EVERYMAN'S SCIENCE

Vol. XLVI No. 3 (Aug '11 – Sept '11)

COVER PHOTOGRAPHS

Past General Presidents of ISCA

1. Dr. Atma Ram	**(1968)**
2. Dr. A. C. Joshi	**(1969)**
2. Prof. A. C. Banerjee (died pre-maturely)	**(1969)**
3. Prof. L. C. Verman	**(1970)**
4. Prof. B. P. Pal	**(1971)**
5. Prof. W. D. West	**(1972)**
6. Dr. S. Bhagavantam	**(1973)**

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

Annual Subscription : **(6 issues)**

Institutional ₹ 200/- ; Individual ₹ 50/-

Price : ₹ 10/- per issue

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EDITORIAL

MINORITY WELFARE : A REFLEXIVE CONCEPTUALIZATION

INTRODUCTION

India is a young democratic country but with a long history dating back to at least six thousand years. In her long history conceivably all types of states, more or less numerous, have existed on the Indian territory. Just before the independence, India was directly under the British rule and barring a few elite Indians were excluded from state. After independence the Indian political elite adopted a democratic model of state aimed at creation of a sovereign, secular, democratic republic. The credit for this goes to many people and many forces. Western educated political and legal elite, of course, played a major role in this and they developed a framework of Indian constitution based on experiences of diverse types of Western democracies, as well as Russian and Chinese experiences. In this framework Indian state adopted the model of parliamentary democracy and federalism though some visionaries like Gandhi were suspicious of this model right from the beginning. This democracy would be meaningless if the interests of minorities are not protected. This article looks at the issue of minorities in India, state approaches to minority question and the corresponding risks.

At the outset it may be said that democracy is a dynamic process. It is not a fixed state of affairs. Unless guarded cautiously against oligarchic tendencies it can easily be subverted in the favor of the elite. One issue that democratization of society poses is the issue of minority. This calls for a reflexive definition of the majority and minorities. As against the Western definitions of minority based on gender and/or ethnicity, India cannot have a simple definition of minorities. Commonly, in India the term minority is used for Muslims. Technically it implies religious minorities. The purposes of defining minorities in India are also different from those in Western countries. It is not merely to fight against the denial of employment opportunities as in the West but it includes radical, active policies to improve representation of minorities in government jobs and education without waiting for the social processes to produce this in the long run.

DEFINITION OF MINORITIES

Using the Gisbert's notion of negative and positive roles of state, the term democracy may be defined not only in the negative sense of protecting the citizenry and providing for food, safety and security, but also in a positive sense of creating a truly participatory democracy. Thus the democracy is to be viewed not only as the negation of totalitarian, autocratic and fascist tendencies but also as a condition in which the minorities have continuing special safeguards protecting them against the tyranny of majoritarianism. This calls for a definition of minorities. The question about safeguarding the interests of the minorities is closely linked with the question of how minorities are conceptualized. As the state evolves in a rapidly changing, globalized world it creates new sources of vulnerabilities and new types of vulnerable groups. Minorities and vulnerable groups need to be constantly redefined.

Louis Wirth defined minority group as "a group of people, who, because of their physical or cultural characteristics, are singled out from the others in the society in which they live for differential and unequal treatment and also therefore regard themselves as objects of collective discrimination."

A minority group may be a numeric majority in society. In the West, for example in Canada, there are two ways of defining minorities. In general, the minorities are defined as constituting of women, persons suffering from any disability, and persons of aboriginal status and external origin. According to the Employment Equity Act of 1995 the Canadian employers are expected to engage in proactive employment practices to increase the representation of all these groups. Specifically, the "visible minority" covers all those visible on the basis of color. They are Chinese, South Asians, Blacks, Arabs/West Asians, Filipinos, Southeast Asians, Latin Americans, Japanese, Koreans and Pacific Islanders. The minorities suffer from hate crimes, higher unemployment and lower incomes despite higher levels of education. More than ten percent population of Canada consists of the latter and very soon their proportion may rise to 20 percent.

INDIAN UNDERSTANDING OF MINORITIES

The constitution of India has been silent on the question of minority. The reason is that the Congress politicians had been nationalist and for a long time they fought against refusal of Indian independence before 1940 on the basis of existence of competing claims on religious and ethnic grounds. The Constitution however recognized the claims of the backward classes, and that too temporarily. As the time passed the Congress politicians started thinking in a different direction. In India the first disadvantaged groups covered under the social justice and chosen for affirmative action were Scheduled Castes and Scheduled Tribes. Their population comprised of nearly 15 percent and 7.5 percent of India's population respectively. They are not called minorities, but in India they are the groups which fit in the conceptual framework of minorities as used in the West. India has a negligible proportion of minorities defined on the basis of foreign origin. The largest of such groups is the population of Hindus and Sikhs who migrated from Pakistan before or after creation of Pakistan. Their movement continued for decades and many of them still live in the condition of poverty but they were not given any special support in education or employment. If at all, there has been a stigma against them. In West Bengal those who came from East Bengal are still called *Bangals* while the natives of Bengal are called *ghotis.* In the western UP those who came from Pakistan were called *Sharnarthis* and the local people had a stigmatizing orientation towards them.

In India the Ministry of Minority Affairs was created on 29th January, 2006 to ensure a more focused approach towards issues relating to the minorities and to facilitate the formulation of overall policy and planning, coordination, evaluation and review of the regulatory framework and development programmes for the benefit of the minority communities. The Government of India created the National Commission for Minorities Act, 1992 on 17 May 1992. It defined the constitution and power of the commission but not the term minority. It said: "minority", for the purposes of this Act, means a community notified as such by the Central Government". In a notification in 1993 under the National Commission for Minorities Act 1992 (19 of 1992), however, the term minority was defined as follows: Muslims, Christians, Sikhs, Buddhists, Zoroastrians (Parsis).

The Government of India definition of minorities leaves the impression that minorities are defined on the basis of religion. Yet, Jains who are also a religious minority are not included in this list. The different religious groups included in the country are at various levels of socio-economic development. NFHS-3 data show that Jains constitute the wealthiest community in India, next only to Sikhs. One is excluded from the definition of minority while the other is included. There is also a big difference in size of population of each. In several states Muslims, Christians and Sikhs also constitute the majority and the other religious groups including the Hindus constitute a smaller

fraction of the total population. It may also be noted that while the proportion of certain religious communities in central government jobs may be less than their share in the population they have the monopoly over land and certain skills. Thus a question may be asked: do the religious minorities in India need special safeguards because they suffer from stigmatic orientation or because a sizeable population of them comes under the backward classes, often for historical reason (one reason being that at the time of partition Muslim elite decided to move to Pakistan). It needs to be emphasized that in India more than 90 percent population comes under backward classes (including SCs and STs) or below the poverty line. The National Minorities Development & Finance Corporation (NMDFC) was created on 30th September 1994, with the objective of promoting economic activities amongst the backward sections of notified minorities. It provides concessional finance for self-employment activities to eligible beneficiaries belonging to the minority communities, having a family income below double the poverty line. Let us not forget that an overwhelming majority of India's population falls below double the poverty line.

As the issue of community based reservations found widespread political support commissions were appointed for examining conditions of backward classes in general and Muslims in particular and the government has partially accepted the recommendations of each of them. Without going into history of these commissions it must be said that there is an increasing political demand for treatment of various communities as backward for reservation in educational seats and jobs and academicians and analysts play a marginal role in debate on minority issues. For all practical purposes in India the minorities are also the beneficiary of schemes launched for backward classes and those below the poverty line.

UNIQUE PROBLEMS OF INDIA

There are many similarities as well as dissimilarities between India and the West. For example, in the past both Canada and India have been dependent on United Kingdom (UK). Canada severed dependence on British Parliament completely in 1982 and India in 1947. Both have a large population of aboriginal people living for millennia. Both have parliamentary democracy and both have a written constitution though unlike Indian constitution Canadian constitution gives importance to uncodified traditions and conventions also. Today in both the countries a large number of people believe that political elite are unresponsive and they do not represent the public opinion. However, Canada is a constitutional monarchy and the prime minister of Canada is much stronger that the prime minister of India. It is noteworthy that due to the post-independence politics Sanskritization, a endogenous model of change and resilience, has been replaced by differentiation implying Sanskritization in society and backwardness in politics. Thus the newly asserting power groups developed on the basis of the old minority policies are often found acting in a reactionary fashion thwarting the process of further democratization.

REFLEXIVE DEMOCRATIZATION AS THE NEED TO PROTECT DEMOCRACY

As said above, unlike the Western approach, Indian approach to minority welfare is radical, legalistic and the result of the post-independence electoral politics. It may cause more problems than it solves. In place of focusing on removing disadvantages it uses state power to implement quotas for various castes and communities which add to more than 90 percent population of India, dividing them into several categories. In absence of a radical employment policy, only about eight percent population being in regular jobs in formal sector, it is unlikely to succeed. It will create distrust, reinforce stereotypes and help only the

elite from all categories. In view of the above, there is a need to define minorities reflexively. There is no alternative to democracy and there is a need for continuous democratization of state and education. Yet, there is a need for academicians and planning experts to draw attention of the government towards the following questions :

1. Should Indian society choose the path of democratization for furtherance of interests of all or should it move towards radical or totalitarian form of state because the minorities are not going to get their rights in a normal course?
2. If democracy is to be protected, what are the key indicators of the process of democratization and empowerment of the powerless? Is it enough that the minority welfare is restricted only to these key indicators of participation or the minorities must have enough say in state and culture?
3. Should the country go for proportionate representation of broad communities in all key areas of development sacrificing the interests of society, or only for their adequate representation? What needs to be done for the backward classes in each community? What criterion should be given precedence - community or class? What about gender? Several political leaders in India (most notably Dr. Lohia) included all women in the category of the backward. Somewhere in the fight for class and religion based affirmative action the issue of gender seems to have been given lesser importance.
4. Which are the groups in need of special provisions to fight against various disadvantages preventing their development and participation at a given time? How can those who have already crossed the threshold level be removed from preferential treatment or affirmative action?

There is a need for experts in politics, sociology and law to assert here. Democracy cannot be left to the self interests of the politicians. If the state processes are left to political leaders alone this too can lead to actualization of Robert Michel's "iron law of oligarchy" and this will kill the democracy. The definition of minority for legitimization of unrepresentative government can do an immense and permanent harm to the democratic fabric and the needs of integration.

Indian approaches towards minority's welfare are fraught with identity politics. It is doubtful whether in a society making rapid progress in the macro economic sense, and yet with an overwhelming majority of people being poor, identity politics can solve the problems of the needy and stigmatized on different bases. This calls for a new thinking on the matter of minorities. The models are :

1. **Sarvodaya model.** This model calls for equalization of rewards at all levels, restriction on the upper income, a simple and sustaining economy and a greater concern for the moral worth of individual even at the expense of isolating national economy from the world economy for some time.
2. **Representative education elite and representative bureaucracy.** This model seems to be the chosen model by the political elite today. Except reservation for Muslims even the main opposition parties concur with this model. This model cannot help the real social minorities. The logical outcome of this model is the demand for "caste and communal representation" in politics/state. The assumption is that equality is an unrealizable goal; it can exist only in the form of fair distribution among the elite of all castes and communities. The risk is the *racialization* of castes and communities of India leading to a *racialization* of all social representations and a civil war in the long run.

3. **A reflexive affirmative action.** This calls for a beginning of reverse discrimination whereby the elite from all categories are truncated from the state support. This implies defining not the backward classes but the forward classes whose share in the power and wealth should be increasingly restricted, be they from any caste or community. This can easily be achieved by raising the level of reservation dynamically to as high a figure as the extent of real poverty and excluding the elite from all castes and communities from the ambit of affirmative action.
4. **The Western approach.** Western approach calls for preferential treatment of minorities. It implies expansion of education facilities, improving quality standards in government schools and providing loans and other facilities to students from the weaker communities. This approach may delay the process of social justice but it will contribute more to integration and development of society.

There is a need to argue for a dynamic mix of the above. It may be hypothesized that a mix of 1 and 3 mentioned above seem to be the most appropriate model for many of the country's problems. It has a potential for social justice, equality, development of citizenship as well as social integration. Let the academicians and visionaries examine the methods and implications of this. It is their historic responsibility to save the oldest civilization from becoming prey to political adventurism.

Dr. A. K. Sharma

Corrigenda

In the Editorial entitled "Small Promises Big in Agriculture and Health!" written by Professor Akhilesh K. Tyagi published in Everyman's Science Vol no 46 issue no 2 (June–July) 2011, the following printing errors have been made :

1. 1st paragraph 1st column line 6 on page 71 should read as "Mello" instead of "Melio"
2. 1st paragraph 1st column line 10 on page 71 should read as "*et al.*" instead of "*et. al.*"
3. 2nd paragraph 2nd column last line on page 71 should read as "*trans*-acting" instead of "frans-acting"
4. 1st paragraph 1st column line 18 on page 72 should read as "- - organisms. The discovery–". instead of "organisms the discovery--" "The discovery - -" should start as new paragraph.
5. 1st paragraph 2nd column line 4 on page 72 should read as "β2" instead of "(32"
6. 1st paragraph 2nd column line 7 on page 72 should as "miR-122" instead of "rniR–122"
7. In Reference on page 73 number 1 should read as "X Chen" instead of "X, Chen"
8. In Reference on page 73 number 1 should read as "X Fire, SQ Xu, - - - CC Mello, *Nature* **391**:806-811, 1988." instead of "A Fire, S Q Xu, --- CC Mello *Nature* **391**:806-811, 1998."

The errors are regretted.

PRESIDENTIAL ADDRESS

STANDARDIZATION : A TRIPLE-POINT DISCIPLINE

L. C. VERMAN, M.S., Ph. D, F.S.E.S, F.N.I

Madame Prime Minister, distinguished guests, delegates and fellow members of the Indian Science Congress :

While expressing my deep gratitude for the honour conferred on me by this august body of Indian scientists, I must confess that the news of my election came somewhat as a surprise to me. Whatever moved the leaders of the Congress and its members to confer this unique honour on me, I could not but feel inadequate to fill an office which in the past had been the occupied so ably by many distinguished men of Science and outstanding leaders of thought, like your most worthy father, Madame. It was, therefore with great diffidence that I accepted it, in the hope that I may be able to be of some service, however small. As it turned out, I have been out of India for most of the year of my term of office and I have been able to take only a limited part in any of the organizational details or in any deliberations concerned with future policy and planning. I, therefore, owe you all my sincerest apologies and regrets.

This, I believe, is the second occasion when a session of the Congress is being held at the seat of an Indian Institute of Technology instead of a university.

Kharagpur Institute was the first one of the kind to be established in independent India under the pioneering care of a distinguished President of the Indian Science Congress, the late Dr. J.C. Ghosh who had the distinction of leading the way for other similar institutes which came later. All of them have rendered outstanding service to the making of engineers and technologists and have established very high standards of educational efficiency and original research. It is now generally acknowledged that their organizational pattern and methods of approach of academic problems are worthy of emulation by universities and other places of higher learning. In beginning to hold its annual sessions under the auspices of the Indian Science Congress, it is breaking new ground, which may be considered as being well in line with its new policy of bringing Science and technology closer together.

It may be recalled that in their presidential addresses both Professor T.R. Sheshadri in 1967 and Dr. Atma Ram in 1968 emphasized the importance of this new role for the Science Congress and recommended that the specialized nature of work of the various sections of the Congress could with advantage, be relegated generally to the specialized scientific societies and academies, while the Congress could divert its energies more and more to the consideration of problems of public interest, in which Science plays an important part. National issues effecting the development of Science in the country should also continue to receive its attention. While there appears to be a general agreement on these proposals, it would seem that the pace of re-orientation needs

* General President, Fifty-Six Indian Science Congress held during January, 1970 at Kharagpur.

perhaps be accelerated. May I offer a suggestion that the Congress could usefully initiate consultations with specialized learned societies, for the latter gradually to take over the specialized functions of it sections. To begin with, it could perhaps be arranged for the sections to meet more often in joint session with some of these specialized bodies. Gradually a more definite pattern might develop for further consideration and action. Many problems are bound to arise during the transition period, but by mutual consultation an agreed plan may ultimately be evolved.

It is customary for the president to talk about some aspect of the subject of his specialization, in which he has been particularly active. I have no profoundly scientific theme to present to you today, but what we have to say about standardization should interest scientists generally. Standardization being of primary public interest, to talk about it may be considered well in line with the new orientation now being given to the activities of the Indian Science Congress. Nevertheless, the subject in sharp contrast to the most exciting and spectacular advances registered in space travel during the past year, particularly man's successful landing on the moon, for which our colleagues abroad deserve our highest praise and heartiest congratulations.

I have chosen to call standardization a triple-point discipline for more comprehension, but perhaps more accurately it might be described as a multi-point discipline, for it is a discipline in which applied sciences, technology, industry and economics play extremely important parts. Human psychology, public relations, management and other social sciences are also involved. In very general terms its object may be described as regulation of man's relationship to man in respect of the daily exchange of goods and services. Each one of these wide fields of knowledge contributes to standardization and all of them in turn profit by it. Standardization, indeed, furnishes the conditions and the environment under which they can act and re-act on each other to mutual advantage and for the benefit of the community.

But whether "standardization" itself is as yet worthy of being called a discipline is a question on which there may be some difference of opinion. During the past twenty years or so, in fact since the end of the second world war, it had made considerable progress in the world, perhaps more than during the previous half a century of its existence as an organized activity in the more advanced countries. The Science Congress secretariat by labelling my own specialization as standardization instead of engineering or something else has, consciously or otherwise, acknowledged it as a discipline. Whatever the general view may be, it cannot be denied that standardization has come to stay as an important activity of a modern society and judging from its present rate of growth, it is bound to play a dominant rule in pooling together the knowledge and experience of various disciplines for the ultimate benefit of society.

It was during the interim government days, just before the independence of India that we in this country began to organize our standardization structure. At that stage we had little knowledge of its contents or methodology, even less of any direct experience. The International Organisation for Standardization (ISO) had just been created to undertake the coordination of national standards in the interest of providing the technological basis for promoting world trade, by removing an important non-tariff barrier.

As our work proceeded, it became more and more clear that the first task was to establish a meaningful vocabulary, specific to this field of work and to clarify the inter-relationships of the various concepts involved. It was in this context that the idea of standardization space was evolved, which today has become widely acknowledged all over the world. This three-dimensional space concept should in no way be confused with the mathematical space concept of the continuous or

discrete variables. The vocabulary has been borrowed merely for the convenience of visualizing the inter-relationship between the subject, the aspect and the level of a standard. Each of these attributes of a standard being independent of the others have some of the characteristics of the independent variables of mathematical space. Such a representation of standardization structure has therefore, been considered of great value by most workers in the field all over the world, particularly in clarifying much of the terminology involved. For example, most arguments about what constitutes a specification and what constitute a standard have been neatly resolved; how in-plant standardization is related to national standardization and how the former depends on the latter has become self-evident. Furthermore, aims and objectives of standardization activity at various levels and in different contexts can now be easily delineated and appreciated. Moreover, with such a scheme in mind, the methodology and approach to several intricate problems become apparent.

From these somewhat theoretical speculations, one was led to the need for defining authoritatively the terms involved in a more precise language. Even for the concept, standardization, there existed several definitions besides the ones given in various dictionaries and encyclopedias. It was obvious that unless an internationally agreed set of definitions of important basic terms was available, the existing divergences will continue to hamper advancement in this newly emerging field of work. At this stage, the ISO set-up was moved, which after several years of discussion finally succeeded in 1960 in securing general international agreement on definitions of seven terms, including standardization, standard, specification, codification and so on. These definitions reflect more accurately the modern trends of thought and meet more closely the need of recent developments.

The most important and basic issue to be settled, however, was the unification of weights and measures and elimination of the multiplicity of existing units of measurement, prevailing in the country. Leading scientists of India had already created the Indian Metric Society which had been advocating this unification on the basis of the metric system. The Science Congress itself had expressed the view that decimalization of currency and introduction of metric system should be brought about side by side at any early date. It only required existence of a body specially concerned with standardization to devote concentrated attention to the matter and give it a real push.

Within two years of its creation, ISI managed to produce a report based on a country-wide survey of opinion of all important interests, in which action-oriented recommendations were made; and which the Government could ill-afford to ignore. In view of the Government's concern with ever so many problems arising out of the partition of the country, it took a good part of six years before it could be persuaded to take a definitive decision and that was made possible largely because of the keen personal interest that the then Prime Minister Jawaharlal Nehru himself took in progressive reforms of this kind. The result is that India today is a metric country both legally and in practice. It has not only led the way for other countries to adopt the metric system, but has also been rendering active technical assistance by way of training and consultancy services to several developing countries, as also to some of the developed ones, like the United Kingdom.

Another thing became apparent in the very beginning that standardization work, being related to and dependent on several disciplines, would require the active participation and cooperation of a very large number of people engaged in applied sciences, technology, industry and economics. Every subject and item of interest to the economy of the country had to be covered, requiring thousands and thousands of standards. The problem was how to enlist the services of numerous specialists, who

should know intimately the processes of design, production, testing and utilization of all sorts of goods ranging from mineral, animal and agricultural inputs to the wide spectrum of industrial outputs. Obviously it was hardly practical to employ specialists on such a wide front, and yet their services were considered indispensable. We soon learnt from sister organizations abroad that time-tried methods existed by which such services could be secured without adding greatly to the staff or the budget of the central organization.

The basic idea is to recognize that standardization serves industry and trade as well as the user and consumer. It brings manifold benefits to all users of standards, by way of economies to be effected on several fronts, which lead not only to the enhancement of profitability of enterprises but also to the expansion of markets, through ensuring consumer satisfaction. The organized consumers, who buy goods and services on a large scale, like governments, corporations, municipalities, and industrial and other enterprises, have the possibility of not only making their budgets go further but also earn the gratitude of users by ensuring serviceability and reliability of stores purchased according to the specified and generally agreed standards. All such organized sectors of economy have a primary stake in reflecting their knowledge and experience in standards and therefore to make their specialized personnel available to the work of the central standards organization on a voluntary basis. In order to ensure such participation on a continued basis, it was essential that the interests concerned were properly approached and the work was efficiently organized. Here is where human psychology and management science enter the standardization sphere.

Although in more advanced countries organized standardization had made a beginning with the opening of this century, its growth had been rather slow until after the second world War. Nevertheless, before the second world war, most producers and organized consumers in those countries had gradually come to realize the manifold benefits they stood to derive from reliance on standards and their regular use.

In the newly independent India how was this consciousness to be brought about ? Obviously many years would be required, if we were to follow the pattern of overseas countries. Fortunately, the national planning effort provided the incentive as well as the means. Successive Five Years plans gave an all-round fillip to the economic growth in all sectors and that in accordance with well-thought out series of inter-related and inter-dependent projects. The Indian Standards Institution (ISI) realized that, if its own efforts were to make a real impact on the economic life of the country, it would have to evolve its own parallel plans and organize its standardization work on a scale commensurate with the increasing demands of the country resulting from its planned advancement under the successive plans. It was necessary, therefore, that ISI should include, as an essential component of its plans, a comprehensive compaign of promoting public relations, which had for its object the education of the public and all others concerned. In particular, producers, users and consumers were to be informed of the manifold benefits they stood to derive from active participation in the standardization movement; their direct participation was to be enlisted in this nation-building work, which, being in fact in their own interest, was to be so projected, Furthermore, they were expected to contribute not only in terms of cash but also in services of their specialist personnel.

The response was wide-spread enough to enable ISI to stabilize itself during the first decade and organize its work on a broad-based foundation to emerge in due course as the largest and most heterogeneous cooperative enterprise in the country, controlled and managed jointly by the governments at the center and in the states, producers, consumers

and trading interests, as also the technologists and the engineers. It is estimated that the interests associated with ISI currently expend on ISI work in the aggregate about the same amount in terms of resources, as the ISI's own total budget which today runs up to about 12.5 million rupees annually.

Obviously, participation of several groups in a joint venture of this nature requires a mechanism for mutual consultations on a vast scale, which is largely a management problem. But philosophical and psychological consideration are also involved. If these diverse groups are to participate of their own free will and are not to be in any way responsible to an electorate or a nominating authority then it is clear that the decisions jointly arrived at cannot be taken by majority vote. It is the consensus principle that plays an all important role in decision-making on the contents of all standards. This approach has proved to be quite successful in most other countries as well as in India. But in India its success was rather astonishing because not long before, we have been told, Indians were not capable of operation among themselves and that independence for them might not be quite in their own interest.

But while the process of arriving at a consensus through cooperation may be acknowledged to have succeeded in the realm of standardization in India, the question may legitimately be asked about its chances of success in other fields of cooperative endeavour—particularly Political Science as applied to large masses of people. As an outsider, it hardly behoves me to tread on unfamiliar ground of such a field as this, in which, Madame, you have shown such a brilliant success in recent months. But one thought does occur to me, which with your permission I would like to express. Modern democratic principles seem to ascribe a magic power to the number 50, when used as a percentage. A majority in elections and in legislatures, no matter how narrow, is taken to distinguish right from wrong, good from evil, suitable from unsuitable, even though a bonaflde case may exist for the justification of a majority view. One is inclined to enquire, whether in most cases it would not be a better approach to attempt and find a solution in which more than the simple majority bordering on 50 per cent could concur? However, such a fundamental change in democratic institutions would require quite a different approach, for example: a change from the subjective to the objective, from that of a generalist to that of a specialist, from predominantly party-bound to predominantly nation-oriented, and so on. To bring about such a change, the examples of older established democracies would hardly furnish any direct guidance. One would have to search a new and be guided by one's own and others' historical experience to find original solutions and establish novel constitutions.

I hope you will excuse this digression, but if a scientific outlook is to guide future development of thought, it is important to learn from every experience. Is it not quite likely that our difficulties in dealing with political problems do not necessarily arise from the peculiarities of our people, but from other more basic causes afflicting most democracies? Is it not conceivable that our experience in the standardization movement in India has provided us with adequate justification for a serious review in other fields?

Another characteristic of the consensus principle is that the standards, which emerge by its application, represent agreements on the widest possible front, among all the divergent interests concerned, which stand to benefit from their use in practice. Thus their implementation becomes an automatic process and no compulsion need be involved for their enforcement. However, there are cases in which certain standards dealing with safety, health and other important matters affecting public good, have to be made legally mandatory. But this is the responsibility of the State, which has to provide the necessary machinery for enforcement

of mandatory standards, like it does for the enforcement of other laws. A broad-based cooperative organization like ISI can only provide the facilities for consultation with all the important interests concerned and also furnish standards based on the largest possible consensus, which the Government could usefully consider for enforcement.

One example of such action that has been taken by our Government concerns the pre-shipment inspection and quality control of exports, which today covers some 85 per cent or more of our exports. While promotional efforts have had a great deal to do with our recently improving export performance, the relativity less well-known contribution of the mandatory application of standards to export goods by Government has not been inconsiderable.

There are many other items controlled in the interest of health and safety under the law of the land, for example drugs, food purity, explosives, boilers, pressure vessels and so on. An example of a field in which Government action is still awaited is the safety of domestic electrical appliances. Coupled with this, of course, is the urgency of securing a more effective implementation of house-hold wiring rules and regulations. With the increased use of electricity in the home and in cottage industries, and with the extension of rural electrification, the importance of such an action cannot be over-emphasized.

Among the large majority of standards intended for voluntary implementation, perhaps the most outstanding example is that of the economic impact made by those dealing with steel and steel structures. A comprehensive survey carried out by the National Council of Applied Economic Research has led to the conclusion that if all the Indians Standards, developed as a result of the Steel Economy Project of ISI were to be implemented, the overall saving in structural steel would amount to some 23.6 per cent. At a modest estimate this may well amount to a saving of 400, 000 tons of steel per year at the end of the current plan period, which means a saving to the Indian economy of some 500 million rupees per year in respect of one item alone. It may also be of interest to mention that these new steel standards were developed well in time for guiding the initial expansion of the steel industry in the mid-fifties and were all written in metric terms. They are among those which are at present being most popularly followed by producers, designers, builders and others concerned.

No similar studies have been made in India in regard to other items of economic interest, but a world-wide interest has been aroused and the International Organization for Standardization (I.S.O) is now considering the possibility of examining the economic effects of international standards on world economy.

Thus far I have given only a few examples of the mutual interaction of industry, trade and economy through standards. The role of Science and technology is equally important. Apart from the indispensable need of standards for terminology, equipment, procedures, methods of test and analysis required for the advancement of Science and technology, it must be recognized that it is Science and technology that constitute the source and furnish the basis of all standardization, which in turn also benefits industry, and trade, and thus influence the economy of nations. While fully acknowledging the valuable contribution made by Science and technology, I am constrained to submit that scientists of India as distinct from technologists have not yet had the opportunity to take a very active interest in standardization. However, the picture is not much different in other countries, though in the Indian context it would be useful if scientists could develop a more active interest in standardization problems bordering on their own particular fields of interest.

It so happens that there are some outstanding problems of standardization which are basic enough to deserve the attention of scientists, perhaps even teams of scientists drawn from more than one discipline. May I mention the most difficult and really basic problem which the standards authorities would like to have resolved early. It is the question of a quantitative estimation of smell and taste. Even the quality of smells and tastes have to be determined subjectively today. Is it possible to find methods for an objective determination of their quality and quantity?

Then there is the field of non-destructive testing, in which many valuable contribution have been made in the recent past. But the whole field may be regarded as wide open and full of opportunities. There is also the need for a satisfactory accelerated weathering cycle or procedure, which could closely simulate the results of normal weathering of protective finishes such as paints, enamels and other organic materials such as textiles and plastics. These are but a few examples. There are many more problems indeed requiring attention. The existing literature may be helpful in defining the problems more precisely, but their satisfactory solution would require quite an original and fresh approach. I am sure the Indian Standards Institution will be pleased to discuss such matters with those of you who may be interested to pursue any of the questions or survey some of the fields as such.

In conclusion, I would again like to express my gratitude for this opportunity that the Science Congress has given me to address the distinguished scientists of India. It is my hope that I have been able to arouse their interest to some extent in this relatively new field which constitutes an interesting and extremely useful meeting ground of several disciplines.

Thank you, Jai Hind

ANCIENT DNA—PORTRAITS OF THE PAST AND THE FUTURE

Anirudh P. Shanbhag*, Manoj Kamalanathan and Ishita Ghosh

DNA is a molecule which contains information about the organism from which it's extracted. Extraction of ancient DNA (aDNA) from the remains/fossils of the organisms enables to establish phylogenetic relationships (relating two organisms to a common ancestor) among extinct and modern species. The cloning of aDNA promises the reintroduction of extinct or endangered species into wild in the near future.

INTRODUCTION

DNA (Deoxyribonucleic acid) is a molecule present in all the multicellular organisms. It contains information about the makeup and character of organisms. Many animals become critically endangered or extinct in the wild and once they are extinct they are lost forever. However, after recent advances in cloning and genomics it is now possible to clone extinct or endangered animals. The prime requirement for cloning is naturally the organism's DNA. But it's not so easy to clone DNA from fossils or preserved remains of dead animals, such DNA is also called as ancient DNA. Mostly, the ancient DNA (aDNA) obtained from organisms belongs to the Pleistocene era which is about 200,000 to 10,000 years ago.

The aDNA acts as an indirect evidence of historical processes that might have occured long time ago. The DNA normally becomes degraded by enzymes in the dead body which cleave nucleic acids such as DNA, RNA etc. commonly known as nucleases. But sometimes, under few conditions such as high salt concentrations, rapid drying and low temperatures, nucleases get destroyed or inactivated before all nucleic acids are broken down into nucleotides (which are the building blocks of DNA)[1].

RETRIEVING ANCIENT DNA :

To retrieve the DNA from dead cells, they are often lysed and methods such as filtration and centrifugation are utilized for the removal of cellular material and debris. The PCR or polymerase chain reaction, a technique which enables to generate multiple copies of DNA in a matter of few hours has made the retrieval of aDNA sequences very easy and hence many samples which have been stored in museums for over two centuries have been utilized and analyzed.[1]

To prevent the contamination of samples by modern DNA, treatment of the laboratory equipment with alcohol (95%–100%), irradiating the entire laboratory and facilities in the laboratory with Ultra Violet (U.V.) radiation, and wearing protective clothing and face shields etc. are executed in the laboratory.

The specimens themselves might be contaminated with modern DNA, and this can be possible despite taking all the necessary measures to prevent contamination. The difficulties increase when we go for extraction of DNA from animals which actually exist even today, for example it's very difficult to extract proper authentic human DNA from fossils as, human DNA is present in the

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laboratories or any other site or place of work. Hence, contamination of ancient DNA sequences by human DNA is often mistaken as ancient human DNA in the samples thus making the findings unreliable.[2]

It's a known fact that the mitochondria and chloroplasts (cell organelles) have multiple copies of their own DNA. Higher amount of copies of the same DNA have high probability of survival as they occur in higher numbers per cell, hence mostly DNA is attempted to be retrieved from mitochondria or chloroplasts. However it's also to be noted that the nucleic acid sequence of the organism often give more phylogenetic information about the organism.[2]

of the molecule)[3]. This condition has been suggested to represent a key adaptation for flight in birds, by reducing the cost of producing energy for the body, associated with having large genome and cell sizes. However, the evolution of genome architecture in birds, or any other lineage, is difficult to study because genomic information is often absent for long-extinct relatives.

Recent finding by Morten E. Allentof *et. al*. showed the identification of aDNA from extinct moa species (*Pachyornis elephantopus*)[4].

STUDY OF ANCIENT DNA IN MAMMALS :

Many fossils of mammals have been found frozen in ice and also in tar pits (such as Rancho

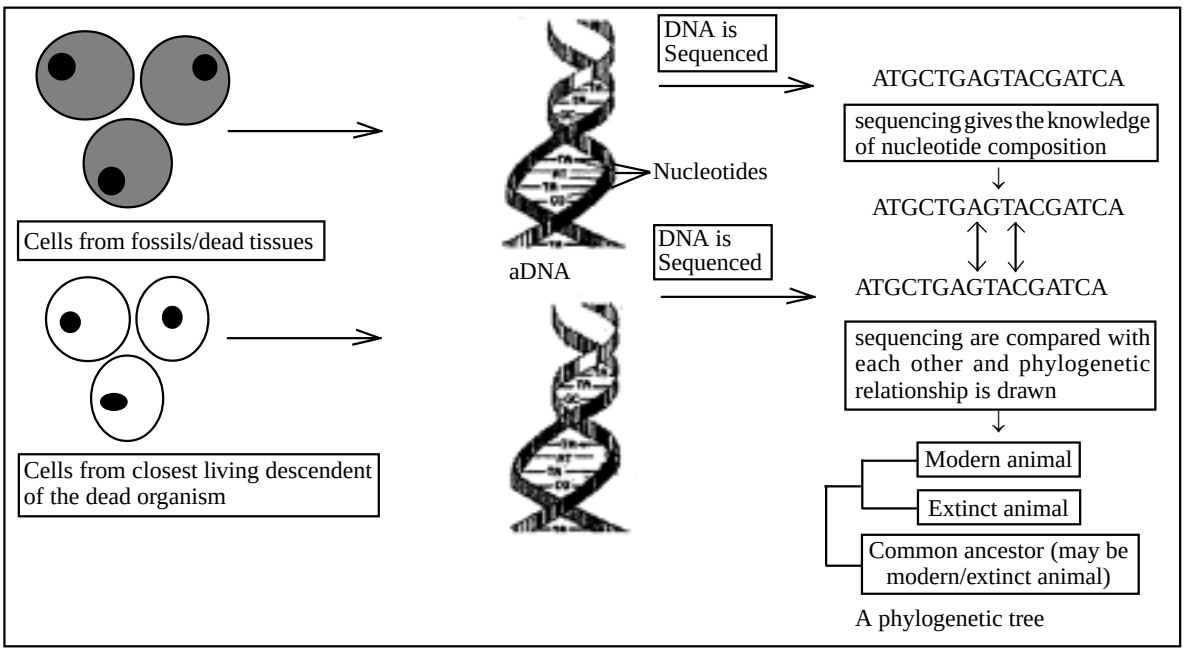


Fig. 1 : **Depiction of overall procedure for phylogenetic classification of organisms**

STUDY OF ANCIENT DNA IN BIRDS :

Avian or bird DNA is small all streamlined compared with those of mammals by virtue of having fewer repetitive nucleotides and less non-coding DNA (i.e. DNA contains some regions which don't show any character of the organism, research suggests that it is present for the stability

la Brea in United States). DNA samples have been isolated and have been studied to find out the phylogentic relationship between them and modern or other ancient species.

One such animal is the woolly mammoth (*Mammuthus primigenius*), which is one of the most intensively studied extinct species at the DNA

level, basically because of its well preseved fossils. The comparison of the nuclear DNA of the mammoths with that of modern elephants showed that Asian elephants are the closest relatives of mammoths.[5]

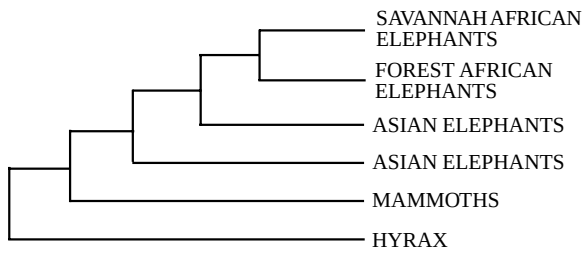


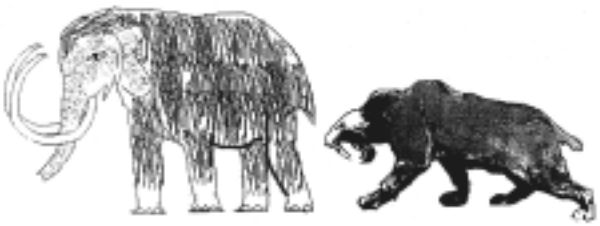
Fig. 2 : Phylogenetic trees showing relationships among mammoths and living elephantids using DNA sequences from five nuclear genes

The second animal, a cave bear (*Ursus spelaeus*), is a relative of modern brown and black bears that lived in caves throughout Europe in the Late Pleistocene. The DNA of this species was isolated from the teeth samples (about 40,000 years old) and cloned. The obtained fragments of DNA were compared to that of a related organism which was the dog, as its DNA was completely sequenced necessary repair was done and the cave bear DNA was obtained. The DNA sequence was then compared with the DNA sequences obtained from modern black, brown polar bears and phylogenetic tree was constructed. About 0.05% of human DNA contamination was present but it was easily distinguishable[6].

Many ancient human DNA sequences have been retrieved and studies pertaining to the classification of humans, their geographical distribution and relation of Neanderthals (closest relative of modern man) with modern humans (*Homo sapiens*) have been established with the help of sequencing genomic DNA[7].

Many other mammalian samples belonging to the Pleistocene era such as the Patagonian Ground sloth (*Mylodon darwinii*) samples, the saber toothed cat (*Smilodon spp.*), the marsupial wolf (*Thylacinus cynocephalus*) and Selerikan horse (*Eqqus spp.*) samples were cloned and sequenced successfully.[1,8]

Samples from coprolities (fossilized excreta) have also been amplified and sequenced. The coprolites from extinct Shasta ground sloth (*Nothrotheriops shastensis*) also contained DNA sequences from various plants which it has eaten, further comparison lead to the conclusion that the Shasta ground sloth used to travel high altitudes (about 80 meters) for search of food[9].



Wooly mammoth Sabre toothed cat

Fig. 3 : Two extinct animals, namely the wooly mammoth and *Smilodon* (Sabre toothed cat), their fossils are found intact in ice or tar pits even today.

FUTURE PERSPECTIVES :

Cloning has become a common process today; the utilization of single embryo in order to develop a complete animal with the same genetic makeup is an established fact[10]. Scientists have succeeded in cloning mice from DNA of mice in frozen conditions this have become successful with modern DNA[11]. This procedure might soon be applied in case of extinct mammals such as the wooly mammoth (*Mammuthus primigenius*), Saber toothed cat (*Smilodon sp.*) and marsupial wolf (*Thylacinus cynocephalus*) where the aDNA has been successfully extracted and phylogenetic classifications have been established. Many attempts have been made to clone various animals which has become either endangered or extinct in the wild such as Wild Ox *(Bos gaurus)* the Bucardo mountain goat *(Capra pyrecenia)* their tissues are being preserved at low temperatures and it is hoped that one day with the advent of better cloning procedures we can bring them back into the wild and establish the natural ecological balance.

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NEED OF GAS SENSORS

D. R. Patil

Mankind and the planet Earth are suffering from the destructive natural events *viz*. Earthquakes, Tsunamis, Cyclones, High tides as well as from the harmful diseases *viz*. High fever, Typhoid, Malaria, Chikungunya, Bird flu, Swine flu, Dengue, etc., which have been increased tremendously. No doubt, these are the products of environmental pollution and ultimately, of the global warming. Industries, vehicles, few natural events and man made events are the major sources of polluting gases. These gases beyond the certain limit cause undesirable and disastrous effects on human and environment. So, there is a strong need to detect the trace levels of gaseous species in the environment. Along with trace level (ppb and sub ppb level) gaseous species detection and gas concentration detection, in the environment, gas sensors are useful for disease diagnosis, food inspection, to detect food freshness, etc.

INTRODUCTION

21st century is the age of automation which requires quick, easy and safety control and easurement technology of physical quantities. It needs more sophisticated and delicate digital instrumentations. To increase the efficiency and capability of the instruments in measurement and detection technology, to reduce the cost, shape, size, weight, etc., it is necessary to introduce the sensor units at the input ports of domestic, industrial and scientific instruments in development.

Man is running, as fast as Tolstoy's man, continuously at day and night, proving contribution in development and hence is not giving proper attention to the damage that is being done by him to the environment. The net visible result is the destruction and degradation of the quality of the environment, which causes tremendous pollution. Environmental pollution has posed serious problems *viz*. physical, chemical, biological, social, economical and what not ?

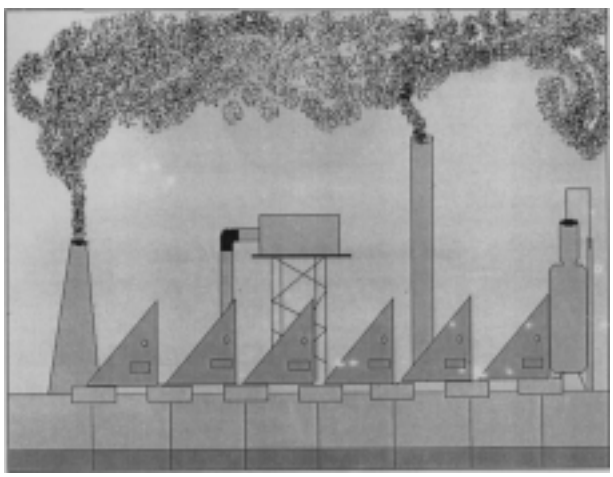

Fig. 1 Industrial pollution

Environmental pollution is defined as "the condition that exists when the atmosphere contains the concentration of pollutants those produce objectionable effects". The environment may be defined as "the imperceptible relationship and interaction between the nature and the human

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mind". If there is no mind, then there is no environment. Man, with a rapidly growing and advancing technology, grabbing and robbing the beautiful natuie speedily and thoughtlessly. During the competition of qualitative and quantitative production and development, many toxic and hazardous gases are released by the industries in the environment (Fig. 1). Man is one of the great deformer of land for many reasons such as mining, cutting, boring, building, construction and deposition, nuclear explosions, bomb attacks, etc. add to imbalance the gravity resulting in land slide.

Environmental pollution[1,5] is a burning global issue. Pollution has raised its ugly head high in the global environment. The pollutants so sadly affect all the components of the environment such as air, water, soil, noise, etc. that the environment has become polluted. Pollution is the price of industrialization and urbanization, and a by-product of development. Carbon monoxide, carbon dioxide, hydrogen sulfide, sulfur dioxide, sulfur trioxide, nitric oxide, nitrogen dioxide, chlorine, ethanol, ammonia, etc. are toxic and polluting gases; the leakages of which can reach to dangerous level up to 100 ppm. It can cause the serious health hazards in all sense. Exposure of a few such gases up to 150 ppm and above can cause death. Unwanted gases released by the industries and vehicles, smoke and particulate matters are the major pollutants in air. The gases which beyond the certain limit cause undesirable and disastrous effects on human and environment are called as air pollutants.

The gases produced by industries in large extent are stored in the tanks. The leakage of storage tanks caused the cruelest events all over the world. The world has not forgotten a most cruelest episode that happened on December 2, 1984 where Methyl Iso-Cyanate (MIC) gas leaked out from the storage tank at the Union Carbide Ltd. plant in Bhopal (India), explosion accident of Chernobyl nuclear power plant (April 26, 1986) in U.S.S.R., horrifying explosion of the gas cracker plant at Nagothane (Nov. 5, 1990) in Maharashtra (India) and number of accidents and explosions of cooking gas in kitchens all over the world. During the single event of Bhopal episode, more than six thousand people died, injured about few lacs and about fifty thousand were permanently impaired.

Secondly, top of the wonders of the world, Taj-Mahal of Agra in India, is blackening away because of the industrial and vehicular air pollution. The most shocking thing is that, the Mumbai has ranked the top of top ten industrially polluted cities of the world, because it has already crossed the danger limits of pollution. Chembur, described as Mumbai's gas chamber, omits more than 50 % of Mumbai's industrial pollutants. Chemical industries, fertilizer industries, oil refineries, atomic and thermal power plants and vehicles do their best to pollute the environment of metropolis.

The share of the man in the floods in India is 49 %[6]. June normally marks the beginning of the monsoon season in India, but early rains triggered floods in north-eastern India earlier than normal. According to news reports, 25,000 people were displaced in India's Assam state when the Brahmaputra river burst its banks in early June[7]. Tsunami waves in Fukushima Japan and India (2005) and in Pacific sea (2009), earthquakes (at jolted parts of Afghanistan and Pakistan: 6.0 on Richter scale, South-West Japan: 6.8, Veracruz in Mexico: 5.4, Indonesia: 7.0, 7.3, 7.9, etc.), cyclones, high tides (not seen from hundreds of years ago) in Indian sea at Mumbai, rainstorm, dry, over floods, along with global diseases like Chickun Gunia, Bird flu, Swine flu, Dengue, Yellow fever, Malaria, Typhoid, and many Physiological and Psychological hazards, are the few examples of natural disasters, occurred because of the imbalance of the earth, caused by air pollution.

The exposure of toxic and hazardous gases can cause heart and respiratory track diseases, lung cancer, reduction in hemoglobin, impairment of nervous system, mental retardation, disorders of

digestive system, disorders of reproductive system, blindness, forgetfulness, headaches, hypertension, etc.

The applications of gas sensing technology range from environmental analysis and food processing to the pharmaceutical industry and medicine. Gas sensors offer great potential for the detection of different microbial species. Some chemical products are specific to fungal and bacterial species and are commonly used as a useful diagnosis tool. Off-flavors in foods originate mostly from bacterial and/or fungal metabolism and several studies have been carried out on the detection of the volatile chemicals produced from the microorganisms mentioned. The isolated species include gram-negative, gram-positive bacteria and several fungi. The risk of fungal contamination is also related to several mycotoxigenic species that produce mycotoxins very harmful to human and animal health. Therefore, early detection of the microorganisms offers many advantages for quality control in the foodstuffs industry. Similarly, specific volatile compounds have been identified and related to the growth of several microorganisms in biological samples and these results promise to be useful for medical diagnostics[8,11].

So, there is a strong need to monitor such gases and to be controlled for safety survival of living beings. It leads to the research and development of a wide range of sensors using simple and cost effective materials and technologies.

AIR POLLUTANTS

Air pollutants are classified as:

Inorganic gases :

This class includes the oxides of carbon, sulfur, nitrogen and other gases viz. H_2S, NH_3, $C1_2$, HF, etc.

Organic gases :

This class includes the hydrocarbons viz. CH_4, C_2H_6, C_3H_8, C_2H_2, C_2H_4, C_8H_{18}, C_6H_6, formaldehyde, vapours of acetone, alcohols, organic acids etc. Vapours of petrol, diesel, LPG and LNG are the gases containing volatile organic compounds.

Particulate matters :

This class includes dust, smoke, ash, carbon, lead, sprays, insecticides, pesticides, oils, greases, paints, etc.

On the basis of direct or indirect release of gases, there are mainly two types of pollutants; they are primary and secondary pollutants.

Primary pollutants :

The pollutants which are directly released from sources are known to be primary pollutants e.g. H_2S, NH_3, CO_2, SO_2, NO, vapours of petrol, diesel, kerosene, LPG, LNG, dust particles etc.

Secondary pollutants :

The pollutants which are formed in atmosphere by chemical interactions among primary pollutants are known as secondary pollutants e.g. NO_2, SO_3, O_3, Ketones, H_2SO_4 etc. Like human activities, few natural activities[12] are also responsible for emitting particulate matters and polluting gases (Table 1).

Table 1 : Natural activities and pollutants released in environment :

Sr. No.	Natural activities	Pollutants released in in the Environment
1.	Eruption of Volcano	Particulate matters, H_2S, SO_2 and CH_4.
2.	Accidental fires in forests	Smoke, unburnt hydrocarbons, CO, CO_2, NO, NO_2 and ash.
3.	Ocean	Salt particles which show corrosive properties to metals and paints.
4.	Plants and trees	Pollen grains and hydrocarbons

HEALTH HAZARDS DUE TO DIFFERENT EMITTED GASES

Different gases cause various health hazards. On the basis of nature and kind of gases, few health hazards are discussed below :

Hydrogen Sulfide (H_2S)

The biogenic decomposition of sulfur containing organic matter occurs both on the land and in the sea. The major sulfur compounds generated in biogenic decomposition is hydrogen sulfide (H_2S)[12]. H_2S is one of the major pollutants, hazardous and toxic in nature, which is also released from industries and laboratories. The primary standard of sulfur oxides promulgated to protect human health is few ppm. However, sulfur oxides alone produce no acute response in humans upto 1.0 ppm. But if sulfur oxides condense on smoke or particulates, it can be inhaled quite deeply into the respiratory track causing infection to respiratory track. This makes breathing difficult, and strains the victim's heart. Higher concentrations of gases containing sulfur lead to bronchitis and lung cancer. These gases containing sulfur destroy plant cells and interfere with chlorophyll synthesis. Leaf blotching and reduction in crop yield occur even at the concentration less than 1 ppm. The exposure of gases containing sulfur can also affect the non living things viz stone leprosy, increase the rate of corrosion of metals and retardation of drying of paints, etc.

Ammonia (NH_3)

Ammonia is utilized extensively in many chemical industries, fertilizer plants, refrigeration systems, etc. A leak in the system can result in health hazards. Ammonia is harmful and toxic in nature. The exposure of ammonia causes chronic lung disease, irritation and even burning the respiratory track, etc.

Chlorine (Cl_2)

Chlorine is a yellowish-green gas having pungent smell, which is explosively utilized in industrial applications such as to bleach paper pulp, to disinfect sewage and drinking water, etc. As it has wide range of applications, its toxicity can affect the health of humans in contact. Chlorine has excellent bleaching ability, but once it is discharged in aquatic systems, it interacts with other industrial effluents to produce a host of chlorinated organics such as dioxin. Dioxin persists in the environment for prolonged periods and has a tendency to bioaccumulate in the food chains, which elicits toxic effects to humans, such as skin infections, psychological disorders and even liver damage.

Ethanol (C_2H_5OH)

Pure ethanol is called as an absolute alcohol. Ethanol is used for beverages, scientific and industrial purposes. Ethanol is a hypnotic (sleep producer) gas. It depresses activity in the upper brain even though it gives the illusion of being a stimulant. Ethanol is also toxic like methanol. Abuse of ethanol is a major drug problem in most countries. Ethanol can be made by fermentation of sugars and it is the alcohol of all alcoholic beverages. The synthesis of ethanol in the form of wine by the fermentation of sugars of fruit juices was probably the first accomplishment in the field of organic synthesis. Sugars from a wide variety of sources can be used in the preparation of alcoholic beverages. Often, these sugars are from grains, so, ethanol is referred as "grain alcohol".

Fermentation is usually carried out by adding yeast to a mixture of sugars and water. Yeast contains enzymes that promote a long series of reactions that ultimately convert a simple sugar ($C_6H_{12}O_6$) to ethanol and CO_2.

Fermentation alone does not produce beverages with ethanol content greater than 12-15 %, because the enzymes of the yeast are deactivated at higher concentrations.

Carbon dioxide (CO_2)

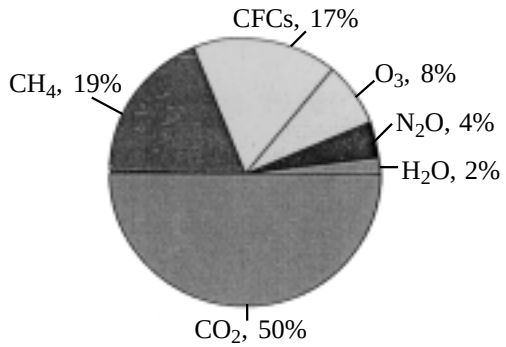

Fig. 2 Contribution of GreenHouse Gases

The atmospheric concentration of CO_2 at present is about 356 ppm. The greenhouse contribution of CO_2 is 50 % (Fig. 2). If the present emission trend of CO_2 continues, a global warming of 3.5 to 4.5°C is likely to occur. It has been estimated that, the sea level may rise 0.5 to 1.5 m in the next 50 to 100 years. An increase in average global temperature is likely to increase the incidence of infectious diseases, viz. malaria, chikungunia, schistosomiasis, sleeping sickness, dengue, yellow fever, etc. The outbreak of cholera in Latin America (1991), the outbreak of pneumonic plague in India (1994) and the Hantavirus epidemic in South America (1994) can be directly linked to global warming[13, 14].

Carbon monoxide (CO)

Hemoglobin (Hb) has about 210 times more affinity for CO than for oxygen. Hence, less oxygen is taken up by hemoglobin, if CO is inhaled during breathing. When CO is inhaled during breathing, it combines with hemoglobin (Hb) in the blood stream to form more stable complex known as carboxy-hemoglobin CO-Hb.

$$HbO_2 + CO \rightarrow CO\text{-}Hb + O_2.$$

This reduces the ability of Hb to carry the oxygen to the body tissues. Prolonged exposure to low levels of CO causes the reduction of ability of a person to see small objects at a distance, the reduction in night vision, hearing ability, mental performance and time discrimination ability. It also causes headache, dizziness, and lassitude and discomfort. Higher levels of CO would result in an increased haematocrit that is percent volume of Red Blood Cells. Thus cigarette smokers have been found to have an increase in haematocrit within minutes of smoking. Smokers having 10-20 % carboxy-hemoglobin level begin to have artery blockages at a very young age.

Liquefied Petroleum Gas (LPG)

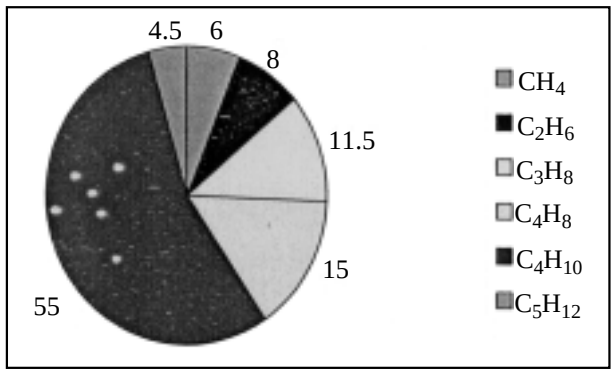

Fig. 3 Constituent components of LPG

Fig. 3 depicts the constituent components of LPG. Liquefied Natural Gas (LNG) and Liquefied Petroleum Gas (LPG) are highly inflammable gases. They are explosively utilized in industrial and domestic fields as fuels. They are referred as town or cooking gases. Cooking gas consists chiefly of butane (55-vol %), a colorless and odorless gas. It is usually mixed with compounds of sulfur (methyl mercaptan and ethyl mercaptan) having foul smell, so that its leakage can be noticed easily. These gases are potentially hazardous because explosion accidents might be caused when they leak out by mistake. It has been reported that, at the concentration upto noticeable leakage, it is very much more than the lower explosive limit LEL of the gas in air.

Hydrogen (H_2)

Energy is the driving force of all activities in the universe. Nothing moves, changes, grows or

decays without consumption of energy. It flows downhill from high-potential to "low-potential and high-temperature source to cosmic cold of the outer space. For most organisms, the energy required is derived from food. Unlike other organisms, human not only require food energy but also energy to drive machines, to produce heat, to generate electricity, to transport, etc.

The energy is obtained from fossil fuels, solar and nuclear resources. Fossil fuels, coal and petroleum have limited age as their consumption is tremendous. These are non-renewable resources. They cause explosive pollution. The extraction of energy from solar radiation causes minimal damage to environment; but not developed well till today and unaffordable to middle class society for domestic use. Nuclear energy has the serious problems with handling and waste disposal.

It is, therefore, necessary to turn our attention towards the development of fuel economy based on hydrogen. Hydrogen is not the primary source of energy. It is an energy carrier. On combustion, it produces only water. Hence, the advantage of hydrogen is its virtually pollution-free combustion. It is therefore, destined to become the fuel of the future. Cracking of hydrocarbons, cracking, electrolysis and thermo chemical decomposition of water produce the hydrogen. Hydrogen as an energy carrier has widespread applications. It is explosively utilized in industrial fields as fuels. It is a colorless and odorless gas. Its leakage cannot be noticed easily. This gas is potentially hazardous because of explosion possibility.

To reduce the risks of global warming, we should control the emission of polluting gases. To reduce the environmental pollution and risks, we can not stop the production through industries and transportation, but many simple things are in our hand, by which we can reduce the pollution viz. periodically tuning the engines, servicing of machines properly and regularly, by using pure form of fuels, by stopping unnecessary working of machines, etc.

Many gas sensors are already, fabricated by Figaro Engg. Inc., Eco Sensors Inc., Sierra monitors, IST, etc. However, they couldn't meet the challenges up to the depth demand by society, e. g. Sensor TGS 824 is ammonia sensor, which could detect the ammonia in the range 50 to 300 ppm of gas concentration. However, the Threshold Limit Value (TLV) for ammonia is 25 ppm. It means that, if ammonia leaks by any means in the environrrient above 25 ppm it affects the living beings in that environment. And at this concentration of the ammonia, the available sensor model TGS 824 detects the ammonia. Table 2 shows the particulars about few available sensor models.

Sensor Model nos	Target Gas	Detection range (ppm)	TLV (ppm)
TGS 824	NH_3	50 - 300	25
TGS 825	H_2S	50	10
TGS 826	NH_3	30 - 300	25
CM 99-447	NH_3	50 - 200	25
TGS 2610	LPG	500 - 10000	100
TGS 2612	LPG	500 - 10000	100
TGS 2620	Ethanol	50 - 5000	200
LPM2610	LPG	500 - 10000	100
GD 801	H_2	1000	100
TGS 821	H_2	50 - 100	100

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LIPASE—AN IMPORTANT ENZYME FOR MANKIND

Alok Kumar and Ved Pal Singh*

Fat and oil degrading enzymes, such as lipases are an important group of industrially and biotechnologically relevant enzymes. Lipases are widely distributed among animals, plants and microorganisms. In animals they constitute an essential component of their digestive system, whereas lipases of microbial origin have found immense commercial applications in various industries such as detergent, food, dairy, leather, chemical and pharmaceutical industry. The commercial requirements of lipases have been increasing day by day. To meet this challenge, there is a great urge to explore novel lipases of industrial uses and to have improved lipases through molecular approaches such as by exploring natural microbial communities by the metagenomic and metaproteomic approaches.

INTRODUCTION

Lipase performs a crucial role in the digestion, transport and processing of dietary lipids (e.g. fats, oils, triglycerides) in humans. Lipases are water soluble enzymes and can be found in every living organism like animals, plants and microorganisms such as bacteria, fungi and even in some viruses also. Lipases of bacterial and fungal origin have found promising application in various industries such as food industry for emulsification, dairy industry for hydrolysis of milk fat, oleochemical industry for production of biodiesel, pharmaceutical industry for synthesis of drugs, detergent industry for lipid stain removal, pulp and paper industry for pitch control and contaminant control, leather industry for removal of subcutaneous fat, baking industry for dough stability and conditioning (in situ emulsifier), in chemical processing industry and in synthesis of surfactants and polymers for resolution of chiral alcohols and amides. Now-a-days, commercial use of lipase is a billion dollar business that comprises a wide variety of different applications. About 1000 tons of lipase is sold every year in the field of detergent industry only.[1,2]

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MICROBIAL LIPASES

Plants, animals and microorganisms are the source of lipase. In general, microorganisms have the ability to withstand most environmental extremes such as high and low temperature and high salinity etc. Thus microbial enzymes such as microbial lipases are relatively more stable and are capable of catalyzing a variety of reactions. Lipases of microbial origin, mainly fungal and bacterial ones belong to most widely used class of enzymes in biotechnological applications and organic chemistry. Importantly, thermophilic bacteria and fungi, which grow under high temperature conditions produce thermostable or thermophilic lipases which are in great demand in diverse industrial applications, as many enzymatic processes in industries run at relatively higher temperatures. The special genomic and proteomic features such as overpresentation of purine bases in protein coding sequences, overpresentation of GC bases in structural RNAs, presence of higher tRNA diversity, enhanced usage of positively

charged and aromatic residues, decrease in polar uncharged residues in the encoded protein and presence of chaperons are responsible for their thermal stability.[3,4] Thus thermophilic microbial lipases are potentially of great importance for diverse industrial and biotechnological applications, and thus contribute to multi billion dollar industries all over the world. Commercial bacterial lipases such as Lumafast and Lipomax have been utilized by detergent industry, while other commercial bacterial lipases, Combizyme 23P and Combizyme 61P have been utilized in waste treatment.

PLANT LIPASES

Research articles indicate that mostly, microbial and animal lipases are used in preference to plant lipases. Over the last ten years, the trend is leading towards the use of plant lipases. Crude lipase preparations are obtained by organic acid or buffer solution extractions from seedlings of oilseed bearing plants. The advantages of these extracts are their availability, their cost and their direct application as biocatalysts. Plants that bear oilseeds such as sunflower, mustard and rape seed store considerable amount of triglycerides that are processed by lipases. In dormant castor bean seeds, very high amount of a triglyceride hydrolase is found, which is probably one of the best known of all plant lipases.[5]

ROLE OF LIPASE

Lipase plays an important role[1,6] in:

- Break down of dietary fats in the human digestive system.
- Production of flavours in cheese. It also accelerates the ripening of cheese and lipolysis of butter, fats and cream.
- Determination of lipids for the clinical diagnosis and in food industry as biosensor is of great importance.
- Household detergents and soaps.
- Vegetable fermentation.
- Meat product curing.
- Fish processing.
- Industrial cleaning.
- Leather processing.
- Bioremediation such as olive oil from oil mills, degradation of polyster waste and removal of biofilm deposits from cooling water systems.
- Cosmetics and perfumeries.
- Paper making industry.
- Digestion for those with low lipase levels, as lipase enzymes are available in tablet or capsule form to aid the process.
- Synhesis of chirally important drugs and their intermediates.

LIPASE AS FOOD SUPPLIMENT

In human, lipase is the main enzyme of the pancreas and break down fat in the digestive system. Generally, human beings produce enough pancreatic lipase, but people suffering with crohn's disease (a disease causing inflammation of digestive system), cystic fibrosis (a genetic disorder that particularly affects the lungs and digestive system) and coeliac disease (an autoimmune disorder of the small intestine) may not have sufficient lipase for metabolic purpose and need it as supplement in their diet.[7] Manufacturers offer lipolytic enzymes in powder form free of other enzymes and sometimes for people with low lipase level. Lipase enzymes are available in capsule or tablet form such as Creon 5, Creon 10, Creon 20, Kutrase, Lipram-UL12, Lipram-UL20, Pencreaze, Pancrecarb MS-8, Pancrelipase, Plaretase 8000, Tri-pase 16, Ultrase, Ultrase MT 18, Viokase 8 and Viokase 16 to aid in digestion.

LIPASE IN LEATHER INDUSTRY

Hungarian Teljes patent describes that lipase treatment is useful for leather processing. Thus lipases are extensively used for leather processing in many parts of the world. In leather processing, wild animal skins were treated with lipase in the presence of deoxycholic acid as catalyst to remove lipids and noncollagenous proteins. Lipases specifically degrade fat and, therefore, do not damage the leather itself and impart more uniform color and a cleaner appearance to skin.[1,3]

LIPASE CONTAINING DETERGENTS

- Rapid-zyme, ultra clean zyme, ultrazyme 2, ultrazyme 3, ROSUN triple plus with ROS,

multienzyme detergent CE are few enzymatic detergents containing lipase enzyme for their actions.[3]

- The use of microbial lipase and other microbial enzymes to increase general detergency of formulations have been described in a German patent to Henkel and Cie, G.m.b.H.[1]
- The patent describes that the efficiency of a detergent product increases when lipase is added in sufficient concentration i.e. 5-500 units/g.
- Commercial lipase Lipase Toyo, type S has been found to be compatible for use in detergents.

MANUFACTURERS OF COMMERCIAL MICROBIAL LIPASE

The following companies / industries are authorized for the manufacture of commercial lipases of microbial origin:

Maps enzymes Ltd., EUCODIS Bioscience, Amano Pharmaceutical, Wallerstein, Nagase, Osaka saikin, Meito sangyo, Rohm and Haas, Tanabe seiyaku, Kenkyu-Sho K.K., Kaken chemical Co. A few commercial lipases known as Lipomax, Lipase-AP, Lipase-MAP, Combizyme 209P, Lipase-MY, Lipase-Saikin, Lumafast, Lipase-B, Lipase Toyo, Lipase QL, Lipoproein lipase, Lipase 3500, Lipase RH,Olipase are available in market for various biotechnological and chemical applications.[1,8]

FUTURE PROSPECTS OF LIPASE INDUSTRY

Lipases exhibit their activities over a wide temperature and pH range, substrate specificity, diverse substrate range, thus making them the biocatalyst of choice for present and future of enzyme industries. Their importance has been tremendously increasing day by day in several industries, such as, detergents, leather, food, dairy, chemicals, pharmaceuticals etc.[2] However, the commercial exploitation of lipases is still not sufficient to meet the present requirement, due to the economics of lipase industry. Thus, there is a great need to develop production and downstream processing systems, which should be cost-effective and time saving. In the light of the facts mentioned above, trend has shifted towards exploration of novel lipases and improving the properties of existing lipases through molecular approaches such as directed evolution and exploring natural microbial communities by the metagenomic and metaproteomic approaches.

CONCLUSION

Lipase plays a crucial role in the metabolism of lipids in humans. In the industrial sector the use of lipase covers a very broad area. It is used in food, dairy, agrochemical, oleochemical, cosmetics, pharmaceuticals, detergent, leather industry, chemical processing, synthesis of surfactants and polymer, vegetable fermentation, meat product curing. Thus, lipase is truly a versatile enzyme as aside from helping the body, it can produce different kinds of products of industrial interests. But as day to day industrial requirements of lipases have been increasing, there is a great urge to explore new microorganisms for their production and industrial applications.

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IMPACT OF INVASIVE ALIEN SPECIES ON ECOSYSTEM

P. Dey

The article deals with a serious problem of invasive alien species vis-a-vis environmental and economic concern related to such species. Mechanism of invasion and procedure to manage the spread has been recommended. Besides, future safeguard plans and research needs have also been suggested.

INTRODUCTION

International Union for Conservation of Nature and Natural Resources (IUCN) defines Invasive Alien Species as an alien species which becomes established in natural or semi-natural ecosystems or habitat, an agent of change, and threatens native biological diversity. These invasive species are widely distributed in all kinds of ecosystems throughout the world, and include all categories of living organisms. They are non-natives and either deliberately or accidentally introduced in new habitat causing dramatic environmental changes that lead to major decline in native population. They have the capacity to alter hydrology, nutrient mining, and can alter gene pool through hybridization. Invasive species are good at exploiting bare soil and empty niches. Being non-natives they infest natural ecosystems, including forest, rangelands, and pastures and dreaded ones can transform diverse and productive ecosystem into sterile land. As per Convention of Biological Diversity estimate of 2006, invasive alien species have contributed to nearly 40% of all animal extinctions since 17th century for which the cause is known. The global economic loss by invasive alien species including cost of control has been estimated at about 63,00,000 crore rupees per year. One way to avoid invasive species is to choose the ones that are native to the area. Natives often are adapted to a specific environmental niche, and have natural controls that keep them in balance. Invasive species, on the other hand, are tolerant against environmental extremes and possess greater flexibility for survival in wide range of conditions with high water, light and nutrient use efficiencies. Some of the invasive species also exhibit fire resistance besides better competitive ability and allelopathy.

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INVASION RAISON D'ÊTRE

Land disturbance particularly by grazing, mining, urban development etc. which causes removal of vegetation and disturbs soil generally promote invasive alien species. Absence of predators and parasites in new found habitat that otherwise kept invasive alien species under control in native habitat also help in advancing invasive alien species. Land development such as fragmentation, corridors through undisturbed vegetation help enabling the spread of invasive species. Global change such as elevated CO_2 level due to greenhouse effect, climate change also promotes invasive alien species. The present era of globalisation and open market economy has accelerated the influx of invasive alien species. Many of these invasive species have caused catastrophic ecological impacts[1,2]. Any invasion undergoes three distinct phases of arrival in new habitat, establishment followed by rapid spread in new found habitat[3'4]. Each of these three

phases of invasions can be managed by three different approaches of quarantine, eradication and containment[1]. Invasive alien species exacerbate poverty and threaten development through their impact on agriculture, forestry, natural systems and fisheries which form the basis for livelihood in developing countries. This damage is aggravated by climate change, habitat loss and human-induced disturbances.

GLOBAL ACTION PLAN AGAINST INVASIVE ALIEN SPECIES

In 1996, concern that invasive species might be one of the most significant "negative externalities" of globalization brought 78 countries and numerous international and intergovernmental organizations together at the "Trondheim Conference." This meeting, sponsored by Norway and the United Nations, was the first global effort to assess the impact of invasive species on the environment. Participants concluded that :

- The impact of invasive species is "immense, insidious, increasing, and irreversible." In other words, every country has been impacted by invasive species, the patterns and trends follow that of globalization, and as long as we engage in international trade, travel, and transport we'll need to manage this problem ;
- Aside from climate change, invasive species are the most significant threat to the environment worldwide. Developing countries will be severely impacted, particularly Small Island Developing States (SIDS); and
- A global plan and strategy is urgently needed to address the problem.

In 1997, three international organisations came together with a commitment to share their expertise and other resources in order to address the scientific and technical aspects of the problems identified in Trondheim. The World Conservation Union (IUCN), CAB International (CABI), and the Scientific Committee on Problems of the Environment (SCOPE) formed the Global Invasive Species Programme (GISP). GISP is a coalition of scientific and technical experts.

INVASIVE SPECIES INTRODUCED IN INDIA

Invasive alien species of plants/animals/ microorganisms are as equally ancient as human civilization, and are ongoing chronologically indistinguishable by man. However, biological invasions have lately become one of the major global issues of concern since June 1992 soon after the UNCED's Earth Summit held in Rio de Janeiro, Brazil. It was estimated that about 40% of the species in the Indian flora are alien, of which 25% are invasive in nature. *Parthenium hysterophorus*, first report in 1951 from Maharashtra was introduced from Tropical America and presently has stretched throughout the length and breadth of India. *Lantana camara* introduced in 1809-10 from Tropical and subtropical America has reached in submontane regions of the outer Himalaya to southernmost part of India. *Eichornia crassipes* was introduced in 1914-16 from Brazil has extended large area of water bodies of India. *Mikania micrantha* is rather neotropical origin but has extended natural forests, plantations, agricultural systems in northeast and southwest India. Other invasive species of India include *Ageratum conizoides*, *Cytisus scoparius*, *Eupatorium adenophorum*, *Eupatorium odoratum*, *Parthenium hysterophorus*. Eutrophication of water bodies by water hyacinth is a major invasive species of aquatic system. Carrot grass is another major invasive species causing economic loss to many agricultural crops. *Chromolaena* is a invasive climber for North-East Himalaya and Western Ghat region. In the fishery sector, African catfish, big head carp, tilapia etc. are invasive species which were introduced either deliberately or accidentially but all found to pose great threat to the native fishes. Invasive insect like coffee berry borer also caused major

economic damage. Microbial invasive species causing major economic damage include banana bunchy top virus, turnip stripe virus, potato wart (a fungal disease caused by *Synchytrium endobioticum*) and golden nematode (*Globodera rostochiensis*).

Invasive alien species and their distribution in India

Name of the species	Native of/ Introduced from	Distribution
Acanthospermum hispidum DC.	South America	Moist places along river beds of Andhra Pradesh and Himachal Pradesh.
Aeschyomene Americana Linn.	Tropical America	Paddy fields of Bihar.
Ageratum conyzoides Linn.	South America	Forest margins, road sides and waste fields throughout the country.
Ageratum houstonianum Mill.	Mexico	Waste fields of Tamil Nadu, Assam, Nilgiri and Puney hills, Sokkim, Dehradun, Madhya Pradesh and West Bengal.
Alternanthera polygonoides (Linn.) HB & K Ex Roem and Schult	Tropical and sub-tropical America	Upper Gangetic plains, West Bengal, Tamil Nadu.
Alternanthera pungens Kunth.	Tropical America	Common in road sides, rail-way tracks of Coimbatore, Bengaluru, Chennai, Mumbai, Andhra Pradesh, Orissa, Delhi.
Argemone ochroleuca Sweet	Mexico	Common in road sides and waste fields of Madhya Pradesh and Delhi.
Bacopa procumbens (Mill.) Greema	Tropical America	Frequent in grassland and gardens of Assam, Bihar, Madhya Pradesh and West Bengal.
Chenopodium ambrosiodies Linn.	Tropical America	Moist places of Delhi and Karnataka.
Cleome burmanni Wt. & Arn.	West Africa	Moist and shady places.
Croton bonplandianum Baill.	South America	Common in road sides and waste fields of Assam, Delhi, Madhya Pradesh, Orissa, Punjab and Tamil Nadu.
Eichhornia crassipes Solms.	Brazil	Ponds and ditches of Andhra Pradesh, Assam, Madhya Pradesh, Karnataka, Kerala, Tamil Nadu and West Bengal.
Ergeron bonariensis Linn.	South America	Open moist soils of Delhi and Madhya Pradesh.
Euphorbia geniculata Orteg.	Tropical America	Open moist soil of Delhi and Madhya Pradesh.
Gomphrena celosioides Mart.	South America	Common in grassland of Karnataka, Madhya Pradesh and Maharasthra.
Ipomoea fistulosa Mart. Ex Choisy.	South America	Common in many habitats of Madhya Pradesh and Rajasthan.
Jatropha gossypifolia Linn.	Brazil	Common as undergrowth of forest and along road sides of many places.
Lippia alba (Mill.) N.E. Brown Ex Britton & Wilson	Tropical America and West Indies	Lakes and ditches of Andamans, Andhra Pradesh, Assam, Bihar, Orissa and West Bengal.
Martynia annua Linn.	Mexico	Common in waste lands and along road sides of Andhra Pradesh, Bihar and Madhya Pradesh.
Nicotiana plumbaginifolia Viv.	Mexico and West Indies	Common in Assam, Delhi and Punjab.
Opuntia elatior Mill.	Tropical America	Dry places of Andhra Pradesh and Delhi.
Oxalis corymbosa DC.	South America	Garden of Assam, Delhi and Pulney Hills of Tamil Nadu.
Oxalis pes-carpae Linn.	Cape of Good Hope	Common in road sides of Niligiri and Pulney Hills.
Parthenium hysterophorus Linn.	Tropical America	Common in road sides throughout the country.
Peperomia pellucoda (Linn.) HB & K	Tropical America	Common in crevices of wall under shade and moist condition throughout the country.
Rauvolfia tetraphylla Linn.	West Indies	Common in river banks of Andhra Pradesh, Bihar and Uttar Pradesh.
Ricchardia scabra Linn.	Tropical America	Common in Andhra Pradesh, Assam, Bihar, Karnataka, Rajasthan and Uttar Pradesh.
Ruellia tuberose Linn.	Brazil	Common in open places throughout the country.
Salanum viarum Dunal.	Brazil	Common in road sides and river banks of Assam, Bihar, Orissa, Sikkim, Tamil Nadu and West Bengal.
Solvia anthemifolia (Juss.) R. Br. Ex Lessony	America	Recently introduced and found in damp places of Uttar Pradesh.
Tithonia diversifolia (Hemsl.) A. Gray.	Mexico and Central America	Common in waste lands of Uttarakhand (Dehradun) and West Bengal.

Name of the species	Native of/ Introduced from	Distribution
Tithonia rotundifolia (Mill.) Blake	Mexico	Common in road sides of Uttarakhand and West Bengal.
Tridax procumbens Linn.	Mexico	Common in gravelly grassland of Assam, Bihar and West Bengal.
Volvulopsis nummularis (Linn.) Roberty	West Indies	Common in grassland of Madhya Pradesh, Orissa and West Bengal.

IMPACTS OF INVASIVE SPECIES ON BIODIVERSITY

Invasive alien species including plants, animal and microorganisms are distributed in all types of ecosystems throughout the globe and have affected native biota all ecosystems. The influences include change in function of ecosystems by changing fire regime, nutrient cycling and hydrology. The Convention on Biological Diversity and its 191 Parties recognize the urgent need to address the impact of invasive alien species. Article 8(h) of the Convention on Biological Diversity states that, "Each contracting Party shall, as far as possible and as appropriate, prevent the introduction of control or eradicate those alien species which threaten ecosystems, habitats or species". As per the Decision V123, the Convention on Biological Diversity has adopted guidelines on prevention, introduction and mitigation of impacts of invasive alien species that threaten ecosystems, habitats or species, which can be accessed on the Convention on Biological Diversity website.

Land clearing and human habitation put considerable pressure on native species. Such disturbance of habitat is prone to invasion by alien species and cause adverse effect on ecosystem. Multiple successive introductions of non-native species can have interactive effect and pave the way for earlier introduced invasive species to flourish. Possibility of genetic pollution through uncontrolled hybridization and introgression and resulting extinction of rare species has also not been ruled out. The following impacts of invasive alien species may be encountered :

- Loss of biodiversity due to capture of habitat by Invasive Alien Species
- Extinction of native animal species by predation
- Loss of biodiversity due to increased fire incidence following exotic grass invasion
- Reduced abundance of threatened and endangered species

IMPACTS OF INVASIVE SPECIES ON SOIL AND WATER RESOURCES

An introduced species might become invasive if it can out-compete native species for resources such as nutrient, light, physical space, and water. Ecosystems in which all available resources are being used to their fullest capacity by native species can be modelled as zero-sum systems, where any gain for the invader is a loss for the native species. However, such unilateral competitive superiority and extinction of native species with increased populations of the invader is not the rule. In fact, invasive species often coexist with native species for an extended time, and gradually the superior competitive ability of invasive species become apparent as its population grows larger and denser and it adapts to its new location.

An invasive species might be able to use resources previously unavailable to the native species, such as water from deeper soil layer may be accessed by a long tap root system, or the ability to thrive on a previously uninhabitated poorly fertile soil. For example, *Aegilops triuncialis* (barbed goatgrass) was introduced to California on serpentine soils with low water retention, low nutrient level, a high Mg/Ca ratio, and possible heavy metal toxicity. Plant population on such soil usually remained at a very low density except barbed goatgrass which proliferate profusely and suppressed the growth of other native species. Every species has a role to play in its native ecosystem which is known as niches. Some invading

species are able to fill niches that are not utilized by native species. Also the invading species have the ability to create niches that were actually absent. *Lantana camara* has potential to compete for scarce nutrients and has the ability to uptake nutrient from extremely impoverished soil. It can also thrive on a very low moisture status. The impacts of invasive alien species on soil and water are :

- Increased soil erosion
- Increased incidence of flooding in some situation
- Increased water use, reduction in water table
- Changes in soil chemistry, e.g., salt accumulation
- Changes in soil microorganisms, e.g., reduced mycorrhizal association with mustards
- Loss in productivity

IMPACTS OF INVASIVE SPECIES ON ENVIRONMENT

Some environmental issues are well documented and flagged as the impacts of alien invasive species. The movement of people, commodities and their conveyances through international trade has augmented the danger of transmit of these unwanted organisms. Although many non-native species has been proved to provide great benefits to society, many others after establishment cause significant and often irreparable damage to the native ecosystems beside negative economic consequences in the new found habitat. Invasive species can also cause dramatic ecological changes due to landscape transformations that reduce the adaptability and competitiveness of more desired native species. Such transformation can be caused by the disproportionate use of resources by invasive species like increased ability to capture light, use water, uptake nutrients.

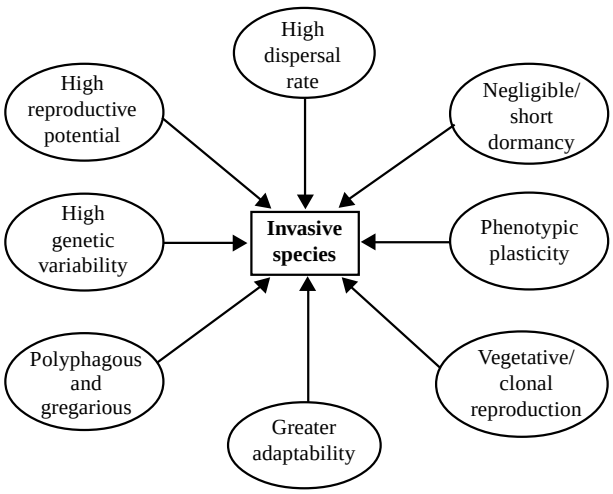
There are abundant rationales for accepting the logic that climate change will favour invasive alien species because they can adopt extreme adverse climatic conditions. Invasive species, being generalists in nature, have greater competitive advantage when species shift ranges and habitat composition changes in response to climate change. The alien saprophytic fungi are ecologically more favoured with climate change and global warming phenomenon and will dominate over the native microbial community due to their tolerance power to higher temperature. Different alien plant pathogen which cause tremendous economic damage to field, plantation and horticultural crops introduced in India at different time[5] are given below :

Pathogen	Disease	Introduced from	Year
Hemileia vastatrix Berkely and Broome	Leaf rust of coffee	Sri Lanka	1879
Phytophthora infestans (Montagne) Bary	Leaf blight of potato	UK	1883
Urocystis tritici Körnicke	Flag smut of wheat	Australia	1906
Erysiphe cichoracearum DC.	Powdery mildew of cucurbits	Sri Lanka	1910
Plasmopara viticola (Berk. & M.A. Curtis) de Bary	Downey mildew of grapes	Europe	1910
Sclerospora philippinensis	Downey mildew of maize	Java	1912
Pyricularia oryzae Cavara	Rice Blast	South East Asia	1918
Xanthomonas campestris pv. campestris	Blac rot of crucifers	Java	1929
Oidium heveae	Powdery mildew of rubber	Malaya	1938
Phytophthora nicotianae Breda de Haan	Black shank of tobacco	Holland	1938
Banana bunchy top virus (BBTV)	Bunchy top of banana	Sri Lanka	1940
Synchytrium endobioticum (Schilb.) Perc.	Wart of potato	Netherlands	1953
Urocystis cepulae (Forst) Liro	Onion smut	Europe	1958
Xanthomonas campestris pv. oryzae	Bacterial leaf blight of paddy	Philippines	1959
Globodera rostochiensis (Wollenweber)	Golden nematode of potato	Europe	1961

MECHANISM OF INVASIVENESS

Invasive species including micro-organisms, plants and animals act as key threat to the functioning of agro-ecosystem although the mechanism is not fully understood. One main reason is that exotic species are too abundant and dominant even in poorly fertile soil and disruptive to the other native species reducing their variability. Majority of the studies have focused on invasive plants and animals, although few have considered the effects of invasive microbes, or interactions of invasive plant and animal species with microbial communities.

Invasive plants, animals and soil micro-organisms have profound effects on the abundance of native species, their diversity and ecosystem functioning. Invasive micro-organisms of decomposer group most likely have little impact, because of limited specificity and great functional redundancy[6]. However, invasive plants and animals can have major effects on microbial decomposition in soil. Another study, however, shown that aggressive invasion of a nutrient-demanding, rapidly decomposable, and invasive plant exert large impacts on soil microbial decomposers[7].



The study of microbial ecology and biological invasion has shown that some plant species accumulate pathogens quickly and maintain low densities as a result of the accumulation of species-specific pathogens, whereas others accumulate species-specific pathogens more slowly and do not experience negative feedback until plant densities reach high levels[8] indicating differential abilities of plants have to influence their abundance by changing the structure of their soil communities, and that this is an important regulator of plant community structure. Another study on *Lantana camera* revealed that it produce secondary compounds toxic to ungulates and also to suppress regeneration of native species[9].

MODUS OPERANDI TO PREVENT GROWTH OF INVASIVE SPECIES

Avoid using known invasive species : This is first and foremost principal of avoiding invasive species. For this, a list of invasive species may be widely circulated through media for awareness of general public.

Minimising landscape disturbance : Invasive species thrive well on bare soil and disturbed ground where the native plant/animal/microbial community has been displaced. Protection of healthy native species is the key to control invasive species.

Judicious use of inputs : Many studies have shown that high nitrogen levels provide an advantage to invasive species that are better adapted to using plentiful nutrients for rapid growth and establishment as compared to native species. Soil test based nutrient application in conjunction with manure is important; slow release of nutrient from manures favours native species.

Regular monitoring of land use plan : All land use plans need to be monitored regularly and invasive species need to be checked for their removal. Scouting at regular interval helps in preventing spread of invasive species. Particularly, seeding need to be checked either by uprooting or by adopting other measures like spot application of herbicide, if necessary. Removal of invasive species when the population is low helps native species to occupy the empty niche.

FUTURE SAFEGUARD PLAN AND RESEARCH NEEDS

- Build capacity in terms of human resource development and technology transfer to address invasive alien species.
- Promote community participation through awareness generation and involvement in efforts to address Invasive Alien Species through promotion of Public-Private Partnership (PPP) approach.
- In line with USDA Invasive Species Information Centre, National Invasive Species Information Centre may be formed for dissemination of knowledge.
- Early warning system against invasive alien microbial species
- Spatial stochastic modelling to map introduction and spread risks of invasive alien species.
- Hazard analysis and critical control point planning to prevent unintentional introduction of invasive alien species.
- Integrating DNA bar-coding into detection and surveillance programs for invasive alien species.
- Exploiting Alice dynamics in the management of invasions.
- Risk analysis of invasive alien species.

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LOW CARBON ECONOMY-A CLEANER OPTION FOR SUSTAINABILITY

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Low Carbon Economy (LCE) is a popular term that refers to economic activities which has minimum output of greenhouse gas (specially the CO_2). The main objectives of these activities are to avoid catastrophic climate change and initialization of an ideal zero carbon economic eras. Integration of different sectors like power generation, transportation, manufacturing, agriculture etc. is very much necessary to achieving LCE and Life Cycle Analysis (LCA) is to be mandatory for those sectors. Low carbon life style, low carbon diet habit, microgeneration technology in commercial houses, eco-design of home appliances are the ways to reach low carbon era.

INTRODUCTION

Climate change has become one of the major challenges for mankind and the natural environment. Greenhouse gases released into the atmosphere in ever rapidly growing volumes are recognized to be responsible for this change. After Kyoto Protocol we are being conscious about temperature rise and green house gas emission, consequently we are also afraid about our future. Lots of new models of refrigerators, air-conditioners, low priced automobiles and several electrical and electronic gadgets are coming up in the market. People are allured to buy these commodities for maintaining a luxuriant life style. All such gadget consume high amount of energy which is obtained by burning fossil fuel. Unfortunately consumerism rapidly affects the global carbon economy. UNEP has prepared a fact sheet in which they discussed, twelve steps to kick out our orthodox carbon habit. They also highlighted de-carbon lifestyle and low carbon economy for sustainability.

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CARBON IN POLICY AND PROTOCOL

One of the major policies related to carbon issue was Kyoto Protocol, which was held at Kyoto, Japan from December 1st to 11th 1997. More than 160 countries met there to fulfill the goal which was set at UNFCC, 1992. In Kyoto Protocol the signatory nations agreed to limit the emission of six greenhouse gases (Carbon dioxide, Methane, Nitrous oxide, Sulfur hexafluoride, Hydrofluoro-carbons and Perfluorocarbons) relative to the levels emitted in 1990. The overall emissions reduction targets for the six gases are weighted by the relative heat-trapping effect of each gas. The agreement specifies that both developed and developing countries must follow a number of steps including :

- Designing and implementing climate change mitigation and adaptation measures;
- Preparing national inventories of emissions removals by 'carbon sinks';
- Implementation and cooperation in development and transfer of climate friendly technologies;
- Partnerships in research and observation of climate science, impacts and response strategies;
- Developing countries are not legally bound to emissions reductions targets yet because, historically, they have been responsible for only a small portion of the global greenhouse gas emissions.

Under the Kyoto Protocol, the overall emissions from industrialized countries would be reduced five percent below 1990 levels during this period, and negotiations on reduction commitments for subsequent periods must begin no later than 2005.The target amounts for technology sharing and public-private partnership programme. The resolution of the conference known as 'Copenhagen Accord'[2] was drafted by United States, China, India, Brazil and South Africa. Though the document does not claim any legal binding commitments for reducing carbon dioxide emission, it recognized that the climate change is one of the greatest challenges of the present day and action should be taken to keep temperature increases to below 2°C. The resolution of the conference did not specify the emission target. But hopefully for stabilizing the global carbon level, some countries verbally mentioned their carbon emission reduction level during this conference which are stated in Table 1[2].

Table 1 Carbon reduction target of several countries

	Proposed carbon reduction by different Countries	
Country	**In Copenhagen (2009)[2]**	**In Kyoto (1997)[3]**
Australia	to cut carbon emissions by 25% below 2000 levels by 2020	permitted increases of 8%
Belarus	by 5-10% below 1990 levels by 2020	#
Brazil	by 38-42% below projected 2020 levels	#
Canada	20% below 2006 levels by 2020	equivalent to 3% below 1990 by levels by 2020
China	by 40–50% below 2005 levels by 2020	#
Costa Rica	to become carbon neutral by 2021	reduction upto 5%
European Union	to cut greenhouse gas emissions by 30% below 1990 levels by 2020	8% reductions
Iceland	15% below 1990 levels by 2020	permitted increases of 10%
India	by 20-25% below 2005 levels by 2020	#
Indonesia	by 26% by 2020	#
Japan	by 25% below 1990 levels by 2020	6% reductions
Kazakhastan	15% below 1992 levels by 2020	#
Liechtenstein	20-30% below 1990 levels by 2020	8% reductions
Maldives	carbon neutral by 2019	#
Mexico	50% by 2050 below 2000 levels	#
Monaco	20% below 1990 levels by 2020	#
New Zealand	10% to 20% below 1990 levels by 2020	0% reductions
Norway	30% below 1990 levels by 2020	#
Philippines	5% below 1990 levels	#
Russia	between 20% to 25% below 1990 levels by 2020	0% reductions
Singapore	16% by 2020	#
South Africa	34% below current expected levels by 2020	#
South Korea	4% below 2005 levels by 2020	#
Switzerland	20-30% below 1990 levels by 2020	#
Ukraine	20% below 1990 levels by 2020	#
United Sates of America	17% below 2005 levels by 2020, 42% by 2030 and 83% by 2050	7% for the US

Data not available

Developing countries also got annual aid from developed nation about $100 billion by 2020 for adapting new low carbon technology. US$ 30bn will be given to the poorest countries for their essential technology transfer in energy, transport and agriculture sectors between 2010 and 2012[2].

CARBON IN ECOSYSTEM–CARBON CYCLE

In environment carbon is present mainly in two forms - gaseous carbon (CO_2 and CH_4) and stored or bound carbon. Fossil fuel (Coal, Petroleum etc.), all biomolecules present in plants and animal tissues, carbonate compounds in rocks and water are common examples of bound carbon. Fossil fuels are incapable to take part in carbon cycle without human interferences. Fossil fuels and all other forms of bound carbons (glucose, cellulose, amino acids, fatty acids etc.) produce CO_2 when oxidized and CH_4 is produced when biomolecules are reduced in anaerobic conditions. Thus biological processes and burning of bound carbon is the major source of gaseous carbon in the atmosphere. The carbon present in atmosphere (0.03% by volume) in the form of CO_2, can be fixed either in biomolecules by means of photosynthesis or in carbonate compounds by means of chemical processes. Carbons fixed in biomolecules are converted to fossil fuel by means of a complex biogeochemical process. The biological carbon fixing process is very rapid one and only green plants can take the prime roles, whereas the carbonate and fossil fuel formation processes require millions of years.

CARBON IN ECONOMY

The fossilized stored carbon deposit is actually key item for economist and policy makers of any country. Stored coal, petroleum and their byproducts have direct relation with industrial development, urbanization and also environmental pollution. The distribution of world coal reserves is dramatically different from world oil reserves, being concentrated in countries such as China, USA, Russia, Australia and India. Economic extraction of transportation fuel from coal could thus completely alter the balance of power in terms of world energy supplies. Former USSR in particular, with its close relationships with other countries benefited from any shift in power through its access to major coal and natural gas reserves. Our dependence on fossil fuels does not look set to go away soon, but the rules of the game will change, drastically limiting their ability to throw economies and the world into turmoil and reducing, given sufficient political will, the damage they do to the environment.

Status of carbon storage

Fossil fuels have taken close to 500 million years to accumulate and will likely to be vanished in less than one millionth of that time. Presently rate of crude oil consumption is 67 million barrels per day and the known crude reserves is 1,037 billion barrels, which will be theoretically exhausted in next 42 years (Figure 1)[3].

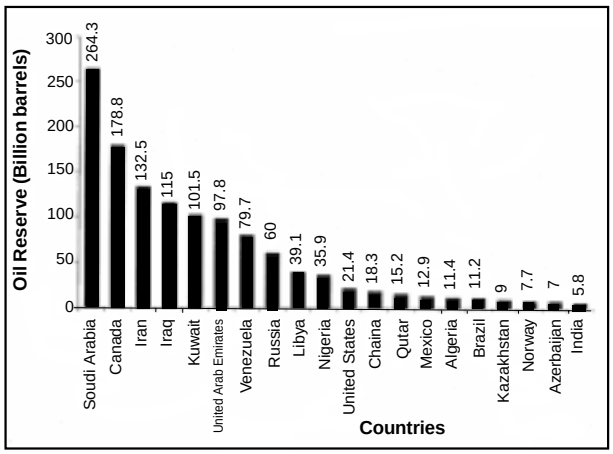

Fig 1 : Country wise oil reserve

As 2014 approaches, discoveries may not keep up with consumption; hence, the price of crude oil will begin to rise. Some Middle East oil fields will be dry by then, but enough fields would still be producing to meet the world's increasing demand. Supply will begin to curtail, but the demand may not be diminished much, will cause the vulnerable rise in the price which has already been started.

Coal shortages in 2014 will not be as critical as crude oil, but by 2114 coal supply will likely become inadequate for demand. Three countries namely the United States, the former Soviet Union, and China possess more than 58 percent of world coal reserves. The United States ranks second in world coal production and are also one of the major coal exporters . Though presently India uses coal and petroleum for power generation and transportation sectors respectively, the energy security of India is no doubt dependent on only coal and coal based power plant. Some statistical review also emphasis that dependency of coal is gradually increasing with the world consumption (Figure2)[3].

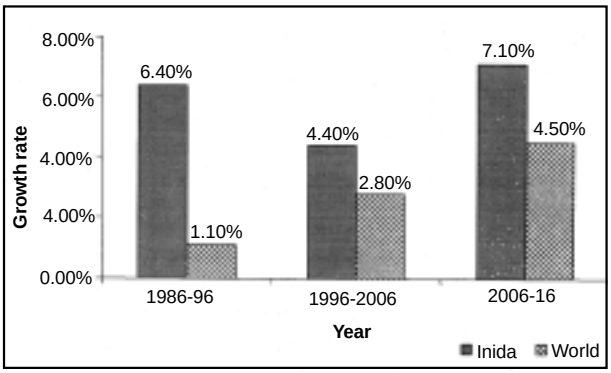

Fig 2 : Average growth rate of coal consumption

Ministry of Coal, Government of India also estimated Indian coal reserves, which will help to make suitable policy regarding coal based energy generation[3] and also to adapt new alternative low carbon energy policy.

Low carbon economy

Resource efficient low carbon economy is urgently required to address the global challenge regarding diminishing fossil fuel reserves and climate change . The majority of fossil fuels are currently used in power and transportation sectors. Low carbon economy is a popular term that refers to an economy which has a minimal output of green house gas (especially CO_2). Implementation of low carbon economy is nothing but an option to avoid catastrophic climate change, and as a precursor to an ideal zero-carbon economy. The main aim of low carbon economy is to integrate all aspects of power generation, transportation, product manufacturing and agriculture. To achieve the expected benefit from low carbon economy, some strategies should be taken in the sectors mentioned below :

(i) Agriculture : Foodstuffs should be produced as close as possible to the final consumers (preferably within walking / cycling distance). This will reduce the amount of carbon-based energy necessary to transport the foodstuffs. Since carbon-based energy are used to preserve and process the food, it is advisable to buy fresh food items rather than preserved one. Cooking is another process which utilizes energy and emits a large amount of CO_2. Energy could be saved if farmers produced more food crops that people would eat without cooking. Most of the agricultural facilities in the developed world are mechanized. Mechanization has increased the productivity significantly, but it also uses lot of energy for the activites like irrigation and transportation of crops from rural areas to market places. Different crops require different amounts of energy input. For example, glasshouse crops, irrigated crops, and orchards require a lot of energy to maintain, while indigenous crops don't need so much maintenance. Those glasshouse and irrigated crops can be cultivated by incorporating new improvements like environmental control systems, heat recovery using condensers, heat storage using buffer tanks, heat retention using thermal screens , alternative fuels (e.g. waste wood) and cogeneration (heat and power). With respect to Carbon emission our food processing units are evaluated in the following table (Table 2).

Table 2 : Status of the food processing units according to carbon emission

Food processing unit	Status according to carbon emission	Comments
Meat	High	● Livestock activities contribute an estimated 18% of the total anthropogenic greenhouse gas emissions. ● Consumption of animal protein by Americans accounts for over 6% of total U.S. greenhouse gas emissions[4].
Sweets, snacks and processed foods	High	● Scientists estimate that these products contribute up to a third of total energy inputs for food production[5].
Seafood	High	● There is a growing awarness that some seafood, especially large fin fish such as Salmon, Tuna and Cod have very high energy inputs. Issues around framed salmon are well-documented, but wild-caught fish are often caught by inefficient, fossil fuel-driven boats[6].
Food waste throughout the food system	High	● Disposal sites are significant contributor of methane emissions, a greenhouse gas 23 times more potent than carbon dioxide in trapping heat close to the earth's surface. ● The big contributor or methane formation in landfills is organic matter - including very significantly, food scraps.
High yielding crops	Hign	● Irrigation require electrical energy
Vegetables and fruits from kitchen garden	Low	● Fruits are consumed locally avoiding any transporation and packing.
Traditional crops	Low	● Using rain water harvesting technology for irrigation.

(ii) Livestock : Livestock activities utilize energy, depending on how they are operated. Using animal feed made from corn, soybeans, and other crops are more energy intensive as because energy is required to produce these crops, process and transport. Free-range farm animals graze on the natural grasslands. Some energy is required to maintain that grassland but not as much as to produce animal feed. Many livestock operations currently use a lot of energy and water for animal nourishment. In the low-carbon economy, such operations require more water conservation methods such as rainwater harvesting, water cisterns, etc. and they should use on-site renewable energy sources (most likely wind and solar) to distribute that water. According to low-carbon economy, farms should be equipped with energy efficiency devices. In dairy industry, some modifications like heat recovery on milk vats, heat recovery from hot water wash, soil moisture measurement to regulate irrigation, bio-digester with cogeneration (heat & power), vat wrap, solar water heating, ripple control, ice bank, chemical substitute for hot water wash etc may be incorporated.

(iii) Fishery : Capture fishery is quite energy intensive. Inefficient, fossil fuel-driven boats are used to catch fishes. Large amount of energy is consumed to preserve these fishes. Improvements such as trawl net technology, heat recovery on refrigeration may be installed to enhance the low-carbon economy.

(iv) Forestry : In the low-carbon economy, forestry operations should be focused on low-impact practices and re-growth. Forest managers should not disturb the soil based carbon reserves too much. Specialised tree farms are the main source of material for many commercial products like rubber, essential oils etc. Quick maturing tree varieties may be grown on short rotations in order to maximize output.

(v) Mining : Flaring and venting of natural gas in oil wells is a significant source of greenhouse

gas emission. The World Bank estimates that 100 billion cubic meters of natural gas are flared or vented annually, an amount equivalent to the combined annual gas consumption of Germany and France, twice the annual gas consumption of Africa, three quarters of Russian gas exports, or enough to supply the entire world with gas for 20 days. The largest flaring operations occur in the Niger Delta region of Nigeria. The leading contributors to gas flaring are: Nigeria, Russia, Iran, Algeria, Mexico, Venezuela, Indonesia, and the United States (in declining order). Eventually contribution to greenhouse gases from mining sector has declined by three-quarters in last four decades[7].

(vi) Industry : For attaining low carbon economy in industries, high efficiency electric motors, high quality furnaces and heat recovery system etc. are very much essential. Variable speed drives and injection modeling system replaced by hydraulic with electric servo motors are recommended for the industries. In site non-conventional energy generation is encouraged to reduce the consumption of fossil fuel generated electricity[8]. India can also able to save energy in several industrial sectors (Figure 3) [9].

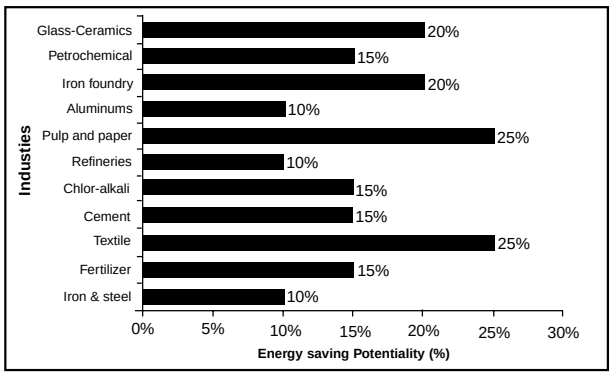

Fig. 3 : Energy saving Potentiality of Indian Industries

(vii) Commercial and retail houses : Retail operations in the low-carbon economy have several new features, like using of skylights to avoid electricity consumption in day time, high efficiency lighting devices (CFL, LED) etc. Many retail stores already use roof-top solar panel arrays in their buildings[16]. Commercial buildings are one of the fastest growing sectors of the Indian economy, reflecting the increasing share of the services sector in the economy. An Energy Conservation Building Code (ECBC) was launched in May, 2007, which addresses the design of new, large commercial buildings to optimize the building's energy demand. Nearly one hundred buildings are already following the Code, and compliance with it has also been incorporated into the Environmental Impact Assessment requirements for large buildings [9].

(viii) Transportation Services : There are several energy saving option and alternatives in transportation sectors. Increased focus on fuel efficient aerodynamic shapes and configurations, vehicle hybridization methods. Low carbon-biofuels (biodiesel, bioethanol, biobutanol) are essential for incorporating low carbon economy. Greater use of public transports specially waterways and rail transport are being encouraged. Load on aviation and road transportation tried to be reduced. Common liquid and gaseous commodities such as water, ethanol. butanol, natural gas, petroleum may be carried by pipelines to reduce pressure on more energy driven tanker transportation. It is true Indian transport sector is not sufficiently updated regarding their machineries. Government of India has taken some policies for their transport sectors, unfortunately which were not able to encourage the low carbon economy (Table 3).

Table 3 : Major alternative policies in Indian transport sector

Measure	Description	Assumption
Fuel economy standards	India has yet to enact fuel economy standards	10% increase over all vehicles compared with reference scenario
Vehicle emission standards	Following the European vehicle emission standards	Impact on pollution and CO_2 emissions, secondary impact on fuel consumption.
Biofuels	5% ethanol blended gasoline was	Enthanol share in gasoline increases to

Measure	Description	Assumption
	introducted in 9 states and 4 union territories in 2003 and was reintroduced and extended nation wide in 2006 although subject to avaiability	10% in 2012. Biodiesel blending in diesel starts in 2009 increasing to 5% by 2015 and 8% share by 2018.
CNG	All commercial vehicles in Delhi, Mumbai and Kolkata run on CNG	Doubling of CNG vehicles compared with reference scenario.
Public transport and infrastructure development	Construction of bus lanes and suburban and underground rail systems to ease road congestion	5% increases in the number of buses (+200 00) compared with reference scenario in 2030.

(ix) Nonconventional micropower generation : Nonconventional micro-power generation systems are now available commercially and they are penetrating the energy markets. Government is providing subsidy along with the technology to the private entrepreneurs. This technology simultaneously generates heat and power in an individual dwelling. It offers an elegant and economically viable way to meet the power/thermal loads enhancing low carbon economy.

CARBON IN INDIAN ECONOMY

In the last decades India had explored their resources to make their economy strong. They had encouraged coal and petroleum based technology in agriculture, industrial, transport and also in defense sectors. But Government of India has undertaken some initiatives which reflect their attitude towards low carbon era (Table 4)[9].

Table 4 : Recent initiatives with a favourable impact on climate change

New Initiatives	Case studies
Metro Rail System	Kolkata and Delhi metro Rail has provided a major boost to public transport, especially in the most congested sections of the Kolkata and Delhi metropolis.
Standards and Labelling Programme for Appliances	An energy lebelling programme for appliances was launched by Bureau of Energy Efficiency in 2006, and comparative starbased lebelling has been introduced for fluorescent tube lights, air conditioners, and distribution transformers.
Energy Conservation Building Code	An Energy Conservation Building Code (ECBC) was launched in May 2007, which addresses the design of new, large commercial buildings to optimize the building's energy demand.
Promoting Green Entrepreneurship	A joint initiative of CII-Sohrabji Godrej Green Business Centre (refer to box 3 for details on GBC) and World Resources Institute, Washington D.C., supported by USAID has been facilitating sustainable enterprise growth by providing sound investment opportunities to emerging Green entrepreneurs since 2005
Promotion of IT : industries	Proliferating throughout India.
Carbon capture and Storage	Several national programmes are being launched Selco, Aditya Solar Lamp, Tata-BP Solar like alternative energy sourses can conserve the carbon based energy sources.
Hotel and resort industries	ITC Sonar Bangla, Kolkata (Hotel) reduces energy consumption upto 20% by using solar heaters, condensed steam to generate hot water and using variable frequency valves in fans.

CONCLUSION

Increase in carbon dioxide in the atmosphere is the result of our habits, lifestyles, and the choices we make due to our unsustainable consumption patterns. Transition to a low carbon economy will have a negligible impact on long term GDP growth

but it will open tremendous opportunities for those who will develop and deliver low carbon products and services. It is argued that strict environmental policies may result in a reduction of jobs. Where as it is expected that transition to low carbon economy will result in creation of new green jobs. According to United Nation, the climate change is creating millions of green jobs in sectors from solar power to biofuels that will slightly layoff else where in the economy[10]. Ethanol production in Brazil had created 500,000 jobs and 150,000 people were employed in China for solar heating manufacturing, where $2.5 billion sales revenues were generated in 2005. The environmental industries in the US employed more than 5.3 million people in 2005. Low carbon economy also promotes lots of new type of jobs such as emission trader, sustainability manager in corporate houses, ecological economist, renewable fuels engineer, green architect, sustainable urban planner, environmental lawyer etc. This policy will be a latest systematic approach, for sustainability of ecosystem and economy of a country. Life cycle analysis, ecodesign, reduction of wastes, uses of renewable energy, and also micro-generation technology at home will be suitable to run this new concept. Moreover incorporation of de-carbon habit in daily life is essential for achieving low carbon era.

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KNOW THY INSTITUTIONS

CENTRAL SALT & MARINE CHEMICALS RESEARCH INSTITUTE, BHAVNAGAR

The mission of Central Salt & Marine Chemicals Research Institute (CSMCRI) and its people is to work in partnership with visionary sponsors and collaborators to generate the knowledge and innovations required for efficient utilization of our coastal wasteland, sea water, marine algae, solar power and silicates. The Institute will also harness its capabilities in biosciences, chemical transformation, process engineering, environmental monitoring, separation science and analysis to address focused needs of industries and organizations in the region and beyond.

GENESIS

With a coastline of about 3,500 miles, inland sources in Rajasthan and Little Rann of Kutch, and the rock salt mines in Mandi, India have possibilities of attaining a high position in salt production among the salt producing countries of the world. As is known, apart from being an indispensable item of food, salt is an important raw material for the manufacture of several heavy chemicals e.g. soda ash, caustic soda and chlorine. Besides, salt is used in food processing industries, such as fish curing, meat packing, dairy products and fruit and vegetable canning.

India had been an importer of salt for a long time as her own production was not sufficient to meet the demand. The position deteriorated further after partition, when the extensive rock salt deposits in the Punjab and the marine salt works in Sind went to Pakistan. Soon after the attainment of independence, in 1947, India was faced with the problem of meeting the acute shortage of edible salt in various parts of the country. The Government set up an interdepartmental committee under the

chairmanship of Shri H.M. Patel, who was then the Cabinet Secretary, to examine and report on the measures for overcoming the shortage of salt. The committee submitted several short term proposals to the Government and also recommended that a Salt Expert Committee should be appointed to investigate into the problems relating to the production, quality and utilization of salt.

The need for salt research was recognized by the Council of Scientific & Industrial Research (CSIR), New Delhi as early as 1940, when, at the instance of Dr. S. S. Bhatnagar, a Salt Research Committee was established to formulate a programme of research on the production,and utilization of salt. This Committee was later amalgamated with the Heavy Chemicals Committee and revived in July 1948 with Dr. Mata Prasad as the Chairman. In April 1948, the Government of India constituted a Salt Expert Committee under the chairmanship of Shri P.A. Narielwala to advise the Government on the measures necessary to place the Indian salt industry on a sound footing. After examining a number of salt works in India, the Committee came to the conclusion that if the quality of salt is to be improved and the salt works are to operate economically and efficiently, it would be necessary (i) to devote more attention to research, (ii) that model factories be set up in the principal salt producing centers to serve as demonstration units for both small scale and large scale manufacture, and (iii) that research stations be established to investigate methods of improving the quality and the yield of salt and also of recovering the byproducts. In September 1951, Shri C.C. Desai, the then Secretary of the Ministry of Works, Production and Supply, proposed that a Central Salt Research Institute be established under the aegis of CSIR for carrying out research on marine salt, and salt from inland lakes and sub-soil brine. It was suggested that the Institute be located at some centre in Saurashtra; the Ministry of Works, Production and Supply would support any proposal for a grant from the Salt Development Cess for setting up the Institute. Meanwhile the Government of Saurashtra made a generous offer to place any of their buildings in Saurashtra at the disposal of the CSIR for housing the Institute. If no building was found suitable, the Saurashtra Government offered to pay for the building, provided the Institute was located in Saurashtra.

This offer from the Saurashtra Government was considered by the CSIR, particularly in view of the proposal from the Ministry of Works, Production and Supply that the Institute should be located in Saurashtra. Shri P.N. Kathju, the Planning Officer of the proposed Institute, carried out a preliminary survey of possible sites, both in the north coast and south coast of Saurashtra, for the location of the Institute. Bhavnagar, which being a flourishing centre of higher education in Saurashtra was considered to be suitable for locating the Institute. The Saurashtra Government offered to place at the disposal of the CSIR a magnificent building, "Raj Hotel", for housing the Institute, two bungalows and 125 acres of land for the Experimental Salt Farm (ESF). In view of the facilities offered by the Saurashtra Government for the establishment of the Institute, the CSIR decided to set up the Institute at Bhavnagar. Thus Central Salt Research Institute (now known as Central Salt & Marine Chemicals Research Institute) was inaugurated by Late Pandit Jawaharlal Nehru, the First Prime Minister of India on 10th April, 1954.

CSMCRI Today :

CSMCRI with much scientific excitement has now achieved technological excellence with several granted patents in the core mandate of the institute and is one among the top performing national R&D laboratories in the country. At the beginning of 2011, the Institute has around 360 staff with 150 S&T staff on its roll and around 250 research fellows and project assistants pursing their doctoral programme. Some of the recent landmark technologies that phenomenally changed the brand image of the institute are:

- Integrated process for the production of SOP, green bromine and high purity magnesia from concentrated natural brine.
- Integrated process for simultaneous production of plant nutrient rich sap and residue rich of K-carrageenan from fresh seaweed.
- Neat biodiesel from Jatropha curcas.
- Development of Hollow Fiber (HF) ultrafiltration membranes for efficient water purification with low rejection rate.
- Development of Thin Film Composite (TFC) Reverse Osmosis (RO) membrane technology for desalination of brackish and seawater to obtain potable water (< 500 ppm TDS).
- Production of high purity salt from natural brines
- Production of spherical shaped crystals of common salt from natural brine
- Production of low sodium salt from bitterns and vegetable salt from Salicornia
- Transgenic agricultural crops conferring salt tolerance through molecular biology and genetic engineering interventions

These key technological achievements are well talked in print and electronic media and brought considerable visibility to the institute at both national and international level. Some of the current major projects include :

- 0.75 TPD Potash Test Bed for integrated production of FCO grade Sulphate of Potash, Ammonium Sulphate and High Purity Magnesia; will also have provision for scale up of K+ extraction with DPA (DST)
- Multi-institutional NMITLI project on Microalgal Biofuel with CSMCRI as nodal lab (CSIR)
- Creation of facility for 50,000 Jatropha tissue culture plants from elite accessions (MNRE)
- Technical feasibility & economic viability of commercial Jatropha curcas production together with life cycle analysis (GM/US DOE)
- Bioethanol from indigenous seaweeds with scaled up off-shore cultivation (MNRE)
- EU project on algal biofuel
- Collaborative ISRO-CSMCRI project on the study of Algal Blooms
- 5 solar powered RO units (in partnership with FORRAD & supported by Coca Cola Foundation) and 5 more RO plants for Afghanistan (Norwegian Church Aid)
- Salt cluster development programme at Rajula to promote ultrapure solar salt technology (Gujarat Industries Commissionerate)
- Collaborative project between CSMCRI-CSIRO on desalination including use of carbon nanotubes
- Under the new CSIR EMPOWER scheme, 13 new projects have been sanctioned in 2010 and are being currently pursued by young scientists of this institute on various domains.

RECENT ACHIEVEMENTS

M/s Archean Group of Companies, Chennai has recently been allotted 60,000 acre of land in the Greater Rann of Kutch to put up a 100,000 TPA sulphate of potash (SOP) plant, integrated with MgO production, based on the Institutes patented (US Patent 7,041,268) process which was licensed to them. The company has been assured an additional 40,000 acre land to expand SOP production to 300,000 TPA in the second phase. Now that land has been formally allotted, the know how demonstration is underway and the major components of the process have been demonstrated successfully to the client.

It is proposed to set up a 3000 TPA unit immediately so that SOP can be provided for large scale trials all across India and also to serve as the

basis for detailed engineering for the larger plant. DST has evinced interest in supporting this nationally important project under Potash Mission and the proposal is getting ready. Apart from this a status note on potash was prepared for Hon. Minister of Science & Technology and newspaper reports suggest that the Government is considering extension of subsidy to SOP. CSMCRI has licensed a fully integrated Jatropha biodiesel process to DRDO on turnkey basis. This will be a zero effluent discharge plant with all waste converted into value and the biodiesel complying with EN14214 standards. The plant is expected to be ready for commissioning in May, 2008. The PCT International Preliminary Report on Patentability has cleared all 21 claims of process from all angles, viz. novelty, inventiveness and utility. Among other achievements, the CSMCRI Qualis van has completed 73,000 km running on neat Jatropha biodiesel with no engine modification and a tie up was established with General Motors to achieve Euro IV norms with the CSMCRI Jatropha biodiesel. On the agriculture front, plantation raised from cuttings in Orissa is faring well. 3 kg of seed yield has been exceeded for some plants and also achieved the highest ever reported seed weight (average of 0.8 g for CP-9) with excellent oil content (40%). The efficiency of our shoot tip micropropagation process has been raised with an improvement of multiplication ratio from 3-4 to 6-8.

Nine RO plants were successfully commissioned in A&N islands under very difficult circumstances. There was huge appreciation for this effort from all quarters. Following the successful demonstration by CSMCRI that saline lignite mine water generated in the mines of Rajasthan State Mines & Minerals can be converted into drinking water with minimum 65% recovery. RSMML issued a tender for a 20 MLD plant with CSMCRI as consultant. The order has been released by RSMML for setting up the 20 MLD plant on DBOOT basis.

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Conferences / Meetings / Symposia / Seminars

5th International Conference on Contemporary Computing (IC3-2012), August 6 – 8, 2012, Noida.

Themes : (i) Algorithms, (ii) Systems (Hardware & Software), (iii) Applications,

Please see the conference website, http://www.jiit.ac.in/jiit/ic3,

Dates for Final Manuscripts and Registration : May 4, 2012

ICYRAM 2012, International Conference of Young Researchers on Advanced Materials, July 1-6, 2012, Singapore

Themes :

- Biomaterials & Healthcare (BH)
- Energy & The Environment (EE)
- Electronic Materials (EM)
- Optical Materials (OM)
- Magnetic Materials & Spintronics (MM)
- Carbon-Based Materials (CM)

Contact : Secretariat Office, Meeting Matters International, 1 Commonwealth Lane, #06-23 One Commonwealth, Singapore 149544,

Email : icyram2012@meetmatt.net, website : http://www.mrs.org.sgr/icyram2012

International Conference of Technology Management (ICTM), 18th–20th July, 2012, Bangalore

Themes :

- Policy, Institutions and Governance
- Corporate Management, R & D Strategy and Competitiveness
- Financing, Commercialization and IPR
- Economic Development, Sustainability and Inclusiveness
- Intellectual Capital, HRM, and Organizational Development
- ICT and OM for Technology Management

Contact : ICTM–2012, Department of Management Studies, Indian Institute of Science, Bangalore–560012, Phone : +91-80-22932379/22933266

Website : www.mgmt.iisc.ernet.in/ictm, Email : ictm@mgmt.iisc.ernet.in

1st International Conference on Vedic Foundations of Indian Management, April 19–21, 2012, Haridwar

Themes :

- Ancient Roots of Corporate Entities
- Ancient Indian Economy : Synthesis of Cultural, Spiritual, Economic and Political Thought
- Business in Ancient Period : Strategies and Structures
- Spiritual Foundations of Economics : Insights from Scriptures
- Indian Ethos and Values of Organizations
- Vedic Literature and Lessons for Management
- Progessive Financial Management : Insights from Sam Veda
- Holistic Human Resource Management : Insights from Yajur Veda
- Decision Making : Insights from Rig Veda
- Quality Marketing Mangement : Insights from Atharva Veda
- Project Management : Insights from Sthapatya Veda
- Strategic Management : Insights from Dhanur Veda
- Production and Quality Management : Insights from Ayur Veda
- Organization Development : Insights from Ramayan and Bhagwat Gita
- Vedic Cultural Intelligence and Modern Corporate Excellence : Lesson from Panchkoshas Theory,

Contact : Conference Secretariat, ISOL Research Foundation, C-17, Raj International Business Centre, Gurunanak Pura, Laxminagar, Near Scope Minar, Delhi-110 092, India,

Email : sunita.singhsengupta@gmail.com

5th IFIP World IT Fourm 2012, New Delhi, 16th -18th April 2012.

Organised by International Federation for Information Processing (IFIP) in partnership in the Department of Information Technology, GOI. Under the overall theme of 'Sustainable Human Development', WITFOR 2012 seeks to bring together 'problem solvers' from across the globe to discuss and debate the potential use, impact and challenges of the use of ICT in four key areas : health, education, agriculture and e-governance.

Contact : IFIT WIFT 2012 Secretariat, B–118, Sector 2, Noida 201301,

Email : witfor2012@in.kuoni.com, witfor@9.9.in

Telephone : +911204010999, Website : www.witfor.org

S & T ACROSS THE WORLD

SCIENTISTS DECODE BRAIN WAVES TO EAVESDROP

Neuroscientists may one day be able to hear the imagined speech of a patient unable to speak due to stroke or paralysis, according to University of California, Berkeley, researchers.

These scientists have succeeded in decoding electrical activity in the brain's temporal lobe—the seat of the auditory system—as a person listens to normal conversation. Based on this correlation between sound and brain activity, they then were able to predict the words the person had heard solely from the temporal lobe activity.

"This research is based on sounds a person actually hears, but to use it for reconstructing imagined conversations, these principles would have to apply to someone's internal verbalizations," cautioned first author Brian N. Pasley, a post-doctoral researcher in the center. "There is some evidence that hearing the sound and imagining the sound activate similar areas of the brain. If you can understand the relationship well enough between the brain recordings and sound, you could either synthesize the actual sound a person is thinking, or just write out the words with a type of interface device."

"This is huge for patients who have damage to their speech mechanisms because of a stroke or Lou Gehrig's disease and can't speak," said co-author Robert Knight, a UC Berkeley professor of psychology and neuroscience. "If you could eventually reconstruct imagined conversations from brain activity, thousands of people could benefit."

In addition to the potential for expanding the communication ability of the severely disabled, he noted, the research also "is telling us a lot about how the brain in normal people represents and processes speech sounds."

Pasley and his colleagues at UC Berkeley, UC San Francisco, University of Maryland and The Johns Hopkins University report their findings in the open-access journal *PLoS Biology*, January 2012.

They enlisted the help of people undergoing brain surgery to determine the location of intractable seizures so that the area can be removed in a second surgery. Neurosurgeons typically cut a hole in the skull and safely place electrodes on the brain surface or cortex—in this case, up to 256 electrodes covering the temporal lobe—to record activity over a period of a week to pinpoint the seizures. For this study, 15 neurosurgical patients volunteered to participate.

Pasley visited each person in the hospital to record the brain activity detected by the electrodes as they heard 5-10 minutes of conversation. Pasley used this data to reconstruct and play back the sounds the patients heard. He was able to do this because there is evidence that the brain breaks down sound into its component acoustic frequencies—for example, between a low of about 1 Hertz (cycles per second) to a high of about 8,000 Hertz -that are important for speech sounds.

Pasley tested two different computational models to match spoken sounds to the pattern of activity in the electrodes. The patients then heard a single word, and Pasley used the models to predict the word based on electrode recordings.

"We are looking at which cortical sites are increasing activity at particular acoustic frequencies, and from that, we map back to the sound," Pasley said. He compared the technique to a pianoist who knows the sounds of the keys so well that she can look at the keys another pianoist is playing in a sound-proof room and "hear" the music, much as Ludwig van Beethoven was able to "hear" his compositions despite being deaf.

The better of the two methods was able to reproduce a sound close enough to the original word for Pasley and his fellow researchers to correctly guess the word.

"This research is a major step toward understanding what features of speech are represented in the human brain" Knight said. "Brian's analysis can reproduce the sound the patient heard, and you can actually recognize the word, although not at a perfect level."

"With neuroprosthetics, people have shown that it's possible to control movement with brain activity," Knight said. "But that work, while not easy, is relatively simple compared to reconstructing language. This experiment takes that earlier work to a whole new level."

The ultimate goal of the UC Berkeley study was to explore how the human brain encodes speech and determine which aspects of speech are most important for understanding.

NEW SPECIES OF ANCIENT CROCODILE DISCOVERED

A University of Missouri researcher has identified a new species of prehistoric crocodile. The extinct creature, nicknamed "Shieldcroc" due to a thick-skinned shield on its head, is an ancestor of today's crocodiles. Its discovery provides scientists with additional information about the evolution of crocodiles and how scientists can gain insight into ways to protect the species' environment and help prevent extinction.The discovery was published in the journal *PLoS ONE* (Public Library of Science).

"Aegisuchus witmeri or 'Shieldcroc' is the earliest ancestor of our modern crocodiles to be found in Africa," said Casey Holliday, co-researcher and assistant professor of anatomy in the MU School of Medicine. "Along with other discoveries, we are finding that crocodile ancestors are far more diverse than scientists previously realized."

Shieldcroc is the newest discovery of crocodile species dating to the Late Cretaceous period, approximately 95 million years ago. This period is part of the Mesozoic Era, which has been referred to as the "Age of the Dinosaurs;" however, numerous recent discoveries have led to some scientists calling the era the "Age of the Crocs," Holliday said.

Holliday identified Shieldcroc by studying a fossilized partial skull specimen, which was discovered in Morocco and held by the Royal Ontario Museum of Toronto for several years before Holliday analyzed it. By analyzing blood vessel scarring on the bone, Holliday determined that the crocodile would have had a structure on top of its head, resembling a shield. The dents and bumps on the bone indicate veins delivered blood to a circular mound of skin, something never before seen in a crocodile. He said the shield was likely used as a display structure to attract mates and intimidate enemies and possibly as a thermo-regulator to control the temperature of the animal's head.

Holliday compared Shieldcroc's skull to those of other crocodilians. By comparing slopes of various bones, he found that the new species had a flatter skull than other known species. With this information, he believes it is unlikely that Shieldcroc wrestled dinosaurs on or near the shoreline. Instead, Holliday said the fossil indicates that Shieldcroc had thin jaws, likely used to catch fish.

In addition, Holliday analyzed Shieldcroc's skull and brain to estimate the overall size of the reptile. He said scientists often use head size of an animal to estimate its total length. Using several parameters, Holliday and Gardner estimate that this specimen had a 5-foot long head and was 30 feet long. "Scientists often estimate body size of crocodilians based on the size of the skull," Gardner said. "However, estimating the body size of Shieldcroc was difficult, due to the enormous size of the skull compared to other crocodilians. To make a size estimate, we compared several features of the bone to many different species."

Although Shieldcroc lived more than 90 million years ago, Holliday said scientists can use information about the animal to gain a better understanding of today's crocodiles. He said this insight grows in importance as humans encroach on ecosystems.

COMPUTER SIMULATIONS REVEALING ALTERNATIVE FUEL PRODUCTION AND CARBON DIOXIDE STORAGE

For some time, researchers have explored flammable ice for low-carbon or alternative fuel or as a place to store carbon dioxide. Now, a computer analysis of the ice and gas compound, known as a gas hydrate, reveals key details of its structure. The results show that hydrates can hold hydrogen at an optimal capacity of 5 weight-percent, a value that meets the goal of a U.S. Department of Energy standard and makes gas hydrates practical and affordable. The analysis is the first time researchers have accurately quantified the molecular-scale interactions between the gases—either hydrogen or methane, aka natural gas—and the water molecules that form cages around them. A team of researchers from the Department of Energy's Pacific Northwest National Laboratory published the results in *Chemical Physics Letters.*

The results could also provide insight into the process of replacing methane with carbon dioxide in the naturally abundant "water-based reservoirs," according to the lead author, PNNL chemist Sotiris Xantheas.

"Current thinking is that you need large amounts of energy to push the methane out, which destroys the scaffold in the process," said Xantheas. "But the computer modeling shows that there is an alternative low energy pathway. All you need to do is break a single hydrogen bond between water molecules forming the cage—the methane comes out, and then the hydrate reseals itself."

Gas hydrates—especially methane hydrates, which store natural gas—look like ice but actually hold burnable fuel. Naturally found deep in the ocean, water and gas interweave in the hydrates, but little is known about their chemical structure and processes occurring at the molecular level. They have been known to cause problems for the petroleum industry because they tend to clog pipes and can explode. A methane hydrate produced the bubble of methane gas that contributed to 2010's Gulf of Mexico oil spill.

In the hydrogen hydrates, which could potentially be used as materials for hydrogen fuel storage, a small hollow cage made from 20 water molecules could hold up to a maximum of five hydrogen molecules and a larger cage made from 24 water molecules could hold up to seven.

The maximum storage capacity equates to about 10 weight-percent, or the percentage of hydrogen by mass in the chunks of ice, although packing hydrogen in that tight puts undue strain on the system. The Department of Energy's goal for hydrogen storage—to make the fuel practical—is above 5.5 weight-percent.

Experimentally, hydrogen storage researchers typically measure much less storage capacities. The computer model showed them why : The hydrogen molecules tended to leak out of the cages, reducing the amount of hydrogen that could be stored.

The researchers found that adding a methane molecule to the larger cages in the pure hydrogen hydrate, however, prevented the hydrogen gas from leaking out. The computer model showed the researchers that they could store the hydrogen at high pressure and practical temperatures, and release it by reducing the pressure, which melts it.

With methane hydrates, some fuel producers want to remove the gas safely to use it. Others see the emptied cages as potential storage sites for carbon dioxide, which could theoretically keep it out of the atmosphere and ocean, where it warms the earth and acidifies the sea. So, Willow and Xantheas tested how methane could migrate through the cages.

"This process is important because it can happen with natural gas. It shows how methane can move in the natural world," said Xantheas. "We hope this analysis will help with the technical issues that need to be addressed with gas hydrate research and development."

THE INDIAN SCIENCE CONGRESS ASSOCIATION

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Nominations are invited for the following Awards to be presented in different Sections during 100th Indian Science Congress to be held at Calcutta University, Kolkata from 3-7 January, 2013.

1. Professor Hira Lal Chakravarty Award—Plant Sciences.
2. Pran Vohra Award—Agriculture and Forestry Sciences.
3. Professor Umakant Sinha Memorial Award—New Biology.
4. Dr. B. C. Deb Memorial Award for Soil/Physical Chemisty.
5. Dr. B. C. Deb Award for Popularisation of Science.
6. Prof. R. C. Mehrotra Commemoration Lecture—Chemical Sciences.
7. Dr. (Mrs.) Gouri Ganguly Memorial Award for Young Scientist—Animal, Veterinary and Fishery Sciences.
8. Prof. G. K. Manna Memorial Award—Animal, Veterinary and Fishery Sciences.
9. Prof. Sushil Kumar Mukherjee Commemoration Lecture—Agriculutre and Forestry Sciences.
10. Prof. S. S. Katiyar Endowment Lecture—New Biology/Chemical Sciences.
11. Prof. R. C. Shah Memorial Lecture—Chemical Sciences.
12. Prof. Archana Sharma Memorial Award—Plant Sciences.
13. Prof. (Mrs.) Anima Sen Memorial Lecture—Psychology & Educational Sciences.
14. Dr. V. Puri Memorial Award—Plant Sciences.

The last date for receiving nominations for the above awards is July 31, 2012.

For further details see the website : http://sciencecongress.nic.in

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