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EDITORIAL

BIOINFORMATICS : FROM THE PRE-GENOMIC TO THE POST-GENOMIC ERA

In the past decade, bioinformatics has become an integral part of research and development in the biomedical sciences. Bioinformatics now has an essential role both in deciphering genomic, transcriptomic and proteomic data generated by high-throughput experimental technologies and in organizing information gathered from traditional biology. Sequence-based methods of analyzing individual genes or proteins have been elaborated and expanded, and methods have been developed for analyzing large numbers of genes or proteins simultaneously, such as in the identification of clusters of related genes and networks of interacting proteins. With the complete genome sequences for an increasing number of organisms at hand, bioinformatics is beginning to provide both conceptual bases and practical methods for detecting systemic functional behaviors of the cell and the organism.

Computational Biology and Bioinformatics are terms for an interdisciplinary field joining information technology and biology that has skyrocketed in recent years. The field is located at the interface between the two scientific and technological disciplines that can be argued to drive a significant if not the dominating part of contemporary innovation. In the English language, Computational Biology refers mostly to the scientific part of the field, whereas Bioinformatics addresses more the infrastructure part.

The goal of this field is to provide computer-based methods for coping with and interpreting the genomic data that are being uncovered in large volumes within the diverse genome sequencing projects and other new experimental technology in molecular biology. The field presents one of the grand challenges of our times. It has a large basic research aspect, since we cannot claim to be close to understanding biological systems on an organism or even cellular level. At the same time, the field is faced with a strong demand for immediate solutions; because the genomic data that are being uncovered encode many biological insights whose deciphering can be the basis for dramatic scientific and economical success. With the pre-genomic era that was characterized by the effort to sequence the human genome just being completed, we are entering the post-genomic era that concentrates on harvesting the fruits hidden in the genomic text. In contrast to the pre-genomic era which, from the announcement of the quest to sequence the human genome to its completion, has lasted less than 15 years, the post-genomic era can be expected to last much longer, probably extending over several generations.

At the basis of the scientific grand challenge in computational biology there are problems in computational biology such as identifying genes in DNA sequences and determining the three-dimensional structure of proteins given

the protein sequence (the famed protein folding problem). Other unsolved mysteries include the computational estimation of free energies of biomolecules and molecular complexes in aqueous solution as well as the modeling and simulation of molecular interaction networks inside the cell and between cells. Solving these problems is essential for an accurate and effective analysis of disease processes by computer.

Besides these more 'timeless' scientific problems, there is a significant part of computational biology that is driven by new experimental data provided through the dramatic progress in molecular biology techniques. Starting with genomic sequences, the past few years have provided gene expression data on the basis of ESTs (expressed sequence tags) and DNA microarrays (DNA chips). These data have given rise to a very active new subfield of computational biology called expression data analysis. These data go beyond a generic view on the genome and are able to distinguish between gene populations in different tissues of the same organism and in different states of cells belonging to the same tissue. For the first time, this affords a cell-wide view of the metabolic and regulatory processes under different conditions. Therefore these data are believed to be an effective basis for new diagnoses and therapies of diseases.

Eventually genes are transformed into proteins inside the cell, and it is mostly the proteins that govern cellular processes. Often proteins are modified after their synthesis. Therefore, a cell-wide analysis of the population of mature proteins is expected to correlate much more closely with cellular processes than the expressed genes that are measured today. The emerging field of proteomics addresses the analysis of the protein population inside the cell. Technologies such as 2D gels and mass spectrometry offer glimpses into the world of mature proteins and their molecular interactions.

Finally, we are stepping beyond analyzing generic genomes and are asking what genetic differences between individuals of a species are the key for predisposition to certain diseases and effectivity of special drugs. These questions join the fields of molecular biology, genetics, and pharmacy in what is commonly named pharmacogenomics.

Pharmaceutical industry was the first branch of the economy to strongly engage in the new technology combining high-throughput experimentation with bioinformatics analysis. Medicine is following closely. Medical applications step beyond trying to find new drugs on the basis of genomic data. The aim here is to develop more effective diagnostic techniques and to optimize therapies. The first steps to engage computational biology in this quest have already been taken.

While driven by the biological and medical demand, computational biology will also exert a strong impact onto information technology. Since, due to their complexity, we are not able to simulate biological processes on the basis of first principles, we resort to statistical learning

and data mining techniques, methods that are at the heart of modern information technology. The mysterious encoding that Nature has afforded for biological signals as well as the enormous data volume present large challenges and are continuing to have large impact on the processes of information technology themselves.

This era witnesses the activity and dynamics that the field of computational biology and bioinformatics enjoys not only among biologists but also among computer scientists. It is the intensive interdisciplinary cooperation between these two scientific communities that is the motor of progress in this key-technology for the 21st century.

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"There is a single light of science, and to brighten it anywhere is to brighten it everywhere."

—Isaac Asimov

SIR ASUTOSH MOOKERJEE—BRIEF PROFILE

Asutosh Mookerjee was born on 29 June, 1864 in Calcutta. From his very childhood Asutosh showed signs of growing into a person of distinction. He joined the South Suburban School and passed the Entrance Examination of the Calcutta University in 1879 securing the second position in order of merit. He was admitted into the Presidency College and passed the F.A. Examination in 1881 securing the 3rd place. Three years later in 1884 he took his B.A. degree standing first in the University. The next year he took his M.A. degree in Physical Science and Mixed Mathematics securing the first position and became first student in Calcutta University to obtain Master Degree in more than one subject. He again sat for the M.A. Examination in Science and the special examination for the award of Premchand Roychand Studentship the following year, and creditably acquitted himself in both. Meanwhile he studied law in the City College and stood first in all the three examinations in law. In 1886 he became Fellow, Edinburgh Royal Society, Member, Royal Asiatic Society and Bedford Association for the improvement of Geometrical Teaching. In 1890 he became Member of Mathematical Society of Palermo, Sicily and *Societe de Physique* of France and he wrote a book '*Geometry of Conics*' in 1892.

He started practising as a lawyer at the Calcutta High Court in 1888 after obtaining B.L. degree the same year, and hardly six years passed by before he got his Doctorate in Law (D.L.) in 1894. Soon he built up an extensive practice and created a name for himself. Lord Curzon invited him to become a Judge of the Calcutta High Court, which he accepted in 1904 after taking the consent of his mother to whom he was fondly devoted.

Asutosh had a special aptitude for Mathematics, and he pursued his study and research in this abstruse subject even when he was busy as a lawyer at the Court. His interest was, however, varied. Having a particular flair for writing he was bent upon raising the status of his mother tongue, Bengali. In Philosophy too he was deeply interested.

He was admitted into the membership of the Asiatic Society at the age of 21 and his first paper to the Society was related to Indian philosophy. Asutosh's contributions to the stock of mathematical knowledge consisted of nearly twenty papers published between 1880 and 1890. While still an undergraduate he published a paper *(Messenger of Mathematics,* Vol. 13) on "Some extension of a theorem of Salmons". The *Journal of the Asiatic Society* published twelve of his papers (1887-1890).

* General President, 01st Indian Science Congress held during 15-17 January, 1914 at Calcutta.

Obscured as the fact is by his later legal and administrative distinctions, it is not widely known that Asutosh began his intellectual career as a lecturer in Mathematics and Mathematical Physics at the Indian Association for the Cultivation of Science from 1887 to 1892. Later in life he became not only a fellow or member of several continental and American academies or societies, specially mathematical societies, but the founder, in 1908, of the Calcutta Mathematical Society of which he was the President up till his death. In 1907 he was elected President of Asiatic Society of Bengal.

His association with the University of Calcutta began in 1889 when he was taken in as an ordinary member. He became the Vice-Chancellor of the University four times consecutively from 1906 to 1914. Once again he became the Vice-Chancellor for two years in 1921. His contribution to the development of this University is not only conspicuous but will be remembered with gratitude by the posterity. He was responsible for introducing Bengali as a separate subject in the M.A. examination, which in those days was a difficult thing to achieve. In 1918 he delivered the first Convocation address of Mysore University in October and on 1st January 1924 at University of Lucknow.

In 1920 he officiated for some time as the Chief Justice of the Calcutta High Court and he retired from judgeship in 1923 and resumed practice at the bar. He was elected President of the Asiatic Society four times, and thus established a record in the annals of the Society up to his time. He presided over the First Session of the Indian Science Congress held from 15th to 17th January, 1914 in the premises of the Asiatic Society at 1, Park Street, Calcutta. A genius of rare distinction, he was connected with almost all the learned bodies of his time in Bengal. While full of the urge to work he died suddenly on 25 May, 1924 at Patna.

This issue is dedicated to Sir Asutosh Mookerjee, First General President, ISCA

SITUATING SIR ASUTOSH MOOKERJEE IN THE ANNALS OF INDIAN SCIENCE CONGRESS ASSOCIATION (ISCA)

Dilip Kumar Sinha*

The purpose of this article is to focus on the genesis of ISCA against the backdrop of the then ambiences on scientific pursuits. That the growth pattern of British Association for Advancement of Science (BAAS) was kept in view is dealt with here. Further, that the perspective on science set forth in Sir Asutosh's Presidential Address found resonance with their counterparts elsewhere has been treated. Finally, that the development of a genre of ISCA was much in the anvil is indicated.

It may sound to be a quirk of historical phenomena that ISCA has its centennial year, well within the celebration of one hundred and fifty years of its first President, Sir Asutosh Mookerjee. Can this be treated simplistically as a passing phase in the trajectories of a personality and of an organization, too ? Or, remarkably at the other end, is it a confluence of events that needs to be delved into, in the wider contexts of genesis, growth and genre of ISCA ? There has been no dearth of historical recipes on the role of Sir Asutosh in bringing about transformations on education and research in science and technology, well in the precincts of the university system. Of the three g's stated above, Sir Asutosh Mookerjee has, almost incontestably, the image of a personality playing an important role for the genesis of ISCA. Asutosh must have been prevailed upon to preside over the first Indian Science Congress by two European scientists, one from the northern part of India and the other, from the southern part. The foundation site was the setting in the premises of the Asiatic Society of Bengal, Park Street at Calcutta. Anglo-centric pursuits used to feature conspicuously in its activities. Asutosh could affordably set in there a transnational dimension through presentations of his papers in mathematics, as he drew upon uninhibitedly the works of G Monge of France, R F A Clebsch of Germany and G H Mainardi of Italy, as well. In a way, Asutosh Mookerjee sought for intellectual and educational models for possible import and pursuits, thereafter. Such a phase in Asutosh's career can be described as one of a gestation period of acquisition, without being discriminating in respect of choice.

The genesis of ISCA, if it is to be focused afresh, ought to seek evidences and data, as well. It is, no doubt, from the standpoint of history, almost a formidable task because of reliability of resources. Perhaps, the historiography in Indian contexts, may provide a wide diversity of perspectives. One thereby becomes reminiscent of relevant works of a mathematician D D Kosambi whose methods should be of immense use. The genesis of

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ISCA, if it is to be construction of the past, concerns of the present need to be necessarily discernible. For assessing the role of Asutosh in framing the genesis of ISCA, one has to take recourse to what has often been described as 'externalised history', entrenched in the domain of his public life.

Truly speaking, Asutosh's public life began soon after his dispensing with his research activities in mathematics. An ilk of his joining the public sphere appeared when he declined the offer of an academic post by the DPI. The data or evidences supporting his entry into the public arena are in no way recorded in his well-known Diary which, of course, tells about his association with, mathematical organizations, societies etc. abroad. His membership in municipal and legislative bodies might have reinforced his abilities to be interactive in wider areas. Asutosh's Fellowship in the University of Calcutta and involvement as a formal member of the Syndicate and Senate of the University must have bolstered upon him to do something uniquely distinctive for the affairs of the University. His active role as a member of both the Sadler Commission and the Indian University Commission and camaraderies with personalities like V K Gokhale at the national level (both being members of Imperial Legislative Council) went a long way to work for a transformation of the University of Calcutta. The innovation lay on the mapping of the university from an examining body, even though stable yet sterile, to a system with academic dimensions. Asutosh pounced upon the British raj's well-known Woods Despatch on Education and assiduously made the colonial raj condescend to unalloyed objectives and terms of an university system, so devoutly wished for all the periods. It is time now, to look back on circumstances leading to the formation of ISCA, particularly, parts of the 'externalised history' mentioned earlier.

The Anglo-centric approach coupled with Indo-Germanic trends, in respect of structures and symbols, could appropriately make a dent in affairs of the Asiatic Society of the Bengal. Asutosh had organized by now what can be described as an attribute of the Westernphillic brand, seeking a translation to an institutional Asian matrix somewhere, different from what Sir William Jones had done in the seventies of the nineteenth century. The fervour of the Hindoo college did not disappear after its closure ; otherwise a British teacher there, Professor Cayley could not have recommended Radhanath Sikdar, a prodigy in mathematics and an ardent Derozian, for the post of a 'Computor' in the then Trigonometrical Survey of India. Religious movements had their heydays in those days of historicity. Three Universities in three Presidencies, Calcutta, Bombay and Madras came up. Missionary colleges also catered to educational aspirations. 1855 saw the birth of the then Presidency College aiming chiefly at turning out pro-establishment civilian and judicial products. Whatever be the ulterior designs of the colonial raj, in going for such establishments, some upshots were strikingly otherwise, perhaps because of the rare intellectual ambience there, allowing some of the recipients to move out later on to the public domain.

Science had started taking its roots in the city of Calcutta. Astronomy, not at all being an ancillary to Mathematics, used to be a desired part of enlightenment, in general, from which two leading missionary colleges, St. Xaviers College and Scottish Church College and the Presidency College, could hardly

dissociate themselves. Mahendralal Sarkar (1833-1904), a product of the Calcutta Medical College and also, a leading medical personality, sought for dissemination on science, well beyond the scientific literacy. Founding the Indian Association for the Cultivation of Science (IACS) as a voluntary organization by him could sow seeds of researches by scientists, with an exploratory bent of mind, irrespective of the areas concerned and as of now, without being paid heavily by the state exchequer. Theoreticians like Asutosh Mookerjee, academicians like Father Eugene Lafont used to deliver lectures on themes that had far-reaching sequels. Asutosh couldn't, even during that period, absolve himself from his ingress of mathematics. So he went in for establishing the Calcutta Mathematical Society in 1908 on the lines of London Mathematical Society. Isn't it a kind of an initiation of rallying concerned researchers under an organization led by mathematically wedded intellectuals ? This may be looked upon as city-wise analogue, London *vis a vis* Calcutta, but a year before one could witness Indian Mathematical Society in realms of Madras but not wholly formally. Indeed, a mathematical mindset kept on coming to the fore when problems of one kind or the other, even in affairs of public bodies, had to be encountered.

There is hardly any point now to have a rehash about institutions like National Council of Education that were set up for providing opportunities and exposures to science and technical education, along with pronouncedly alternative pathways. Not being impervious to what the imperialist regimes put in for a so-called middle path, Asutosh's endeavours were such that aversions to nationalist aspirations were in no way explicit ; rather his were efforts that eked something innovatively alluring. Having stepped out deftly the ruts of the purely examining complexion of the University, he could with his cohorts and the public, in general, realize the existence of isolated centres of scientific activity. Both faculty-wise and region-wise, these warranted for a shift. For example, Gauri Sankar Dey, the famous teacher of Mathematics of General Assembly Institution (Scottish Church College) and a teacher of Acharya Brojendra Nath Seal, used to take care of eight papers, at the postgraduate level. Each of such situativities had the definitive characteristics, despite infirmities which, in turn, would have assumed disquieting proportions if there be no holistic counterpart(s). Being reared up in mathematical realms, Asutosh dealt this somewhat axiomatically in that one could hardly proceed if there be no centre-circumference hypothesis. Shifts on such scores from one to another could well form the kinematics of the dynamics of teaching cum learning, that could be ushered in by Sir Asutosh Mookerjee when he took over the cudgels of leadership in the University of Calcutta. The University had to face irritants but his developing both academic science and industrial (Applied Physics & Applied Chemistry) sciences, in the university portals must have posed a fairly complex set of problems for him. As for his concerns on these, if not angsts, one ought to turn to some of his convocation addresses at the University of Calcutta, Mysore and Lucknow.

British Association for the Advancement of Science (BAAS) could become fairly known in scientific and technological circles and more so, those who used to keep themselves apprised of what kept on happening in realms of science and technology. Among all organizations, dealing with scientific and technological areas,

BAAS has not, so far suffered from the impression of being an elitist organization. Sir J C Bose had to labour hard on his classic experimental feat, in the premises of the well-known Royal Institution in London, perhaps, to acquire a greater scientific credibility. BAAS still deals with programmes on public understanding of science. Yet, BAAS can boast of brilliant scientists of England associated deeply with it. Being highly enamoured of BAAS, the Indian leadership on matters of science, cherished to have the ISCA patterned essentially on the lines of BAAS. It looks enigmatic about why IACS could not have connectivities with BAAS or why collaborative linkages with American Association for the Advancement of Science (AAAS) or any such European association could not be in the air at that point of time. Perhaps, the British fascination had the sway over other possible contenders. One can't be sure, so far as records say, whether Asutosh was individually inclined to BAAS or to others. At least, setting up the linkage went unquestioned, at least from its founder President, Sir Asutosh Mookerjee, whose Presidential address in 1914 could feature inadequacies and the infirmities, as mentioned earlier. Positively speaking, that was a public address, to the scientific community to rope in practitioners on technology and industry in variegated fields of human endeavour.

It must have been felt that human development called for mobilisation of human resources, that might have rested on their oars, without being concerned about quality and excellence in the disciplines concerned. It would be prudent and more so, scientifically, to cull in the thought process of Sir Asutosh Mookerjee, revealed often candidly through his convocation addresses. In the convocation address on 14th March, 1914 the Vice Chancellor, Asutosh Mookerjee was effusive about the visit of the BAAS delegation consisting of scientists of the stature of Professor Herbert Hall Turner, Sadlerian Professor of Astronomy at the University of Oxford, Professor Ernest William Brown of the University of Yale, Professor Henry Edward Armstrong, Professor of Chemistry in the Imperial College of Science and Technology, Professor Willam Mitchinson Hicks, Professor of Physics in the University of Sheffield and Professor William Bateson, Fullerian Professor of Physiology in the Royal Institution of England ; here is an exemplar where scientists of BAAS delegation delivered lectures at the University of Calcutta in the very year of birth of the ISCA.

Asutosh Mookerjee did not mince words in his espousing the image of IACS. Indeed, his were not just words of appreciation and not about its founder but the rationale for such activities. Asutosh said : "It was my deepest conviction that Science has unfettered the mind, enthroned reason, taught the duty and responsibility of independent thought and brought to mankind the message of intellectual enlightenment and liberty, that I planned the foundation of a University College of Science and Technology and approached, for fulfillment of any cherished ambition, two of the noblest sons of India, Sir Taraknath Palit and Sir Rashbehary Ghose". That's perhaps, just before he expiry of one of his tenures as a Vice Chancellor of the University, he laid the foundation of the University of College of Science in the then Upper Circular Road, Calcutta. But he saw to it that munificences from the great benefactors did not go by default. Endowments could become available to the University with the condition that Sir

Asutosh Mookerjee would be the Chairman of all the Trust Committees and their recommendations would be mandatory on the University for implementation. This is something unbelievable, as things stand now. Going a bit further, let us cite what Asutosh thought about universities being treated as a 'corporation'. In his convocation address on 28th March, 1914, he was outspoken, when the freedom and autonomy of the university were frightfully at stake. He told the gathering : "The question which agitates my mind is that of the degree and the measure of the ultimate independent authority which a corporation such as the University of Calcutta is entitled to claim. It is well understood that an Indian University, and guardian of great public interests is ultimately accountable for all its measures to the Government, whether the Government be provincial or supreme". Whatever be the vocabularies used in those remarks, nuances therein continue to be relevant now, as they were earlier. Whoever be the trustees or custodians of the policy, there has been a qualitative breakdown.

Corporate Social Responsibility (CSR) could well be foreseen by Sir Asutosh Mookerjee and personalities of that stature. Sir Asutosh, in particular, could seldom be found to have reservations on harping on what an university ought to be. One may read into these, metaphors or rhetorics but he was always in search of missing elements in the university system. Paradigms in seats of learning, whether they be prior to their being within the canopy of the university, could be identified but shifts in paradigms must have occurred. Certainly to facilitate that process, even if transitory, Asutosh sought for alliances with institutions/organizations. In his Presidential Address, he waxed eloquently on private industries and also on government-run organizations like Geological Survey of India, pleading for collaborative and interactive styles of functioning. Academic sciences, *per se*, could almost naturally find seats in the University College of Science & Technology (UCST), despite allegedly surreptitious moves by the then government agencies and agents, too. Peer review did not exist on the evaluation of the academic science but the appointments did not raise any question. The rationale of the totality of Applied Sciences, instituted within the framework of UCST, might have grown out of the public opinion to go in for industrialization. One could hardly preclude the simmerings and aspirations as well, for developing corporate and technological sciences in university realms. But evaluators on such scores should be sponsors or employers. In fact, there used to be industrial fairs ; for example, the pertinent one should be the first of its kind in which the participants were drawn not only from industries but also from student-entrepreneurs. This took place in 1921 with the support from and under the leadership of, Sir Rajendranath Mukherjee, a distinguished industrialist and a President of ISCA, later on. Surprisingly, that was the occasion which saw the portrait of Sir Asutosh Mookerjee as a 'Bengal Tiger', the young artist being Atul Chandra Bose who later on became a celebrity in the field of Fine Arts. Another President of ISCA was Professor Gilbert Walker, a Mathematical Physicist of the Imperial College, London, playing a pioneering role in building up the Survey of India, particularly the India Meteorological Department.

Formally speaking, Sir Asutosh Mookerjee, did not happen to be the Vice Chancellor of

University of Calcutta when he was presiding over the first session of ISCA. But he could hardly stay away from his concerns about and interests in Calcutta University. One may well describe that period as one of introspection on the part of Sir Asutosh Mookerjee. It would be an exciting area of research on the contemporaneity, unfolding new complexions of Calcutta University and having convergences with emerging trajectories of ISCA. For this, it is a necessity to have qualitative data, embedded in occasional events of ISCA and educational institutions offering science and technology. A retrospective configuration can then possibly emanate. Mutuality of interests, complementarity and supplementarity need to flourish between establishments like educational institutions with their appropriate peripheries. Educational pathways, to be truly effective, have to have allies like ISCA so that the requirements just mentioned, are fulfilled. The leadership is the vital issue as to rope in a wide diversity of users.

In sum, it is not the chronology of events in ISCA and Calcutta University, apparently parallel, that can affordably be interpretative about where the image of Asutosh Mookerjee stands in respect of stewardship of ISCA, in its entirety. A double-arrow indicator, seeking one to one correspondence, can facilitate the task of situating Asutosh in the annals of ISCA. Should a semiotic view be confined only to the period of his being the General President of ISCA ? An affirmative response to this, should reckon with Asutosh's outpourings elsewhere, not only those quoted above. As for annals of ISCA, one should necessarily glean through themes, periods, occasions and lead articles/addresses without, being bereft of annals-conditioned positive perspectives. Shouldn't that lead to an oeuvre on an intellectual leadership, engaged in shaping ambits of an University system ? And that too, with accessible inputs from professional organizations like ISCA, surely, in its nascent phase ?

SCIENCE IN INDIA AFTER INDEPENDENCE : AN OVERVIEW

S. P. Singh*

There was a leap forward in Indian science immediately after independence primarily due to the keen interest of Pandit Nehru who had great respect for science and used the term 'Scientific Temper'. An early start placed India as a global player in some selected areas such as atomic energy and space. However, the leadership could not be maintained as many other emerging countries made rapid strides. There are many impediments for doing good science in India which include bureaucratic mindset, decline of the university system, lack of support from industry, inability of science to attract the most talented students and societal perception towards science. Recent governmental initiatives-INSPIRE scheme, establishments of IISERs, adequate funding for S & T and formulation of STI Policy-2013 are aimed to strengthen Indian science in the coming years.

INTRODUCTION

Foundation of scientific base of India was laid by the first Prime Minister, Pandit Nehru, who had graduated from Cambridge in natural sciences, and considered laboratories as temples of modern India. Nehru was greatly influenced by the vision of three of his associates: H. J. Bhabha, S. S. Bhatnagar and Vikram Sarabhai.

While Bhabha, who was the founder chairman of the Atomic Energy Commission, built first atomic reactor in Asia at Trombay in 1956, Bhatnagar is credited with the establishment of CSIR laboratories, which are now the largest public funded chain of laboratories in the world. Sarabhai, rightly considered as the father of Indian space programme, was a versatile person who had also established Physical Research Laboratory (PRL) and Indian Institute of Management (IIM), both at Ahemdabad. Unfortunately, such a genius person died at an early age of 52!

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STRENGTHS

As a result of these efforts, India got an early lead and substantial gains particularly in the areas of atomic energy and space technology. Development of fast breeder reactor by Indian scientists is attracting global interest. Efforts are being made to make India as one of the few countries in the world with advanced nuclear technology that can generate non-polluting electricity.

The expertise of Indian scientists and technologists became evident by the launching of Mars Orbiter Mission (*Mangalyaan*) in 2013 at a cost which is a fraction of the money spent

by the other global agencies. *Mangalyaan* used fully indigenous technology as opposed to the first rocket launched 50 years before in Nov. 1963 with almost everything coming from abroad. If successful, India will become the fourth country to study the *red planet* by Sept. 2014. One has to remember that the annual budget of Indian Space Research Organisation (ISRO) is 1/10th of that of the American space agency, NASA.

One of the most visible faces of the strength of Indian technology is the IT sector which provides jobs to millions of young people. The industry aims to generate $ 200 billion by export in 2020 from the current figure of $ 86 billion in 2013-2014. Today, Bangalore is considered to be one of the largest technology clusters of the world.

Establishing and increasing the number of IITs and Indian Institutes of Science Education and Research (IISERs) are great steps taken by the successive governments for the growth of Science and Technology in the country.

WEAKNESSES

In spite of an early lead and substantial gains, Indian science could not retain its primacy among the developing countries. It is now lagging behind China, South Korea and Brazil. While it is true that good science is being done at selected institutions, however, the number of good practicing scientists is declining. We are still waiting for the day when a scientist working in independent India bags a Nobel Prize!

India's contribution to global research journals is only 3.5% as compared to 28% of USA, 10% of China and 6% of Brazil. Whereas USA publishes 2 million scientific articles and China 1 million, India's contribution is only 240,000 articles with 10th position in the world. However, India scores somewhat better than China in Citation Per Article (CPA) (2.71 vs. 2.21). Developed countries have higher CPAs close to 7.

UNIVERSITY SYSTEM

Decline of quality science research in Indian universities is more visible. The Times Higher Education World University Rankings-2013 show only one Indian University, Panjab University, occupying 239th position, higher than four IITs (Delhi, Kanpur, Kharagpur and Roorkee) which occupy positions between 351 and 400. Five areas determining these positions and weightages are: teaching (30%), research (30%), citations (30%), industry income (2.5%) and international outlook (7.5%).

A recent Elsevier report (2012) reveals that only 4% of the total R & D expenditure in India is from higher educational institutions thus putting India at a lower rank as compared to other advanced countries such as USA (17%), Japan (14%) and China (10%). Obviously there is greater priority on R & D spending in the other areas like space, atomic energy and defence. Almost similar budgetary allocation of about Rs. 6000 crores in 2013-2014 to each departments of Science & Technology, Space and Atomic Energy is reflective of this trend.

Universities in India are now primarily considered a place for teaching and not for research unlike in developed countries where generating curiosity among the students, which develops into creativity, is considered equally important as the transfer of knowledge in class room teaching. Close and continuous interaction between students and teachers is very conducive for carrying out quality and original research. It is, therefore, not surprising that nearly all the Nobel Prizes go to scientists working in the university system.

It is true that with the opening of a large number of national laboratories, focus on research has shifted away from the universities. Significant inbreeding in recruitment and disincentive for migration of teachers has also contributed to the decline of science research in the universities.

For improving the quality of science research in universities, built-in arrangements are to be made for frequent interactions between teachers and researchers working in national laboratories. There is also a need for incentive in the form of an out-of-the-box remuneration package. For example, research projects may have component for honorarium to teachers like 3 month's salary as exists in many American universities. There is great need to create awareness that science is a rewarding career particularly when global companies are heading towards India for their R & D programmes.

BUREAUCRATIC AND OTHER HURDLES

Scientists in India face bureaucratic hurdles which are reflected in asking for a sanction to purchase equipment or for attending a professional meet. This problem is acknowledged by the successive Prime Ministers in the inaugural addresses of the Indian Science Congress. A. B. Vajpayee, for example, said in 2001 "for Indian science to flourish, officials should serve as facilitators and not as masters of scientists". Similar sentiments were expressed by the next Prime Minister "It is unfortunately true that the red tape (and other factors) have all contributed to a regression of Indian science" (2010). It is apparent that the problem is acknowledged by the policy makers but they find it difficult to address. Scientific Advisory Council (SAC) to the Prime Minister has also recommended the elimination of bureaucracy in science research and to make structural change for better administration.

Let us hope that the newly established National Science and Engineering Research Board (NSERB), managed by scientists with simplified funding procedures, will curtail the role of bureaucracy in science research.

A major impediment for the lack of originality in Indian science is the age old tradition of not questioning the elders and teachers and thus carrying a stereotype model from generation to generation. "The challenge now is to create a nurturing environment for creative irreverence within India" said Dr. R A Mashelkar, a distinguished scientist of the country. A questioning mind and logical explanation for the existing facts are major requirements to accept (or reject) an existing theory. Such 'creative irreverence' is totally missing in our educational system.

Lack of funds is a great impediment for quality research in our country. We are spending only 1% of the GDP for research as compared to 3.4% and 2.7% of the GDP by Japan and USA, respectively. The government has now proposed to increase the funding to 2% of the GDP by the end of 12^{th} five year plan.

It is paradoxical that science in India does not get any support from industry in spite of the fact that the industry reaps the fruits of science. This is in sharp contrast to other countries such as USA, Japan and South Korea where almost 50% of research funding comes from industry.

Such an inadequate funding prompted C N R Rao to say that "Investment in science in India is marginal, subcritical and idiotic" in the first statement after the conferment of *Bharat Ratna*. His disappointment with the

budgetary allocation for science is particularly noteworthy as he heads the SAC to the Prime Minister. All those who are interested in Indian science are grateful to Prof. Rao for his candid remark. Known for plain speaking, he earlier wrote to the Prime Minister "If you are worried about economic competitiveness and not about scientific competitiveness, then I think the future will be bleak".

NEW GOVERNMENTAL INITIATIVES

In order to attract talent into science studies and research, the DST has launched a scheme known as INSPIRE (Innovation in Science Pursuit for Inspired Research). This is a 5 year programme for encouraging young students to pursue career in science, and so far a million students have been benefitted. According to the Secretary, DST "We hope to catch them young and build a cadre of top quality researchers". In another major initiative, 25 Jawahar lal Nehru Fellowships have been instituted, under which globally recognized scientists anywhere abroad are invited to work in Indian institutions for 12 months over a 3 year period.

The Prime Minister has unveiled the new Science, Technology and Innovation (STI) policy-2013 at the centenary session of the Indian Science Congress held at Kolkata in Jan., 2013. The approach makes the STI policy more relevant for national development with particular focus on the participation of the industry in Research and Development (R & D) activities.

The STI policy envisages making career in science research attractive to the brightest students and the presence of world class R & D infrastructure in order to position India among the top 5 global scientific powers by 2020. This is to be achieved by increasing the share of global scientific publications from the present 3.5% to over 7% and quadrupling the number of papers in the top international journals.

Keeping in view that only countries that have advanced in science actually have made significant progress, the STI policy aims at promoting the spread of scientific temper amongst all sections of society, establishing world-class laboratories for gaining global leadership in frontier areas of science, increasing the number of scientists working in the laboratories by more than 50% of the present strength in the next 5 years, and treating scientific research in the private sector at par with public institutions for availing public funds.

SOME CHALLENGES

Indian science has to address many national problems in the coming years. The first among them is the challenge in the agricultural sector. In mid 1960s, when India was importing 15 million tonnes of food grains, introduction of dwarf variety of wheat triggered Green Revolution increasing the production manifold. However, subsequent increase in the population of the country levelled off its benefits and now there is a need for second revolution, may be 'Gene Revolution' based on Biotechnology. By 2020, India needs 400 million tonnes of foods grains with reduced availability of land (from 170 million hectares to 100 million hectares) and with reduced water availability. There is a need to develop seeds that will ensure good yield even under constraints of water, and generate technology for soil upgradation, dry land agriculture and salinity resistant seeds.

Water availability in the country is at a critical point. In 1951, it was 3450 cubic meter per person (cmpp). It is now 2000 cmpp! An attractive alternate area is to create new perennial source of fresh water desalination by developing cost- effective technology. Desalination of sea water using reverse osmosis (RO) is being employed in many countries of the Middle East. A few desalination plants are already functioning in Chennai.

Another challenge for scientists and technologists is to provide energy security to the country. To meet electricity requirement, generating capacity has to get tripled from the existing one hundred and fifty thousand megawatts. In the medium term, developing nuclear energy appears to be the only solution. While France generates 75% of its electricity requirement through nuclear power, other advanced countries such as USA, Russia and UK produce about 20%. In contrast, the capacity of nuclear reactors in India is only 3% of the requirement. Technology has to be developed to make nuclear energy cost-effective by using more indigenous resources.

However, in spite of the governmental support, societal perception has to undergo a sea change for the horizontal and vertical growth of science in the country. It looks strange that in the recently concluded general elections, there was absence of a definite road map for the growth of science and technology in any manifesto of political parties. There is a promise of creating millions of jobs without giving a thought that how jobs can be created unless there is a strong technological base which has to come from science? Science has to be the part of our value system for its development. "This is not only necessary because our future depends on it, but also because instilling a scientific attitude and temper in our population is essential for developing a progressive, rational and humane society" said Dr. Manmohan Singh, then Prime Minister while inaugurating 101st Indian Science Congress in 2014.

To fulfil the Nehruvian dream of economic prosperity through science, even media needs sensitization for highlighting the achievements of science, recognizing the contribution of Indian scientists and providing connect between science and society.

ESTIMATION OF ETHNICITY FROM HANDWRITING PATTERNS

Monika Saini and A. K. Kapoor*

Biometric recognition refers to the automatic recognition of individual using physiological or behavioral characteristics. A wide variety of biometrics determines the identity of individuals like DNA, fingerprint, iris, voice, signature, handwriting etc. Personal identification based on handwriting is a very usual and reliable biometric system but,ethnicity recognition based on handwriting is an unexplored area. In this paper, a new approach to identify the ethnicity of the writers of handwritten documents has been introduced.The aim of the present paper is to examine how handwriting features and characteristics may be utilized for the identification of ethnic groups.

INTRODUCTION

Biometric personal identification is an important research area aiming at recognizing individuals based on their physiological or behavioral characteristics and is receiving growing interest from both academia and industry. There are two types of biometric features: First one is physiological features like fingerprint, face, iris pattern and palm prints and Second type is behavioral features like handwriting, signature and voice. Behavioral biometrics is based on skills, style, preference, knowledge, motor-skills or strategy used by people while accomplishing different everyday tasks.

Handwriting has been proven to be a very useful tool for biometric identification and confirmation.A handwritten document reveals an enormous wealth of information like age, gender, education level, mood and handedness. Over the past few years, a lot of efforts have been devoted in the physiological biometric identification of ethnicity e.g. ethnicity recognition based on facial images, iris texture, fingerprints, hand geometry etc.[11, 1] but establishing ethnic identity on the basis of handwriting is a novel concept.

It has been observed that many studies have been conducted on the Handwriting identification and recognition[4, 3, 8]. These studies highlighted writer identification using different models and approaches like hidden Markov model (HMM), Markov Random Field-based (MRF) approach and binary vector dissimilarity measures etc.

So far, no work on ethnic identification from handwriting has been introduced in public literature. In this paper, we propose automatic ethnicity estimation based on handwriting features. We also analyze the variability in

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handwriting patterns among different ethnic groups.

DEFINING ETHNICITY, ETHNIC GROUPS AND ETHNIC IDENTITY

Ethnicity as a concept is derived from the Greek word 'ethnos' which means nation, people, caste, tribe, and such others. 'Ethnic', according to *Webster's Third New International Dictionary* (1967), relates to the gentiles or nations not converted to Christianity; community of physical and mental traits possessed by the members of a group as a product of their common heredity and cultural tradition; or indicates the racial, linguistic, and cultural ties of people with specific group or exotic primitive culture. Ethnicity, therefore, stands for the ethnic quality or affiliation of a group bearing different meanings in varied situational contexts. The meaning of the concept of ethnicity depends on the meaning of several other concepts, particularly those of ethnic group and ethnic identity. The concept of ethnic group is the most basic one, from which another one can be derived. It refers to ethnicity as the collective phenomenon. The objective dimensions of ethnic groups include presence of at least some community institutions or organizations, the fact of having descendants and ancestors, as focus of cultural transmission and identity formation and the fact that there is a "script" for cultural behavior, in the form of customs, rituals and preconceptions which provides the content to culture and its transmission and is manifested in overt behavior patterns. Members of an ethnic group may, however, distinguish themselves on the basis of certain common physic-cultural characteristics.

Ethnic identity refers to ethnicity as an individually experienced phenomenon. It can be defined as a manner in which persons, on account of their ethnic origin, locate themselves. Ethnicity itself is an abstract concept which includes an implicit reference to both collective and individual aspects of the phenomenon[12].

HANDWRITING AS A TOOL OF IDENTIFICATION

Handwriting is an acquired skill and that is a complex perceptual-motor task, sometimes referred to as neuromuscular task. Writing is actually a brain function and hand is merely a device with which to carry out instructions sent to it by the brain.

Each person's handwriting has some unique features which can be used for personal identification. Individuality is an extremely important concept and part of the handwriting identification process.Recognition can be done by properly analyzing the significance and frequency of occurrence of handwriting features in random writings.

Handwriting is taught to, and learned by, a person using either a copybook letter form or observing and adopting a letter, combinations of letters as written by someone else like parents, teachers, friends etc. Hilton defines copybook from this way: "The design of letters that is fundamental to a writing system. This term is derived from the old methods of teaching handwriting from a copybook containing engraved script printed on each page for the student to imitate".

There are many discriminating elements in writing that have potential value in writing identification like Arrangement, Margin, Slant or Slope, Spacing, Letter Formations, Embellishments, Connections, Commencements and Terminations etc. These elements or features are influenced by a number of

factors like physical factors (Maturity, Practice, Handedness, Illness), genetic factors (Familial Relationships, Sex), psychological factors (Emotional Stress, Nervousness, Mental Illness), mechanical factors (Pen, Ink, Writing Material and Writing Surface) and variations in occupations, in methods and degree of thoroughness in teaching and in writing instruments.

HANDWRITING AND ETHNICITY

It is generally understood that the biological unit of human classification is the ethnic group. To understand the possible relationship between the handwriting and ethnicity following perceptional bases can be taken into consideration :

- The ethnic groups share unique biological and cultural trait such as language. "Language is systems of symbols; writing is a system for symbolizing these symbols. A writing system may be defined as any conventional system of marks or signs that represents the utterances of languages..., it was once generally held that all writing systems represent some stage in a progression toward the ideal writing system, the alphabet. The accepted view today is that all writing systems represent relatively optimal solutions to a large and unique set of constraints, including the structure of languages represented, the functions that the system serves, and the balance of advantages to the reader as opposed to the writer"(Encyclopedia Britannica, 1988).
- A particular type of people associated with specific ethnicity shares almost alike neuromuscular and motor functions because of their similar biological and physical bodily features. As the handwriting is the function of neuromuscular activity controlled by brain so it is likely to say that a certain degree of commonness exists in the handwriting features of the people of same ethnic group.

Ethnicity in India is tremendously complex subject intertwined with varied culture and religion. The uniqueness in the ethnicity of this country is the factor that makes it different from other nations. In India ethnicity would refer to a class of social collectivity which may be divided into types based on particular marks of distinction like caste, religion, language, culture or some composited of these items. The anthropological studies of various ethnic groups and communities have been done in India[5, 10, 2, 7, 9].

Personal identification based on signature has been used for a long time; use of handwriting for automatic identification has started recently. But no work has been performed on ethnic identification based on handwriting elements. In our previous work we used 19 handwriting characteristics for ethnic identification[6]. These features were divided into Macro and Micro features which were also used to establish the discriminating power of handwriting among different ethnic groups. In this study seven ethnic groups were identified on the basis of differences in handwriting patterns. Variations in handwriting features of ethnic groups (Brahmin, Panjabi, Jat, Baniya, Ahir, Bengali and Tamilian) were seen in case of Slant, Spacing, formation of 'm' humps, lower case 'o' loop formation and beginning strokes.The main handwriting features of Brahmin ethnic group were moderately right slant and inner loop formation in lower case 'o'. In Panjabi group vertical slant, lower case 'o'closed at the top with no loop formation and larger line spacing

than other ethnic groups were main features of handwriting. Among the Jat ethnic group peculiar handwriting pattern was seen in the case of beginning stroke i.e. curved left to right. A rounded hump in lower case 'm' was a main feature in the Baniya ethnic groups. Lowest line spacing was found in the Tamilian ethnic group.

In conclusion, this study shows that handwriting patterns can reliably identify ethnic groups. It also represents that ethnic groups can be differentiated on the basis of specific handwriting elements. In order to unravel the correlation between handwriting features and ethnicity more research is needed at global level as well.

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GREENHOUSE EFFECT AND GLOBAL WARMING : CONCEPT, CONCERN AND REMEDIATION

Kashinath Bhattacharya*

The earth's natural climate has always been, and still is, constantly changing. Greenhouse effect is a warming of the surface of the earth by a complex process involving sunlight, trace gases and particles in the atmosphere. Some of the heat energy escapes to the space but much of this does not pass through the layers of atmospheric greenhouse gases to outer space and gets absorbed by the greenhouse gases. Thus the earth's lower atmosphere heats up. The greenhouse effect is a natural phenomenon and vital to life. Without the greenhouse effect the earth's average temperature would be –18°C, instead of current average temperature of 15°C. However, problems may arise when the atmospheric concentration of greenhouse gases such as CO_2, CH_4, N_2O, O_3, halocarbons and water vapour increase. The properties that make those trace gases to become greenhouse gases are : (i) dipolic nature, (ii) having extremely strong, broad absorption band that overlaps with some of the wavelengths of IR, (iii) transition between the vibrational energy state, (iv) Formation of vibration-rotation spectrum. The recent IPCC Scientific Assessment of Climate Change estimated the globally averaged surface temperature and these changes may lead to a number of serious consequences like (a) Global warming and climate change, (b) Rising Sea level, (c) Disruption of the water cycle, (d) Worsening health effects, (e) Changing Forest and natural ecosystem, (f) Challenge to agriculture and the food supply. As per provision of Kyoto Protocol in 1997, there should be legally binding limits on the six major greenhouse gases (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6) emissions of developed countries to an aggregate reduction of 5%. In this connection many measures are to be needed, which would require improved technology and additional cost. There is additional requirement to switch over to low or no carbon fuel and also to switch over to non-fossil fuel sources of energy, such as solar, hydroelectric, nuclear, etc. Passenger cars must emit 60% less nitrogen oxides and 40% less hydrocarbons. Production of CFCs, halons, carbon tetrachloride in refrigerators, air conditioners solvents etc., should be banned. Alternative chemicals will need to be developed. Recycling of chemicals will be required. It is advised to increase afforestation through agroforestry, social forestry, etc. and to decrease deforestation. Economists have

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suggested two policy tools for reducing global CO_2 emissions. such as (i) A transferable discharge permit (TDM) which proposes that countries would be allocated CO_2 emission permits equal to their permitted base level emission and (ii) the Carbon tax. This tax would be levied on the carbon context of the fuels consumed. The IPCC also proposed the policy of the Clean Development Mechanism (CDM) for joint implementation for credit in developing countries.

INTRODUCTION

Climate change is a shift in the "average weather" that a given region experiences. Global climate change means change in the climate of the earth as a whole. Global climate change does occur naturally and the earth's natural climate has always been, and still is, constantly changing. The climate change we are seeing today differs from previous climate change in both its rate and its magnitude.

WHAT HAPPENS TO ENERGY COMING FROM THE SUN?

The chief forms of energy are (1) *Radiant energy* (Solar energy), (2) *Heat energy*, (3) *Chemical energy* (in the bonds of organic compounds) and (4) *Mechanical energy* (two forms viz. *Potential energy* or stored energy and *Kinetic energy* or useful energy).

The Sun is the source of all energy for organisms on the earth. In the Sun by nuclear fusion (continuous transmutation of hydrogen atoms into helium) high amounts of energy releases which radiates out in all directions in the form of *electromagnetic waves* called Solar radiation . Only a very minute portion of this radiation (i.e. half a millionth of Sun's energy output) reaches the earth's atmosphere. Part of the radiant energy in wavelengths between 390nm to 720 nm is the visible range. We receive $173{,}000 \times 10^{12}$ watts of energy from the Sun through electromagnetic radiation. Out of this electromagnetic radiation[1] :

— 30% of the incoming radiation is reflected straight back to the space,

— 47% of the radiation is absorbed by atmosphere, land and seas,

— 23% of the radiation evaporates water and moves moisture around the water cycle,

— below 1% of the remaining radiation drives the wind and currents,

— only about 0.01% of radiation is used in photosynthesis (Fig.1).

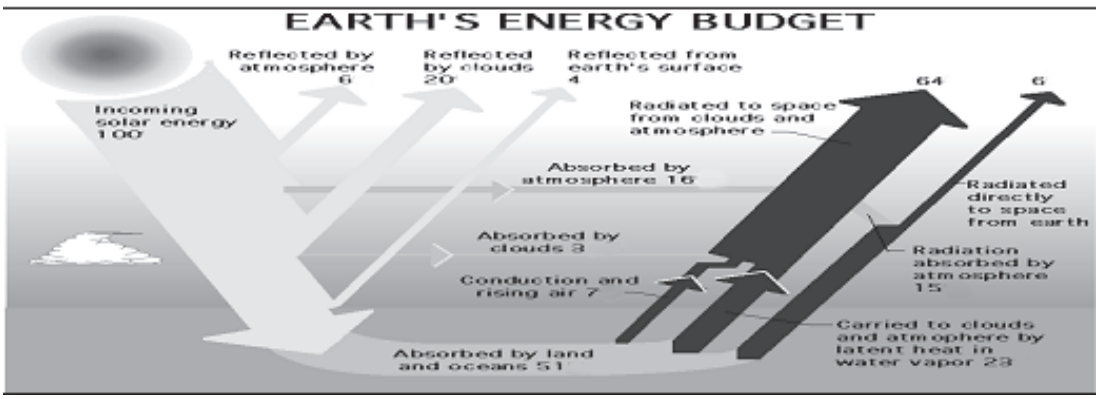

Fig. 1 : The Solar energy budget[10]

THE SOLAR CONSTANT

The amount of solar radiation at the outer boundary of the earth's atmosphere, received on a surface perpendicular to the direction of the sun is called the solar constant[2]. It has a value of 1360 + 20 Wm^{-2} or 1.95 cal cm^{-2} min^{-1}, assuming the conversion value of 1 cal cm^{-2} day^{-1} = 0.484 Wm^{-2}. The *Nimbus-6* with regard to earth radiation budget of 1977 suggests a value of 1392 Wm^{-2} (1.99 cal cm^{-2} min^{-1})

GREENHOUSE EFFECT — THE CONCEPT

Greenhouse effect is a warming of the lower atmosphere (troposphere) and surface of the earth by a complex process involving sunlight, gases and particles in the atmosphere.

When electromagnetic radiations of shorter wave length (UV 320-390 nm, visible spectrum; and some shorter IR) from the Sun enters the earth's atmosphere, about a third of it is reflected back to space (Fig.1). Of the rest, some is absorbed by the atmosphere, but most of it is absorbed by the surface of the earth. The earth emits energy at longer wavelengths, mainly middle or high infrared (IR) portion (2000-40000 nm) of the electromagnetic spectrum. Here the earth acts like a *black body*, in other way a good radiator. According to the nature of a black body, the earth absorbs all the incoming radiations and reradiates energy at longer wave lengths (IR) to the outer space[2]. Since the earth radiates at an effective blackbody temperature of 255K , a very low temperature compared to the Sun's blackbody temperature of 6000K, the earth's emission occurs over a broad range of wavelength from 1200-40000 nm with a flat maximum of about 12000 nm. Therefore, according to the property of a blackbody, the earth must be radiating as much as the radiation absorbed i.e. the power radiated by the earth will be equal to the power received by the earth[3].

Temperature of any radiating body determines the wavelength of the radiation. As the Sun is very hot it gives off its energy mainly in short-wave radiation (UV, Visible, Short IR). Most of this radiation passes through the earth's atmosphere and warms the surface of the earth. As the earth is nowhere near as hot as the Sun, when the earth radiates the heat back up into the atmosphere, it is in the form of long-wave radiation (IR or heat) which

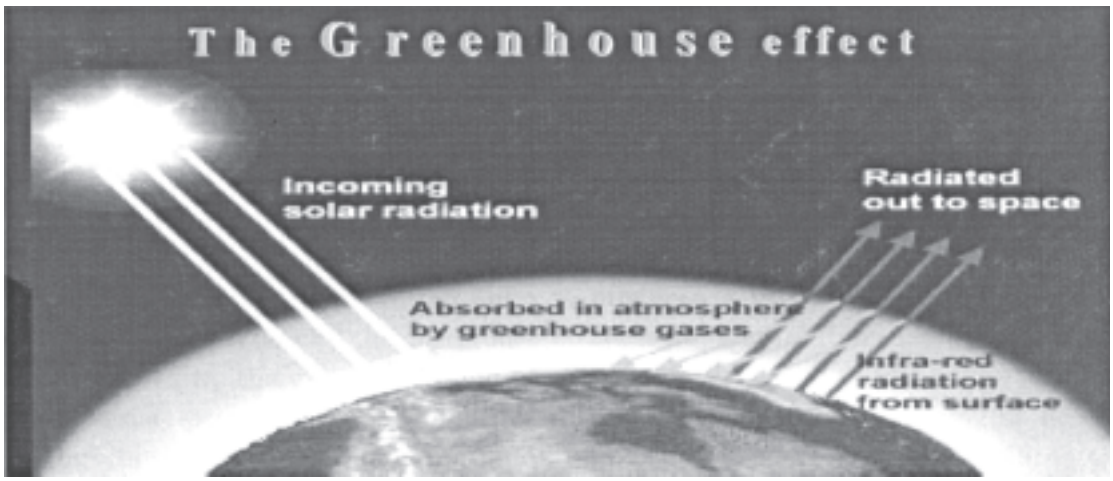

Fig. 2. The greenhouse effect[11,12]

is much more easily absorbed than the short-wave radiation by the earth's atmosphere. Hence the surface temperature of the earth increases[4].

Some of the IR or heat energy escapes to the space but much of this does not pass through the layers of atmospheric greenhouse gases to outer space and gets absorbed by the greenhouse gases in the atmosphere. Thus the earth's atmosphere heats up. This helps to warm the surface and the troposphere, keeping it (33°C) warmer than it would otherwise be. This is the natural greenhouse effect (Fig. 2) and vital to life.

BENEFICIAL ACTIVITY OF GREEN-HOUSE EFFECT :

Without the natural "greenhouse effect" the earth's average temperature would be-18°C, instead of current average temperature of 15°C, and life as known today would not be possible. Instead, credit goes to greenhouse gases for keeping the earth's average temperature in a more hospitable 15°C. However, problems may arise when the atmospheric concentration of greenhouse gases increase[5].

"GREENHOUSE EFFECT"–WHY IT IS SO NAMED?

A greenhouse (Glass house) in cold countries stays warm even when the outside temperature remained low. In those greenhouses sunlight comes in through the transparent glass and strike the ground. The reflected heat or infrared radiation cannot be transmitted out because, a significant portion of the infrared radiation is absorbed by the glass, thus tends to warm the interior surfaces of the greenhouse for nurturing its ground plants and other materials. The natural greenhouse effect in a global scale is similar to the action of a greenhouse and atmospheric greenhouse gases thus act like the glass panels of a greenhouse[4].

WHAT MAKES CO_2 (AND OTHERS) A GREENHOUSE GAS

The greenhouse gases such as CO_2, CH_4, N_2O, Surface O_3, halocarbons (CFCs, etc) and water vapour which are transparent only to the visible light, can also absorb much of the re-radiations i.e. long-wave radiations (wave-length ranging 4,000-20,000 nm).The following properties are required for such gases to become greenhouse gases[6] :

1. Dipolic nature
2. Having extremely strong, broad absorption band that overlaps with some of the wavelengths of heat radiations.
3. Transition between the vibrational energy states.
4. Formation of vibration molecular spectrum.
5. Formation of vibration-rotation spectrum.

CO_2 and other such gases have an extremely strong, broad absorption band which overlaps with some of the wavelengths of heat radiations (Fig.3). When a greenhouse gas absorbs electromagnetic radiation in the infrared region, transitions occur between the vibrational energy states of that gaseous molecule and therefore, a vibration molecular spectrum is produced. However, transitions between two vibrational energy states are accompanied by a change in the rotational energy states and that gaseous molecule produces a vibration-rotation spectrum. Two types of vibration frequency are noted, viz. (i) *Bond streching vibration*: In case of bi-atomic molecules streching of bonds takes place, (ii) *Angle bonding vibration* : In tri-atomic molecules a change within a angle takes place[7].

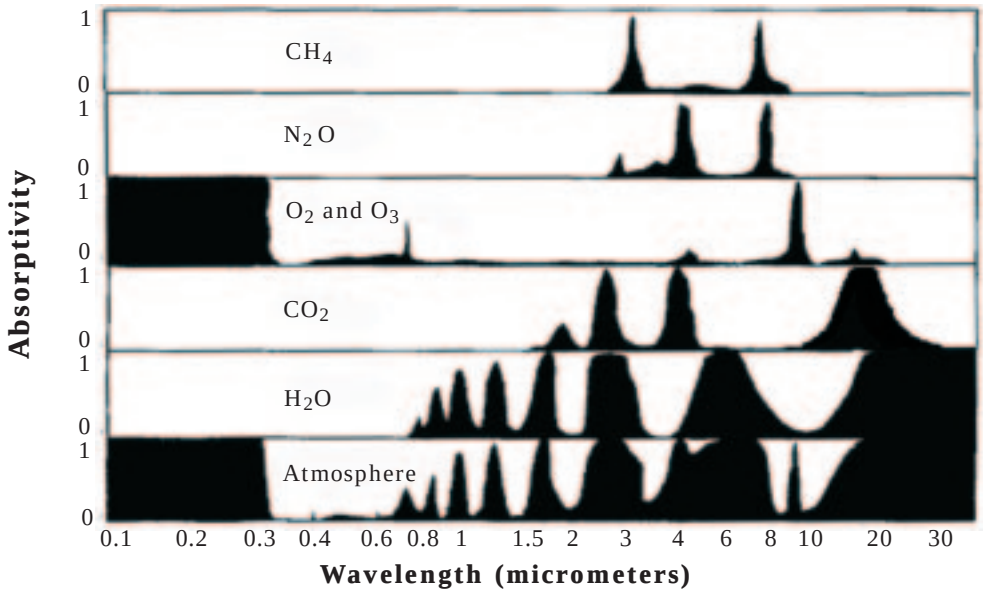

Fig. 3 : Absorption bands of different greenhouse gases[3,4]

GREENHOUSE GASES–THEIR SOURCES, RELATIVE CONTRIBUTIONS AND EFFECTIVENESS

Many greenhouse gases occur naturally. However, modern industry and lifestyles have led to new sources of greenhouse gases, as well as to the emission of entirely new greenhouse gases. The most important greenhouse gases are : Carbon di-oxide, Methane, Nitrous Oxide, Halocarbons, Ozone and water vapour. The relative contribution and comparative effectiveness of greenhouse gases have been given in the Table 1, showing the percentage contribution.

Carbon di-oxide (CO_2) :

CO_2 is one of the major contributors among greenhouse gases. Before the industrial revolution, there were 275 ppm of CO_2 in the atmosphere. The amount of CO_2 in the atmosphere today has risen to 330 ppm. Since the industrial revolution, CO_2 is produced when coal, oil and natural gas are burned to produce energy and because of this, an extra 5 billion tons of CO_2 is emited into the atmosphere. Land use changes viz. clearing land for logging, ranching and agriculture, also lead to CO_2 emissions. Vegetation decays or burns, deforestation have contributed to atmospheric CO_2 increase.

Methane (CH_4) :

Methane is the second most important greenhouse gas resulting from human activities. In the atmosphere today, there is a level of 1.7 ppm of CH_4 and this level increases by 1% per year. The main sources of CH_4 are paddy fields, cattle dumps, termites, swampy areas and decaying material in land fills. In the absence of oxygen bacteria produce methane gas by breaking down organic matter. CH_4 is also emitted during coal mining and oil drilling, and by leaky gas pipelines.

Nitrous Oxide (N_2O) :

Nitrous oxide contributed 6% to the greenhouse gases and there is a level of 301 ppb of N_2O in the atmosphere. Soils and oceans are the primary natural source of N_2O. Humans contribute through soil cultivation and use of nitrogen fertilizers, nylon production, and the burning of organic material and fossil fuel.

Nitrous oxides are formed when ammonium nitrate is heated. As a result of the increasing number of farmers using ammonium nitrate based fertilizer, the levels of nitrous oxides in the atmosphere are rising.

Halocarbons :

Halocarbons are human-produced chemical compounds containing members of the halogen family (bromine, chlorine, fluorine) and carbon. other gases namely *Hydro Fluro Carbons (HFCs), Perfluoro Carbons (PFCs)* and *Sulphur Hexafluoride (SF_6)* were considered as major greenhouse gases.

Surface Ozone (O_3) :

In the troposphere, ozone is another important greenhouse gas resulting from industrial activities. It is created naturally and also by oxidation of carbon monoxide and

Table 1. Relative Contribution, Comparative effectiveness of greenhouse gases and their sources

Greenhouse gases	*Relative contribution (%)*	*GHGs Effectiveness compared to CO_2*	*Life span in atmos (yrs.)*	*Sources*
CO_2	50	1	±100	Fossil fuel combustion, deforestation, change in land use, biomass burning, erosion, cement industry
CH_4	18	30	10	Anaerobic bacterial activity in swampy land, Enteric fermentation, Coal mines, gas leaks
N_2O	06	270	170	Fertilizer, biomass burning, fossil fuel combustion
O_3	12	2000	Short	Photochemical reaction
Halocarbons	14	CFC-11: 4300 CFC-12: 7100	70-170	Refrigerators, airconditioners

Halocarbons are typically involves in various industrial and home uses with CFCs being the most familiar. CFCs are the most effective heat trapping greenhouse gases of all. Some CFCs are upto about 7000 times more effective than CO_2 as a greenhouse gas, but the average CFCs are 40 times more effective than CO_2. CFCs are used in fridges as a coolant, airconditioners, aerosols, solvents and foam packaging. At present there are 223 ppm of CFC-11 and 384 ppm of CFC-12 in the atmosphere. In the 1997 Kyoto Protocol, three

hydrocarbons in the presence of nitrogen oxides produced from motor vehicles and power plants. However, the magnitude of ozone contribution is uncertain because of its very short atmospheric life time. O_3 in the lower atmosphere is estimated to add about 15% to the direct warming effect.

Water Vapour :

Water vapour comes from natural respiration, transpiration and evaporation. The amount of water vapour stored in the

atmosphere increases as the earth's temperature rises.

Since the beginning of the industrial revolution, atmospheric concentrations of CO_2 have increased nearly 30%, CH_4 concentrations have more than doubled, and N_2O concentrations have risen by about 15%. Energy burned to run cars, buses and other vehicles, heat homes and businesses, and power factories are responsible for about 80% of society's CO_2 emissions, about 25% of U.S. methane emissions, and about 20% of global N_2O emission. Increased agriculture, deforestation, landfills, industrial production, and mining also contribute a significant share of emissions. In 1987, the United States of America being the largest contributors, emitted about 18% of total global greenhouse gases, followed by Russia and its neighbouring countries (12%), Brazil (10.5%), etc. (Table 2). The total world emissions of CO_2 has been given in the Table 3 which shows that the developed countries contributed much more amount (73%) of the CO_2 than the developing countries (27%). It is estimated that by 2035, developing countries will catch up and contribute half of the global emission of CO_2 (Table 3).

Compared with a molecule of CO_2, a molecule of either of the two most abundant CFCs (CFC-11 and CFC-12) is more than 4300-7100 times effective in trapping heat (Table 1). Because, the absorption cross-sections of CFCs are considerably larger than the selective absorption bands of CO_2. In the similar way, O_3 is about 2000 times, N_2O is about 270 times and CH_4 is about 30 times more effective in trapping heat than CO_2 (Table 1). A single CH_4 molecule survives for 10 years, CFCs for 70-170 years and N_2O for 170 years. The extreme persistent nature of CFCs is one of the major reasons behind the push by scientists and environmentalists to secure their complete ban.

Table 2. Ten top countries with highest greenhouse gas emission[7,10,11]

Rank	Country	Total % contribution to greenhouse gas emission
1.	U.S.A.	17.6
2.	Russia and Others (Formerly USSR)	12.0
3.	Brazil	10.5
4.	China	6.6
5.	India	3.9
6.	Japan	3.9
7.	Germany (FR)	2.8
8.	U.K.	2.7
9.	Indonesia	2.4
10.	France	2.1

Table 3. Total World emissions of Carbon di-oxide[7,10,11,12]

Developed World	**1995**	**2035**
U.S.A.	22%	15%
East Europe	73%	50%
West Europe	17%	12%
East Asia	7%	4%
Developing World		
China	11%	17%
Latin America	4%	6%
Africa	3%	8%
Mid Asia	3%	5%
Asia (other)	6%	14%

CONSEQUENCES OF GLOBAL WARMING

Now, the relevant question comes, "Why should a few degrees of warming be a cause for concern? The United Nations (UN) Environment Programme established the *Intergovernmental Panel on Climate Change* (IPCC), with a remit to search for an authoritative international consensus of scientific opinion on climate change, its impact and possible responses[10,11]. The IPCC's First Assessment report in 1990 concluded that continued accumulation of greenhouse gases in the atmosphere would lead to climate change and were likely to have important impacts on natural and human systems. This was confirmed in Second Assessment Report, published in 1996. The recent IPCC Scientific Assessment of Climate Change estimated the globally averaged surface temperature and these changes may lead to a number of serious consequences (Fig.4). These include:

(a) Global warming and climate change : Global warming means surface temperatures have increased 0.6-1.2°F since the date 19th century. The 10 warmest years in this century all have occurred in the last 15 years. Of these, 2005 was the warmest year on record after 1850. The globally average surface temperature will increase by 1.0-3.5°C (about 2-6°F by the year 2100) [Fig. 5].

(b) Rising Sea level : The snow cover in the Northern Hemisphere and floating ice in the Arctic ocean have decreased. Globally, sea level has risen 4-6 inches over the past century. In the next century, rapid global warming could triple that rate. By 2050, the oceans may rise another 8 inches, causing low-lying shorelines to recede significantly. Vast coastal areas would be lost. These low-lying countries with large coastal populations are the most vulnerable : Bangladesh, Indonesia, Pakistan, Thailand, Gambia, Maldives, Mozambique, Senegal, Egypt, Surinam and peninsular India.

(c) Disruption of the water cycle : Worldwide precipation over lands has increased by about one per cent. Evaporation will increase as the climate warms, which will increase average global precipitation. Soil moisture is likely to decline in many regions, and intense rainstorms are likely to become more frequent that may lead to flooding. More floods could contaminate water supplies with pollutants washed from disrupted treatment systems, rising the spread of infectious diseases.

(d) Worsening health effects :

(i) Climate change is likely to have wide-ranging and mostly adverse impacts on human health. The projected increase in the duration and frequency of heat waves is expected to increase mortality rates as a result of heat stress. People might suffer more often from heat-stroke, and more may die from heart attacks and other ailments aggravated by the heat. The heat in some hot weather regions may become unbearable, forcing people to migrate.

(ii) Hot, stagnant conditions could cause smoke particles and noxious gases to linger in the air and accelerate chemical reactions that generate other pollutants. Such conditions increase the risk of respiratory diseases like bronchitis and asthma.

(iii) Climate change is also expected to lead to increase the potential transmission of many infectious diseases, including malaria, dengue and yellow fever, extending the range of organisms such as insects that carry these diseases into the temperate zone, including parts of the United States, Europe and Asia. A morbidity survey estimated that the zone of potential malaria transmission may enlarge from an area containing 45% of the world population to 65% by the end of 21st Century, resulting in 50-80 million additional cases of malaria per year.

(e) Changing Forest and natural ecosystem : A rapid and large-scale climate change could severely harm the earth's ecosystem and such a change could make it difficult for many species to survive in the regions they now inhabit. Some could be forced to migrate, while others could become extinct.

(f) Challenge to agriculture and the food supply : It may be possible for global agricultural production to keep pace with increasing demand over the next 50-100 years if adequate measures are made, but there are likely to be difficulties in some regions. Regional changes in crop yields and productivity are expected to occur in response to climate change. There is likely to be an increased risk of famine, particularly in sub-tropical and tropical semi-arid and arid locations.

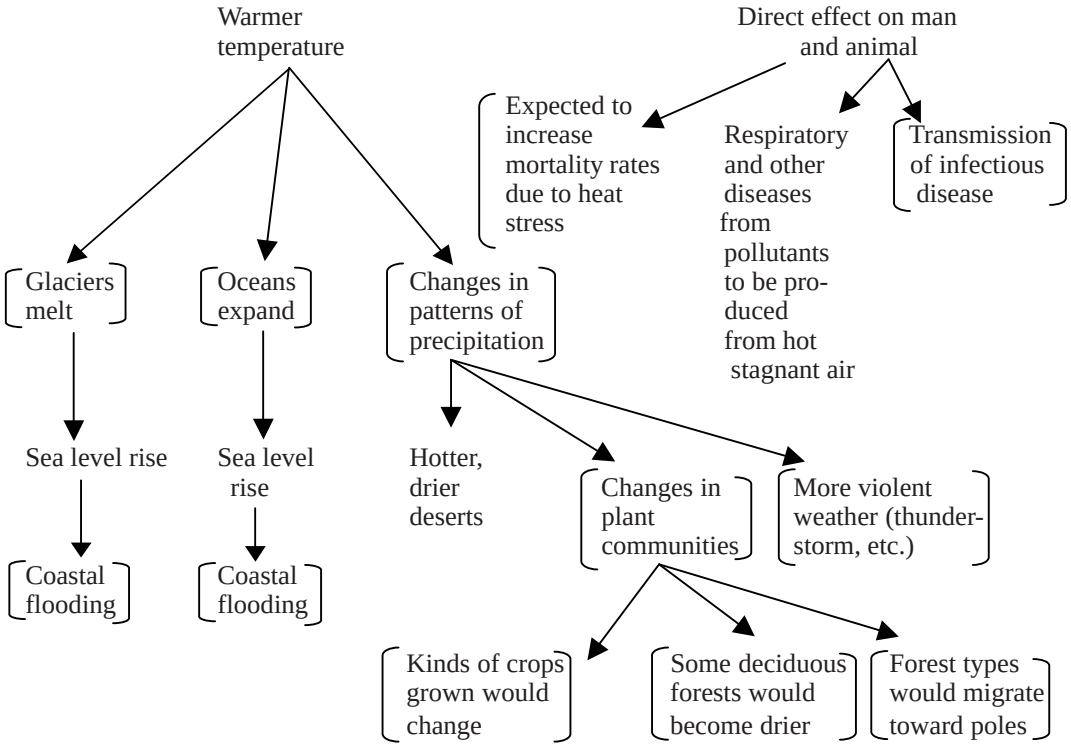

Fig. 4. The effects of global warming

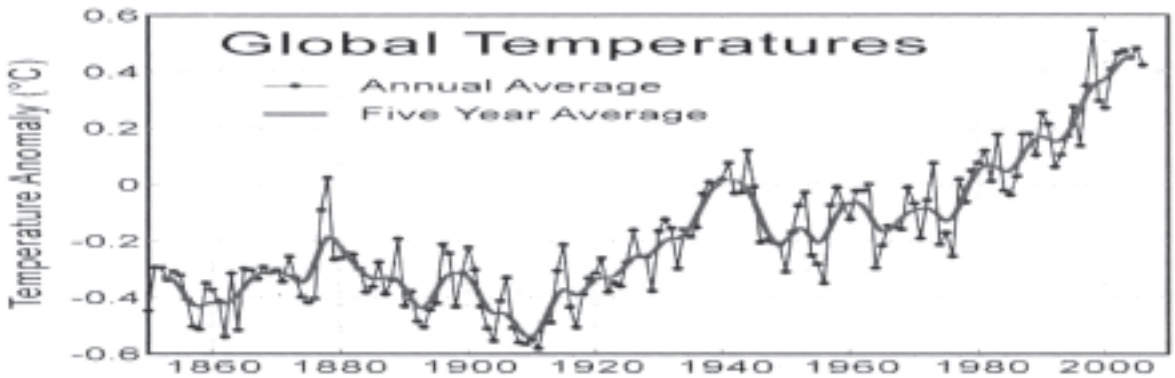

Fig.5. Change of global temperature over years[10,11]

THE PROPOSED MEASURES ARE TO BE NEEDED TO REDUCE EMISSIONS OF GREENHOUSE GASES

It is almost difficult, but not impossible to reduce the emissions of major greenhouse gases. Several International and Intergovernmental organisations (IPCC) have started to cut the emissions of greenhouse gases.

As per provision of Kyoto Protocol in 1997, there should be legally binding limits on the six major greenhouse gases (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6) emissions of developed countries to an aggregate reduction of 5% on 1990 levels. In this connection many measures were to be needed, which would require improved technology and additional cost. In future the following programmes may be adopted to check global warming[8,9] :

(a) To increase energy efficiency in consumption and production. New automotive technology will need to be developed. There is requirement to switch over to low or no carbon fuel. Passenger cars must emit 60% less nitrogen oxides and 40% less hydrocarbons.

(b) To promote complete combustion in vehicles through proper maintenance and to increase fuel efficiency in vehicles. Cleaner burning fuel is required. So different oil companies will need to develop new fuels. On board canisters are required to capture vapour during refueling.

(c) Switch over to non-fossil fuel sources of energy, such as solar, hydroelectric, nuclear, etc.

(d) Toxic emissions must be reduced to 90%. So factories must install maximum achievable control technology. This includes small business which may need help to meet this standard.

(e) Production of CFCs, halons, carbon tetrachloride in refrigerators, air conditioners solvents etc., will be banned. Alternative chemicals will need to be developed. Recycling of chemicals will be required.

(f) Less utilization of private fuel vehicles has been proposed with more utilization of non-fuel vehicles like bicycle, rickshaw, etc.

(g) Increase afforestation through agroforestry, social forestry, etc. and decrease deforestation.

(h) There is an idea that plankton living in the surface water of world's ocean can control the global climate by uptaking CO_2 through photosynthesis. The growth of plankton is initiated by supply of iron and as a result greater the removal of CO_2 from atmosphere, thereby preventing global warming. Researches on oceanic plankton have shown that the growth of plankton increased by a factor of 20 and the dissolved CO_2 level of sea water fell by 60%.

(i) Economists have suggested two policy tools for reducing global CO_2 emissions[7]. They are

i. A transferable discharge permit (TDP) which proposes that countries would be allocated CO_2 emissions permits equal to their permitted base level emissions which will be determined by any of the four criteria, namely (1) equi-proportionate reduction in emission, (2) ability to pay criteria, (3) polluter pay principle, (4) equal per capita consumption.

ii. Carbon tax - This tax would be levied on the carbon context of the fuels consumed. It has been estimated that a worldwide reduction of 20% in CO_2 emission would require a tax of 45 dollar per ton of carbon. If the CO_2 emission is further reduced to 50% that will

require a tax of 140 dollar per ton of carbon which may be burdensome for developing countries.

(j) Besides these technological and policy options, Kyoto Protocol has proposed the policy of the Clean Development Mechanism (CDM) for joint implementation for credit in developing countries. CDM will allow companies in the developing nations to enter into co-operative projects to reduce emissions of greenhouse gases in developing world. Under an emission trading regime, countries or companies can purchase less expensive emission permits from countries that have more permits than they need and this emission trading imparts flexibility to solution.

(k) Recently, the United Nations Conference on Sustainable Development - or Rio+20 - took place in Rio de Janeiro, Brazil on 20-22 June 2012. – twenty years after the landmark 1992 Earth Summit in Rio. In this summit, world leaders, with thousands of participants from the private sector, NGOs and other groups, assembled together with an object to reduce poverty, advance social equity and ensure environmental protection especially from global warming. We hope for a better future.

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BARCODING OF ANIMAL SPECIES : ITS SOCIAL IMPACT

Tapas Goswami[1], Birendra Prusty[2] and K. Viswas[3]

Biodiversity is the nature's creation encompassing millions of eukaryotic species existing on the earth and their identification with accuracy is still a challenging task. Suitable segment of mitochondrial DNA having 650 bases is sufficient to be a distinguishing marker for species differentiation which is the criteria for DNA barcoding. The sequence information is stored in the form of electronic data in computer for further use.

INTRODUCTION

In modern life, very often we observe that almost every commercial item purchased from departmental stores has been marked with several parallel bars of thick and thin lines of similar type. All these bars represent some form of data not written in any vernacular language, rather such data can be retrieved through an optical machine reader. These bars are not only restricted to commercial products, rather for many more applications like postal delivery tracking, airline luggage checking system, cataloging library book and so on. Biological species identification using barcoding system is a recent introduction which is still under the biologist's domain. Scannable barcodes and their wide applications in consumer market attracted biologists for species identification using the genetic code of the species represented by their inherent specific gene sequence. In 2003, a few scientific groups proposed a new identification system to "tag" species according to a segment of a mitochondrial gene, which they considered to be the molecular identity signature of animal life[1]. Therefore, it is all in the genes with a unique order of four nucleotides, is the sole criteria for DNA barcoding to identify millions of species. It involves application of DNA based techniques amalgamated with computer knowledge for storing and retrieving of data, at any time, any where through web based public data domain system.

WHY BARCODING ?

Since ages human beings remain curious to identify living species existing around him. Due to several reasons, larger species are always being the choice of attraction due to their shape, size, colour and behavioral characteristics, rather than smaller species like bacteria and viruses. Biodiversity is the nature's creation encompassing millions of eukaryotic species existing on the earth and their identification with accuracy is still a challenging task. Moreover, morphological and anatomical characters, and chromosomal studies taken as criteria for species identification have led to many errors.

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Subsequently when more number of species was identified, there was a demand for specialized taxonomists having species specific knowledge. Undoubtedly the availability of computerized data storing system and web based applications made it easy to store the morphological characters using high resolution imaging to some extent, but still nearly 8 million species yet to be described. Once all the information is generated resulting in an enormous amount of data, it will be increasingly difficult to ascertain whether a specimen matches a known species or a new addition. Identification of a species is particularly difficult when the subjects are young. Further more, juvenile forms of animal species, which are morphologically indistinguishable, need proper rearing till they attain adulthood for exact identification. Rearing to adulthood is neither feasible nor a practical approach. A large number of invertebrate species which accounts for more than 95% of all animal species are only identifiable at their adult form by their morphological and anatomical characters. Due to conservation characteristic of DNA pattern of any species which remains the same throughout the life, identification of those species using bar code identity solves this problem. As morphological and classical genetic approaches were unsuccessful to complete this huge task, other approaches such as "a gene tag for every living thing and a catalogue of the earth's biodiversity" may be of some help to complete the assignment in a meaning full way[2].

DNA BARCODING

Although antecedent papers have shown that DNA based identification systems using nucleotide sequence difference is sufficient to investigate evolutionary relationship among species and highly effective for small taxonomic assemblages, Canadian biologist Paul D N Hebert and his team from University of Guelph, Ontario suggested that a single gene can be scanned to identify species. In 2003, he proposed a method to distinguish between species using a small piece of DNA. Hebert group targeted a small stretch of DNA segment of animal genome common to every species that would faithfully distinguish one species from other[1]. According to them, DNA barcoding project will develop sufficient biological data in an electronic form that can be stored and transferred to reference library with morphological characters and descriptions for that species. Those stored data can be used by public for scientific purposes through out the world using net working web based system. Subsequently several research groups have contributed further in this project leading to the formation of the consortium for the barcode of life (CBOL), launched in May 2004 comprising of 120 organizations from 45 nations, which aims to provide a DNA bar code for every species on the planet[3].

TARGET DNA FOR BARCODING

In spite of fascinating idea conceived by the pioneering group, most challenging task is the selection of suitable segment of DNA that carries sufficient information to be a distinguishing marker for species differentiation and tiny enough to complete the sequencing job in minimal time period. Such DNA segment must exhibit slow mutation with as few insertions and deletions as possible. After several critical experimentations resulting in variable success, it was decided to target a DNA segment located in the mitochondria[4]. The specific DNA segment considered as standard reference for animal species is the one that codes for respiratory enzyme, cytochrome oxidase[5].

WHY MITOCHONDRIAL DNA

Mitochondria are the energy producing organelle of the eukaryotic cells. As we all know, genomic DNA is the blue print of cells which is packed in side the nucleus. Beyond nucleus, a minute quantity of DNA is also available inside the mitochondria. In animals, mitochondrial DNA occurs as a double helical, circular molecule and several copies of such molecules are present in each mitochondrion. Mitochondrial DNA offers several advantages over chromosomal DNA such as slow mutation rate, limited exposure to recombination, haploid mode of maternal inheritance and high copy number per cell. While only 2 copies of nuclear DNA are present in each cell, the same cell harbors 10^2-10^4 copies of circular mitochondrial DNA therefore success rate of mitochondrial DNA recovery is much higher. Sequence difference among closely related animal species in mitochondrial DNA is about five to ten times as compare to nuclear DNA. Contrary to this inter species difference in mitochondrial DNA, intraspecies sequence variation in mitochondrial DNA is quite low. Sequence comparison of protein coding genes is much easier as they generally lack insertions and deletions, which are more frequently observed in ribosomal genes. In animals species mitochondrial genes rarely contain introns which are non coding sequence interspaced between the coding regions of genes[6].

WHICH GENE IS TO BE LOOKED FOR ?

In brief the mitochondrial DNA (mtDNA) contains 37 genes essential for normal functioning of mitochondria. Out of these 37 genes, 13 genes are dedicated for synthesis of respiratory enzymes involved in oxidative phosphorylation pathways of cell metabolism and remaining genes devoted for transfer RNAs and ribosomal RNAs. The target gene for species identification is the subunit I of cytochrome c oxidase[5]. Cytochrome c oxidase is the respiratory enzyme, located on the mitochondria, which is highly conserved across species (fig-1). The enzyme acts as an electron acceptor in the oxidative phosphorylation process of respiratory chain. The cytochrome oxidase enzyme is composed of three subunits (I, II & III) and each one is coded for by separate set of gene from mitochondrial DNA. Cytochrome c oxidase subunit I (CO1) is the catalytic part of the enzyme, and this subunit is the actual target gene chosen for species differentiation. Approximately the first half of the CO1 gene segment comprising of 648 base pair starting from 5' end is selected for processing[7] (fig-1). Closely related species of vertebrate generally show more than 2% divergence at another mitochondrial gene cytochrome b, which is not a suitable marker

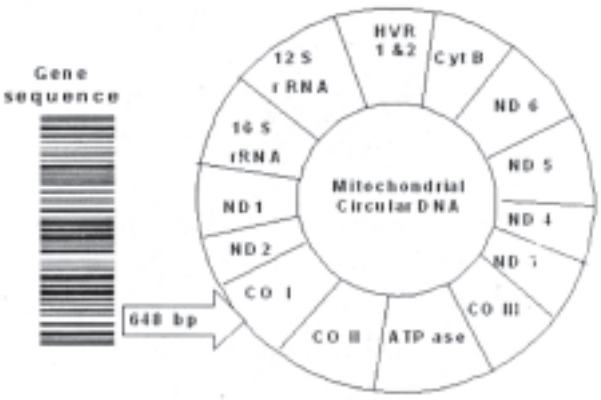

Fig. 1. Sketch diagram representing Cytochrome oxidase C (CO I) gene sequence in mitochondrial DNA for species identification. Parallel bar of black marking represent specific nucleotide for that specimen

for species differentiation[5]. Apparently every individual differs considerably from each other but there is barely one or two base pair difference recorded at the gene sequence of 648 base pair of CO1 gene. On the contrary, as many as 60 and 70 base pair variation is observed in the same region of human beings in comparison with that of chimpanzee and gorilla respectively[8]. Therefore amplification

of CO1 mitochondrial gene is a straight forward approach taken by the scientists.

WHAT IS BEING DONE IN LAB ?

In actual test protocol, the targeted DNA is extracted from the available specimen sample followed by DNA amplification using polymerase chain reaction subsequently gene sequencing is performed. Once the targeted gene is sequenced next job is to develop reference library of this specific segment from species whose identity is already confirmed and firmly established. As soon as the amplified COI sequence is matched with the available sequence data, the newly sequenced gene is taken for quantitative and qualitative analysis of sequence divergence using a well accepted genetic model known as Kimura-2 parameters, to resolve the ambiguity in identification of species within narrow taxonomic grouping. A sizable number of fully published studies of animals in which DNA barcoding using part of CO1 gene has been shown that each species had a unique nucleotide at CO1 with only slight intraspecific K2P divergence. Although critics have doubt over bar coding accuracy, efficacy of the CO1 gene for species identification has been tested on vertebrates and invertebrates, which have proved its authenticity up to 98 % accuracy with error rate of 2%. It has been found that the sequence could differentiate all of the 2000 species compared till date. The only group that proved tricky was of jellyfish and sea anemones, which seem to have evolved very slowly for DNA differences between species. The DNA barcode technique has also provided greater accuracy when used for immature and extinct species and individual species at different stages of life cycle.

BAR CODE LIBRARY

In real term a researcher has to collect tissue samples and perform the suitable test protocol to amplify the CO1 gene segment by PCR and complete the base pair sequencing and finally enter the data in to a barcode database. When one compares the barcode DNA from some creature against the available reported specimen, researchers can determine whether the organism is a member of a known species or some thing new. To make a library of barcode data of any species acquisition of authentic specimen is mandatory. Although the extent of variation within each species is low, a minimum of ten individuals per species should be analyzed to register the diversity[8]. Considering all these steps of the barcoding procedure the task is never an easy job for any single individual or research groups working in isolation. Cooperative approach taken by many institutions across the globe have made it possible to establish tissue banks to store and preserve DNA sample so that it can be made available for analysis in future. This has led to the formation of the consortium for the barcode of life (CBOL) which aims to provide DNA barcode for every species on the planet[8]. Collection and preservation of huge data in an error-free manner and to retrieve the data for public use is a tough job. However progress has already been made to establish public database system known as Bar Code of Life[8]. The BOLD has its repository of 46,0000 records of from animal kingdom. The records includes several details such as, name of the species, bar code gene segment, location from which sample is collected, photograph of the species and biological data link of the established specimen. The International barcode of life project comprising of 25 nations alliance which

has taken the responsibility to assemble the available records with a target to process specimens from about 5 million species by 2014. Several organizations, including the U.S National Museum of Natural History at the Smithsonian Institution in Washington DC, are also beginning to apply the technique for museum specimen.

IMPACT ON SOCIETY

Presently the impact and the applicability of the DNA bar coding project is well perceived in the human society and has far wide range of applications and not merely academic. A standardized library of barcode will enable scientific community to identify species whether available globally or locally, existing or extinct. This may help government to take wise decision in policy making to address the issues like agriculture, human health, and environment and formulate well-informed regulations to protect the consumer. Better understanding of the food chain through analysis of food stuffs using bar code technique is being adapted for consumer safety. An accurate barcoding method would improve species identification, which is essential in determining associated hazards, addressing economic fraud issues, and in food-borne illness outbreak investigations. The Environmental Protection Agency is testing barcoding to identify insects and pests for crop protection. Researchers are however concerned with biosecurity and agricultural quarantine issues. In the medical field, accurate knowledge and labeling of the bioactive compounds derived from leeches relies on species determination that is confirmed by bar coding system under FDA approval[9]. Prominent human health-related efforts include barcoding of several species of mosquitoes responsible for human malarial infections are consistently undermined by species misidentification, where DNA barcoding can tremendously assist the world's expert mosquito taxonomists[9].

CONCLUSION

Nearly 35 yrs back, the concept of DNA sequence study, initiated by Carl Woese at the University of Illinois to reconstruct the tree of life[10], has gradually been improvised in 2003 to the present stage of gene sequencing from a uniform locus has made land mark scientific advancement in the field of taxonomy. The barcode is a sequence of about 650 DNA letters, found in a gene on mitochondrial DNA are suitable for genetic identification as there are many copies in each cell, and their DNA evolves relatively quickly, creating differences between species. The importance of barcoding is immense yet for the present discussion we can summarize few of them such as it can identify species from minute tissue sample even from processed food stuffs and samples which is morphologically unidentifiable. Bar coding system can be applied to sample recovered from all stages of life like egg, larvae and cryptic species. Cryptic species are those organisms which looks alike but exhibit genetic difference. DNA bar coding is also suitable for museum specimens and extinct species. However, one should not claim that DNA barcoding can ever replace taxonomy or reconstruct phylogenies. Many systems have been applied by various workers to identify species includes phylogenetic, typological, morphological, biological isolation and mate recognition, each of them have its own merits and demerits. Hopefully in coming future barcoding system will receive wide acceptance and low criticism among biologists across the globe.

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PHAGE THERAPY : NEW EMERGING FIELD FOR FOOD INDUSTRY

D.N. Nalage and C.D. Khedkar

In the fight against unwanted bacteria, phages offer a unique opportunity. Phages are easy to use and can enhance food safety without affecting the organoleptic properties of foodstuffs, or indeed, without any negative side effects. They offer a completely natural solution to the problem of food borne pathogens and are set to provide a positive contribution to the food processing industry and public health.

Bacteriophages-Greek for "bacteria eaters"-were discovered almost a century ago. Edward Twort (1915) and Felix d'Herrelle (1917) independently isolated filterable entities capable of destroying bacterial cultures and producing small open areas in bacterial lawns (Figure 1). This implied that the discrete particles were involved. They were jointly given credit for the discovery, but it was d'Herrelle who appointed these entities bacteriophages and dedicated his life in search of bacteriophages, including their therapeutic potential.

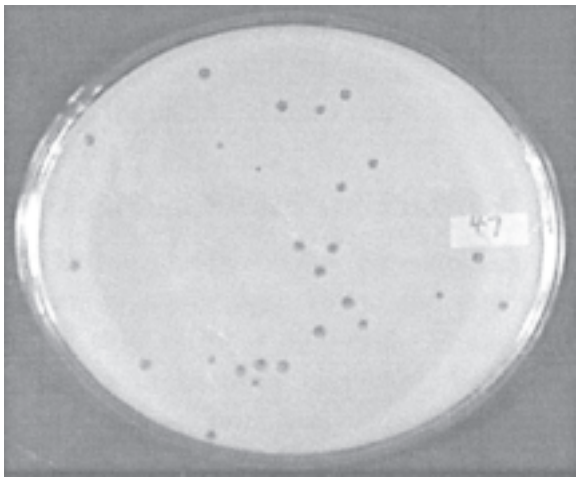

Fig 1. Bacteriophage destroying bacterial cultures and producing small cleared areas on bacterial lawns

Bacteriophages (or phages) are now widely recognized to outnumber bacteria by an estimated tenfold. They are abundantly present in water and foods of various origins[3]. Phages are bacteria-specific, each particular phage is specific for a particular bacterium and they have host specific mechanism. They do not show any detrimental effects on humans, animals, and plants. Scientist has found that, in some foods 100 million phages/gm can be found; in aquatic ecosystems, up to 1 billion phages/ml can exist. Due to advance technology, now we can understand the mechanism of interaction between phage and bacteria. The phage resistance mechanisms and phages thus have a key role in the regulation of bacterial populations in most, if not all, habitats. Bacteriophages contribute to bacterial homeostasis in the wild, keep bacteria under control. But, thanks to today's technology, we can now understand and utilize this natural tool. Phages do not affect smokers bacteria in foods (eg. start Cultures), the flora

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of the gastrointestinal tract, and accompanying bacterial flora in environment. They do not change the organoleptics property (i.e. taste, structure, color, and odor) of food and food products, do not leave an ecological footprint-phages contains disintegrated amino acids and nucleic acids, and are normal commensals of humans and animals[1]. This becomes logical agents selective control of certain dangerous pathogenic bacteria, such as *Listeria* in food products. Dynamic phage host may also be important in the re-emerging field of phage therapy. Because the phenomenon of antibiotic resistance has become a global public health concern, phage therapy is now being re-evaluated as a means to treat or prevent bacterial infections worldwide. The advantages and disadvantages of phage therapy have been widely documented. A significant disadvantage is the risk of encountering phage resistant pathogenic bacteria and promotes the emergence of bacterial phage strains. With insensitive to the emergence of antibiotic resistance, the current priority for food security, and consumer appeal for "green" and natural products to fight against unwanted bacteria, the use of phages can become a new standard.

ECOLOGICAL NICHE OF PHAGES

In Marine and freshwater ecosystems, phage numbers typically reach 10^7/ml and sometimes exceed this number 300-fold. Phages are teeming with bacteria in niche[4]. Very little food products are completely sterile, this means that most foods contain bacteria and are, therefore, the phages are capable of being present. This ferment is especially true for products and raw vegetables. Phages can easily be isolated sauerkraut. In one study, 26 different phage four-storey commercial sauerkraut fermentation was isolated[5].

Propionibacterium freudenreichii and lactic acid bacteria of thermophiles bacteriophage to 7×10^5 PFU the level Switzerland will feed plant and Argentina dairy products (plaque forming units)/g, respectively, 10^9 PFU/ml (plaque forming units) /g^{-1} was isolated.

More importantly, the bacteriophages nonfermentation culture, was also isolated from various food sources. *Escherichia coli* phage 10^4/g numbers of phage fresh chicken, pork, beef, mushrooms, lettuce, raw vegetables, chicken pie, including food and delicatessen products, many have been isolated. In addition, *Campylobacter* phage were isolated at 4×10^6 PFU/g of chicken, and in another study of several different *Brocothrix thermosphacta* phages were isolated from beef [9]. In all these cases, researchers have been looking for phages infecting individual bacteria, but if we consider the many bacteria associated with soil and vegetables, it becomes clear that there would also likely to find phage associated with the multitude of other species . A recent article in the presence of *E. coli* and *Campylobacter* phages in vegetables and New Zealand chicken phages found in 90 % of samples of 250 PFU/g[2]. We know that the amount of phages in the world more than the number of bacteria. In general, after lysis of host many progeny phages (50-200) are released. This happens because - in order not to disappear, at least one phage needs to find a new host, often in a three dimensional matrix before being inactivated by factors such as UV rays, denaturation, and compounds proteolytic or simple adsorption to particles making them inactive.

REMEDIAL APPLICATIONS OF BACTERIOPHAGES

Dynamic phage-may also be important in the field of re-emergence of phage therapy. Because

the phenomenon of antibiotic resistance has become a global public health problem, phage therapy is reviewed as a way to treat or prevent bacterial infections worldwide. Bacteriophage remedy has been extensively tested, and many successes have been reported for a variety of diseases, including dysentery, typhoid and paratyphoid, cholera and pyogenic infections urinary tract. Early interest is reflected in the fact that nearly 800 articles on phages were published between 1917 and 1956. The results were highly variable due to non phage, often characterized in unknown concentrations, which were given to patients without specific bacteriological diagnosis.

With the advent of antibiotics, phage research was abandoned in much of the Western world. Only in France, Poland and Soviet Union the former therapy by therapeutic phages continued. In France, Jean-Francois Vieu therapeutic efforts directed phage until early 1980. He worked in the "Service section Enterobacteriaceae" of the Institute Pasteur in Paris. The most comprehensive work on phage therapy was performed under the auspices of the Institute bacteriophage in Tbilisi in the Republic of Georgia, original institute of d'Herrelle's of in Georgia, where phage therapy is still part of the general standard of care, which is extensively used in children, treatment of burns, surgery and hospitals.

Appearance in the world of bacteria resistant to antibiotics has been responsible for a renewed interest in phage therapy in the Western world. A clearer understanding of the ecology of the phage, the nature of the infection, and improved methods of laboratory resulted in a large number of publications documenting successful phage therapy of infections in animals. Experiments indicate that the phage therapy may be more than one treatment with antibiotics, for example, the calf diarrhoea, it is ready for commercial development. Much of this work has been revised. More recent articles on the treatment of phage cover not only the potential of human diseases, but also include other applications, such as replacing or supplementing antibiotics in the treatment of aquaculture[10]. The cost of clinical trials of new drugs is a barrier to phage therapy. On the other hand, the research provides overwhelming evidence that phages are harmless to humans.

SUBSTANTIATION OF SAFETY

Phages are huge amounts of different ecological niches in water, such as various foods. There are millions of phages in our digestive system, and millions of others who regularly consume food and water. Although this only provides overwhelming evidence of its safety, additional support data. Decades of extensive use in applications-phage display medicine are not limited to oral ingestion, but systemic adverse effects of the application instead of being commonly showed the presence of any type. Specific research related to security was also performed. An oral toxicity study in rats given high doses of *Listeria* - LISTEX phage P100 revealed no side effects and in human study *E. coli* Phages can infect strains of *E. coli*-Specific bacteriophage and pathogenic strains showed no effect is not desired[7]. Two simple safety rules must be observed : phage-temperate easily perceived by genome analysis should be avoided. In addition, phages capable of generalized transduction should be avoided unless the production host is not pathogenic. A major disadvantage is the risk of encountering resistant pathogenic bacteria phages and promotes the development of phage strains insensitive bacteria.

TARGET ORGANISMS

The food industry is mostly concerned with the "big four" food pathogens: *Listeria monocytogenes*, *Salmonella*, *Campylobacter*, and *E. coli*. Of these, only *Listeria* regularly colonizes production facilities and thus is able to contaminate food very late in the production process. Therefore, the treatment of the phage in the step wherein such contamination is likely to occur is the logic conclusion. For many foods, thus it will be sometime before the packing, but the cheese, for example, they may be vulnerable to contamination along the maturation phase. The studies on the number of successful phage treatment of various foodstuffs contaminated with *Listeria* have been published. The other three organisms do not regularly colonize facilities, and it is usually raw products that introduce contamination. As a matter of fact, these organisms colonize animals whose meat is used for human consumption. Therefore, one possible treatment is application of phages during livestock farming, in addition to-or as an alternative to-treating the meat after slaughter. There have been studies for the treatment of chickens with phages against *Salmonella* and *Campylobacter* and for the treatment of ruminant's specific phages against pathogens *E. coli*[8]. In most of these studies, significant reductions of bacterial loads were observed. A reduction shortly prior to slaughter can significantly lower subsequent food safety risks and, in any case, does not exclude additional phage treatment at later stages of food production, which several studies show to be highly effective. Researchers report complete eradication of an artificial *Campylobacter* contamination on chicken skin. Treatment of facility surfaces is also a possibility. Food-contact surfaces, in particular, could be cleaned effectively using phages, even during production, without interrupting manufacturing processes. Non-food-contact surfaces could also be treated using phages. However, the added benefit of this seems doubtful because phages cannot reach certain places that aggressive chemicals can. Thus, chemicals, which may readily be used to this end, are likely to be as effective at lower costs.

FUTURE APPLICATIONS OF PHAGE THERAPY

Crop protection is an additional application for phages. Plant diseases caused by bacteria, such as tomato and pepper spot, or fire blight in apple trees, are candidates for phages targeted at the causative pathogens. Another application is the use of phages for external treatment of an animal prior to slaughter. If, for example, pathogenic *E. coli* colonizes the intestine of an animal, the bacteria can be found in its excrement, which may be deposited on its hide. Dust from the hide may contaminate the meat after or during slaughter. If, however, the hide is rinsed with a phage solution, this problem may be avoided. Little or no efficacy data has been published in scientific journals on these applications.

CURRENT STATUS OF BACTERIOPHAGE PRODUCTS AND REGULATORY AFFAIRS

In the United States in the past two years, several bacteriophage applications have been approved for use. In 2006, EBI Food Safety's *Listex*, a natural and organic anti-*Listeria* phage preparation that can be used as a processing aid with all food products susceptible to *L. monocytogenes*, was approved as GRAS by both the Food and Drug Administration and the U.S. Dept. of Agriculture. In November 2007, *Listex* was

awarded the prestigious Food Ingredients Europe Gold award as best industry innovation. EBI Food Safety, The Netherlands (www.ebifoodsafety.com), viewed as a product leader in phage technology, is also developing phage products against methicillin-resistant *Staphylococcus aureus* (MRSA), *Salmonella*, *E. coli*, and *Campylobacter*[6]. In 2007, OmniLytics Inc., Salt Lake City, Utah (www.omnilytics. com), received FDA approval for an anti-E. coli hide wash and an anti-*Salmonella* wash/mist/spray for treatment of live animals prior to slaughter. In 2006, the U.S. Environmental Protection Agency granted approval to OmniLytics *AgriPhage* products to combat tomato and pepper spot. The FDA granted approval to Intralytics Inc., Baltimore, Md. (www.intralytics.com), for *LMP 102*, a cocktail of six different phages to be used as an additive against *L. monocytogenes* during packaging of poultry and ready-to-eat meat products[9]. An increasing number of companies—and dozens of research groups—are now developing phage technology for many different applications.

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INDIGENOUS EDIBLE PALM PRODUCTS (*Borassus flabellifer* L.)

P. Saranya and T. Poongodi Vijayakumar*

The world's greatest palm biodiversity and utilization is found in Asia. The palm family Palmae is made up of 202 genera and approximately 2700 species. All parts of palm tree are useful. The fresh sap is used for beverage which is reportedly a good source of B-complex vitamins. The other edible parts are young kernels, fruit pulp and seed shoot. The fresh young kernels are rich in minerals; fresh fruit pulp is rich in vitamin A and C and seed shoot contains more fibre content which is also highly nutritious.

INTRODUCTION

India is one of the most important fruit producing nations in the world, accounting for about 10.4 % of all fruits and nearly 40 % of tropical fruits produced globally. Fruit production in India increased at an average annual growth rate of 3 % between 1995 and 2004. India is the second largest producer of fruits after China, with a production of 44.04 million tones of fruits from an area of 3.72 million hectares[1]. There are quite a large number of indigenous and underutilized fruit crops, which are being used by the local inhabitants. In fact for people living in villages, these underutilized fruits are the only source of protective food to meet their vitamin and mineral requirements in their poor diet. The curative properties of these fruits have been used in Indian systems of medicine such as Ayurveda and Unani. Apart from their nutritive and medicinal values quite a few of these underutilized fruits have excellent flavour and very attractive colour[2].

Palms have a long history of management for both subsistence and commercial products, many of which are deeply embedded in local cultures. Asia ranks ahead of the new world in terms of palm biodiversity, with Africa a distant third. An estimate of 385 species of palms occurs in Asia[3].

Fig. 1: Palm tree (*Borassus flabellifer* L.)

The palmyra palm is known simply as Palmyra which is based on the Portuguese *palmeira*, the tree was named originally for resemblance of the leaf to the palm of a hand. Other names are toddy palm, wine palm, Cambodian palm and botanically known as *Borassus flabellifer* L. *Borassus* is from a Greek

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word describing the leathery covering of the fruit, *Flabellifer* means "fan-bearer" (Fig.1)[4].

Palms are 10- 20 m tall; leaves 30-40, fan like at the crown, 1-2 m across. Flowers occur in stalks up to 1.5 m long; male and female flowers occur on different trees. The flowering and fruiting time of the plant is usually from February to April. The great majority of its economic edible products such as immature endosperm (nungu), mesocarp pulp (fruit pulp), tuberous seedlings (tuber) were obtained only from female palms[5].

Every part of the palm tree is used in India. There are several communities who depend on the palm tree for their livelihood. The Palm tree has been termed the princes of the vegetable kingdom Palmyra is the "State Tree" of Tamil Nadu. Palmyra tree prevents soil erosion and protects natural wealth. It is usually grown in strictly seasonal tropical or subtropical climates on any kind of soil. It is a very adaptable palm, however, growing well in dry areas and is quite drought resistant. The palm products are free from pollution and eco-friendly. It is distributed from India through South-East Asia to New Guinea and North Australia. The palm starts flowering and fruiting 12-20 years after germination, usually in the dry season[6].

EDIBLE PARTS OF PALM TREE

Palm Toddy

Palmyra palm toddy is a traditional drink and has a refreshing quality. The sap obtained from the flower spathes is collected in large quantities and either made into 'toddy' by fermentation, or boiled down for making sugar or jaggery. Seasonally the toddy palm forms a cluster of fruit stalks that are sapped for juice. Once the sapping of the fruit-stalk starts, it must be collected twice a day from each inflorescence, normally in morning and evening. An earthen pot is used by toddy palm worker as container to store the juice. The sap flows for 5-6 months; a male palm yields about 4-5 l per tree per day, female gives 50% more than male and the juice is mainly processed for jaggery. One gallon (3.8 l) of sap yields about 680 g jaggery sugar which is about 80% saccharose or sucrose[7]. The fresh sap is reportedly a good source of B-complex vitamins.

Fig.2 : Traditional way of collecting Palm Juice in pots

The juice collected before morning is refreshing and light drink called Thaati Kallu in Telugu, Neera (नीरा) in Marathi and "Pathaneer" in Tamil has extremely cool in sensation, and sugary sweet taste. The juice collected in evening or after fermentation becomes sour - is called Tadi (ताडी) in Marathi and Kallu in Tamil. Tadi is consumed by coastal Maharashtra mostly by villagers as raw alcoholic beverage.

Palm Jaggery

Palm Jaggery can also be obtained from palm sap and is useful in Indian cuisine. The young inflorescence (male and female) plants produce a sugary sap called Toddy. A beverage called 'Arrack' is made from fermented Toddy,

or it is concentrated to a crude sugar called palm jaggery.

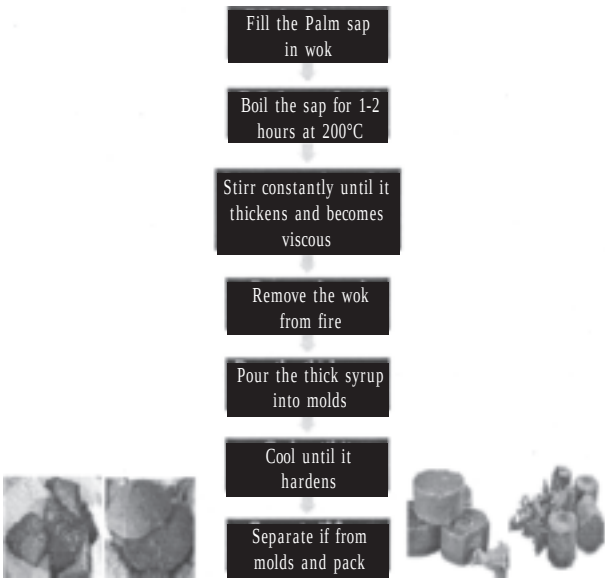

Fig. 3 : Process Flow chart for manufacturing of Palm Jaggery

It is not refined or bleached and has a high nutrient content as compared to most sweeteners. It contains up to 50% sucrose, 20% invert sugars, 20% moisture, and the remainder is made up of other insoluble matter such as wood ash, proteins and fibers[8]. Palm sugar, which is like coconut palm sugar reportedly has a lower glycemic index than table sugar and has high water content. It is described as similar to brown sugar in taste, but with a richer butterscotch or caramel flavor. It cooks, melts and boils very much like table sugar and is therefore good for health than chemically prepared white sugar crystals.

Palm Kernals (Ice apple)

The kernels or young seeds are much used as an article of food, being sold in large quantities in the bazaars during the months of April and May for its cooling effect. The mature fruit of the palm tree is peeled to obtain the juicy pulp which has a mild sweet taste and is jelly like in appearance. In Southern India, where it is called *nungu*. The tender fruit (ice apple) is part of embryo and it expands into the inner nut and absorbs the water. Palm fruit is highly nutritious, a good source of calcium and phosphorus.

Palm Fruit

The soft orange-yellow mesocarp of the ripe fruit is sugary, dense and edible; have excellent flavour and very attractive colour which contains gums, albuminoids, fats and is reportedly rich in vitamin A and C. *Borassus* also contains bitter compound called flabelliferrins, which are steroidal saponins[11]. Major part of the production of palmyra palm fruits are under utillized because of its bitter taste which limits the use of palmyra palm fruit pulp (PFP). Over 60 % of the annual fruit yield is being lost due to rot in storage.

Palm seed embryo

When the palmyra is ripe and falls from the tree, germination or sprouting begins. The seedling, called an embryo grows near the nut. Palmyra palm seed embryo is a good source of carbohydrate, fibre, amino acid, protein, calcium, sodium, magnesium, zinc and iron[12]. The germinated seed's hard shell is also cut open to take out the crunchy kernel,

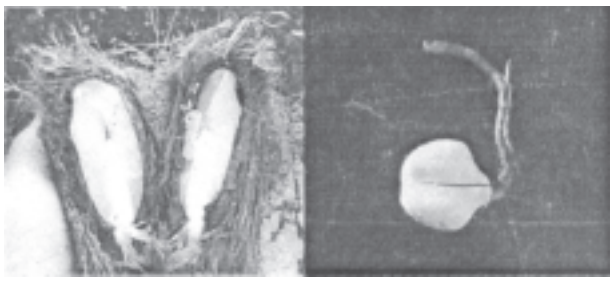

Fig. 4 : Plam Seed embryo of *Borassus flabellifer* L.

Table–1 : Nutritional value of edible palm products[9, 10]

S.No.	Nutritional Parameters	Quantity				
		Palm Sap[a]	Palm Jaggery[9]	Palm Kernels[10]	Palm fruit[c]	Palm Seed Shoot[c]
1.	Carbohydrate (g %)	99.07	98.89	6.5	16	64.33
2.	Protein (g %)	0.35	0.24	0.6	0.875	8.77
3.	Fat (g %)	0.04	0.37	0.1	0.6	8
4.	Crude fibre (g %)	–	–	0.3	6.1	2.5
5.	Minerals as ash (g %)	0.54	0.5	0.2	0.19	2.16
6.	Calcium (mg %)	Trace	0.08	10	Trace	0.06
7.	Phosphorus (mg %)	0.14	0.064	20	Trace	0.46
8.	Iron (mg %)	0.4	30.0	0.5	–	–
9.	Vitamin C (mg %)	13.25		4	29	–
10.	Vitamin A (mg %)	–	–	–	1.95	–
11.	Tiamine (umg %/)	3.9	Nil	Trace	–	–
12.	Riboflavin (umg %)	Nil	229		–	–

Values are the average of three determinants.

which tastes sweeter. It is called "dhavanai" in Tamil.

Palm Seed Shoot

The tender root of the germinating seed (locally called *Panangizhangu*) is a good source of essential nutrients. It is still steamed and consumed in many villages as an evening food.

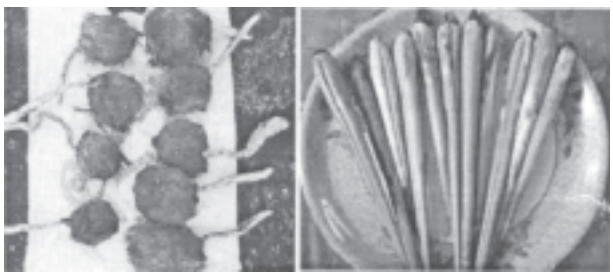

Fig. 5 : Plam Seed shoot *Borassus flabellifer* L.

MEDICINAL VALUES OF PALM TREE PRODUCTS

The different parts of the plant are used for the various treatments. Young roots are diuretic and anthelmintic, and a decoction is given in certain respiratory diseases. The ash of the spadix is taken to relieve heartburn and enlarged spleen and liver. The bark decoction, with salt, is used as a mouth wash, and charcoal made of the bark serves as a dentifrice. Sap from the flower stalk is prized as a tonic, diuretic, stimulant, laxative and anti phlegmatic and amebicide. Sugar made from this sap is said to counteract poisoning, and it is prescribed in liver disorders. Candied, it is a remedy for coughs and various pulmonary complaints. Fresh toddy, heated to promote fermentation, is bandaged onto all kinds of ulcers. The cabbage, leaf petioles, and

dried male flower spikes all have diuretic activity. The pulp of the mature fruit relieves dermatitis[13].

CONCLUSION

Palm sap and tender palm fruit are consumed as coolant and are rich source of minerals. The germinated seed shoot which is highly fibrous and has low glycemic Index value when compared with all other root vegetables. Research on preservation of Palmyrah Nungu and Palmyrah Fruit Jam has been completed and the technical know-how has been provided to the Tamil Nadu State Palm gur and Fibre Marketing Cooperative Federation.

Growth in the palmyra palm tree processing of all parts will provide employment opportunities and income. Hence, there is no doubt that the production of palmyra palm products will support rural entrepreneurs. Fruit of palmyra palm can provide an alternate choice for fruit selection by low cost which is nutritious too. This will contribute positive change in food security. Tree of Palmyra Palm is considered as "Karpaha" because all parts of the tree can be utilized for various purposes.

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University of Mumbai
Indian Science Congress Association
102nd Session of Indian Science Congress, 3-7, January 2015
Announces
Infosys Foundation – ISCA Travel Award

With a donation from Infosys Foundation, Bangalore and the amount accrued from interest of selling of the special volume on "Shaping of lndian Science" published by ISCA on the occasion of the 90th Indian Science Congress, The Indian Science Congress Association has instituted the award namely, "Infosys Foundation – ISCA Travel Award" from 2004-2005 to be given annually to **ten** students (upto Class XII) during the Annual Session of the Indian Science Congress Association. Among ten, **First Five** awardees will be given a Plaque during the annual session of Indian Science Congress . All ten students along with one guardian will be given T.A. (AC III – tire/Chair Car Train Fare), local hospitality, for attending the 102nd Indian Science Congress to be held in the University of Mumbai, Mumbai during 3-7 January, 2015.

The selection of the awardee will be made by a committee constituted by the host university on the basis of the write-up on—"*What developments in Science during the last two years have influenced him/her and why*?"

Interested students (upto Class XII) are requested to submit an application with the above write up and brief bio-data (name, address, school, date of birth, class, phone/e-mail, extracurricular activities etc.). The application should be forwarded by the School Principal/ Headmaster.

Application must reach the address mentioned below on or before **November 15, 2014.**

Dr. Naresh Chandra, Local Secretary, 102nd Indian Science Congress, Pro-Vice-Chancellor, University of Mumbai, Fort, Mumbai-400 032. Email id;pvc@fort.mu.ac.in

Dr. Rajpal Hande, Local Secretary, 102nd Indian Science Congress, Director, Board of Colleges and University Development, University of Mumbai, Fort Mumbai-400 032. Email id;uom.isc2015@gmail.com

Dr. Vijay Joshi, Convener, Children's Science Congress**,** 102nd Indian Science Congress Principal, K.J.Somaiya College of Science & Commerce, Vidyavihar, Mumbai-400 077. Email id;vijayjoshi2002@yahoo.com

THE INDIAN SCIENCE CONGRESS ASSOCIATION

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

ANNOUNCEMENT FOR AWARDS : 2014–2015

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

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

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

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

THE INDIAN SCIENCE CONGRESS ASSOCIATION

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

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

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

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

Eligibility :

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

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

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

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

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

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

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

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

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

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

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

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

THE INDIAN SCIENCE CONGRESS ASSOCIATION
14, DR. BIRESH GUHA STREET, KOLKATA–700 017

ISCA BEST POSTER AWARD PROGRAMME : 2014-2015

To encourage Scientists, The Indian Science Congress Association has instituted two Best Poster Awards in each Sections. These awards carry a sum of ₹ 5,000/- besides a Certificate of Merit.

1. Applications are invited from members (Life, Annual & Student) of the Association who have paid their subscription on or before **July 15, 2014**.
2. Four copies of full length paper along with four copies of the abstract (not exceeding 100 words) must reach the office of the General Secretary (Membership Affairs) not later than **September 15, 2014**. At the top of each copy of the paper and its abstract, the name of the Section under which the paper is to be considered should be indicated. For details of Sections see http://www.sciencecongress.nic.in
3. Along with the Four copies of paper, Four copies of the Application Form (to be downloaded from ISCA website http://www.sciencecongress.nic.in) with brief bio-data of the candidate (not exceeding 2 pages), full length paper, abstract in the form of a CD must also be sent simultaneously along with the hard copies.
4. The number of authors of each poster submitted for the award shall be limited to two only. The **first author** of the poster shall be **presenting author**.
5. The research work should have been carried out in India and this has to be certified by the Head of the Institution from where the candidate is applying.
6. The candidate should give an undertaking that the paper being submitted has not been published in any journal or presented in any other Conference/ Seminar/ Symposium or submitted for consideration of any award.
7. A scientist shall submit only one poster in any one Section (and not a second poster on the same or any other topic in any other Section) for consideration for poster presentation award.
8. A person who has already received ISCA Best Poster Award in any section once will not be eligible to apply for the above Award in the same or any other section.
9. Incomplete Application will not be considered.
10. Full length papers will be evaluated by experts and twenty posters in each section will be selected for presentation during 102nd Indian Science Congress.
11. The final selection for the Awards will be made by a duly constituted committee and the awards will be given during the Valedictory Session of 102nd Indian Science Congress session.
12. Applications submitted for the above award will not be returned.
13. The last date for receiving applications for the above award at ISCA Headquarters is **September 15, 2014.**

All correspondences should be made to : **The General Secretary (Membership Affairs), The Indian Science Congress Association, 14, Dr. Biresh Guha Street, Kolkata-700 017. Tel. Nos. (033) 2287-4530/2281-5323 Fax No. 91-33-2287-2551, E-mail : iscacal@vsnl.net, Website : http://www.sciencecongress.nic.in**

FORM IV

Rule 8

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I, Ashok Kumar Saxena, hereby declare that the particulars given above are true to the best of my knowledge and belief.

Ashok Kumar Saxena

Date : 17.04.2014

Ashok Kumar Saxena
Publisher
Everyman's Science

KNOW THY INSTITUTIONS

INDIAN INSTITUTE OF VEGETABLE RESEARCH, VARANASI

Vegetable research was given impetus through establishment of AICRP on vegetable crops during 1971 at IARI, New Delhi with the responsibilities of coordinating and monitoring of vegetable research programmes of the country. To give a fillip to the vegetable research and to meet the challenges of nutritional security, the status of AICRP on vegetable crops was elevated to the level of Project Directorate of Vegetable Research (PDVR) during 1986, further during 1992 the headquarter of AICRP on vegetables was shifted to Varanasi from IARI New Delhi. During the year 1999, ICAR approved the establishment of an independent research institute on vegetables named as Indian Institute of Vegetable Research (IIVR). Within a short span of time an excellent research infrastructure was established and significant achievements have been made by the institute.

Mandate

- To undertake innovative, basic, strategic and applied research for developing technologies to enhance productivity of vegetable crops, their nutrient quality, post harvest management and value addition.
- To provide scientific leadership in coordinated network research for solving location specific problems of production and to monitor breeder seed production of released / notified varieties.
- To act as a national repository of scientific information relevant to vegetable crops and as a centre for

training for up-gradation of scientific manpower working on vegetable crops.

- To develop high yielding, good quality, disease and pest resistant varieties/ hybrids of selected vegetable crops.
- To develop high yielding, good quality, disease and pest resistant varities/ hybrids of selected vegetable crops.
- To develop advanced production and protection technologies for selected vegetable varieties/hybrids.
- To undertake germplasm collection, maintenance and documentation in vegetable crops.
- To improve the compilation of data and analysis by provision of micro processing facilities especially of regional trials undertaken in coordinated research project and network schemes.
- To provide technical supervision for the breeder seed production of released varieties and parental lines of vegetable crops.

DIVISIONS

Crop Improvement

The main research focus of the Division of Crop Improvement is to develop high yielding insect and disease tolerant varieties/hybrids. In addition, research is also being carried out to develop lines having tolerance to multiple biotic and abiotic stresses. Being a National Active Germplasm Site, a large number of vegetable germplasm have been collected from different parts of India, which are being maintained for efficient utilization. The division has advanced facilities to carry out cutting edge research is the frontier areas of molecular breeding, transgenic, genomics, proteomics, seed technology etc.

Major Areas of Research

- Germplasm collection, evaluation and maintenance
- Breeding of vegetable varieties for premium traits
- Mapping and tagging of genes for useful traits
- Development of transgenic lines
- DNA fingerprinting of vegetable varieties
- Hybrid seed purity testing
- Studies of seed-transmitted pathogens
- Nuclear and breeder seed production

Crop Production

The Division of Crop Production at IIVR, was established to conduct research with a focus on development of sustainable production technology for vegetable crops, development of suitable vegetable based cropping systems, integrated plant nutrient management, nursery management, organic farming, protected cultivation, nutrient dynamics, and input use efficiency, precision farming, drip irrigation and fertigation, soil health, resource conservation, post harvest management and value addition, and impact assessment of technology adoption by farmers.

Major Areas of Research

- Agronomy
- Soil science
- Water management
- Physiology and biochemistry
- Post harvest technology
- Social science

Crop Protection

The main research focus of the Division of Crop Protection is to develop technologies that reduce pesticide consumption and simultaneously have an effective sustainable management of pests and diseases in vegetables. Molecular characterization of viruses, development of PGPR's for the management of soil borne diseases, management of brinjal fruit and shoot borer

(BFSB), *Helicoverpa armigera* in tomato, fruit fly in cucurbits, bioefficacy of new generation pesticides are some of the multitude of activities performed in the division.

Major Areas of Research

- Fungal pathology
- Plant bacteriology
- Plant virology
- Plant nematology
- Entomology

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Indian Institute of Vegetable Research
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Fax No. 91-5443-229007
E-mail : directoriivr@gmail.com

Conferences / Meetings / Symposia / Seminars

1st Global Conference of Biological Psychiatry and the 10th Annual National Coference of Indian Association of Biological Psychiatry (Xth ANCIABP), 25-28 September, 2014, New Delhi, India.

Theme : Behavioural Neurosciences–Pathobiology to Therapeutics

Topics :

Innovative treatments

- Pharmacological
- Brain Stimulation

Novel mechanistic understandings

Measurement/assessment of neuropsychological processes

Brain Computer Interface

Preventive psychiatry

- Prodrome
- Mild cognitive impairment

Biomarkers

- Molecular
- Genetic
- Neuroimaging

Newer techniques of data mining/analysis

Clinical trials and associated issues

Ethics

Adjunctive treatment

Abstract Submission date : 30 July, 2014

Contact : Professional Congress Organizers, 508, Topiwala Centre, Off S. V Road, Goregaon (W), Mumbai-400062, Tel : 022-28787861, E-mail : medisquire@gmail.com

International Conference on "Recent Advances on the Role of Basic Sciences in Ayurvedic Medicine (ICRARBSAM)", 18-19 October 2014, Varanasi.

Topics :

- Need of Research in Ayurveda
- Pharmaceutical Science & Pharmacology in Ayurvedic drug science.
- Leads for drug development from Ayurvedic medicine.
- Agro-technology in Ayurveda.
- Precedence regarding scope & outcome of interdisciplinary research.
- Understanding pathology & Pathogenesis : Ayurvedic wisdom.
- Biotechnology and Ayurveda.

- Molecurlar Biology and Ayurveda.
- Biochemistry & microbiology in Ayurveda.
- Latest developments in research and treatment and translating them into clinically useful knowledge.
- Traditional Perspectives in Nutrition and Dietetics.
- Ayurveda and Modern Biology.
- Pharmacological research in Ayurveda.
- Scope of biomedical engineering in Ayurveda.
- Clinical trials and pharmaco-vigilance in Ayurveda.
- Behavioral sciences/psychology in Ayurveda.
- Recent contributions of Ayurvedic herbs and natural products to medicine and healthcare systems.
- Recent advances in analytical techniques for Ayurvedic herbal drug & product research.
- Public perception and uses of Ayurvedic Medicine.
- Research on yogic science in Ayurveda.
- Recent recearches in different disciplines of Ayuveda.

Panel Discussion :

- Evidence based research in Ayurveda : Need of Time.
- Scope of Interdisciplinary Research in Ayurveda.

Abstract Submission last date : 10th October, 2014

Contact : Ratnesh Kumar Rao, Secretary-Mahima Research Foundation and Social Welfare, Director-Mahima Publications, Chief Editor-IAMD, STRAM, SAIIRSTFCPPEB, 194, Karaundi, BHU, Varanasi-221005, India, E-mail : mrfsw kvns@yahoo.com. Cell : 09335094154

18th World Congress on Clinical Nutrition (WCCN) "Agriculture, Food and Nutrition for Health and Wellness", December 1–4, 2014, Ubon Ratchathani, Thailand

Topics :

- Role of indigenous products in health and wellness.
- Advances in processing techniques for bioactive compounds.
- Efficacy of bioactive compounds and functional foods.
- Bioactive ingredients from plant and animal sources.
- Role of prebiotics and probiotics in health.
- Nutrition, risk factors and novel biomarkers.
- Epidemiology of nutritional factors
- Complex and refined carbohydrates

- Emerging trends in dietary management
- Role of traditional and alternative medicine in healthcare

Contact : Dr. Ekasit Onsaard, Secretary to the Organizing Committee,
E-mail : info_food@ubu.ac.th or reg_food@ubu.ac.th, www.18thwccn.ubu.ac.th

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

Topics :

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

Submission last date : 30th August 2014

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

S & T ACROSS THE WORLD

SCIENTISTS TAKE STEP TOWARD USABLE FUSION ENERGY

Scientists have taken a key step toward using fusion, the process that powers the Sun, to produce energy, according to a report appeared Feb, 13, 2014 in the journal *Nature.*

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

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

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

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

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

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

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

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

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

FRUIT FLIES FOUND TO "THINK" BEFORE THEY ACT

Fruit flies "think" before they act, a study suggests.

In experiments in which the insects had to tell apart ever more similar concentrations of an odor, researchers found that the flies don't act instinctively or impulsively, but seem to accumulate information before acting that has been considered a sign of higher intelligence.

"Fruit flies have a surprising mental capacity," said University of Oxford neuroscientist Gero Miesenböck, in whose laboratory the new research was performed.

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"Freedom of action from automatic impulses is considered a hallmark of cognition or intelligence."

The researchers also found that a gene called FoxP, active in a small set of brain cells, facilitates the choosing.

"Before a decision is made, brain circuits collect information like a bucket collects water. Once the accumulated information has risen to a certain level, the decision is triggered. When FoxP is defective, either the flow of information into the bucket is reduced to a trickle, or the bucket has sprung a leak," said Oxford's Shamik DasGupta, the lead author of the study.

The researchers watched *Drosophila* fruit flies choose between two concentrations of an odor presented to them from opposite ends of a narrow chamber, having been trained to avoid one concentration. When the concentrations were very different and easy to tell apart, the files usually decided quickly and went to the correct end of the chamber. When the concentrations were very close and hard to tell apart, the flies took much longer to decide and made more mistakes.

The researchers found that mathematical models developed to describe the mechanisms of decision making in humans and Primates also matched the fruit fuly behavior. And flies with mutations in the FoxP gene were particularly indecisive. The researchers tracked down the gene's activity to a small cluster of around 200 neurons, or brain cells, out of the 2,00,000 in the fruit fly brain, implicating these neurons in the evidence gathering process.

The team reports its findings in the April 10, 2014 issue of the journal *Science*.

Fruit flies have one FoxP gene, while humans have four related FoxP genes. Human FoxP1 and FoxP2 have previously been associated with language and cognitive development. The genes have also been linked to the ability to learn fine movement sequences, such as playing the piano.

"We don't know why this gene pops up in such diverse mental processes as language, decision-making and motor learning," said Miesenböck, But "one feature common to all of these processes is that they unfold over time."

"FoxP is not a 'language gene, a 'decision-making gene,'" or any more specific category, he added "What FoxP does give us is a tool to understand the brain circuits involved in these processes. It has already led us to a site in the brain that is important in decision-making."

FIRST REALISTIC UNIVERSE SIMULATION SAID TO BE CREATED

Move over, Matrix—astronomers have done you one better, creating what they call the first realistic "virtual universe" using a computer simulation.

Before, "no single simulation was able to reproduce the universe on both large and small scales" at once said astronomer Mark Vogelsberger, a collaborator in the work. Called Illustris, it mimics a period of 13 billion years, almost the whole estimated age of the universe

Previous simulations were hampered by lack of computing power an the complexities of physics, scientists said. As a result they were limited in detail, or in the space covered. They had trouble mimicking interctions—thought to strongly affect how the universe developed—between star formation, stellar explosions, and giant black holes.

Illustris assumes the presence of "dark matter", material believed by most astronomers to be an unseen ingredient of the universe though it is detected only through its gravity.

The simulation cube contains 12 billion pixels, or resolution points. The team dedicated five years to developing the program. A simulation run-through took three months, using 8,000 computer processors running together—an average desktop computer would have taken over 2,000 years to do it.

The digital re-enactment "begins" when the universe was about a thousandth of its current estimated age.

When astronomers ran it, by the time it reached "present," they counted more than 41,000 galaxies in the cube. There was a realistic mix of galaxy types, including spiral galaxies like our Milky Way, they said. It also recreated large-scale structures like galaxy clusters and so-called "bubbles" and "voids" of a cosmic "web", and on a smaller scale, the chemistries of individual galaxies.

Since light travels at a fixed speed, the farther away astronomers look, the farther back in time they can see. A galaxy one billion light-years away is seen as it was a billion years ago. Telescopes can give us views of the early universe by looking further out, but can't show stages in one galaxy's evolution.

With Illustries, "we can go forward and backword in time. We can pause...and zoom into a single galaxy or galaxy cluster to see what's really going on," said study co-author Shy Genel of the Center of Astrophysics, It's "like a time machine."

The team is releasing a high-definition video morphs between different components of the simulation to highlight various layers. They're also releasing several smaller videos and images at www.illustris-project.org. The results are reported in the May 8 issue of the journal *Nature*, with Vogelsberger, of the Massachusetts Institute of Technology/ Harvard-Smithsonian Center for Astrophysics, as lead author.

(Courtesy : World Science)

ASIAN INSTITUTIONS RELEASE GENOMES OF 3,000 RICE LINES

As a step toward boosting rice producing to meet a projected 25% increase in demand by 2030, researchers from three Asian institutions announced the release of the genetic sequences of 3,000 rice lines.

"The 3,000 genomes will help us explore new genes needed to create new adaptive varieties; this is becoming increasingly important to sustain rice productivity and to ensure food security under the impact of climate change," says Hei Leung, a plant geneticist at the International Rice Research Institute (IRRI) in Los Baños, the Philippines, and one of the scientists involved in the project.

The backers hope that this genetic information will lead to identifying genes for draught, disease, and pest resistance as well as tolerance for poor soils. The first rice genomes were sequenced in the mid-2000s, but this advancement in understanding rice genetics had limited impact in improving rice strains.

"A single genome does not reveal the large store of genetic diversity in rice," says Leung, who notes that many important genes are not present in the previously sequenced rice lines, "Many useful genes are carried in traditional [rice] landraces ; without sequence information it is difficult to use treasure." he says.

The sequencing of 3,000 rice lines acquired from 89 countries has confirmed that there are five broad varietal groups. More importantly, the effort identified approximately 18.9 million single nucleotide polymorphisms, or minor genetic differences, that might represent important traits. Leung says the next step is to connect the genetic sequence information to specific phenotypical traits.

The sequencing effort was a collaboration among IRRI ; BGI in Shenzhen, China; and the Chinese Academy of Agricultural Sciences in Beijing. The Bill & Melinda Gates Foundation and The Chinese Ministry of Science and Technology funded the project.

The report on the sequences and a commentary by officials from the three institutions appear May 28, 2014 online in *GigaScience*. The entire data set is available at the journal's affiliated database, GigaDB. Seeds of all of the rice lines are held by the International Rice Genebank Collection housed at IRRI.