JA Jr. Cowling RM. *Science*. 311 (5761), 610, 2006.
2. Blaustein AR. Dobson A. *Nature*. 439 (7073), 143-4, 2006
3. Fierer N. Jackson RB. *Proc Natl Acad Sci U S A.* 103(3), 626-31, 2006
4. De Cauwer B, Reheul D, Nijs I, Milbau A. *Common Agric Appl Biol Sci.* 70(1), 17-49, 2005
5. Wing SL, Harrington GJ, Smith FA, Bloch JI, Boyer DM, Freeman KH. *Science*. 310(5750), 993-6, 2005
6. Natidoo R, Adamowicz WL. *Proc Natl Acad Sci* U S A. 102 (46), 16712-6, 2005
7. Cherry M. *Nature*. 437(7063), 1217, 2005
8. Odling-Smee L *Nature*. 437 (7059), 614-6, 2005
9. Savolainen V, Cowan RS, Vogler AP, Roderick GK, Lane R. *Philos Trans R Soc Lond B Biol Sci.* 360(1462), 1805-11.
10. Fukami T., Wardle DA. *Proc Biol Sci*. 272(1577), 2105-15, 2005
11. Gavrilescu M, Chisti Y. *Biotechnol Adv*. 23(7-8), 471-99, 2005

SHORT COMMUNICATION

BACTERIOPHAGE—LIVING ANTIBIOTICS

D. Balasubramanian*

What is infection ? One form of life living on another and multiplying ; the little ones preying on a larger body. The prey ("host" in polite circles) fights back using chemicals that it releases to kill the invader, through mechanical engulfment and melt-down of the predator. The infecting little beasties are equally prepared. They work with numbers—multiplying fast on the prey and overwhelming it. Their generation time is in hours or minutes. Within a day of infection, their number in the infected body can run into billions : a runaway chain reaction. Jonathan Swift, of ***Gulliver's Travels*** fame, puts this idea across when he wrote about how the tiny Lilliputians could overcome and tie up the giant. And, as the noted biologist Joshua Lederberg reminds us (in his article in an issue of the ***PNAS, USA***), Swift alo wrote thus :

So, naturalists observe, a flea
Hath smaller fleas that on him prey ;
And these have smaller still to bite 'em,
And so proced *ad infinitum*,

Indeed, life has layers an onion. We live on the earth feasting and depending on its bounties, eating up some plants and animals. On animals prey microbes—or to put it from the latter's point of view, one animal is ample for zillions of fleas to live on. Parasites live on some of these fleas. Then, there are viruses that live on bacteria, these are given the special name : bacteriophage. These are the smallest fleas known, and they teeter on the twilight zone between the lving and non-living. A virus is the last post or frontier—beneath, it is the world of the non—living—no *ad infinitum*, the chain stops with the viruses.

Eating habits and preferences become less stringent and more diverse as we ascend the tree of life. Many viruses at the bottom are rather finicky about what they eat or prey on. Bacteriophage lambda (that is its name) lives on the bacterium *E. coli* ; it does not grow on most other bacteria. The phage called P22 likes the microbe *salmonella typhimurium* (the one that causes food poisoning and stomach infection) best as its host. The parasite that causes malaria is a little higher than viruses in the totem pole of life, since it has its own metabolic machinery. It is picky too about what it eats—it resides inside a mosquito and eats the blood that the mosquito sucks off you and me. The mosquito is a little more adventurous : it can live on man, cattle and other animals. Fleas and flies are even more open-minded ; they go wherever filth and grime is. As we go up the ladder of evolution, there is even greater gastronomic diversity.

* L. V. Prasad Eye Institute, LV Prasad Marg, Banjara Hills, Hyderabad 500034, e-mail : dbala@lubly:itph.net. Article published earlier in The Hindu, Reproduced with permission.

Back to infection. If I am infected by *E. coli*, my guts are its breeding grounds and they multiply there merrily, eating off me. And when *salmonella* enters my body, it breeds there happily and can debilitate and weaken me to death. Not that I take it lying down ; I mount an immune response and produce fighter molecules that are so exquisitely shaped to fit the top surface of the bugs and knock them out ; I unleash special cells called phagocytes ("eating cells") that finish the microbes off by devouring and digesting them. But that is only one layer of defence. We need to arrest the growth of the bug itself. It better be quick or they multiply.

In this light, the discovery of Frederick W Twort in 1915 and of Felix d'Herelle in 1917 becomes important. They are the ones who discovered that there are viruses which specifically feast on bacteria. These viruses are referred to as bacteriophages (the Greek word 'phagein' means to eat, to devour). Almost immediately, several scientists realised the importance of this discovery. Here is a method to specifically knock out unwanted bacteria that infect our body. It there is a way by which we can isolate a specific bacteriophage and administer it to the infected individual, the phage will feast on the bacterium, multiply rapidly and thus finish off the bacterium and the body becomes free of bacterial infection. There is no danger of infection by the bacteriophage itself because the only thing it will touch is its 'host' bacterium.

As Professor Lederberg reminds us in his article, this idea was the central theme of the famous romance ***Arrowsmith***, written by the American author Sinclair Lewis who won the Nobel Prize for literature in 1930. The hero Arrowsmith, inspired by reading the accounts of d'Herelle's attempts in the discovery of phage, to control plague in the community by administering phage to its residents. However upset by his wife's death from an accidental infection, he abandons experimental controls and administers the phage indiscriminately. As a result, no definite conclusions could be drawn as to whether phage helped in controlling the disease or not.

In real life, phage was indeed studied carefully for its role in cholera. Three scientists did attempt to clean up a contaminated water supply by administering cholera phage into the water. But what seems to have turned the attention away from phage was the discovery of antibiotics that were isolated from microbes. The period 1930-1960 saw a flurry of activity that led to the isolation and effective use of antibiotics such as penicillin, tetracycline and the like. Antibiotics were found to have the advantage of being broad spectrum—that is, they can kill a variety of bacteria and are not specific to one type or the other, as phages are. There are other problems in the use of phage as well. When administered with phage, the human body reacts shortly thereafter by producing immune response against the phage. Antibodies are produced that can knock out the phage. Also, if taken orally, the phage can be inactivated and degraded by the body's acids and gastric juices. Thirdly, bacterial strains also evolve rapidly, several of which become resistant to phages. Even more important than these degradative and immunological defences was the discovery by Carl Merril, of the National Institute of Mental Health in Washington DC, that the body has mechanisms of eliminating the phage that is administered to it. This occurs with the help of the cellular network contained in the sheet or the skin covering various organs in the body, refered to as the reticuloendothelium system or

RES. This mode rapidly eliminates the bacteriophage from circulation.

With the recent worry that infecting bacteria are increasingly becoming antibiotic-resistant, it becomes imperative to try other modes of containing or killing them. It is with this in view that bacteriophages have been revisited. Carl Merril and his associates at the NIMH have joined hands with Dr Sankar Adhya of the Laboratory of Molecular Biology, National Cancer Institute, NIH, Bethesda, Maryland and colleagues at a commercial firm called Exponential Biotherapies in New York, and devised a new strategy to use bacteriophage as anti bacterial agents and have published their finding in the same issue of ***PNAS, USA***, wherein Dr Lederberg's commentary appears.

How did they overcome the difficulties connected with the phage administration that we mentioned earlier ? They first inoculated mice with phage and then isolated those variants of the phage that survive in the circulation. The so-isolated phages were again passed through the mouse—indeed, ten times over so that the phage that is isolated at the end of these ten passages is a robust one that is not eliminated by the RES but becomes RES tolerant and circulates for long periods of time in the body. Secondly, they purified the phage rigorously so as to reduce the toxin content and thus reduce side-effects ; thirdly, they used bacteriophages that are specific to the bacterial strains used to infect the experimental animals. Two infective bacteria were tried. One was *E. coli* and the second was *Salmonella*. The phage used to control *E. coli* was Lambda, while that to control *Salmonella* was P22. Using the above methods, they were able to obtain long-circulating, toxin-free and bacterium-specific Lambda and P22 strains of phage.

Armed with these phages, they infected mice with bacteria. When *E. coli* was injected without any phage, most animals died within 24 hours because the bacterial count became so high and infection levels so fatal that the mice could not withstand it. However, when they injected the long-circulating bacteriophage W-60 after infecting the mouse with *E. coli*, the symptoms of the disease vanished after a 100 hours. In other words, while infection by *E. coli* caused death within 40 hours, such an infection followed by the injection of the selected strain of phage protected the animal against illness.

A similar experiment, involving *Salmonella* infection and chosen strains of P22, gave equally encouraging results. Merrill, Adhya and co-workers conclude that the use of toxin-free, bacteria-specific phage strains along with the serial passage technique may provide insights for developing phage into therapeutically effective antibacterial agents.

What is exciting about this experiment is that it is now possible to surmount a defence mechanism based on the phage. Secondly, unlike penicillin or tetracycline, phage are living antibiotics ; they grow, multiply and proliferate in the body. It is also possible, using modern molecular biology techniques to fine-tune the phage so that there are no risks or side-effects. We thus enter the age of living antibiotics.

Writing about this in his "Commentary", Professor Lederberg points out that one can use the phage technique not only in pestilence but in famine as well. Can we not also deal with bacterial infestations of plants ? Blights in potato, maize, wheat and citrus are caused by fungal pests. Virus-like agents are known in many fungi. Would it not be possible to use these long-lived and

specific viral bullets to knock-out the infested fungi and to counter crop blight and famine ? Lederberg says :

> There would be a worthy challenge to contemporary bio-technology. Hopefully, that would also be accompanied by the most prudent enquiry about what might go wrong, but the long-term prospects of earth's food supply are not so robust that we can afford to ignore such opportunities.

I had the pleasure of talking to Dr Sankar Adhya about his work during one of my visits to the NIH, and he was beaming with enthusiasm about the possibilites. He underscored the advantages of phage therapy. Selection methods provide fine-tuning for long circulation. Massive doses of phage can be safely given, say a billion phage per milliliter of blood, so that their action can be quick and safe, with no time-lag given for the body to elaborate its immune defence against the phage and weaken its therapeutics. And, he thinks in terms of decorating the surface of the phage with peptide signals that can target it to specific organs or tissues in the body. He also talked about the possibility of phage therapy against enterococci-like streptococcal infections and against cholera, two diseases prevalent in India, and particularly in Bengal, the region where Sankar Adhya hails from, and we wish him all the best in this novel approach of his.

DO YOU KNOW?

Q5. Normally tiny diamonds that are cut in hundreds in Surat. How many faces each has ?

Q6. How much fish is consumed annually by mankind ?

Q7. The tiger is known for its stripes, the fur have stripes. Does the skin have stripes ?

KNOW THY INSTITUTIONS

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES), NAINITAL

The Aryabhatta Research Institute of Observational Sciences, with acronym **ARIES**, is an autonomous institute under the administrative control of Department of Science and Technology (DST), Government of India. It is devoted to basic scientific research in the frontier areas of astrophysics and atmospheric physics. The name ARIES incidentally signifies the zodiacal sign of Sun at two historically important epochs of the Institute separated by 50 years, the first one being its formation on April 20, 1954 under the Uttar Pradesh State Government while the second one is its reincarnation on March 22, 2004 under the Government of India. It was known as U. P. State Observatory (UPSO) till the formation of Uttaranchal in November 2000. The Institute came into existence in the holy city of Varanasi at the initiative of Dr. Sampurnanand, the then Education minister and later the Chief Minister of Uttar Pradesh and Prof. A. N. Singh, a Professor of Mathematics at Lucknow University. It was moved over from dust and haze of the plains to the more transparent skies of the hills in Nainital in 1955 and to its present location at Manora Peak (longitude 79°27´E ; latitude 29°22´N ; altitude 1951 m), a few km south of Nainital in 1961.

Director of the Institute is the Principal Executive Officer. The staff of the Institute comprises of scientists, engineers, supporting scientific and engineering staff, administrative and other supporting staff.

LOCATIONAL ADVANTAGE

The strong point of ARIES is its geographical location. The longitude (79° East) locates it almost in the middle of about 180 degree wide longitude band having modern astronomical facilities between Canary Islands (~ 20° West) and Eastern Australia (~ 155° East). Therefore, the observations which are not possible in Canary Islands or Australia due to day light, can be obtained from ARIES. With its latitude of ~ 30° North, astronomical objects of both the Northern and Soutern hemispheres are accessible from the place. Because of its geographical location and existence of good observing conditions for a good part of the year (September to June), the Institute has made unique contribution in many areas of astronomical research, particularly those involving time critical phenomena despite having only small (£ 104-cm) size optical telescopes. Two best examples of this are the contribution in the discovery of Uranus rings in 1977 and the earliest optical observations of the Gamma-Ray Burst (GRB) afterglows in 2001. Others are optical observations of a large number of GRB afterglows including the first two successful obsevations from the country ; nearby galaxies ; star clusters and both extrinsic and intrinsic variables. Study of quasar variability, discovery of several new variables and micro-lensing events are a few latest additions to the above list.

The location of the site is also suitable for carrying out cetain unique aspects of atmospheric studies and can supplement the studies done on low altitude based stations. The possible research areas include the 'excess' atmospheric absorption at short wavelength by clear-sky atmospheres as predicted by radiative transfer models, aerosol-cloud interactions, gravity wave propagation, mesospheric temperature variability and the role of black carbon in radiative forcing.

OBJECTIVES

The objectives of ARIES are :

- To promote, guide and carry out front-line basic research through establishing state-of-art observational facilities ; provide interactions with the Universities and other institutions ; conduct research programmes leading to Ph. D. degrees and arrange advanced level schools/ workshops in astrophysics and atmospheric sciences.
- To establish, maintain and manage in-house laboratories, workshops and other units to assist scientific research in areas related to activities of the Institute.
- To co-operate and collaborate with other national and international institutions/ organisations and laboratories in the fields relevant to the objectives of ARIES.
- To create trained human resources in Science and Technology.
- To conduct Science popularization programmes with particular reference to space sciences so as to strengthen the scientific temper of students and people at large in the country.

Facilities

The Institute, which started with a 25-cm refractor in 1955, installed other four telescopes

namely 38-cm, 52-cm, 56-cm and 104-cm till 1972. The 104-cm Sampurnanand reflector telescope is the mainstay of the photometric, spectroscopic and polarimetric observations at ARIES. The focal plane instruments available for the telescope are Cassegrain plate holder, Meinel camera, photoelectric photometer, near-infrared JHK photometer, a laboratory spectrum scanner, modern cooled CCD cameras, imaging polarimeter, three channel fast photometer and an optical multi-channel analyzer. ARIES also has two 15-cm reflectors equipped with H_a, Ca II K and CN filters and CCD cameras for carrying out observations of solar activities namely sunspot, faculae, plages, flares, prominences, etc. with a time resolution of up to 25 millisecond.

The Institute was one of the 12 global centres established by the Smithsonian Astrophysical Observatory, USA, during the International Geophysical year (1957–58), but the only centre in India for optical photographic imaging of man-made earth satellites using a 79/51-cm f/1 Baker-Nunn Satellite Camera along with a precision timing system capable of recording upto ten millionth part of a second. The first photograph of an artificial satellite was taken on 29 August 1958. The use of camera for optical imaging of the satellites was stopped in 1976 due to the advent of modern techniques in this area. It successfully photographed a total of over 45,700 satellite transits including that of the Apollo-11, Apollo-12 and Apollo-17 and the *Indian Satellite Aryabhatta*. Now, this camera is being converted into a wide field (~ 5 ´ 5 square degree) Schmidt-telescope for carrying out astronomical survey work.

As a result of optical tracking of artificial earth satellites, the position of the centre of the location of the Baker-Nunn camera at ARIES is determined with a precision of 10 m and can, therefore be used as *reference point for geological survey work.*

For the studies related to atmospheric science, ARIES has a multi-wavelength radiometer (MWR) ; an optical particle counter (OPC, model 1.018 of Grimm Aerosol Technik, Gmbh, Germany) ; Aethalometer (Magee Scientific, USA model AE-21) ; a 5-channel Microtops Sun photometer (Solar Light Co., USA), and an automatic weather station (Campnell Scientific Inc., Canada). They are routinely used to characterise long term behaviour of aerosols and other related phenomena.

In order to meet the requirements for maintenance, design and fabrication of the instruments, ARIES has electronics and electrical workshop, a mechanical workshop, fine technics laboratory which includes aluminizing unit and optics workshop, a well maintained library with more than 11,000 volumes of research journals and excellent collection of books and a modern computer center.

ACCOMPLISHMENTS

The Institute is well known for its precise observations in the area of astrophysics and atmospheric science. Comensurating with its observing capabilities, the Institute started a number of front-line research programmes during the last decade e.g., optical follow up observations of GRB afterglows, radio and space born astronomical sources, intra-night optical variability in Active Galactic Nuclei (AGN) as well as gravitational microlensing and milli-magnitude variations in the rapidly oscillating peculiar A type stars. As a part of atmospheric studies, characterisation of aerosol at an altitude of about

2 km is going on since 2002. In 2004, the Institution completed 50 years of scientific research, discovery and training of manpower by maintaining a wide range of close collaboration with institutions and scientists from both within the country and abroad. The Institue has contributed significantly in the studies of nearby galaxies, variability of AGN, optical follow-up of transient events like Novae, Supernovae and GRBs, dark matter, stellar populations, stellar variability, stellar energy distributions, star clusters, planetary physics, solar activity, solar spectroscopy, airglow emission and aerosol content at high altitute in Himalayas. These contributions have resulted over 800 research papers. Out of these ~ 75% are published in reputed refereed journals, ~ 15% in proceedings of conferences / meetings / workshops and remaining in circulars. The Institute has also contributed to over 40 Ph. D. theses so far. Main highlights of the work done so far are given below.

- In the country, first photoelectric observations of stars and occultation of a star by a minor planet, near-IR, Fabry-Pero spectroscopic, optical observataions of a GRB afterglow and micro-lensing event have been taken at the Institute.
- The Institute actively participated in the discovery of rings around Neptune, Uranus and two additional rings around Saturn.
- The Institute's scientists have not only observed a large number of comets including Comet Halley, eclipsing binaries, variable stars, star clusters, high energy optical transients, nearby galaxies and AGN but also published many new results on them. For example, the slope of initial mass function above one solar mass in young star clusters has been found to be similar to the Salpeter's value in the solar neighbourhood ; the duration of star formation in a molecular cloud is several Myr and the plane defined by the interstellar dust is tilted with respect to the formal galactic plane. Many new variable stars and AGNs have also been discovered including a rare rapidly oscillating Ap star in the northern part of the sky.
- Out of many new molecular species predicted in the Sun's Photosphere and Sinspots by Institute's Scientists, the presence of SH, C_2 and SiO has been confirmed observationally.
- As a result of optical tracking of artifical earth satellites, the location of Manora Peak has been determined with a precission of 10 metres in the frame of reference of Standard Earth. This information is valuable for the geological survey.

Citations of the Institute's contributions in reputed scientific journals indicate that a good number of them are internationally recognised.

CONCLUSIONS

Together with other astronomical institutions in India and abroad, ARIES is playing a useful role in the promotion of pure scientific research. Setting the agenda in astronomy, the decadal Vision Document 2004 published by Indian Academy of Scienes, Bangalore says that the unique contributions that ARIES can make are in the area of studies of galactic and extra-galactic variables, all sky polarisation survey, optical identifications of radio, UV and X-ray sources, optical observations of high energy transient events and in the studies of star formation and stellar evolution. The aerosol characterization at ARIES

has contributed significantly to the ongoing ISRO-GBP Aerosol Climatology and Effects Project.

Thus one can sky that with dedicated staff and expanding facilities for research, ARIES is expected to make an increasingly valuable contribution to the country's scientific and technological development by attracting young talented students and faculty. Research work in the experimental side of ARIES is expected to have useful applied fallouts specially in the field of electronics, softwares and Information Technology.

For details contact **:** Director, Aryabhatta Research Institute of Observational Sciences (ARIES), Manora Peak, Nainital-263 129, (Uttaranchal) India

Phone : +91-5942-232655, 233727, 233734, 233735, 235136, 233583

Fax : +91-5942-233439

E-mail : library@aries.ernet.in

Website : http://aries.ernet.in/

ANSWERS TO "DO YOU KNOW?"

A1. Cloche is a small translucent cover, used to protect delicate plants.

A2. Actuary is a skilled mathematician and statistician who applies estimates based on mathematical probability upon all kinds of financial risks, problems and calculations.

A3. The name is derived from the Latin word 'Toporius' for ornamental gardener.

A4. Poison is actually a saliva rich in protein which helps snake to digest its prey better.

A5. 58.

A6. Approximately 100 billion tons.

A7. Yes.

Conferences / Meetings / Symposia / Seminars

Date	Topic	Contact
20-23 June 2006	36th International conference on **Computers in Industrial Engineering**, Taipei, Taiwan	**Prof. Daniel Sheu** Program Chair, Department of Industrial & Engineering Management National Tsing Hua University Email : dsheu@nthu.edu.tw
6 to 9 June 2006	2nd Annual International Conference on **Surveying, Positioning and Locational Intelligence** Bangalore.	**Graticule 2006 Secretariat** GIS Development G-4, Sector—39, Noida 201301 Email : info@Graticule.org
7-8 July 2006	National Conference on **Innovations in Information and Communication Technology,** Coimbatore	**Organising Sectetary,** NCIICT—2006 Department of Information Technology PSG College of Technology Peelamedu, Coimbatore-641 004 Email : nclict2006@mail.psgtech.ac.in
18-20 July 2006	10th International Congress on **Insurance : Mathematics and Economics,** Belgium	**AFI Leuven Research Center** Katholieke Universitet Leuven Naamsestraat 69 3000 Leuven, Belgium Email : ime2006@kuleuven.be
16 to 19 August 2006	Frontiers in **Nanoscale Science Technology and Education** Cochin	**Dr. Ravi Pandey** Department of Physics Michigan Technological University Email : pandey@mtu.edu

September 18-21 2006	**Global Organization Development** Summit Mysore	**Dr. Mohanakrishnan Raman** SDM Institute for Management Development, Site No. 1, Chamundi Hill Road Siddarthanagar Post Mysore – 570 011
October 15-17 2006	National Conference on **Vibration Problems,** Guna	**Dr. Vipin Tyagi** Jaypee Institute of Engineering and Technology AB Road, Raghogarh Guna (MP)—473226 Email : tyagivipindr@rediffmail.com
November 17-19 2006	11th Word Congress on **Clinical Nutrition** Mumbai	**Dr. S. B. Gupta** 18, Greylands, Railway Officer's Lines, Mumbai (MS) 400020, Email : sbgupta@vsnl.net
November 23-25	National Conference on **Quality Improvement in Food Processing : Role of Science & Technology,** Kolkata	**Dr. Biswanath Das** General Secretary Indian Association for Productivity Quality & Reliability AD-276, Sector - I Salt Lake City, Kolkata 700064 Email : iapqr@yahoo.co.in
2006 24-26 November 2006	National Conference on **Innovations in Indian Science, Engineering & Technology,** New Delhi	**Dr. D P Bhatt** National Physical Laboratory Dr. K S Krishnan Road New Delhi 110012 Email : vigyanbharati2@rediffmail.com
November 27-28, 2006	National Conference on **Beneficiation and Value Added Mineral Products,** Nagpur	**Dr. A. K. Nandi,** Mineral Information and Development Centre, 206, Gulmohar Apartments, Tilak Nagar, Nagpur 440 010 Email : aknandi@sify.com

BOOK REVIEWS

QUESTIONS AND ANSWERS IN ENVIRONMENTAL SCIENCES—*S. K. Basu and A. K. De*, University Press, 3-5-819, Hyderguda, Hyderabad – 500029, Price 210/- ISBN 81 7371 547 5

It was indeed a pleasure for me to go through the book entitled "Questions and Answers in Environmental Science" authored by S. K. Basu and A. K. De and published by the University Press, Hyderabad. The purpose, content and concept of the book have been explicitly explained in the Preface. However, there are many books on environmental science which are narrative and voluminous. One can get lots of useful information from those books. But ask questions and get the right answers type of books are very few. Monotonously narrative treatment very often makes any subject very dull. But short intelligent questions provoke interest and enthusiasm among the readers. If the answers are readily available, the book becomes a boon to the readers. Environmental science is now emerging as an essential discipline not only in the field of formal education but also in our social life. After Stockholm conference on Human Environment in 1972 and Earth Summit at Rio in 1992, the problem of environment has got highest priority in our sociopolitical domain. The authors of the book have been very meticulous in selecting the right type of questions covering various subdisciplines of Environmental Science. More than 1500 questions have been asked in a classified manner under 14 sections starting from Ecology and Ecosystem to Environmental Legislation and Planning. The approach of the book is multidisciplinary and objective questions of various types are asked and appropriate answers are provided. I appreciate the endeavour of the authors for providing a list of acronyms and exhaustive references. I am confident that the book will be a ready reckoner to the students, researchers, teachers, environmentalists, environmental officers, NGO personnel concerned with environmental issues and common educated people. However, I suggest few changes/modifications given below which may kindly be considered in the next edition :

Suggestions

Sl. No.	Page No.	Items
1.	1	Ecology and Ecosystem-this section should start with the definition of Ecology (Which is given in Page-3)
2.	4	Atmosphere, lithosphere and hydrosphere are not the subdivisions of biosphere (See P-6, where definition of biosphere is given)
3.	6	The first definition of biosphere is not correct.
4.	7	Definition of food chain is not precise. Consult ecology book
5.	10	Steps of energy flow is not correct-Consult ecology book
6.	25	The definition of limnology is not correct-See book on limnology
7.	35	Phytoplankton are not found in air
8.	79	Include Leibig's Law of the minimum
9.	216	Definition of biomonitoring should be more precise. What is seniors ?
10.	231	The definition of indicator species should be precise.

Prof N. C. Datta
Retired Professor
Department of Zoology
Calcutta University, Kolkata

HARIDRA (TURMERIC) : ANTIMICROBIAL POTENTIAL by *Purshotam Kaushik*, Chowkhamba Sanskrit Series Office, K—37/99 Gopal Mandir Lane, Post Box No 1008, Varanasi 221 001, Price 175/-, 2003, pages 124, ISBN 81-7080-084-6

This book entitled "Haridra" starts its introduction with the history of turmeric. Turmeric, *Curcuma longa*, is one of the 42 species of the genus curcuma grown commercially in India. Few pages have been devoted to the use of turmeric in Sanskrit literature particularly Charaka Samhita. Some of the Sanskrit slokas containing the medicinal properties of turmeric have been explained in details in this book.

Turmeric contains curcumin, which has a lot of biological potency. Reports indicate that curcumin has antiinflammatory, antioxidant, antimicrobial, inhibition of platelet aggregation, hepatoprotective, and chloretic properties. The chemical constituents along with properties and estimation of curcumin have been discussed. The medicinal properties of turmeric have been interpreted in terms of its traditional uses and as folklore medicine. The cultivation and micropropagation of turmeric have been also discussed.

This book brings a discussion on patenting in the light of Trade Related Aspects of Intellectual Property Rights (TRIPS). Many of our medicinal plants including neem, turmeric, basmati, karela, brinjal, jamun etc have been patented by multinational companies. The patent to turmeric has been won because of sincere efforts of CSIR. The author suggests that to safegurard the biological wealth of India a well documented inventory of Indian Flora should be prepared and patented before foreign companies gain access to them.

The introduction ends with a writeup on microbial and clinical manifastations, mechanism of action of antimicrobial drugs and factors affecting antimicrobial activity. The curatives properties of some medicinal plants as referred to in the four Vedas have been mentioned.

The second chapter on review of literature starts with classification of microbes. The bacterial virulence factors have been discussed where focus has been made on medicinal contributions of *Curcuma longa*. The active principle of turmeric is curcumin which has been reported to posses antioxidant and antimicrobial properties. Some of the recent reports on curcumin have been cited in this chapter.

The author indicates that the above traditional reports and medicinal properties of turmeric have inspired him to find out the antimicrobial effects of aqueous extracts of *Curcuma longa*. As a result, in the next two chapters he has given a detailed report of his laboratory studies with turmeric extract. The chapter on materials and methods discusses the preparation of medium for microbial culture, isolation of microorganism, preparation of the alcoholic extract of *C longa*, and techniques for antimicrobial studies.

The results and observations of this experiment, discussion and summary are given in the next chapter. It has been found that alcoholic extract of *C. longa* has significant effect on growth of gram negative bacteria. The results has been found to be compatible with antibiotics. Keeping these observation in view the author explains why turmeric helps in curing urinary tract infections as used traditionally by ayurvedics. The book ends with a number of references and an index. There are several coloured photographs attached to support the results of the experiment performed.

The above book in divided into two portions. The first portion relates the traditional use of turmeric, which is written for layman and the second part contains experiment and results, which is for researchers. The manuscript book appears to be printout of a thesis rather than a book. The experiment done is a repetition of work carried out earlier in several laboratories. The chemical compound possessing antimicrobial properties in the extract of *C. longa* has not been identified and also the exact mode of action of turmeric extract has not been discussed. This report is a preliminary work done to identify the antimicrobial property of *C. longa*. It is not very clear for which type of readers the book is intended.

There are a lot of printing mistakes in the book. Some of the photographs could have been easily avoided to reduce the price of the book. This could have helped the research students working on turmeric to preserve a copy for their reference.

Dr. Amit Krishna De
The Indian Science Congress Association
Kolkata

S & T ACROSS THE WORLD

LESS EXPENSIVE VERSION OF COCHLEAR IMPLANT

Indian scientists are working on an indigenous version of cochlear implants which are electronic devices implanted in the skulls of those persons who are suffering from hearing loss.

There are only three companies, one in the USA, one in Australia and the third in Austria where these implants are made. Now the Defence Research and Development Organization (DRDO) in New Delhi would also be involved in the manufacture of this cutting edge piece of equipment. The cost of these implants is Rs 5 to 10 lakhs abroad, which puts it far beyond the reach of the vast majority of people in the country, but the indigenous version would be priced much more modestly at Rs 50,000 to Rs 1 lakh.

The product is likely to be ready in four to six months following which it would be tried out on animals. Most likely guinea pigs would be used for the tests, who would be made deaf by drugs and then the device would be implanted to see whether they can hear. These animal studies would be conducted at the Defence Institute of Physiology and Allied Sciences (DIPAS) and the Ram Manohar Lohia Hospital, New Delhi, would also be involved in the studies.

(Science Service, Nov 16-30, 2005)

PROBING BENEATH MARS' SURFACE

An international research team has reported the first radar soundings of the subsurface of the planet Mars, which reveals layered deposits reaching more than one km deep at its poles and a shallow buried structure that may be an impact basin.

The planet's north polar layered deposits consist mainly of an upper unit, thought to be dominated by water ice, and a lower unit with a large amount of sand that is probably cemented with the ice. Additional data from the northen lowlands of Mars' northern equatorial region, reveal a quasi-acicular structure about 250 km across that is believed to be another impact basin.

These findings have been reported by the European Space Agency's Mars Express spacecraft carrying the Mars radar probe called MARSIS.

(AAAS Release, Nov 30, 2005)

GENETIC ROOTS OF EUROPEANS

Based on the extracted and analysed mitochondria of 24 skeletons of early farmers from 16 locations in Germany, Austria, and Hungary, researchers have concluded that these early farmers belonging to the Neolithic, or "New Stone Age", who brought agriculture to Europe about 7500 years ago did not leave much of a genetic mark on modern European populations. Instead, the roots of European ancestry can be traced to the " Old Stone Age" Paleolithic hunter-gatherers who arrived in Europe around 40,000 years ago.

For the purposes of the study, the researchers studied mitochondrial DNA from early farmers in central Europe. Mothers pass on mitochondrial DNA to their offspring primarily" as is", without or recombination with mitochondrial DNA from their fathers. Mitochondrial DNA therefore provides a way of piecing together how closely members of a species are related, using maternal lineage as a guide.

It is hypothesized that small pioneer groups may have carried farming into the new areas of Europe from the "Fertile Crescent" of the near east where it was practised about 12000 years ago, and once farming took hold, the surrounding hunter-gatherers could have adapted to the new culture and then outnumbered the original farmers. A range of archaeological evidence supports different aspects of this hypothesis.

("Science" Journal, Dec'2, 2005)

COMPUTER TECHNOLOGY TO TACKLE SECURITY ISSUES

Battelle, a leading US company in science and technology, hasteamed up with UK based OmniPerception Ltd a major computer vision player, to develop and deploy next generation "specific object recognition" capabilities for the world's security and defence communities.

Best known for its unique automatic facial recognition technology for identity cards, biometric passports, and other security initiatives, the UK company is also the world's leading supplier of market research tools for the analysis of TV and film footage. This collaboration with Battelle is expected to extend further OmniPerception's core technology to intelligent computer vision in the national security arena and will create a new range of intelligent computer vision solutions.

(Battelle News, Dec 3, 2005)

भारतीय विज्ञान कांग्रेस संस्था

14, डा० विरेश गुह स्ट्रीट, कोलकाता 700 017, भारत

THE INDIAN SCIENCE CONGRESS ASSOCIATION

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

Telegram : SCICONG : CALCUTTA
Telephone : 2247-4530, 2281-5323
Website : http://sciencecongress.org
http://sciencecongress.nic.in

Fax : 91-33-2240-2551
E-mail : iscacal@vsnl.net
iscacal_2004@yahoo.com

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- *As per resolution of Executive Committee in its meeting held on October 10, 2004 application for membership of ISCA in 'Care of' of some other person is generally discouraged. However, if in the application form "care of" address is given then there should be also signature of the person in whose name "care of" is given.*
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14, डा० विरेश गुह स्ट्रीट, कोलकाता 700 017, भारत

THE INDIAN SCIENCE CONGRESS ASSOCIATION

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

Telegram	:	SCICONG : CALCUTTA	Fax	:	91-33-2240-2551
Telephone	:	2247-4530, 2281-5323	E-mail	:	iscacal@vsnl.net
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Membership of the Association is open to persons with *Graduate or equivalent academic qualification* and interested in the advancement of science in India.

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

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

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**Admission fee of Rs. 50/- is needed only for becoming a new annual member and not for sessional member / life member / Institutional member / student member / donor.*

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

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

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

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

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

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

Note : All Money Orders, Bank Drafts etc. should be drawn in favour of "*Treasurer, The Indian Science Congress Association*". Members are requested to mention their Card No. while making any correspondence to ISCA office.

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