EVERYMAN'S SCIENCE

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EDITORIAL

MENACE OF POOR-QUALITY OF MEDICINES AVAILABLE IN INDIA

India has a huge burden of communicable and non-communicable diseases. Major communicable diseases include HIV (Human immunodeficiency virus), TB (Tuberculosis), malaria, diarrhoea, acute respiratory infections, and infections related to maternal and perinatal conditions; while non-communicable diseases, which account for the second largest share of disease burden in India include cancers, cardio-vascular disorders (CVD), stroke in young, diabetes, respiratory conditions such as asthma and chronic obstructive pulmonary disease (COPD), and mental health disorders. The true burden of all the diseases may be beyond estimation as there is paucity of high-quality epidemiological information and validated data to arrive at any baseline estimations on prevalence or incidence. With such a wide spectrum of diseases in a heavily populated developing country like India, there arises a correspondingly high demand of affordable and good quality pharmaceuticals products. To meet this need, there has been a significant increase in the number of licensed drug-manufacturers.

The Indian pharmaceutical industry is growing fast, and caters to one of the most complex health systems in the globe. The consumers include government hospitals and primary health centers which cater mainly to the poor population, corporate hospitals which offer medical tourism as well as health services to the local elite, private medical practitioners, and also the unqualified practitioners who prescribe a full range of treatments, often from several systems of medicines.The increased production of drugs to be supplied to this huge market, thus, has led to fall in prices and greater accessibility and better treatment options,which is beneficial to the end consumer. However, at the same time, factors like poorly regulated pharmaceutical market, poor compliance of Good Manufacturing Practices (GMP), production of spurious drugs, over-the-counter availability, self-medication and prescriptions by unqualified practitioners pose a huge threat to the health of people.[1]

The 'poor-quality medicines' have now emerged as a major public health problem in India. These may include counterfeit drugs which are maliciously produced by the manufacturer, substandard drugs produced incompetently, wrongly labeled, or contaminated with pathogens, leading to ineffectiveness and direct harm, or degraded medicines due to improper storage. The production of poor-quality drugs could be multiple factors. These could be due to supply of inactive ingredients by the supplier to the manufacturer or selling of counterfeit medicines by the manufacturer itself. Recently, Ranbaxy pleaded guilty against serious charges of selling adulterated medicines with intent to defraud. Their medicines failed to meet specifications and they intentionally made false statements to the government. It has also been seen that pharmaceutical companies targeting their home market produce the highest percentage of substandard medicines. In these cases most of such manufacturers do not comply with GMP standards, hence their products for local sale are not up to the standards produced by internationally traded generic products.[2]

Poor-quality medicines are even sold for deadly diseases such as malaria.[3] According to WHO,

antibiotics and antimalarials are the most common counterfeited drugs in the developing countries. As a collateral damage of using substandard antibiotics as well as irrational use of antibiotics, past several years have seen a number of reports of superbugs resistant to most of the first line and many second line antibiotics from India: methicillin-resistant *Staphylococcus aureus*, vancomycin-intermediate *S. aureus*, vancomycin-resistant *S. aureus* (VRSA)[4], the so-called ESKAPE organisms (an acronym for *Enterococcus faecium, S. aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa,* and enterobacter species)[5], multidrug-resistant TB (MDR-TB), extensively-drug-resistant TB (XDR-TB), and more recently, the reports of New Delhi metallo-β-lactamase (NDM) in isolates of *K. pneumonia* and *E. coli* in 2008, and totally-drug-resistant TB (TDR-TB)[6] i.e. *M. tuberculosis* strains resistant to 5 first line drugs and 7 second line drugs from India in 2012. If this menace of epidemic proportions of antibiotic resistance is not controlled, there could be a return to the pre-antibiotic era, where many people could suffer or die from untreatable infections.

There is an urgent need at both national and international levels to lay down strict legislature regarding manufacturing of drugs, as well as strict implementation of these regulations, including surprise checks and visits to production facilities to maintain the required quality.[7] There should be a board whose members can work in collaboration with international agencies to keep a check on quality control. The WHO recommends that each country should have a "central coordinating body with overall responsibility and accountability for all aspects of drug regulation for the entire country."[8] In 2003, Indian government constituted a committee under the Chairmanship of Dr. R. A. Mashelkar (Ex Chief CSIR) to examine the counterfeit drug problem.[9] The committee's report highlighted that many of the states in India do not have functional drug testing laboratories and are not well equipped and staffed. The Committee also recommended creation of a National Drug Authority to upgrade and implement the prevailing rules and regulations regarding manufacturing of medicines. Since then, the creation of a National Drug Authority has been proposed several times in India but has yet to be enacted. Another burning issue concerns with formulation of a national policy to control the rising trend of antimicrobial resistance, by implementing rational antibiotic usage in the country, both in hospitals and over the counters. Also, the concepts of rational antibiotic usage need to be inculcated in medical students, both at the undergraduate and post-graduate levels, and this warrants modifications in the existing medical curricula.

It remains an important issue that good quality medicines be made affordable to poor populations of developing countries. A family living in extreme poverty may decide that buying cheap medicine is a risk worth taking rather than not taking an expensive medicine at all, thus being denied of adequate healthcare. Poverty and lack of education provide platform for some companies to propagate low quality medicines just to make huge profits.This further presents an opportunity for the multinational companies to push their medicines for extended patents, as well as for renewal of to-be-expired patents by 'ever-greening' strategies, which could hurt an access to quality generic medicines. A strong political will and administrative commitment, thus, will be an inherent requirement in the battle to provide equitable healthcare facilities for everyone.

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REFERENCES

1. C.S. Gautam, A. Utreja, G.L. Singal. *Postgrad Med J,* **85**, 251-256, 2009.
2. R. Bate, L. Mooney, J. Milligan, *Pharmacologia,* **3**, 46-51, 2012.
3. A. M. Dondorp, P. N. Newton, M. Mayxay, W. V. Damme, F. M. Smithuis, S. Yeung *et al., Tropical Medicine & International Health,* **9**, 1241-46, 2004.
4. G. A. Menezes, B. N. Harish, S. Sujatha, K. Vinothini, S. C. Parija, *JMed Microbiol,* **57**, 911-2, 2008.
5. D. Yong, M. A. Toleman, C. G. Giske, H. S. Cho, K. Sundman, K. Lee, T. R. Walsh, *Antimicrob Agents Chemother,* **53**, 5046-5054, 2009.
6. Z. F. Udwadia, R. A. Amale, K. K. Ajbani, C. Rodrigues. *Clin Infect Dis,* **54**, 579-581, 2012.
7. P. Brhlikova, I. Harper, R. Jeffery, N. Rawal, M. Subedi, M. Santhosh, *Global Health,* **7**,10, 2011.
8. World Health Organization (2002) Effective Drug Regulation : A Multi country Study. (Available at : http://www.who.int/medicinedocs/pdf/s2300e/s2300e.pdf.)
9. Report of 2003 by the expert committee on, "A comprehensive examination of drug regulatory issues, including the problem of spurious drugs."(Available at: http://cdsco.nic.in/html/Final%20Report%20mashelkar.pdf)

A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it.

— Max Planck

PRESIDENTIAL ADDRESS

SCIENCE AND TECHNOLOGY IN INDIA DURING THE COMING DECADE(S)

R. C. Mehrotra, D.Phil (Alld), Ph.D., D.Sc. (London), F.N.A.Sc., F.A.Sc., F.N.A.

Let me at the very outset take this opportunity of expressing my gratitude to the scientists of the country for the honour they have done to me by electing me to the exalted office of the President of the Indian Science Congress for the current year, Founded in 1913, the annual meetings of the Science Congress have grown through the last sixty-six years in size, stature, number of sections and participants. Since its inception, the annual sessions of the Science Congress have provided a forum for exchange of ideas to the scientific community. For a number of years, the deliberations were mainly divided in separate sections dealing with different disciplines where research workers either presented their individual research work or held discussions on topics of mutual interest. With the increasing urge of the scientific community to contribute its mite towards solution of national problems, a new innovation was introduced three years ago with the adoption of a Focal Theme for every session around which discussions have been organized not only in various sections but also in a collective form. The Focal Theme for the last three sessions have been :

1. Science and Integrated Rural Development,
2. Survey, Conservation and Utilisation of Resources, and
3. Science Education and Rural Development.

The theme chosen for the current session is : Science and Technology in India during the coming decade (s).

The august presence of our Prime Minister Shri Morarji Desai is a source of inspiration to all of us. With a life dedicated to truth and righteousness, marked with unflinching devotion and firm determination in the service of the nation, his words of wisdom and advice would no doubt evoke a creative response among all the devotees of science.

AGE OF SCIENCE, ITS TECHNOLOGICAL AND HUMANISTIC ASPECTS

In the modern age of Science and Technology, the importance of Science education and training of scientific personnel has been receiving the foremost attention all over the world for the last 3-4 decades. In a less developed country like ours, the question assumes even greater importance as our material progress as well as national security are intimately related to the number of well-trained scientists available and their capacity to handle efficiently the multifarious problems which face the country.

In spite of the rapid progress made in our country since 1947, it cannot be denied that the gap between the technologically advanced countries and ours has been widening further. India is one of the countries which has been the cradle of an ancient civilization and prominent names like Aryabhatt,

* General President, 66th Indian Science Congress held during January, 1979 at Hyderabad.

Varahamihir, Bhaskaracharya, Nagarjun, Ramanuj, Patanjali, Charak and Shushrut come immediately to mind as leaders of scientific thought in the world of their times. However, there appears to be dark period from about the 13th century. Unfortunately, during the period of 18th and 19th centuries when the West was able to build up a strong scientific and technological base as a result of industrial revolution and scientific researches, our nation remained deprived of the benefits of the new scientific developments under the shackles of a foreign rule.

Modern scientific research appears to have been initiated in India in the 1920's. The individual efforts of a few dedicated scientists like Mahendra Lal Sircar, Shrinivas Ramanujan, Jagdish Chandra Bose, Chandrashekhar Venkata Raman, Prafulla Chandra Ray, Meghanad Saha, Birbal Sahani, Sisir Kumar Mitra, Sahnti Swarup Bhatnagar, Karyamanikan Shrinivas Krishnan and Homi Jahangir Bhaba put India on the scientific map of the world and their personal contributions can certainly be compared with those of their contemporaries in any part of the world. However, these were isolated examples. The country, as a whole, remained educationally and scientifically very backward till the emergence of independence in 1947. Not only was there initially a big gap to be bridged, but the developed countries have also been in the meantime making advances in their Science and Technology at a tremendous pace (with a doubling period of about eight to ten years), thus enhancing the gap even further.

A glaring feature of the world today is its division into two blocs one, represented by 400 million people in Europe and North America, has a per capita annual income of more than Rs. 10,000, whereas the other, with more than a billion people in Asia, Africa and South America, has a per capita income of less than Rs. 1,000. In addition to this large difference the western world is saving and investing productively about 10% of its income, i.e., about Rs. 1,000 a year per head, in advancing their technology to create more wealth. The West is thus saving and is able to invest more than the East is spending on all its needs. It is no wonder that the gap in wealth between the two blocs is steadily widening.

Such gross disparities are a source of grave anxiety not only to the poorer but even to the richer countries because in the rapidly shrinking world of today, this imbalance is a potent source of psychological dissatisfaction, discontent and upheavals. With instability and suspicion in relations amongst rich nations and the proliferation of authoritarian regimes amongst the poorer ones, the danger of a global conflict cannot be eliminated. In this context, the anxiety of the peoples of the world for the risk of their total annihilation in a nuclear war is quite understandable. However, the suggestion being mooted by some developed nations, that developing countries should not indulge in any such exercise while they continue to add to their arsenal more and more deadly nuclear weapon, appears to be unfair and would increase the disparities in this direction also. It is worth emphasising that our country has from the very beginning limited all her nuclear researches towards peaceful purposes only.

Due to insufficient precautions taken and uncontrolled exploitation of Science and Technology without keeping the large-range interests of the society in the forefront, serious problems like air and water pollution and accumulation of waste materials are tending to create misapprehensions in the minds of the people of most advanced countries about the possible evil consequences of too fast a growth of technology, Consequently, there appears to be a type of "drift away from Science" in some of these countries. It is gratifying to note that in our country we are becoming cautions in these directions and already, effective steps are being taken for checking the pollution of environment from uncontrolled growth of industry. Although it would

be advisable for us to draw suitable lessons from the experience of others and not to commit the same mistakes, yet it would be unfortunate if following the fashion of the West, developing countries like ours also slacken their efforts towards the development of Science.

Another common pretext being explicitly or implicitly advanced sometimes for not enhancing the inputs for faster development of Science in our country is that its fruits are not reaching the common man and have yet made only an insignificant impact on the rural sector which constitutes 80% of the country's population. While these deficiencies of our scientific and technological progress are partly true and concerted attempts are being made to make our scientific and technological efforts more relevant to the needs of the country, it has also to be realized that the challenges faced by our scientists and technologists have been unprecedented in the history of mankind. In view of the fastly rising cost of scientific research, much more enhanced inputs are absolutely essential for the large body of our highly trained scientists and technologists to play their effective role in the progress of the nation. It must, however, be emphasized that although increased financial support would be of great help in our efforts, not much can be achieved without the spirit of dedication and patriotism which were probably the main factors for the spectacular success of some of our individual top scientists in the pre-independence days, who obviously worked against much greater odds and without any support whatsoever from any source.

In the context of above remarks, it may not be out of place at this stage to say a few words about the recent changes in the philosophical and ethical aspects of Science. The origin of scientific thought could be traced in the philosophical pursuits of scholars through the centuries. In the eighteenth and nineteenth centuries, with the advent of the experimental era, the world of Science tended to break off its metaphysical ties. More and more accurate experimental measurements, fitting the data in the form of a hypothesis/theory and then testing the theory with even more precise measurements became predominant factors in the development of modern Science in the 19th century. The extra-ordinary progress made in unraveling the secrets of nature and the apparent successes achieved in trying to control its processes gave the scientists an over-confidence that nothing was "beyond Science". Spectacular success of materialistic Science led to the development of a philosophy of "logical positivism" according to which truth in Science merely connotes "verifiable in fact". These trends finally culminated in a school of thought amongst the scientists according to which every thing in the world could be interpreted in terms of scientific principles and anything which cannot be so understood or explained in the framework of Science was "irrational". On the basis of this attitude, even human life could be regarded merely as a simple biological process. The origin of moral and ethical values — qualities which govern human kinship and make him a social fellow helping even in his scientific pursuits, is as yet beyond the realms of scientific analysis and understanding. Nobody would suggest that such values are irrational merely because they are beyond the realms of Science. In fact, the qualities and values which appear to be essential for the success of any scientific worker are not much different from those which have been advocated by most of the religious leaders for betterment of mankind.

In a paper entitled "Impact of Science on Moral Values" (*Man, Science and Society;* pages 277-282, published by the Indian Institute of advanced Studies, Simla, 1972), I had tried to identify some of the essential qualities for the success of scientists as :

1. Dedication to and a relentless desire for the search of truth;
2. Capacity to analyse data and the courage to dissent from accepted explanations on the

basis of new facts or possible better interpretations, without losing respect for earlier workers;
3. Tolerance arising not from indifference but derived from mutual respect; and
4. Feelings of humility and imperfection.

It may be worthwhile to say a few words more about the last quality of "imperfection". A good teacher while trying to explain the present status and knowledge about any topic tries to arouse questions about some unexplained facts. It is only in the search for imperfection in the work of earlier workers and thinkers that any progress in scientific thought and methodology can take place. This feeling of imperfection has achieved even a greater philosophical significance since the discovery of the principle of "uncertainty" by the Nobel Prize winner Heisenberg. That our most delicate techniques of measurement themselves disturb the "fact" sufficiently not to render it "absolutely verifiable", has given to the scientific method an air of "imperfection" which sounds like a human quality and has brought Science nearer to the values which man has cherished for long. "Reducing the limits of imperfection to move towards perfection which is in itself unachievable", is a dictum universally accepted in the highest form of scientific activity and is really so close to philosophical or religious beliefs in their most abstract forms.

Einstein once said "Science is lame without religion, and religion is blind without science". Dr. D. S. Kothari while delivering lectures on *Science and Religion* at the University of Delhi towards the end of 1977 observed : "As science advances, and as it gets more abstract and more mature, its contribution becomes increasingly significant to the profoundest and most intractable, of all problems, the mystery of our *being*".

The following words of Julian Huxley in this direction have to my mind, a special meaning today and would be worthy of our closest attention in future as we progress more and more in the field of materialistic aspects of Science :

"The new and central factor in the present situation is that the evolutionary process, in the person of mankind, has for the first time become conscious of itself. We are realizing that we need a global evolutionary policy, to which we shall have to adjust our economic and social and national policies". 'To succeed in this we need to reorganize our Science, to switch the various branches of Science out of their separate channels, and bring them together in a cooperative effort. In particular we must switch more and more of our scientific efforts from the exploration of outer space to that of inner space, the realm of our own minds, and the psychometabolic processes at work in it. It is here that the greatest discoveries will be made, here that the largest and most fruitful territories await our occupancy. All branches of Science and learning, from biophysics to social anthropology, from psychiatry to aesthetics can join in this great venture of exploration".

My main intention in making the above brief remarks was to focus attention on the rapidly emerging new image of Science and on the renewed alliance between Science and Philosophy. With our deep philosophical heritage and contributions that we have made in these directions for centuries, we have to ponder over these aspects even more deeply. The world is looking towards us for enlightenment and let us hope that we would not disappoint it in these expectations. It is, therefore, gratifying to note the efforts of our prominent scientists like E.C.G. Sudarshan who has created a stir in the scientific world by postulating the possibilities of velocities greater than that of light. In a recent article published in a book entitled *"Science and Technology in India"* (Vikas, 1977), the author has identified six basic principles of the "temper of science" as :

1. Rationality *(karyakarana viveka),*
2. Humility *(anahamkara),*
3. Experimentation and innovation *(svatantranvesana),*
4. Relentlessness *(nirdaksinya),*

5. Integrity *(arjavam),* and
6. Creativity *(pratibha).*

Another new facet of Science to which I would like merely to draw your attention is that it is now being increasingly recognized as an instrument of social change of the people in addition to its effective role in economic development of the region. In this context, the following words taken from the Nobel Prize winning work : *Economic Growth and Structure* (1966) of Kuznets appear to be particularly relevant :

"By application of Science to problems of economic production and human welfare we imply that it is distinguished by a climate of human opinion, by *some dominant views on the relation of man to the universe,* that foster Science and its application. In this connection, *it is particularly important to stress the interrelations of technological,* social and spiritual changes. Application of Science *via* Technology would not have taken place without changes in social institutions. New attitudes were needed to accommodate and foster adjustment of social institutions and practices to the exploitation of the potential provided by science-based technology".

GROWTH OF SCIENCE AND TECHNOLOGY IN INDEPENDENT INDIA

It is well-known that ever since independence, the national investment on Science and Technology has been continuously increasing. The following Tables 1 and 2 give an idea of the basic expenditure on scientific research and development sector-wise and organisation-wise :

Table–1
National expenditure (in crores of rupees) on scientific research and development

Year	1948-49	1958-59	1965-66	1973-74	1974-75	1975-76	1976-77
Central Government	—	21.78	62.45	199.05	279.44	354.44	418.70
State Governments	—	1.60	3.51	24.13	29.28	32.33	45.91
Private Sector	—	0.15	2.43	30.35	35.68	42.42	48.81
Total	1.10	23.53	68.39	253.53	344.40	429.19	513.42

Table–2
Science and Technology budget (in crores of rupees) of major organisations

Name of Organisation	1974-75	1975-76	1976-77
Department of Atomic Energy	47.52	52.83	66.71
Department of Space	28.10	34.91	41.08
Council of Scientific & Industrial Research	30.12	37.49	44.44
Defence Research and Development Organisation	40.16	45.00	52.77
Indian Council of Agricultural Research	28.58	32.94	37.03
Department of Electronics	9.29	5.73	5.19
Indian Council of Medical Research	2.98	2.75	4.05

In addition to the financial support, the Indian Parliament was probably one of the first in the world to adopt a "Science Policy" resolution in 1958, the preamble and concluding portions of which exemplify a resolve that would help any under-developed country in solving its problems:

"The key to national prosperity, apart from the spirit of the people, lies, in the modern age, in the effective combination of three factors, technology, raw materials and capital, of which the first is perhaps the most important, since the creation and adoption of new scientific techniques can, in fact, make up for a deficiency in natural resources, and reduce the demands on capital. But technology can only grow out of the study of Science and applications..."

"The Government of India have decided to pursue and accomplish these ... by offering good conditions of service to scientists and according to them an honoured position by associating scientists with the formulation of policies, and by taking such other measures as may be deemed necessary from time to time".

Since independence, India has taken long strides towards agricultural and industrial progress. Today, she is the world's tenth most industrialised country. India has the third largest number of trained technical personnel after the USA and the USSR. She is the world's fourth largest food grain producer and a leader in wheat research. Exports from India to various parts of the world include a whole spectrum of products from hides and skins to power generating equipments to "turnkey" processes in the face of a stiff international competition.

The data in Table 3 gives a bird's eye-view of the progress made in the production of a few selective items since independence.

It is evident from the data presented in the above three tables that our country has made substantial progress in Science and Technology during the last three decades. In addition to technologies based on "know-how" imported from abroad, the applied research carried out in scientific organisations listed in Table 2 has led to the establishment of a large number of industries based on indigenous "know how" developed in our own laboratories. A perusal of the data in Table 1, however, shows clearly that the major effort in Science and research development is still confined to the public sector. Unfortunately, the private industry which is a major beneficiary of the establishment of a technological base in the country does not contribute more than an insignificant fraction (10%) of the total financial input. This to my mind is a serious lacuna which harms the industry itself in the long run, as it is not able to keep itself up-to-date and adopt modifications towards the improvement of its quality and efficiency.

Table–3

Item	Productions shortly after independence	Present estimated production
Agricultural output	50 million tonnes	125 million tonnes
Steel	1.4 „ „	10.6 „ „
Alluminium	4000 tonnes	2.1 lac tonnes
Copper	7000 „	24,000 tonnes
Nitrogenous fertilizers	9000 „	20 lac tonnes
Phosphatic	9000 „	5 lac tonnes
Petroleum (crude oil)	1 lac tonnes	125 lac tonnes
Sulphuric acid	1 „ „	18 „ „
Soda ash	0.5 „ „	6 „ „
Caustic soda	0.1 „ „	5 „ „
Cement	25 „ „	195 „ „
Iron Ore	30 „ „	425 „ „
Coal (including lignite)	300 „ „	1100 „ „
Machine tools	Rs. 0.2 crores worth	Rs. 115 crores worth
Automobiles	Rs. 15,000	92,000
Motor Cycles and Scooters	—	2.3 lacs
Cycles	75,000	27 lacs
Sewing machines	20,000	4 lacs
Electricity generated	5000 million kwh	9000 million kwh
Electronic items	Rs. 180 crores worth (1971)	Rs. 500 crores worth

Notwithstanding India's considerable scientific and technological strength, it must be admitted that till recently there has been little conscientious attempt at harnessing this strength for tackling the problems of rural poverty and backwardness. The possible reason for this seems to be a lack of appreciation of the precise role of Science and Technology in rural development. For this purpose, therefore, the problems of rural development need to be identified in precise terms so that they can be resolved by application of modern scientific knowledge. To obtain effective and real results, it is essential that scientists with proper motivation and commitment should be encouraged to spend extended periods of time in rural environment in order to get a direct feedback at the grass-roots level, both in respect of the actual problems capable of scientific solutions and the organisational framework required for this purpose.

It is again a happy development that Science and managerial problems of labour-intensive technologies are receiving priority attention. For example, the handloom industry ranks next only to agriculture in its employment generating potential. There are about 3.8 million handlooms in the country employing 10 million people. Soon after the present Government assumed office in March 1977, a policy decision was laken that the content and scope of handloom development programmes should be expanded by doubling the plan outlays for the same. The handicraft sector, which includes a large number of traditional crafts other than handlooms, employs 1.9 million workers. Handicrafts and handloom exports are now around Rs. 450 million a year. Obviously, labour-intensive sectors like these require urgent and concerted efforts on the part of scientists and management experts so that the benefits of modern Science and Technology are able to reach the largest number of the weaker sections of our society.

ROLE OF EDUCATIONAL INSTITUTIONS IN THE GROWTH OF SCIENCE AND TECHNOLOGY IN INDIA

Even before the establishment of postgraduate teaching departments in some of the Universities for which lead was taken by the Calcutta University during the period 1915-17 under the stewardship of Ashutosh Mukherjee — some of the premier affiliated colleges did have Science departments; the Presidency College, for example, was the venue of the researches of J. C. Bose in Plant Sciences and P. C. Ray in Chemistry, The education in engineering appears to have been started in India with the introduction of a course in Electrical Engineering in 1915 at the Indian Institute of Science, Bangalore. This was soon followed in 1917 by a course in Metallurgy at the Banaras Hindu University due to the foresight of Madan Mohan Malaviya. There has been a rapid increase in the number of universities and colleges with a consequential increase in the overall expenditure on education in the country since independence. It was, however, unfortunate that till recently Science departments in the universities did not receive much direct financial support for their research activities.

It is well recognized that the teaching institutions at the higher level are not able to discharge their primary function of imparting suitable training to the students it the undergraduate and particularly at the postgraduate level without their teachers having been exposed to research methodology and the best results are achieved when teaching and research are carried out actively in collaboration with each other within the same institution.

The departments of Science in the universities were unfortunately in the initial years of independence depleted of some of their capable staff who were attracted away by the better conditions of service in the newly established

Table–4

Growth of educational institutions in India

Year	No. of universities, IITs & others			No. of institutions offering post graduate courses in Engineering	No. of medical colleges
	Universities	IITs	Other institutions deemed as universities		
1947	20	—	—	5	22
1952	30	1	—	10	30
1962	55	5	4	33	71
1971	85	5	9	67	102
1975	102	5	9	67	107
1977	105*	5	10	67	108

* This figure is 107 on 1.10.1978.

Table–5

Output of scientific and technical personnel from India universities

Year	B.Sc	B.Sc (Ag)	MBBS	BE/BSc. Engg. % Tech.	M. Sc.	M.Sc. (Ag)	Ph.D (Sc.)	Ph.D. (Ag)	M.D/. M.S.	ME/M.Tech. Enggl. & Tech.	Ph.D. Engg.
1947	5,996	535	959	1,076	905	79	n.a.	n.a.	n.a.	30	n.a.
1952	11,087	870	2,164	2,889	2,129	223	108	5	113	118	12
1962	26,930	2,609	3,567	6,863	5,195	576	489	38	525	477	23
1972	111,798	5,600	9,524	17,315	15,951	1,496	1,311	267	1,420	1,051	110
1975	95,382	3,966	10,144	12,537	17,341	1,511	1,484	289	2,204	1,228	136

Sources : 1. For data up to 1960: S. K. Roy, CSIR, in *Nature*, May, 1975
2. For data from 1962 to 1970 : University development in India, Basic Facts and Figures 1971-72, UGC 1976
3. Data for 1972 and 1975 collected from UGC Office.

research institutions. Further, in the budgets of most of the state universities, not a rupee is provided for scientific research which was considered to be merely the responsibility of the individual research worker who was supposed to apply and secure funds from other agencies. The position has been altered to a limited extent during the last few years by the establishment of the Science Research Council and Panels on different subjects by the U.G.C. and by the direct support that the Commission has been providing to the individual workers as well as departments for research work in different fields in all the universities of the country.

Table–6

Expenditure on education

Year	(Rs. Crores)
1947–48	55 .18
1950–51	114 .38
1955–56	189 .66
1960–61	334 .48
1965–66	622 .02
1970–71	1,118 .29
1975–76	2,104 .70
1977-78	2,500

Source : Education in India by Ministry of Education

I may be pardoned for dealing in a little greater detail on the pivotal role of universities and institutes of higher learning in the scientific and technological development of the country. There is considerable substance in the complaints from different quarters (e.g., the deficiencies in our system of education in engineering colleger were indicated by Dr. Atma Ram, the Chairman of the National Committee on Science and Technology in the recent convocation address at I.I.T., Madras) about the deterioration in the quality of education and there is much room for improvement, Steps have already been initiated by the University Grants Commission as well as by the universities to remove the deficiencies and some of these have been spelt out in a document entitled "Development of Higher Education in India — a Policy Frame", prepared by the University Grants Commission in consultation with the universities. I would be discussing some of these measures at a later stage but at this point it may not be out of place to emphasize some of the achievements also of the university system in spite of the pressure of numbers as well as other concomitant problems. It is to the credit of the university system that with the meagre resources placed at its disposal, it has given a very high level of trained manpower, the size of which is one of the largest in the world. It is not only the size but the quality of the top levels of these professionals is certainly comparable with and in some cases may be even superior to that of their counterparts trained in institutions of higher learning in much more developed countries with many times better resources and facilities. The enthusiasm with which the services of our scientists, medical graduates and engineers are in demand by organisations in much more developed countries for their key jobs and certainly their increasing demand in less developed countries often in preference to those available from more developed societies than ours, provides a convincing proof of their comparative quality in this highly competitive world of today. Even in the field of scientific research, some systematic studies for certain disciplines like Physics have shown that with only a very minor fraction of total national input being made available to the universities, their output constitutes a major fraction of the total national research output in the field.

Having mentioned some of the achievements of our educational system, I shall be failing in my duty if I do not acknowledge a number of basic weaknesses. Unfortunately, our educational system continues to be dominated by models and value systems adopted during the colonial regime. For example it continues to lay much greater emphasis on narrow individualism and unhealthy competition. These deficiencies have not allowed it to move in the direction of cooperative interdisciplinary studies and team work which have become absolutely essential due to the exponential growth of knowledge in individual disciplines and their increasing overlap with one another. In view of this individualism and the scholars sticking to their narrow disciplines without interaction with other cognate areas of study, the research output of the universities remains mainly academic and does not lead in most cases to its applications to the solution of real life problems which generally require an interdisciplinary approach for their solution.

There has been a considerable amount of argument in this country as well as outside regarding the role of the universities in the fundamental versus applied types of research. To my mind, much of this argument is becoming almost meaningless as the boundaries between fundamental and applied research are getting fastly blurred. A few decades ago a breakthrough in ideas or a result of fundamental importance discovered on the research bench in a University laboratory used to take a few decades before it was actually exploited in the industry. This intervening period is getting shortened and in fact, there are examples like the field of polymers where industrial applications have even outstripped a clear fundamental understanding of the topic.

The University is the best place for adventure in the realm of ideas and for fundamental research pursuits which extend the existing boundaries of our knowledge in any field. In developed countries like the U.S.A. where the Universities have close collaboration with the industry, the University research has contributed substantially to the research and development problems of the industry. It is imperative particularly at our present stage of national development that problems chosen by us should preferably have much greater relevance to our own environmental situations and local needs rather than merely follow a fashionable area of research which is of much greater relevance and has potential applicability to the developed countries. In fact, one of the main weaknesses of university system in our country today is its isolation from the society and it is in this context that the "extension" role of the university is being emphasised in the academic circles and should receive a very high priority.

It is often argued by academicians that knowledge of Pure Science in any field is international and cannot have much of a regional bias. While this may be true as far as fundamental ideas are concerned, yet there is no justification that while dealing with any topic like the availability of ores and minerals for a particular metal, our textbook should continue to mention resources available in the U.S.A., the U. K. and Germany etc. only, without emphasising the newly discovered regional resources within the country. The fact is that even in the field of research the traditional culture and background of the region sometimes plays a significant discerning role. In a recent lecture at the University of Delhi, Dr. D. S. Kothari has drawn our attention to one of the fundamental principles of modern atomic Physics named by Niels Bohr as the "principle of complementarity". This principle is an expression of a novel situation in atomic phenomena according to which it is no longer possible to make a sharp distinction of the subject from the object or between the knower and the thing to be known. This fundamental concept has brought Science much closer to the realm of metaphysics and *Vedanta*. It is significant that the great Japanese Nobel Prize winner physicist Yukawa remarked that the Japanese physicists did not feel the same difficulty as those in the West in adapting their thinking to the complementarity principle : "Bohr's argumentation has always appeared quite evident to us... we in Japan have not been corrupted by the logic of Aristotle".

Finally, the system of education must inculcate proper social and ethical values. Mahatma Gandhi had rightly diagnosed that the traditional middle class values of glorifying intellectural work and denigrating manual work had dominated our educational system and led to a total divorce between work and education with disastrous effects on both the individual and the society. The basic system of education enunciated by Gandhiji in 1937 is essentially "Education through Life and for Life." The Kothari Commission Report in 1965 emphasised that Gandhiji's ideas are equally applicable to all stages from primary to research levels. However, instead of modifying and developing the underlying ideas (development of the total personality of the learner including his productive and functional efficiency) to suit modern times and needs, we appear to take pride in importing now the same or almost similar ideas from foreign countries (Dr. Seymov Eskow, President of one of the community colleges in New York, describing the essential features of the experiment emphasised that in these institutions: "students do not learn for work but learn through work"). It may be rather a far-fetched conclusion, but the weakness of instrumentation in our research efforts may be a reflection of the lack of practical training in earlier stages to soil our fingers by manual work.

SCIENCE AND FUTUROLOGY

Dazzled and dazed by the rapid changes brought about by scientific development not only in the

physical sense but also in personal and psychological as well as sociological facets, there is a fastly growing interest during the last two decades in "futurology" which tends to forecast the type of changes one could expect in the future and be prepared for meeting their challenges. In recent years, the literature on the topic has grown with a number of journals, e.g., the "Futurist" and the "Futures" being published for the last 9-10 years, and an ever-increasing number of articles dealing with Futurology in other common magazines and periodicals. A new organisation "The World Future Society" founded in 1966 in Washington, tries to serve as a clearing house for data that could influence the future and as a forum on which intellectuals could exchange ideas. In June 1975, the Society arranged an international conference attended by as many as 2,000 futurologists from all over the world. At the end of the conference, the Society tried to summarise its conclusions in the following words :

"In this short time (25 years) the human race may wipe itself out through war or destruction of its natural environment. On the other hand, the next quarter century could be a period when human beings join to create a global civilisation happier and more productive than ever."

Alvin Toffler, the author of a book "Future Shock" has expressed in a dramatic way the startling changes in the living style of man brought about by advances in Science and technology. Dividing the span of 50,000 years of known human history into 800 "life times" of 62 years, he estimates that out of these the first 650 or so were spent in caves. It is only during the last 70 of life times that the art of writing has made it possible to communicate effectively from one generation to another. Further, it is only during the last 6 life times that masses of men have come across the printed word. The invention of electric motor is about 2 life times old. The automobile became common only one life time ago. Nuclear energy revealed its potential only about half a life time ago, man's explorations into space are barely l/3rd of this unit old, the synthesis of genes is an event which occurred only l/10th of this unit ago and the first test tube baby is barely a four months' young infant. The rapidity of changes occurring at the present moment has been depicted even more eloquently by Kenneth Boulding, an eminent economist and imaginative social thinker, in the following words :

"The world of today ..... is as different to the world in which. I was born as that world was from Julius Caesar's".

I have mentioned these points in some details as these clearly show the vast changes which have happened in the world during the last few decades. Obviously, the changes expected in the coming decades would be even more spectacular and revolutionary and it would certainly be very exciting to try to predict and forecast them in advance.

The world's population is currently 4 billion and is expected to increase to 7 billion by the end of the century. The implications of this exponential population growth were analysed by the Club of Rome which commissioned a group of scholars of the M.I.T. to study the interaction of technical, social, economic and political factors in what they called the "world problematique" or the "Predicament of Mankind". The group's report "The Limits of Growth" (Dennis L Meadows, *et.al.*, New York Universe Books, 1972) had a mixed reception. The report was taken quite seriously in most quarters, just as Rachael Carson's famous publication "Silent Spring" (Houghton Miffin, U.S.A., 1962) had stimulated public opinion to react vigorously against the extravagant and unintelligent use of pesticides. Fortunately, both these publications have encouraged the introduction of such effective anti-pollution measures in many parts of the world that it now seems most unlikely that the predicted disastrous effects will ever come to pass. The warning given in the Dennis' report

Role of institution of higher education in scientific and techlological development of the national functions and suggested improvements

Dissemination of knowledge	Creation of new knowledge		Extra-curricular activitity & extension service (cf., U.G.C. Document—Policy frame)		
	Basic and academic	*Applied*	*Extension service*	*Moral & cultural values*	*Social service*
Interdisciplinary programmes of teaching UNIT COURSES : FLEXIBILITY in Combinations (Curricula based on national and regional environments, Indian Textual material for even science and technical subjects)	Fundamental Research in frontier areas (Adventure in the realm of ideas); Continuous search for better expression and exposition for more efficient DISSEMINATION OF KNOWLEDGE Development of new instruments and experimental techniques. As well as to revolt against it in order to generate newer ideas, concepts and theories for the progress of knowledge.	(Relevant to national development; collaboration with national laboratories, industries; sandwich courses) Education, Research and productivity Triangle, (cf., Kothari Commission Report)	(International with society; useful for society and deriving expertise from society; Adult education and Literacy; Popularisation of knowledge etc. Creation of scientific temper and similar programmes)	University to be open to all ideaologies and cultures, but not to be swept off its feet. Practice better than precept. Simple living and high thinking	A few months compulsory/social/ Technical training before awarding a degree. Capacity to live in harmony with and serve rural or urban population, relevant problems of which they should identify and seek to resolve (participation should be both of students as well as teachers).

All the above aspects are intimately interlinked. Lack of collaboration and interaction amongst depeatment and institutions within the same University, collaboration amongst Universities, between Universities and other sections of society is a serious deficiency

about the exhaustion of non-renewable natural sources, however, did not appear to create the same sense of imminent peril and in fact, it has been contradicted in many optimistic reports since then. For example, Herman Kahn, William Brown and Len Martel in a book entitled "The Next 200 years" (William Morrow and Company, Inc. New York, 1976) has, on the basis of considerable data collected by a team of 40 analysts at the Hudson Institute, contradicted the above dismal view of the future — that the world is running out of food, energy and other resources and that growth must therefore be stringently limited. Kahn predicts a population of 15 billion people in the year 2176, but his team feels optimistic that the world could produce by improvements in conventional technology itself sufficient food for even double this number (30 billion). The team envisaged that through eradication of the "*tsetse*" fly and advances in soil research, even large tracts like the sub-Saharan desert could be harvested. Finally, high yielding varieties of grain "triticale", for example, could double or triple the yields per acre. Further, the potentialities of non-conventional varieties of food are even more exciting. It is expected that by the mid-1980's a high-protein food (may be a single cell protein), grown on a petroleum based medium or by conversion of cellulose from trash wood, or agricultural waste to glucose and then to protein, may be suitable for animal feed on a large scale, and shortly afterwards as a supplement to the human diet. As the earth's oil and coal resources are likely to disappear in about 150 years from now, many new energy sources (fusion power, windmills, bio-conversion, solar radiation, photovoltaic power, ocean thermal power and geothermal) could be tapped effectively. As regards other resources like metals, Kahn does admit a possible shortage of two metals, chromium and mercury. However, in most other cases like

aluminium (of which acute shortage is predicted in the earlier report), metallurgical processes for extraction of the metal from sources (actual abundance of aluminium is 7% of the earth's crust) other than the currently exploited "bauxite" have already been perfected.

In India also, considerable interest has been aroused in the Science of futurology. In a Seminar organised at Delhi in April 1977 by the National Council of Applied Economic Research and the U.S. Information Service, Mesarobic (author of another famous Club of Rome Study, "Mankind at the Turning Point") surprised even the most sophisticated amongst his audience by the massive amount of data collected around his proposed model and by the efficiency with which a simple Delhi-Cleveland Computer hook-up could bring back answers on a television screen to the most complicated questions not only about the western world, but about India and Asia as well. The "futurology research" has now become highly sophisticated in "model building" using advanced computer techniques and its importance can be gauged by the fact that more than 400 American Universities and Colleges offer "futurist" courses of one kind or another and a number of research foundations are studying problems whose scope and range vary widely and encompass diverse areas such as home and family, work, lifestyle, technology, energy, population, food supplies, urban rush, agriculture, vehicles of justice and mass media. It is a happy sign that the Department of Science and Technology is taking a deep interest in this fastly emerging and imaginative field of investigation and has been planning a large number of workshops on the methodology of the futuristic studies. This is to be encouraged even further as we as a nation should not depend upon the data and models developed elsewhere only in an important and sensitive area like futurology which consists of critical analysis of the past trends, current realities and future possibilities.

In this connection, it may be emphasized that the theory and methodology of futuristic research as developed in countries like the U.S.A., Germany, Japan and the U.S.S.R. may not be directly applicable to conditions obtaining in fastly developing countries like ours. In more developed countries, the approach generally has been based on projections of the current trends or sometimes prognostics based on the current as well as expected trends. Such extrapolations do give us an idea of the expected shape of the future if human agencies do not interfere too much in the historical process. In our country, however, we have the very challenging task of trying to bridge the gap brought about by centuries of slavery and misery in as short a period as possible and also to translate into reality a future with the welfare and happiness of the common man as our main objective. We cannot obviously achieve this future objective of our dreams if we merely continue to imitate the present industrialized countries. In other words, we have deliberately to think of factors which can effectively alter the expected projections towards a goal of our own image of the desired future.

I have taken this opportunity of discussing about the new scientific activity of futurology in some detail as it is so relevant to our current focal theme. Although responsibility in this direction was allotted to the Department of Science and Technology in 1971, the actual work on it commenced only in 1973 when the N.C.S.T. panel on Futurology was set up under the Chairmanship of Dr. B.D. Tilak. The panel has identified the following areas for intensive and analytical studies in terms of immediate forecasts for 1985 and the likely future in the year 2000 A.D. in our country :

1. Energy generation and needs
2. Food
3. Transportation
4. Communications
5. Urbanology and slum problems

6. Rural Development and Life Styles in Rural India
7. Housing
8. Management
9. Education
10. Water
11. Health
12. Teaching & Research in Futurology and
13. Future of the Islands of the Republic of India.

In addition to the above, 25 special studies have been commissioned out of which the following 12 have already been completed till November, 1978 :

1. Systems of Education in 2000 A.D. (Dr. Kunthala Jayaraman)
2. An outlook for India's Future for Housing (Mrs. P. M. Apte)
3. Prediction of Food Production including Rainfall Uncertainties. (Dr. R. Narayana lyengar)
4. Management Education-Future Trends 1976-2000 A.D. (Dr. A. P. Paul)
5. Regipplis 2000: A State in Intermedia Urbanisation with new Growth Centres (Dr. Santosh Ghosh)
6. Developing A Strategy for Mass Communications in India (Mr. Ashoke Chatterjee)
7. Scientific and Technical Human Resources Development in India (Outlook for 2000 A.D.) (Dr. Aqueil Ahmad)
8. Executive Development in India: A Dalphic Study (Dr. A. V. Srinivasan)
9. *Social* Communication and Social Educators: A Futuristic Analysis (Dr. Utpal K. Banerjee)
10. Power in Organisations: Can this change in 2000 A.D.? (Mr. Francis A. Menezes)
11. India's Freight Transport: Problems and Prospects (1976-2000 A.D.) (Dr. M. Raghavachari)
12. Community Housing (Dr. K. R. Unni).

SCIENCE AND TECHNOLOGY IN INDIA DURING THE COMING DECADE(S)

Ours is a vast country and it should have every aspect of Science operating at all levels. In order not to be a back-bencher in the competitive world of today and not to be caught unprepared when apparently basic and fundamental science of today makes a revolutionary breakthrough in practical applications, we have to nurture such fields including the so-called "Big-science" requiring heavy inputs. At the same time, we would be unrealistic if our scientific and technological efforts do not enhance our immediate productive capacity in a marked manner, which is absolutely essential not only for the progress of the country but for sustaining the heavy inputs required for the growth of our scientific efforts. In a poor country like ours, the most pressing concern of the scientists and technologists must be to improve the living standards and happiness of the common man, and in order to bring about tangible results in these directions, so called "barefoot technology" intended to help in our rural programmes should receive our immediate and urgent attention. There must be a continuous flow of knowledge and feedback from the high "ivory-tower research": down to the "grass-roots level" pervading through the entire scientific community. As indicated above, there has been phenomenal progress in the field of Science and Technology in independent India even in sophisticated fields such as nuclear energy, space research, electronics, metallurgy and other chemical industries. In the field of applications of Science and Technology to agriculture also, there has been tremendous progress resulting in "green revolution" and "self-sufficiency in food." In spite of such phenomenal progress and advancement, doubts are often raised whether the benefits of all this progress and consequential prosperity could satisfy the one simple test prescribed by Mahatma Gandhi. "Has this benefited the poorest man?". Although as a result of our technological progress we have come within the

first ten industrialised countries of the world, we are still a predominantly rural and agricultural society and unless the fruits of modern Science and Technology are taken to the doorsteps of the common villager who constitutes 80% of the population, the impact of this progress will remain in a very limited sector and instead of bringing about a general feeling of satisfaction and welfare on the national scale, it might result in enhancing the disparities and conflicts making everyone less happy and more dissatisfied.

As emphasised above, we have to place much greater emphasis on development of technologies which have direct short-term relevance to the welfare of the common man, but the eclectic altitude which we have followed so far in this direction should not be discontinued. The Chinese model of giving emphasis only to "barefoot technology" and efforts to develop it in isolation attracted the attention of the rest of the world during the last two decades and appeared to influence considerably the thinking of some people in this country also. In this connection, it would be appropriate for me to draw your attention to some recent developments in China during the last few months. A new policy based on an altogether new model has been spelt out in a Conference of about 6000 scientists in Peking in the latter half of March 1978 *(Nature,* Vol. 274, August 31, 1978, pages 831 to 839). While adopting, the plan of scientific and technological development for the next 8 years up to 1985, it was admitted that China was in 1978 lagging 15 to 20 years behind in some branches and even more in others and this was the situation in spite of the country having attained advanced world levels in a few scientific and technological spheres as early as mid-sixties. The new plan envisages an increase in the number of professional scientific research personnel to 8 lacs and preferably (if possible) to 1 million by 1985. For this purpose, a large number of new up-to-date centres have been planned for scientific research which should be of a nation-wide interlinked, and inter-communicating type. The 8 year outline plan has laid down all-round tasks of researches in 27 sectors including natural resources, agriculture, industry, military technology, transport and communications, oceanography, medicine and education. 108 items have been chosen as key projects in this nationwide endeavour, but the following spheres have received maximum attention in the new plan :

1. Agriculture
2. Industrial sources,
3. Materials,
4. Computer technology,
5. Laser optics,
6. Space science,
7. High Energy Physics and
8. Genetic engineering.

China is for the first time planning to send more than one lac of its scientists to the U.S.A. and other countries for further training and has also opened its doors to scientists from many parts of the world. Some of these visitors, although critical in their outlook, have observed "If they can hold on to the course set by the leaders of the country, there is a chance that by the end of the century, China will indeed be among the most advanced scientific and industrialised nations."

In spite of the continuing emphasis on the programmes of population control and family welfare, it appears that we have to prepare ourselves for the human needs of approximately 1,000 million people to which figure the population of our country is expected to grow by the year 2,000 A.D. Rohtagi and Bowander (Background paper and Special Notes and Discussions, Vol. I, Chap.IV, National Committee on Science and Technology, 1976) have in a paper attempted to forecast the requirements of food materials (in million tonnes) of a few typical varieties for this population, These estimated figures, and the actual production in 1971 are being indicated in brackets after the name of each item :

cereals [140 (84)]; sugar [17.5 (4.3)]; pulses and nuts [36.3(11.8)]; fruits and vegetables [48 (12.6)]; meat [2.44 (0.46)]; fish [5.9 (1.8)]; milk and milk products [70 (21); fats and oils [0.3(2.5)].

The study has further indicated that even if a conservative 5% annual growth rate of consumption is assumed, our known chromite and bauxite reserves will be depleted by the turn of the century, and it has, therefore, been suggested that long-range planning must be initiated urgently to substitute such short supply metals with materials which we may have in surplus. The picture about such essential items as steel, cement and nitrogen fertilisers also appears to be gloomy unless some technological breakthrough is achieved or the present rates of consumption are reduced by use of substitutes or alternatively, by social measures. A comparative data on steel quoted by Rohtagi and Bowander is rather revealing that even if we are able to produce 55 million tonnes of steel per annum by 2,000, the same will not be adequate and we would not be able to achieve the level of *per capita* steel consumption of Argentina in 1950 or Mexico in 1970.

I have selected the above few projected requirements of the country in the year 2,000 to emphasise the essential need for identification and development of new technologies relevant both to the rural environment as well as to the sophisticated industrial sector. As regards the problems of harnessing more resources, the attention of the scientists has already been directed to lesser exploited regions like the ocean bed. It is gratifying that a special panel on Oceanographic Research has already been constituted in October 1978 under the Chairmanship of the Prime Minister for accelerated work in this area. Inspite of all these innovations, challenges in many directions appear to be so formidable that it does not seem possible to meet them merely by advances in the field of Science and Technology. One would have to think boldly in terms of changes in living patterns and social values to alter the consumption rates of some essential commodities to be able to meet the requirements of the growing population in the decade(s) to come.

In the above account of "Science and Technology in India in the Coming Decade(s)", I have deliberately avoided a number of controversial issues regarding the directions which should be adopted for an optimum growth of Science and Technology in India during the coming decades. A few of these issues relate to very important decisions such as

1. Import of Technology vs. Development or our own know-how
2. High Technology vs. Intermediate Technology
3. The role of public sector vs. private sector
4. Capital intensive technology vs. Labour intensive technology
5. The question of appropriate or relevant technology.

There is considerable amount of material which has already been written on these and other issues and there would be further detailed discussions and deliberations, I hope, on some of these and other specific themes in different sections and forums of the present Science Congress Session. As I am not an expert in these fields, it would not be correct for me to forestall the discussions in these directions amongst real experts and specialists who know much more than I do.

In conclusion, I would like to emphasise that India continues to be in a unique situation. The Agraria, Industria and the post-Industria facets continue to co-exist here simultaneously and in view of the democratic form of life that we have accepted, these shall in all probability continue to exist together in the foreseeable future. In a situation like ours, controversies like a one-sided choice between "appropriate" technology and "high" technology are not of much relevance and in fact, these should not be treated as "either-or" questions. There are sectors in which appropriate technology

in a dynamic (not static) form would certainly be more relevant and must be increasingly encouraged. Simultaneously in other areas like judiciously selected "sophisticated technologies" (e.g., space research, ocean resources, mining and application of remote-sensing techniques for agriculture and water resources), we must leap frog and make a quantum jump into the future. The most important consideration to my mind is that although we should learn from the experience of others without following their course of development blindly, yet we should certainly avoid the mistakes and pitfalls of an uncontrolled growth of technology in many countries which are paying a heavy price in the forms of pollution, ecological disturbances and unhappiness of man, who many a time appears to have become subservient to machine. In this connection, the enthusiastic manner in which the well-known economist E. F. Schumacher advocated the development of "A Technology with A Human Face" in his famous book "Small is Beautiful" has created a great impression on all of us and this is certainly a welcome direction for us to explore. It may, however, be appropriate to recall that a few decades earlier, the Father of our Nation had also warned us that in the large-scale mechanisation based on modern Science and Technology, man should not lose his importance and significance, but should continue to be at the "pivot" of all things that he has been able to create by learning the secrets of nature. The importance of Gandhiji's emphasis on learning to live with nature rather than trying to control it, has assumed new significance today. While as a student of Science, I should not advocate blind acceptance of any advice irrespective of the source from which it is derived, yet the words of wisdom from such a great "man of the ages" should always continue to receive our serious consideration. Few of us realize that Gandhiji himself was a revolutionary and staunch believer in change. It should be a profitable exercise for us to try to guess how he might have changed his plans of action in our present state of development for building a self-reliant and glorious India of his dreams. These details also do not matter as much as his passionate concern for the good of the humanity and the common man and if we could be infected with even a fraction of his concern, all will be well for the future of this great country.

The foregoing analysis clearly demonstrates that Science and Technology have a crucial role to play during the coming decades in raising the standards of living us well as the quality of life of the people in this country. In order to achieve these objectives, we have to recast our priorities in such a manner that we do not get afflicted by the problems of alienation and fragmentation which currently have become a source of serious worry to the western society. Along with the development of the highest technologies in an appropriate form, we have to nurture our impoverished rural environment with low cost technologies to eliminate the socio-economic disparities between urban elites and rural masses.

In such a situation, no task is more urgent, no imperative is more categorical than the restructuring of our scientific and technological priorities to ensure a balanced growth of the country. Let us hope that we rise to the occasion and do not belie the expectations of our countrymen who have great faith in us !

RAIN WATER HARVESTING : A SOLUTION FOR PROBLEM OF WATER IN URBAN SECTOR

Satish V. Kulkarni

A brief discussion and review of the importance of rainwater harvesting for compensating the effect of water shortage, which are repeatedly occurring due to current climate change and ever increasing utilization of water for drinking / irrigation and industries has been presented here. Unpredictable rain and rapid urbanization cause majority of the cities to suffer from the water shortage and problem of urban flooding. In urban areas, restricted rainfall in absence of proper management creates acute scarcity of water on one hand and on the other, the flood like situation during monsoons. Though the concept of rainwater harvesting is not new, there is a lack of awareness. The rainwater harvesting offers ideal solution in areas where there is inadequate supply of groundwater or insufficient surface sources. It also reduces urban flooding such as roads, subways, railway lines etc. The other major benefit of rainwater harvesting is improvement of quality of groundwater by recharging water into the aquifers.

INTRODUCTION

The water is an essential need of all forms of life and used in many different ways. But now a day the supply of water is decreasing rapidly. Lack of water is caused by low water storage capacity, low infiltration, larger annual fluctuations of precipitation (due to monsoon rains) and high evaporation demand. Majority of the water comes from the underground sources. These sources depend on the percolation of rainwater in to the ground (recharge of groundwater). In India, the rainfall is restricted to monsoon. However, this rainfall occurs during short spells of high intensity. Because of such short duration of heavy rain most of the rain falling on the surface tends to flow away (runoff) rapidly leaving very little for recharge of groundwater. Because of this urban centers in India are facing an ironical situation today. On one hand there is the acute water scarcity and on the other, the streets are often flooded during the monsoons. This has led to serious problems with quality and quantity of groundwater. One of the solutions to the urban water crisis is rainwater harvesting-capturing the runoff.

The term rainwater harvesting is used frequently these days, however, the concept of water harvesting is not new for India. Water harvesting techniques had been evolved and developed centuries ago. In India, water harvesting means utilizing the erratic monsoon rain for agriculture and conserve excess runoff for drinking and for recharge purpose.

Ground water resource gets naturally recharged through percolation. But due to indiscriminate development and rapid urbanization, exposed surface of soil has been reduced drastically with resultant reduction in percolation of rainwater, thereby depleting ground water resource. Rainwater harvesting is the process of augmenting the natural filtration of rainwater in to the underground

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formation by some artificial methods. "Conscious collection and storage of rainwater to cater to demands of water, for drinking, domestic purpose & irrigation is termed as Rainwater harvesting."

The rainwater harvesting offers ideal solution, in areas where there is inadequate groundwater supply or insufficient surfaces sources. It also reduces urban flooding such as roads, subways etc. Other major benefit of rainwater harvesting is improvement of quality of groundwater by recharging water into the aquifers.

IN URBAN AREAS RAINWATER CAN BE HARVESTED FOR FOLLOWING PURPOSES :

- Storing rainwater for ready use in containers above or below ground
- Charged into the soil for withdrawal later (groundwater recharging)
- To avoid flooding of roads, subways, railway lines

FROM WHERE TO HARVEST RAIN :

In urban areas rainwater can be harvested from the following surfaces,

- **Rooftops :** If buildings with impervious roofs are already in place, the catchment area is effectively available free of charge and they provide a supply at the point of consumption.
- **Paved and unpaved areas :** The landscapes, open fields, parks, stormwater drains, roads and pavements and other open areas can be effectively used to harvest the runoff. The main advantage in using ground as collecting surface is that water can be collected from a larger area. This is particularly advantageous in areas of low rainfall.
- **Stormwater drains :** Most of the residential colonies have proper network of stormwater drains. If maintained neatly, these offer a simple and cost effective means for harvesting rainwater.

Out of these roof top rainwater harvesting is most suitable in urban areas. In this method rain water collected from the roof of the building is diverted to a storage tank. The storage tank has to be designed according to the water requirements, rainfall and catchment availability. Each drainpipe should have mesh filter at mouth and first flush device followed by filtration system before connecting to the storage tank. It is advisable that each tank should have excess water over flow system.

Excess water could be diverted to recharge system. Water from storage tank can be used for secondary purposes such as washing and gardening etc. This is the most cost effective way of rainwater harvesting. The main advantage of collecting and using the rainwater during rainy season is not only to save water from conventional sources., but also to save energy incurred on transportation and distribution of water at the doorstep. This also conserves the groundwater, if it is being extracted to meet the demand when rains are on.

ROOFTOP RAIN WATER HARVESTING (RTRWH) :

It is a system of catching rainwater where it falls. In rooftop harvesting, the roof becomes the catchments, and the rainwater is collected from the roof of the house/building. It can either be stored in a tank or diverted to artificial recharge system. This method is less expensive and very effective and if implemented properly helps in augmenting the ground water level of the area.

COMPONENTS OF THE ROOFTOP RAINWATER HARVESTING SYSTEM :

The system mainly constitutes of following sub components :

- Catchment
- Transportation
- First flush
- Filter

Catchment

The surface that receives rainfall directly is the catchment of rainwater harvesting system. It may be terrace, courtyard, or paved or unpaved open ground. The terrace may be flat RCC/stone roof or sloping roof. Therefore the catchment is the area, which actually contributes rainwater to the harvesting system.

Transportation

Rainwater from rooftop should be carried through down take water pipes or drains to storage/harvesting system. Water pipes should be UV resistant (ISI HDPE/PVC pipes) of required capacity. Water from sloping roofs could be caught through gutters and down take pipe. At terraces, mouth of the each drain should have wire mesh to restrict floating material.

First Flush

First flush is a device used to flush off the water received in first shower. The first shower of rain needs to be flushed-off to avoid contaminating storable/rechargeable water by the probable contaminants of the atmosphere and the catchment roof. It will also help in cleaning of silt and other material deposited on roof during dry seasons Provisions of first rain separator should be made at outlet of each drainpipe.

Filter

There is always some skepticism regarding Roof Top Rainwater Harvesting since doubts are raised that rainwater may contaminate groundwater. There is remote possibility of this fear coming true if proper filter mechanism is not adopted. Secondly all care must be taken to see that underground sewer drains are not punctured and no leakage is taking place in close vicinity. Filters are used for treatment of water to effectively remove turbidity, colour and microorganisms. After first flushing of rainfall, water should pass through filters. There are different types of filters in practice, but basic function is to purify water.

BENEFITS OF RAINWATER HARVESTING

Rainwater harvesting in urban areas offers several benefits including provision of supplemental water, increasing the groundwater table via recharge, solving the problem of urban flooding and improving the quality of groundwater. In homes and buildings, collected rainwater can be used for irrigation, toilet flushing and laundry. The major benefits of rainwater harvesting are summarised below:

- rainwater is a relatively clean and free source of water.
- rainwater harvesting provides a source of water at the point where it is needed.
- it is owner-operated and managed with low running costs.
- it is socially acceptable and environmentally responsible.
- it promotes self-sufficiency and conserves water resources.
- it reduces stormwater runoff and thereby flooding.
- it uses simple, flexible technologies that are easy to maintain.
- provides safe water for human consumption after proper treatment.

DISADVANTAGES

The main disadvantages of rainwater harvesting technologies are limited supply and uncertainty of rainfall. The other disadvantages include low storage capacity especially in urban areas whereas, increasing the storage capacity will add to the construction and operating costs making the technology less economically feasible and possible contamination of the rainwater with animal wastes and organic matter which may result in health risks.

SUSTAINABILITY

Rainwater harvesting is one of the most promising alternatives for supplying water in face of increasing water scarcity and escalating demand. Rainwater harvesting presents an opportunity for the augmentation of water supplies allowing at the same time for self-reliance and sustainability and mitigating the problem of flooding in urban areas. Rainwater harvesting should be made compulsory for all urban housing projects by making proper amendment in law so that the burden on the groundwater source will be reduced and the expenditure on maintenance of roads and underground drainage will also be reduced. The urban areas where rainwater harvesting has been practiced have become self sufficient in their need of water.

REFERENCES

1. www.rainwaterharvesting.org
2. www.rainwaterconference.org/Rainwater harvesting an overview.
3. Reference Book-Ground water Surveys and Development Agency, Govt of Maharashtra, Pune, 41-42- 2005.
4. Central Ground Water Board, Ministry of Water Resources, Govt. of India.
5. Dr. R. K. Sivanappan : Nat. Seminar on Rainwater Harvesting and water Management, Nagpur, 1-5, Nov. 2006
6. M. Dinesh Kumar *et. al.* : *Land Use and Water Resources Research* **6**, 1-17, 2006.
7. R. K. Parghane, S. P. Kulkarni & A. W. Dhawale : Nat. Seminar of Rainwater Harvesting and water Management, Nagpur, 31-36, Nov. 2006.

ADDENDUM

The following name to be included in the **list of ISCA Awardees for 2012-2013** published in Everyman's Science Volume no. XLVII issue no 5 (Dec 2012–Jan 2013)

ASUTOSH MOOKERJEE MEMORIAL AWARD

Dr Venkataraman Ramakrishnan, NL

The omission is regretted

TELOMERASE REVERSES AGING

Sreemoyee Chatterjee and Shruti Agrawal

A new theory of aging that holds many promising possibilities for the field of anti-aging medicine is the telomerase theory of aging. Telomeres plays a central role in cell fate and aging by adjusting the cellular response to stress and growth stimulation on the basis of previous cell divisions and DNA damage. Telomerase helps to protect these telomeres and in turn posses a great hope as an anti-aging agent.

INTRODUCTION

A telomere is a region of repetitive DNA at the end of a chromosome, which protects the end of the chromosome from deterioration. Its name is derived from the Greek nouns *telos* "end" and *meros* "part". The telomere regions deter the degradation of genes near the ends of chromosomes by allowing for the shortening of chromosome ends, which necessarily occurs during chromosome replication.

During cell division, enzymes that duplicate DNA cannot continue their duplication all the way to the end of the chromosome. If cells divide without telomeres, they would lose the ends of their chromosomes and the necessary information they contain. The telomeres are disposable buffers blocking the ends of the chromosomes and are consumed during cell division and replenished by an enzyme, the telomerase reverse transcriptase[1].

Telomere shortening mechanism normally limits cells to a fixed number of divisions, and animal studies suggest that this is responsible for aging on the cellular level and sets a limit on lifespan. Telomeres protect a cell's chromosomes from fusing with each other or rearranging-abnormalities that can lead to cancer and so cells are destroyed when their telomeres are consumed. Most cancers are the result of "immortal" cells that have ways of evading this programmed destruction[2].

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TELOMERASE (A CELLULAR IMMORTALIZING ENZYME)

Telomeres are the repetitive DNA sequences at the ends of all human chromosomes. They contain thousands of repeats of the six-nucleotide sequence, TTAGGG. In humans there are 46 chromosomes and thus 92 telomeres (one at each end). Telomeres are required for chromosome end protection, shortening of which leads to cell death or senescence after many cell division, short telomeres limit tissue renewal. Telomere length may predict onset of certain age related diseases. Telomerase is essential for telomere maintenance.

In 1985 the enzyme was discovered by Carol W. Greider and Elizabeth Blackburn. In 1997 Greider collaborated with Ronald A. DePinho to produce a telomerase "Knockout Mouse", a mouse genetically modified to have the telomerase enzyme removed, causing short telomeres and premature aging. Nobel Prize for telomere research were awarded to Carol Greider and colleagues in Medicine for their discovery and work on telomerase, the enzyme that lengthens telomeres[3].

THE HAYFLICK LIMIT AND TELOMERE LENGTH

Prior to 1961 it was assumed that cells of vertebrates could divide indefinitely. It was Hayflick who demonstrated that a cell can only divide between 40 and 80 times before it would slow down and die. Hayflick speculated that cells had a "counting mechanism". It is now understood that the counting mechanism is telomere length. Peer reviewed publications have a theoretical limit on the human lifespan of 125 years and the limit on our lifespan and a reason for our decline in health is the gradual decrease in the length of the telomeres. Therefore, telomere length can be viewed as our biological clock ticking down to the eventual death of the cell[4].

UNIQUE FEATURES OF TELOMERASE

Telomerase has two components-Telomerase Reverse Transcriptase (TERT) protein and telomerase RNA. Internal RNA serves as template for reverse transcription by TERT. The gene for the telomerase catalytic subunit (the reverse transcriptase mimic) is approximately 4 kb in length. The catalytic subunit, named TP2, has a molecular weight of approximately 130 kDa. Shaped almost like a hand, its "fingers" and "thumb" pull the telomerase RNA and telomere DNA strands into the active site (the "palm"), where the telomere is elongated. The other major telomerase protein is the RNA-binding subunit, named TP1. The amino-terminus of TP1 is sufficient to bind telomerase RNA *in vivo*. Both TP1 and TP2 have similarities with telomerase-binding proteins of other species [5, 6].

ADVANTAGES OF TARGETING TELOMERASE

Telomerase-positive tumors : 80-90%, cancer stem cells are also telomerase-positive. No other tumor-associated gene is as widely expressed in cancers so tumors are less likely to develop resistance to telomerase-based therapies. Low or transient expression of telomerase in normal tissues leads to broad therapeutic window.

EVIDENCE IN SUPPORT FOR TELOMERE/ TELOMERASE THEORY OF AGING

Telomeres are shorter in most tissues from older individuals compared to younger individuals. Children born with progeria (early aging syndrome) have shortened telomeres compared to age-matched controls and telomeres in normal cells from young individuals progressively shorten when grown in cell culture. Experimental elongation of telomeres extends proliferative capacity of cultured cells. Many diseases seen in families with insufficient telomerase share features of age-related disease, Bone marrow failure, Immune senescence, Chemotherapy intolerance, Pulmonary fibrosis, Liver disease, Increased cancer incidence.

HOW DOES IT WORK

Telomerase works by adding back telomere DNA to the ends of chromosomes, thus compensating for the loss of telomeres that normally occurs as cells divide. Most normal cells do not have this enzyme and thus they lose telomeres with each division. In humans, telomerase is active in germ cells, *in vitro* immortalized cells, and the vast majority of cancer cells and possibly, in some stem cells. High telomerase activity exists in germ cells, stem cells, epidermal skin cells, follicular hair cells, and cancer cells. Research also shows that the counter that controls the wasting away of the telomere can be "turned on" and "turned off". The control button appears to be an enzyme called telomerase. Most cells of the body contain telomerase but it is in the "off" position so that the cell is mortal and eventually dies. Some cells are immortal because their telomerase is switched on like blood cells and cancer cells.

Many experiments have shown that there is a direct relationship between telomeres and aging, and that telomerase has the ability to prolong life and cell division. Scientists have successfully tested

Telomerase Reverse Transcriptase (TERT), one of the components of telomerase, in mice and have shown that it could restrain cancer. The test revealed that TERT could improve the fitness of epithelial barriers, particularly the skin and the intestine. It also produced a systemic delay in aging accompanied by extension of the median life span[7].

Although the gene for telomerase is present in all cells, human Telomerase Reverse Transcriptase (hTRT) is present only in immortal cells, where it serves to fuse the repeating sequences of DNA to the chromosomes, thereby lengthening the telomeres. On December 1st, 1997 issue of *Nature Genetics*, Geneon researchers offered the proof for the role of hTRT gene in cellular mortality.

TA-65

The main and first telomerase activator is a molecule called TA-65. TA-65 is derived from the Chinese herb *Astragalus*. One can not just take the herb, it has to be concentrated so much, for telomerase activation and so TA-65 is expensive. It appears to lengthen the shortest telomeres and protect the ends of the chromosomes from damage and allows them to divide beyond their normal limit. This is cutting edge as it not only stops the erosion of the chromosomes, it actually extends them. California Biotechnology Company, Geron Corporation has been studying this since 1990. They are part of a group that is responsible for the development of TA-65. Together with Sierra Sciences, TA Sciences, Physio Age and the Spanish National Cancer Research Center, TA 65 was developed[8].

SUMMARY

Telomeres are found at the ends of our chromosomes. The division of chromosomes enables cell growth and reproduction. Telomeres help regulate cell reproduction – they shorten as the cell ages. When telomeres become fully depleted it signals the end of life in a particular cell. The enzyme telomerase is responsible for producing telomeres in developing embryo cells. By the time a baby is born, telomerase activity reduces. Telomerase, in the adult body, is found only in germ (regenerative) cells, and in cancers. When body cells become cancerous, they are able to keep growing because they have reverted to an embryonic state. Cancer cells are called "immortal' because the telomeres do not deplete and cause the death of the cell in the way that normal cells age and die.

Medical science is now actively looking for a drug that will stop telomerase production in cancer cells and so kill cancer off. Progress is slow because man made drugs cannot differentiate between telomerase in cancer cells and the telomerase that occurs in the regenerative and immune cells of the adult body. Cells in our body can become critically damaged by inflammation, oxidative and mental stress. Use of illicit drugs, trying to eliminate excess prescription drugs, toxins in food and the environment are the major causes of stress to the body – together with anxiety, alcohol abuse and lack of exercise. Holistic methods now prove that telomere strands in the body can be maintained for longer, in healthy body cells, by giving up drugs of addiction, eating good food and taking regular exercise.

REFERENCES

1. SE Artandi, S Alson, MK Tietze, NE Sharpless, S Ye, RA Greenberg, DH Castrillon, JW Horner, SR Weiler, RD Carrasco, DePinho RA. *Proc Natl Acad Sci USA*, **99**, 8191–8196, 2002.
2. SE Artandi and RA DePinho. *Curr Opin Genet Dev*, **10**, 39–46, 2000.
3. CW Greider and EH Blackburn. *Cell*, **43**(2 Pt 1), 405-13, 1985.
4. L Hayflick and PS Moorhead. *Exp Cell Res*, **25**, 585–621, 1961.

5. L Harrington, T McPhail, V Mar, W Zhou, R Oulton, MB Bass, I Arruda, MO Robinson. *Science*, **275**, 973–977, 1997.
6. RC Allsopp, H Vaziri, C Patterson, S Goldstein, EV Younglai, AB Futcher, CW Greider, CB Harley. *Proc Natl Acad Sci USA*, **89** (21), 10114-10118, 1992.
7. C Autexier and NF Lue. *Annu Rev Biochem*, **75**, 493-517, 2006.
8. Cenegenics, Jacksonville, Medical Institute. Telomere Activation: The first scientifically proven way to extend your lifespan? Blog site powered by Interchanges.com, 4th May, 2011.

HEALTH AND NUTRITIONAL BENEFITS OF BEANS

Sheel Sharma, Nidhi Agarwal and Archana

Cultivated and used all over the world, beans are ancient food, low on production cost and high on nutritional value and health cost. Their carbohydrate content is 55-60% of energy value and includes starch, soluble sugar and dietary fibre. The protein and fat content range between 20-30% and 4-5% of energy value respectively. They act as important source of calcium, magnesium, iron, zinc, potassium and phosphorous. An expanding body of research suggests that consumption of beans promote good health, reduce risk and improves recovery/ management outcomes of several non communicable diseases.

INTRODUCTION

Bean is an ancient food, cultivated and widely used all over the world since time immemorial. They are also relatively inexpensive to produce, portable and have a long storage life. Their low cost and high nutritional value have contributed to their global populatiry. Beans have served as a staple food for more than 10,000 years in China, India, Middle East, America and other countries.

As a matter of fact, the common name—*bean*, has been given to large plant seeds of several genera of the family Fabaceae (Leguminosae) that are used on human food stuff. In many parts of the world, beans are mostly called pulses. A family of plants, distinguishable by their bearing pods and characterized by two classes : oilseeds (soybeans and peanuts) and grain legumes (edible dry beans-lima beans, cowpeas, fava beans and chickpeas, lentils and dry peas). Of the estimated 16,000 legume varieties, more than 100 are cultivated commonly world wide. The most popular dry bean in use in India and soybean, kidney bean, cowpea, chickpea and lentil.

Although many species and subspecies of legumes are known, only about a dozen of them are important as commercial food crops. Table 1 enlists are contribution of different legumes to the total world production along with the major producing countries. Beans and peas each account for about 25 percent of the total production of legume crops. Chickpea and broad beans rank next in importance. Some of the legumes, however, are of only regional or local importance.

Table 1. Common legumes and their scientific names

Common Name	Scientific Name
Peanut, ground-nut	*Arachis hypogaea*
Redgram, arhar.	*Cajanus cajan*
Pigeon pea, yellow dhal, congo pea	*Cajanus indicus*
Chickpea, Bengal gram, garbanzo	*Cicer arietinum*
Horse gram	*Dolichos biflorus*
Lentil, masur dhal	*Lens esculenta*
	Lens culinaris
	Ervum lens

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Common Name	Scientific Name
Broad bean, Windsor bean	*Faba vulgaris*
Soybean	*Glycine hispida*
	Glycine max
	Glycine soja
Lupin	*Lupinus SPP*
Velvet bean	*Mucuna pruriens*
Mung bean, green gram,	*Phaseolus aureus golden gram*
	Phaseolus radiatus
	Vigna radiate
Lima bean	*Phaseolus lunatus*
Black gram, urd, mungo bean	*Phaseolus mungo*
Kidney bean, navy bean, pinto bean,	
Haricot bean, snap bean	*Phaseolus vulgaris*
Pea	*Pisum sativum*
Winged bean	*Tetragonolobus purpureus*

The world production of pulses in 1997-98 was 56.9 million tones. India is the second largest producer of pulses in the world coming next only to china, with a production of 14.2 million tones. The yield of pulses recorded in countries like China, Yemen and Egypt has been 15.79, 12.40 and 30.22 respectively in quintals per hectares. There has to be a marked increase in the production of pulses in India either by increased area of cultivation or by a technological breakthrough resulting in increased yields per hectare, to meet the present requirement of more than 20 million tones.

COMPOSITION

The chemical composition of edible pulse seed depends upon the species. As for energy content, they supply the same amount as cereals i.e. 350 calories per 100 g dry weight.

Protein content of beans is generally between 20-30 percent of energy. A serving of beans provide 5-8 g of protein. In general, their protein content is high and commonly more than twice that of cereal grains, initially constituting about 20% of the dry weight of seeds. Legumes are better than cereals as source of essential amino acids like lysine, isoleusine, phenylalanine, threonine and valine. Pulse protein are chiefly globulin but albumins are also present in a few species. Their nutritional importance depends not only on the quantity of protein but also on its quality which in turn depends upon the amino acids composition. Lysine and threonine contents are low in ground nut. Overall, more satisfying pulse protein from the stand point of FAO provisional pattern is that of soybean i.e., 40%.

Legumes contain about 55-60% of total carbohydrate including starch, soluble sugar, fiber and non available carbohydrate. Some of the species like ground nuts and soybeans are rich in oil. Starch accounts for the major portion of carbohydrate in legumes. Most beans are very low in fat containing 5% of energy. The fat contains high amount of polyunsaturated fatty acid. Besides, oleic, stearic and palmitic acid are also present. The predominant fatty acid in bean is linolic acid, but n-3 fatty acids and α-linoleic acid are also present. However, because of overall fat content of most beans being low the dietary contribution of beans to α lionlic acid intake is generally minor. As noted, soybean is quite high in fat and the consumption of full fat soy food contributes significantly to α - linoleic acid intake[1]. Along with cereals, legumes meet the requirement of essential fatty acids.

Beans are important sources of calcium, magnesium, iron, zinc, potassium and phosphorous. About 80% of phosphorous is present as phytate phosphorous. The calcium content is between 100-200 mg percent and its bioavailability is about 20% which is lower than that from milk and green leafy vegetables, but is still reasonably good[2]. Calcium bioavailability from soybeans and soy foods is quite good and essentially equivalent to that from milk despite the fact that soybean is high is phytate

and oxalates[3]. Iron content of pulses is high, being 8-10 mg% (less in lentil and split pea). Iron absorption is two to four times higher when dhal is eaten instead of whole grain because the outer seed coat which constitutes about 15% of grain weight contains polysaccharides, tannins and roughage which interfere with iron absorption. In acute studies, addition of vitamin C to foods markedly increased non haem iron absorption[4]. But in long term studies, the effect of vitamin C intake on iron absorption and status have been reported[5]. Availability of zinc for absorption of soybeans depends on the phytate content as removal of phytate increases zinc absorption. In contrast to iron, zinc from legumes has relatively good standing at 25% bioavailability[6]. Beans are excellent source of folate which is an essential nutrient, thought to reduce the risk of foetal neural tube defects in expectant mothers[7]. One serving of beans provide more than half of the current RDA for folate.

Legume seeds and excellent source of B complex vitamins particularly folic and panthothenic acid and they contain small amount of β carotene or provitamin A. Many pulses contain 50-300 International Units of vitamin A/100 g. Fresh pulses like peas may have vitamin A activity considerably in excess of this figure. The carotene content increases appreciably on the third day after germination when the shoots change from yellow to green probably with an increase in the chlorophyll content. Pulses are also fairly rich in niacin (About 2 mg/100g) and thiamin. They are poor in riboflavin and dry legumes are almost devoid of ascorbic acid. The vitamin C content of pulses can be greatly increased by soaking them in water and allowing them to germinate.

Beans are excellent sources of dietary fiber. One serving provides 2-4 g of a mix of the soluble and insoluble fiber[8].

INCREDIBLE HEALTH BENEFITS

In industrialized societies as well as in developing countries, the prevalence of diabetes, obesity and cardiovascular diseases is increasing rapidly especially in young individuals. Nutrition is contemplated to play a decisive role in the increasing burden of these chronic conditions. Nutritional factors might also potentially exert causative impact in the prevention and treatment of the chronic diseases. Consumption of pulses as component of healthy diets is encouraged because it is believed that this is likely to be helpful in reducing the non communicable diseases including cancers. An expanding body of research suggests that beans promote good health and reduce risk for, or improve recovery outcomes of, several diseases as summed up below :

Management of Diabetes

Beans may reduce the rise in blood glucose level as they contain resistant starch which limits the sharp spikes in glucose level that normally follow consumption of food high in easily digestible starches (sugar, fruit, juice, white bread, potato and pastries) even when the source of resistant starch consumed many hours before. Beans based low glycaemic index foods have been shown to reduce fasting and post prandial glucose, triacylglycerol and non esterified fatty acid concentration. In addition, these diets increase HDL cholesterol and decrease total and LDL cholesterol. Glycaemic response to five kinds of beans were tested and compared with glycaemic response to bread and although glycaemic responses to different beans varied significantly, they all were lower than that to bread.

Reducing Cancer Risk

Pulses contain in wide range of nutrients and non nutrient bioactive micronutrient constituents that may prove protective aganist cancer when consumed in sufficient quantity. Pulses are useful sources of a number of micronutrients even some

microminerals (Selenium and Zinc) and non nutritive bioactive substances (phytate) which may improve antioxidant defence.

Table 2. Examples of potential protective components against cancer provided by pulses

Nutrients	Bioactive Micro Constituents
Resistant starch	Protease inhibitors
Non-starch polysaccharides	Saponins
Oilgosaccharides	Phytosterols
Folates	Lectins
Selenium	Phytates

Pulses are rich in starch and because of the way it is packed in starch granules its relatively high content of amylose is slowly digested in the small bowel, so that substantial quantity flow to the large bowel as Resistant Starch (RS). There is strong negative correlation between the intake of starch and risk of Colorectal Cancer (CRC) and it has been hypothesized that it is the resistant starch fraction which contains protection. The non starch polysaccharide and oligosaccharide fractions of pulses also provide substrate for the large bowel microflora and there is ample evidence that the resistant starch, non starch polysaccharide and oligosaccharides in peas and beans are extensively fermented within that organ. Saponins, a class of phytonutrient found beans, may cause a reduced risk of lung and blood cancer[9]. Beans are also abundant source of inositol, specifically inositol hexa phosphate, an antioxidant compound that can help in preventing cancer and controlling the abdominal growth[10]. Hyperinsulinemia also may be a factor in reducing cancer risk. Consuming a diet that consists of a low glycaemic food load such as beans are associated with reduced risk of colorectal cancer[11]. People with the highest intake of legumes such as beans, were significantly less likely to have prostrate cancer. High intake of legumes including beans is associated with significantly lower risk of pancreatic cancer among overweight and obese subjects.

Reducing Cardiovascular Disease Risk

Coronary heart disease is a single larger killer of men and women. In addition, coronary heart disease is one of the leading causes of premature and permanent disability. Many constituents of legumes contribute to the potential protective effect on cardiovascular disease. Legumes including beans, may protect against cardiovascular disease through various mechanisms[12]. The cholesterol lowering effect has been known for over 50 years. Saponin, a non nutritive bioactive substance, binds to primary bile acids in the gut and form micelles. These micelles are too large to pass through the intestinal wall, thus leading to reduce the absorption of bile acids, diversifying them to excretion through faecal route. As a consequence, an increased synthesis in primary bile acid in the liver from the endogenous cholesterol pool is initiated leading to a decrease in plasma cholesterol level. Phytosterol probably also retard cholesterol absorption by driving cholestrol out of the micelles that normally help to absorb the cholesterol from the gut. The nutrient in bean e.g. fibre, folate, copper, magnesium suggest inverse association with CVD. The folate, copper, magnesium suggest inverse association with CVD. The soluble fibre of beans (about 6-9 g per half cup cooked bean) helps in lowering blood cholesterol by binding bile acid and preventing cholesterol reabsorption[13].

Copper, a trace element highly available in beans, may help to reduce the risk of cardiovascular disease by lowering blood pressure and cholesterol levels. Folate too may help to reduce the risk of cardiovascular disease and stroke. The persons who consumed the most folate (average intake, 405 µg/d) exhibited 21 percent lower risk of stroke and 14% lower risk of cardiovascular disease than did individuals who consumed the least folate (99 µg/d average intake). Diet that replaces some refined carbohydrate with protein sources low in saturated fat, such as beans, may help to reduce the

cardiovascular disease risk and mortality[14]. People who ate legumes, including beans, at least four times a week over a long period showed a 22% lower risk of coronary heart disease as compared with those who ate beans less than a week.

Overweight and Obesity Management

Legumes contain resistant starch which increases fat burning in the body. People who enjoyed a meal in which only 5.4 % of its starch was the resistant kind, the rate at which their bodies burned (oxidized) body fat increased by 23 % for a full day. However, by adding more resistant starch did not increase the rate of fat burning or its duration. It seems that a little goes a long way. Persons who regularly consumed beans had a 22% lower risk of obesity when compared with non bean eaters[15].

Various types of carbohydrate found in beans are likely contributors to healthier weight status. Eating foods with a high glycaemic index or load may stimulate appetite sooner after a meal than those eating low glycaemic load foods, such as beans.

Beans also function by slowing digestion, prolonging the feeling of fullness and reducing hunger, in part because of their effect on hormonal response to a meal.

Beans contain significant amounts of protein and protein may provide more satiety than fat. People consuming higher protein diets reported less hunger on reduced caloric diets. Bean consumers had higher intake of dietary fibre, potassium, magnesium, iron and copper. Those consuming beans had a lower body weight and smaller waist size relative to non consumers. Additionally, consumers of beans had a 23% reduced risk of increased waist size and 22% reduced risk of being obese[16].

Flatulence

Beans cause significant gas and bloating. However, the same bean components that cause gas, oligosaccharides and fiber, also are responsible for some health promoting properties, including stimulating healthy gut flora. There have been reports of new insight into human beings' ability that is to adapt bean consumption with reduced flatulence occurring overtime[17]. People return to "normal" after the second to fourth week of regular bean consumption who complained an initial increase in flatulence.

Other Health Conditions

Bean may also help to alleviate other health disorders. The intake of legumes including beans was linked to lowering risk of benign prostatic hyperplasia (non cancerous enlargement of the prostrate gland)[18]. Beans provide significant quantity of protein, energy and act as a resource of vitamin and mineral including iron. The common bean is an attractive candidate for biofortfication, because there is a genetic variability of iron concentration and therefore it is possible to breed for significant increases in iron concentration in beans. Also iron concentration in beans is high relative to other crops and, therefore, beans can deliver substantial amount of iron.

Baked bean consumption was associated with a lower systolic blood pressure . Additional research is underway to study the efficacy of a bean based food to improve growth and development and to slow the progression of AIDS in a group of HIV positive children. Nutritional intervention with a bean micronutrient fortified sorghum porridge improved growth and development when compared with a sorghum only porridge (a familiar food in the region) that was micronutrient fortified but contained no bean ingredient. The protein quality of the bean protein enriched product was equal to that of a similar soy based product used in similar nutrition-intervention relief work. Preliminary data has revealed that nutritional intervention reduced the prevalence of growth stunting by half and the prevalence of underweight by 22 percent.

Recently "soy protein and diabetic kidney disease hypothesis" suggests that substituting soy protein for animal protein will protect against development of kidney disease in diabetic individual and be effective in reversing or slowing the progression of established kidney disease in diabetic individuals. Protein from dry bean may also have similar renal protective effect.

Soy isoflavones affect positively on bone mineral density as preliminary human studies also support the potential role of soy isoflavones in increasing bone mineral density in postmenopausal women.

The reduction in estrogen production in middle aged women results in symptoms commonly associated with menopause. Several preliminary studies of the effect of soya isoflavones administration on menopausal symptoms suggest the benefit.

PROCESSING

Legumes, especially the beans are considered important protein and dietary fiber sources in human nutrition. Further, beans contain a considerable amount of vitamins and minerals. However, their wide acceptability is adversely affected by the presence of α-galactosides, phytic acid, tannins and other antinutritional substances. Since free radicals are implicated in the causation of chronic and degenerative diseases, phytate and phenolic compounds, being quenchers of free radicals, can have a role in the prevention of such diseases. However, they also act as some kind of antagonist in the absorption of iron, calcium, magnesium and zinc, a fact that can induce their deficiency, especially of iron, calcium and zinc. Thus a cautious approach aiming at the removal of a high level of these phytochemicals through simple processing methods like hot water blanching, soaking, germination etc. seems practical.

Traditional treatments such as soaking, normal and pressure cooking and autoclaving have been used to improve nutritional quality of legumes or dry beans. It has been shown that antinutritional factors are removed considerably by utilizing these simple and inexpensive processes.

SOAKING

Soaking reduces antinutritional factors particularly oligosaccharides and raffinose family. Many pulses, particularly whole gram which had outer covering, need soaking prior to cooking. During soaking, water enters through the helium or scar where the bean is attached to pod. From there, it sieves into the bean and causes the seed coat to wrinkle. The wrinkles are eliminated when the bean swells and fills the seed coat. Pulses are generally soaked in cold water overnight or in warm water (60-70°C) for 4-5 hours. Soaking makes the pulses tender and hastens the processing. It also reduces the phytic acid. Hard water makes the outer surface of the bean more resistant to water penetration during cooking. A two minute boiling period prior to soaking beans inactivates enzymes and avoids possible souring during and overnight soaking in cold water.

Other quick processing alternative is to boil the beans for two minutes, and soak them in hot water for an hour and then simmer until done. Addition of soda to water reduces the cooking time significantly by about one third. This saving in cooking time is priced for the amount of thiamine lost as a result of the alkaline environment.

When legumes are in contact with water, hot or cold, some leaching of water soluble nutrients from the legumes into the water will occur. This process is greatly enhanced in the presence of broken seeds or split seed coats. Water used for soaking can be used in cooking to minimize these losses. Soaking allows the enzyme, *lactobacilli* and other healthful organisms to break down and neutralize a large portion of phytic acid in grain.

Table 3. Main non-nutrient bioactive substances present in legumes and processes commonly used for their reduction or elimination

Bioactive Substance	Commonly Used Elimination Processes
Enzyme inhibitors	Heat treatment, Fermentation
Lectins	Heat treatment
Phytic acid	Enzymatic degradation (exogenous/endogenous phytase), germination, fermentation)
Oxalate	Cooking, dehulling
Phenolic compounds	Dehulling
Saponins (soya)	Sprouting

GERMINATION

It is a process that involves the soaking of pulses overnight. Whole grams are soaked overnight and water is drained away, the seeds tied in a loosely woven cotton cloth and hung. Water is sprinkled twice or thrice a day. In a day or two, germination takes place. Moisture and warmth are essential for germination. Green gram can be germinated in a short time. In summer, germination process is faster than that in winter. Bengal gram, dry bean and dry pea can also be germinated. It is a simple measure used for processing of pulses in water for 2-3 days and it improves their nutritive value and vitamin A and C contents. Germination increases the content of folic acid and other vitamins of the B group by a factor of 2 or 3.

Germination also brings about the change in carbohydrate of the pulses. Some of the starch being converted into sugar. During sprouting dormant enzymes get activated and digestibility of nutrient is improved. Ratio of essential to non essential amino acid changes providing more of essential amino acid. Sprouting reduces trypsin inhibiting factor due to the release of enzymes. Similarly, tannin and phytate, which adversely affect bioavailability are broken down by germination. The action of cytases and pectinases are released during sprouting and cell wall is broken down and availability of nutrients increases. During sprouting, minerals like calcium, zinc and iron are released from bond form.

Germination metabolizes oligosaccharides and hence germinated legumes don't produce gas or flatulence. Germination decreases cooking time, mucus inducing properties of legumes and thickening power of starch and it adds variety to the diet and improves taste and texture.

FERMENTATION

The processing of food pulses by fermentation increases their digestibility, palatability and nutritive value. Additionally toxic substances of pulses can be eliminated by fermentation. Fermentation of dhal to produce *idli*, *dosa* and *dhokla* improves the availability of essential amino acids and enhances its vitamins of B group and decreases the level of phytate and trypsin inhibitor.

MILLING

Dry pulses seed have fibrous seed coat husk or skin which often is indigestible and may have a bitter taste. In such cases, the skin has to be removed. Legumes are generally milled to remove the outer husk by wet or dry processes. Germ is removed usually during dehusking and this may result in some loss of thiamine. Dhal may not be nutritionally as good as the whole seed but its keeping quality, cooking time and digestibility will be better.

A number of methods are available for decertification. A simple methods is to soak the seed for a short time in water, the husk takes up more water than the seeds and may be easily separated by rubbing, while still moist. Alternatively, the soaked grain may be dried and the husk removed by pounding and winnowing. Roasting also renders the husk easier to separate.

The most beneficial effects of dehulling are cooking time in terms of removing the impermeable

seed coat of pulses which hinders water uptake during cooking. The polyphenol also called tannin, which is considered to be the potential antinutritional factor are mostly present in the seed coat. In case of pulses, seed coat accounts for 80-90% of the total polyphenols[19, 20], which are significantly reduced during dehulling. Removal of hull facilitates reduction of fiber and tannin content and cause improvement in the appearance and texture of the grains.

Dehulling improves the protein quality e.g. in pulses example the true protein digestibility and net protein utilization of dhal components were significantly higher than those of whole seeds of pigeon pea, including the beneficial effects of removal of seed coat[19].

COOKING

It destroys the enzyme inhibitors and improves the nutritional quality of food pulses. Cooking also improves the palatability. However, pulses should not be overcooked as this reduces the quality of protein. Longer cooking causes a drop in the nutritive value of pulses as it results in the loss of vitamin and consequent loss of nutritional value. Pulses contain an indigestible factor (trypsin inhibitor) which is destroyed by cooking. Hence unless properly cooked, dhal is not easily digested and incompletely absorbed. Green gram is better digested than other pulses not only due to smaller size (because of increased surface area for better action by the intestinal enzymes) but also due to a lower level of protease inhibitors (trypsin and chymotrypsin inhibitor). That is why it is in our tradition that during ailments like fever, dyspepsia and other gastro-intestinal conditions, easily digestible *green gram khichdi* (green gram porridge) is given as a kind of grand mother's prescription[21].

Thus one finds that grain legumes have a nutritional silver lining in being food stuffs low in fat and rich in proteins, vitamins, minerals and phytochemicals.In addition, their carbohydrates are slow releasing owing to the presence of soluble dietary fibers. Besides, their potential as hypocholesterolemic agents is also more or less established. Presence of phytochemicals, most prominently of polyphenols, make them posses both anticarcinogenic and antioxidant properties.

Antioxidant acts of phytochemicals are inherent in their capacity to scavenge free radicals and other reactive oxygen species which inhibit oxidative processes that lead to degenerative diseases. However, a major aberration in grain legumes is that almost all of them are deficient in sulfur containing essential amino acid methionine. Likewise, the difficult fact is a number of antinutritional factors being present in each type in different combinations and in proportions.

But all in all, the secret of prudent life, as some one have said very wisely, lies in turning and transforming the stumbling blocks into stepping stones. Much in the same way, secret of fruit full legume nutrition could rest on their supplementation with cereal and other food stuff containing some amount of complete protein as also in subjecting beans to simple household adaptive appropriate processing regimen. With the virtues of vegetarianism coming up, it will not be a far cry to ensure adequate protein and micronutrients nutrition to the masses by harnessing the full potential of legume nutrition on one hand, and healthy cholesterol levels and low incidence of cardiovascular and other diseases on the other.

REFERENCES

1. M. J. Messina, *Am J Clin Nutr,* **70**, 4, 39S-50S, 1999.
2. C. M. Weaver, R. P. Heaney, W.R. Proulz, S.M. Hinders and P. T. Packard, *JFoodSci*, **58**, 1401-1403, 1993.
3. C. M. Weaver, K. L. Plawecki, *Am J Clin Nut,* **59**, 12385-41 S, 1994.

4. E. R. Mosen, L. Hallbarg and M. Layrisse, *Am J Clin Nutr,* **40**, 42-47, 1984.

5. J. R. Hunt, S.K. Gallagher and L.K. Johnson, *Am J Clin Nutr,* **59,** 1381-1385, 1994.

6. B. Sandstorm, A. Almgren, B. Kivisto and A. Cederblad, *J Nutr,* **119**, 48-53, 1989.

7. L. E. Daly, P. N. Kirke , A. Molloy, D. J. Weir and J.M. Scott, *JAMA,* **274**, 1698-1702, 1995.

8. J. A. Marlett, *JAm Diet Assoc,* **92**,175-186, 1992.

9. www.sprouts-as-medicine.com

10. I. Vucenik, A. M. Smamsuddin, *Nutr Cancer,* **55**, 109-125, 2006.

11. S. Higginbothom, Z. F. Zhana and I. M. Lee, *JNatl Cancer Inst,* **96**, 229-233, 2005.

12. J. Anderson, A. Major, *Br J Nutr,* **88**, S263-S271, 2002.

13. www.mahalo.com/fibre-supplements

14. D. Winham, A. Hutchins, *Nutr Res,* **27**, 382-386, 2007.

15. Y. Papanikolaou, S. Fulgoni, V. Gulgoni R. Kelli and S. Rose, *FASEB J,* **20**, A575, 2006.

16. Y. Pappanikollaou, V. L. Fulgoni, *J Am College Nutr,* **27**, 5, 569-576, 2008.

17. D. Winham, T. Reeves, A. Hutchins Finley, *FASEB J,* **21**, A1077, 2007.

18. S. Rohrmann, E. Giobannucci, W. Willdl and E. Platz, *Am JClin Nutr,* **85**, 523-529, 2007.

19. U. Singh, *Plant Food Human Nutrition,* **43**, 171-179, 1993.

20. P. V. Rao, Y. G. Deosthale, *JSci FoodAgri,* **33**, 1013-1016, 1982.

21. K. Aparna, *JFoodSci Technol*, **37**, 2, 169-173, 2000.

LEARNING STYLES AND ITS CLASSROOM APPLICATION

Kaberi Saha

Learning Style is a pattern of behaviour that human use for new learning. Every person is unique in their styles of learning. Teacher need to know and adopt different teaching styles as one style does not fit for every pupil. Educators need to focus their instruction based on individual differences in learning styles. For decades, education researchers designed models that differentiates how people learn. Yet the results are often harder to understand than the people describe. The proponents say that teacher should asses the learning styles of their students and adapt their classroom method to best fit each students learning style to make teaching learning process effective. This paper discusses about the different learning styles and its importance for teaching learning process.

INTRODUCTION

We know that students learn in variety of ways like by seeing and hearing, working alone and in groups, reasoning logically and intuitively and sometimes by memorizing or visualizing. Teacher's also teaches in variety of ways. Some instruct, some give lectures, some demonstrate or discuss some focus on principles, and some focus on application. But how a student learns in a class depends on many things. Among the other things, the most important thing (the student learns) is based on the compatibility between their learning style preferences and the teacher's teaching styles.

LEARNING STYLES, WHAT IT IS ?

Learning Styles defined the ways how people learn & how they approach information. It is interesting to note that sometimes we feel like we can't learn something important even if we use the same method, which has been suggested by our parent, colleague or teacher. But we may learn and process information in our own special way, though we all share some learning patterns, preferences or approaches. Thus we may have different learning styles than other persons. Knowing our own learning styles can help us to realize that other people may approach the same situation in a way that's different from our own. Learning styles thus are various approaches or ways of learning on which the Education Researcher are working from the decades. Learning Styles involve educating method particular to an individual that are presumed to allow that individual to learn best. The idea of individualized "learning styles" originated in the 1970s and acquired enormous popularity. Proponents say that teachers should asses the learning styles of their students and adapt their classroom methods to best fit each student's learning styles which is called the "meshing hypothesis" Meshing hypothesis means, a student learns better if taught in a method deemed appropriate for him. Though there are lot of controversies regarding this "meshing hypothesis", however, this does not mean that individuals do not have learning styles or preferences or it does not have impact on teaching learning process.

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MODELS OF LEARNING STYLES

Researcher's has developed different Models of learning styles. Some of them are :

1. David Kolb's Model .
2. Honey and Mum Ford's Model.
3. Anthony Gregorc's Model.
4. Sudbury model of democratic education.
5. Fleming's VAK/VARK model (neuro-linguistic programming, visual, auditory and kinesthetic learners).
6. Chris. J. Jackson's 2007,(neuropsychological hybrid model of learning in personality).
7. R. M. Felder and R. Bronte's model.

SOME COMMON FACTS IN TEACHING LEARNING PROCESS

We always assumed that what students learn is always less than what we teach. However, how much they learn is depended upon different factors like their (i) native ability, (ii) background in their course topic (iii) match by their learning style (iv) teaching style as well on the basis of their "Perceptual Modality" According to Howard Gardner, every individual has seven Perceptual modalities which is popularly known as (Multiple Intelligence) which are important to describe how one learn. The basic multiple intelligence are 1. Verbal-linguistic (sensitive to the meaning and order of words) 2. Musical (sensitive to pitch, melody rhythm and tone.) 3. Logical-mathematical-(able to handle chains of reasoning and recognizes patterns and order) 4. Spatial (Perceive the world accurately and try to re-create or transform aspects of that world.) 5. Bodily- Kinesthetic : able to use the body skillfully and handle object 6. Interpersonal (understand people and relationship) 7. Intrapersonal (possess access to one's emotional life as a mean's to understand oneself and other). It is to be noted that we can't do much of their ability background or learning style but we can do something with our teaching styles in the teaching learning process.

HOW STUDENT LEARN AND HOW TEACHER TEACH ?

Research studies revealed that there are basically two types of learners, Sensing Learners & Intuitive Learners. Sensing learners are those who focus on external input (see, hear, taste, touch and smell). They are practical, observant, (notice details of environment). They like to do concrete thinking, learn through repetition (drills replication of experiences). They are very much methodical, like working with details. They have no apparent connection with real world and have problems with exams and run out of time. On the other hand, the Intuitive learners like to focus on internal output (thoughts, memories, images). They are imaginative and look for details. They also love abstract thinking. They are quick, like working with concepts, always complain about courses, and do lot of silly mistakes.

Researcher also found that on the basis of Input Modality there are again two types of learners i.e., Visual & Verbal Learners. Visual learners demands to see what is taught i.e. they like pictures, diagram sketches flow charts graphs etc. whereas Verbal Learners demand to explain the spoken words, to explain the written words to explain the symbols etc.

On the basis of Processing there are two types of learner i.e., Active (A) & Reflective (R) Learners. Active Learner tends to process actively and they try out first and see how it goes. On the other hand, the Reflective Learners tend to process reflectively, thinking about presented material, then doing something about it. They work introspectively !

On the basis of Understanding, there are two types of Learners i.e., Sequential & Global Learners. Sequential (Sq) Learners build understanding in logical-sequential steps, function with practical understanding of information make steady progress,

explain easily and good at analytical thinking. On the other hand, Global Learners absorb information randomly then synthesize the big picture, can't explain easily and synthesis holistic thinking.

IMPLICATION OF LEARNING STYLES IN THE CLASSROOM TEACHING : HOW MISMATCH OCCURS

Everybody is both sensor and intuitor but everyone has a preference that may be mild, moderate or strong. Research studies revealed that most undergraduate are sensors. On the other hand, most teachers working in college are intuitors. As a result there is a mismatch between the teaching style and learning styles. Again it was observed that, visual and verbal information is processed differently by the brain. A student will learn more if the information is presented by the teacher in their preferred modality.

Most people are visual learners while 90-95% of most course content is verbal. Thus, there is a mismatch between the teaching and learning styles. Again it is observed that all classes have both active and reflective learners. Most classes (except labs) wants to hear passively, whereas the active learners do not get to act on the material presented and the reflective learners do not do much reflecting during the lectures.

CONSEQUENCES OF LEARNING AND TEACHING STYLE MISMATCH

When the mismatch between the teaching and learning styles occurs many students can't get what's being thought. As a result they become—

- Bored, inattentive or disruptive in class,
- Do poorly on tests,
- Get discouraged about the course, curriculum and about themselves, on the other hand, Teacher/Professor observe,
- Low test scores, unresponsive or holistic classes, poor attendance, dropouts,
- Teacher may themselves get defensive or hostile (making things even worst),
- They may question whether they are in right profession or not ?

WHAT TEACHER SHOULD DO IN THE CLASSROOM SITUATION ?

Every teacher should have to know that in a classroom situation student may possess different types of learning styles. Most teaching are abstract (intuitive) verbal and sequential, and most classroom are passive. Hence the teacher needs to address all teaching styles. They have to make a balance. The teacher has to note that if the students are taught only in their less preferred modes, they will be uncomfortable to learn effectively and will not gain skills in either mode. Again if they will be taught only in their preferred mode they will gain skills in those modes but will not develop equally important skills in their less preferred modes. The teacher should try to balance concrete information (facts, data, observation) in sensing and abstract information (principles, theories, models) i.e. intuitive in all courses. The teacher has to make use of pictures, schematics, graphs and simple sketches before, during and after presenting material (sensing, visual). They have also to give students time to think about what they have been told (reflective). Sometimes we have to give small group exercises in the class (active learning). The teacher can also assign some drill exercises in home work (Sensing activity).

For the students having high intelligence, the teacher can also assign some open ended problems and exercises that call creative thinking and critical judgment (all styles), can also tell the students about the learning styles or let them assess their own style. The teacher can also cooperate students in doing their homework (cooperative learning), which is the combination of all styles.

REFERENCES

1. David H. Jonassen & Barbara L. Grabowski , Handbook of Individual differences, Learning and Instruction, Lawrence Erlbaum Associates, Publishers, 1993, Hillsdate, New Jersy, Hove & London.
2. Rita Dunn, *Survey on Research on Learning Styles Educational Leadership*, **46** (6), 50-58, 1989.
3. H. Gardner, Frames of Mind : The Theory of Multiple Intelligences, Basics Books, New York, 1998.
4. Ronald R. Sims and Serbrenia J. Sims, The importance of learning Styles, Greenwood Press, Westport, Connecticut, London.
5. Susan Bentham, Psychology and Education, Routledge, Newwork Publication, 2002.

DIOXINS ; A THREAT TO HUMAN WORLD

S.Parthiban, M. Ranjithkumar*, V.Kumar and K.Ravikumar

Dioxins are highly toxic and ubiquitous compounds that are unintentional by-products of several chemical processes on earth. One of the biggest threats to public health is posed by dioxin. Dioxin is the most toxic chemical known to man; its potency is second only to radioactive waste. The present review focuses on dioxins chemical nature, mode of action, TEF values, sources, human exposure, health risks and prevention.

INTRODUCTION

One of the biggest threats to public health is posed by a chemical known as Dioxin. Dioxin is the most toxic chemicals known to man; its potency is second only to radioactive waste. Dioxin is formed as an accidental by-product during the manufacturing, and incineration process of Chlorine based products. Once released into the environment, its contamination becomes very wide spread. Small traces of this substance can in fact be found in the clothing you wear, in the food you eat, and in the toys that your children play with. Dioxin is very long lasting, and has the ability to accumulate in living tissues. It is present in your body from the moment that you are born, to the moment you die. There is no safe level of Dioxin that a person can be exposed to, the smallest amounts have been proven to significantly increase the chances of developing cancer, as well as various health defects like birth defects, hormone disruption, diabetes, learning disorders, behavioural problems, reproductive difficulties, cardiovascular disease, and problems of the immune, nervous and gastrointestinal systems[1].

CHEMICAL NATURE OF DIOXINS

Dioxins are a class of structurally and chemically related polyhalogenated aromatic hydrocarbons that mainly includes polychlorinated dibenzo-*p*-dioxins (PCDDs or dioxins), dibenzofurans (PCDFs or furans) and the 'dioxin-like' biphenyls (PCBs). They constitute a group of persistent environmental chemicals and usually occur as a mixture of congeners. Their Presence in the incinerator fly ash samples was firstly reported by Dutch and Swiss scientists in the year 1977 and 1978, respectively. Only 7 of the 75 possible PCDD congeners, and 10 of the 135 possible PCDF congeners, those with chlorine substitution in the 2,3,7,8 positions, have dioxin-like toxicity[2, 3]. Likewise, there are 209 possible PCB congeners, only 12 of which have dioxin-like toxicity. Most toxic dioxin is 2, 3, 7, 8-tetrachlorodibenzo-*p*-dioxin (TCDD).

MODE OF ACTION

The general population exposure to dioxin chemicals occurs as an exposure to a mixture of different congeners. The effects were mediated through an interaction with the aryl hydrocarbon receptor (AhR). Dioxins induce a broad spectrum of biological responses, including induction of gene expression for cytochrome P450, CYP1A1, and CYP1A2, disruption of normal hormone signalling pathways, reproductive and developmental defects. Briefly, it indicates that the inappropriate modulation of gene expression represents the initial steps in a

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series of biochemical, cellular and tissue changes that result in the toxicity observed[4, 5]. The variation in the toxicity amount of dioxins and furans and the effect at the AhR is 10,000 fold, with TCDD being the most potent.

TEF VALUES

All dioxin-like compounds share a common mechanism of action via the aryl hydrocarbon receptor (AhR), but their potencies are very different. This means that similar effects are caused by all of them, but much larger doses of some of them are needed than of TCDD. Each congener has been given a toxicity equivalence factor (TEF). This indicates its relative toxicity as compared with TCDD. The most toxic dioxin 2, 3, 7, 8-tetrachlorodibenzo-*p*-dioxin (TCDD) as per definition has a TEF of one[6].

WHO Toxic Equivalence Factors (WHO-TEF) for the dioxin-like congeners of concern

Example

Polychlorinated dioxins	TEF
2, 3, 7, 8 - TCDD	1
1, 2, 3, 7, 8 - PeCDD	1
1, 2, 3, 4, 7, 8 - HxCDD	0.1
1, 2, 3, 6, 7, 8 - HxCDD	0.1
1, 2, 3, 7, 8, 9 - HxCDD	0.1
1, 2, 3, 4, 6, 7, 8 - HpCDD	0.01

SOURCES OF DIOXINS

Dioxins are mainly by-products of industrial processes but can also result from natural processes, such as volcanic eruptions and forest fires. Dioxins are unwanted by-products of a wide range of manufacturing processes including smelting, chlorine bleaching of paper pulp and the manufacturing of some herbicides and pesticides. In terms of dioxin release into the environment, uncontrolled waste incinerators (solid waste and hospital waste) are often the worst culprits, due to incomplete burning[7].

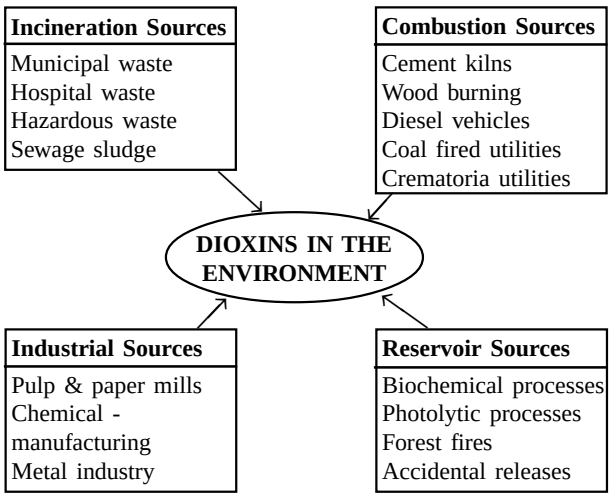

Fig 1. Sources of Dioxins

EXPOSURE OF HUMAN BEINGS TO DIOXINS

Although dioxins are emitted into the air and find their way to our waters, very few people are exposed to dioxins via air or water. More than 90% of human exposure is through food, mainly meat and dairy products, fish and shellfish. Air emissions of dioxin settle out on grasses eaten by farm animals or in sediments that are eaten by fish. The dioxin builds up in fatty tissues and is passed on to humans. Beef, pork, fish, shellfish, dairy products, and human milk are the major sources of human exposure. Burn barrels, usually located close to the ground, tend to localize the dispersion of dioxin emissions, putting people who eat locally produced food at greater risk for dioxin exposure. Dioxins can cross the placenta, exposing children prenatally. In addition, newborns can be exposed through breast milk[8].

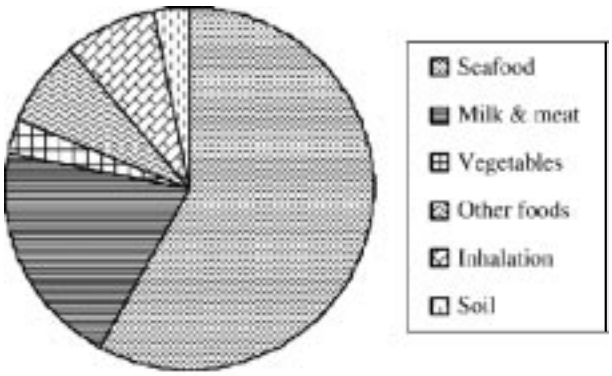

Fig 2. Exposure of human beings to dioxins[9]

EFFECTS OF DIOXINS ON HUMAN HEALTH

The developing foetus is most sensitive to dioxin exposure. The newborn, with rapidly developing organ systems, may also be more vulnerable to certain effects. Some individuals or groups of individuals may be exposed to higher levels of dioxins because of their diets (e.g., high consumers of fish in certain parts of the world) or their occupations (e.g., workers in the pulp and paper industry, in incineration plants and at hazardous waste sites). Short-term exposure of humans to high levels of dioxins may result in skin lesions, such as chloracne and patchy darkening of the skin, and altered liver function[10]. Long-term exposure is linked to impairment of the immune system, the developing nervous system, the endocrine system and reproductive functions[11]. Chronic exposure of animals to dioxins has resulted in several types of cancer. TCDD was evaluated by the WHO's International Agency for Research on Cancer (IARC) in 1997. Based on animal data and on human epidemiology data, TCDD was classified by IARC as a "known human carcinogen"[9]. Other effects like behavioral problems, diabetes, cardiovascular disease, were also evident.

PREVENTION AND CONTROL OF DIOXIN EXPOSURE

The first and most important step is to create public awareness. There are many methods that can be used to reduce the emissions of Dioxin. Provide local alternatives to backyard trash burning and burn barrels. Where garbage collection services do not exist, municipalities should provide incentives for recycling and composting to eliminate the need for backyard trash burning. Ban all backyards burning or, at a minimum, enforce the law on burning plastic household waste and provide more alternatives to burning, especially in rural areas. Proper incineration of contaminated material is the best available method of preventing and controlling exposure to dioxins. It can also destroy PCB-based waste oils. The incineration process requires high temperatures, over 850°C. For the destruction of large amounts of contaminated material, even higher temperatures - 1000°C or more - are required.

Prevention or reduction of human exposure is best done *via* source-directed measures, i.e. strict control of industrial processes to reduce formation of dioxins as much as possible. This is the responsibility of national governments, but in recognition of the importance of this approach, WHO, in collaboration with the Food and Agriculture Organization (FAO), through the joint FAO/WHO Codex Alimentarius Commission, has established a 'Code of Practice for the Prevention and Reduction of Dioxin and Dioxin-like PCB Contamination in Foods and Feed' (CAC/RCP 62-2006)[12].

More than 90% of human exposure to dioxins is through the food supply, mainly meat and dairy products, fish and shellfish. Consequently, protecting the food supply is critical. One approach includes, as mentioned above, source-directed measures to reduce dioxin emissions. Secondary contamination of the food supply needs to be avoided throughout the food-chain. Good controls and practices during primary production, processing, distribution and sale are all essential to the production of safe food.

CONCLUSION

Food contamination monitoring systems must be in place to ensure that tolerance levels are not exceeded. It is the role of national governments to monitor the safety of food supply and to take action to protect public health. When incidents of contamination are suspected, countries should have contingency plans to identify, detain and dispose of contaminated feed and food. The exposed population should be examined in terms of exposure (e.g. measuring the contaminants in blood or human milk) and effects (e.g. clinical surveillance to detect signs of ill health).

REFERENCES

1. Washington state department of ecology, focus s feet : Hazards of Dioxin, 2001.
2. Y. Masuda, A. Schecter and O. Papke, *chemosphere*, **37**, 1773–80, 1998.
3. H. Kiviranta, J. T. Tuomisto, J. Tuomisto, E. Tukiainen and T. Vartiainen, *Chemosphere*, **60**, 854-869, 2005.
4. A. B. Okey, *Toxicological Sciences* **98**, 5–38, 2007.
5. P. K. Mandal, *J. Comp Physiol B Biochem Syst Environ Physiol*, **175**, 221–30, 2005.
6. M. Van den Berg *et al*., *Toxicol. Sci.* **93**, 223–241, 2006.
7. D. R. Anderson and R. Fisher, *Chemosphere*, **46**, 371–81, 2002.
8. R. E. Alcock and K. C. Jones, *Environ Sci Technol*, **30**, 3133–43, 1996.
9. A. Kishimoto, T. Oka, K. Yoshida and J. Nakanishi, *Environ Sci Technol*, **35**, 2861–6, 2001.
10. R. Pohjanvirta and J. Tuomisto, *Pharmacol. Rev.* **46**, 483–549, 1994.
11. M. H. Sweeney and P. Mocarelli, *Food Addit. Contam.*, **17**, 303–316, 2000.
12. WHO media centre.

A MULTIDISCIPLINARY FRAMEWORK OF ASSESSMENT AND MANAGEMENT IN CEREBRAL PALSY

Vijay Batra

Cerebral palsy is a non-progressive motor disorder invariably associated with disturbances of sensation, cognition, communication, perception, and / or behavior, and secondary orthopaedic deformities. Comprehensive management of cerebral palsy is based on clinical presentation, functional abilities, multidisciplinary assessment. It includes treatment planning, goal setting and implementation of individually tailored treatment and therapy program.

INTRODUCTION

Cerebral Palsy (CP) is a heterogeneous group of disorder of movement and posture caused by non-progressive defects or lesions of immature brain at prenatal, perinatal or postnatal period. It is considered the most common cause of childhood physical disability dominated by muscle weakness, poor selective motor control and abnormal motor sequences & synergies (such as contraction of agonist - antagonist muscle groups) resulting in absent or poorly developed postural reactions thereby affecting postural control and normal motor development [1].

CP is a common problem, the worldwide incidence being 2 to 2.5 per 1000 live births while in developing world, the prevalence of CP is not well established but estimates are 1.5-5.6 cases per 1000 live births [2, 3].

The etiological and risk factors are many and an awareness of the interplay of multiple factors in the causation of Cerebral palsy is crucial. Cerebral Palsy is invariably associated with many deficits such as mental retardation, speech, & language problems, oromotor dysfunction [2, 3] and secondary orthopaedic deformities (such as hip dislocation and scoliosis of spine).

There are three basic recurrent elements that provide the basis for a concise definition. These are: significant problem with motor function resulting from something gone wrong with the brain during its early development and disturbance of typical brain development which occurred over a discrete period of time and does not represent a continuing, recurrent or progressive process. Depending on the location and extent of the damage, cerebral palsy can be mild, revealing itself as a kind of awkwardness, or severe, largely incapacitating a child from infancy.

Cerebral Palsy can be congenital or acquired depending on the cause and time of involvement[3]. The major causes associated with Cerebral Palsy are : birth asphyxia, trauma, premature birth and central nervous system infections etc.

CLINICAL PRESENTATION

Cerebral Palsy is characterized by abnormal muscle tone, faulty posture, incoordination; persistent reflexes, absent and poorly developed postural reactions, delayed milestones and Poor functional performance and abilities [4]. The classical symptoms are spasticity, unsteady gait, and

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dysarthria. Secondary symptoms can include speech or communication disorders, seizures, hearing or vision impairment or cognitive or perceptual abilities, learning abilities, and/or behavioral and orthopaedic complications.

Secondary orthopaedic problems in cerebral palsy include contractures and deformities. The bones in order to attain their normal shape and size require the stresses from normal musculature which gets affected in cerebral palsy because of tonal variations. Osseous findings will therefore mirror the specific muscular deficits. The shafts of the bones are often thin (gracile). When compared to these thin shafts (diaphyses) the metaphyses often appear quite enlarged (ballooning). With lack of use, articular cartilage may atrophy, leading to narrowed joint spaces. Depending on the degree of spasticity, children with Cerebral Palsy may exhibit a variety of angular joint deformities. Because vertebral bodies need vertical gravitational loading forces to develop properly, spasticity and an abnormal gait can hinder proper and/or full bone and skeletal development in cerebral palsy.

ASSESSMENT & MANAGEMENT

A thorough neurological, developmental and functional assessment of the child with Cerebral Palsy helps in formulating a comprehensive early intervention program. Comprehensive assessment of a child with C.P. is essential to plan appropriate treatment[8, 9, 10]. Because of the multiplicity of problems, a multidisciplinary team [10] comprising of a neuro-developmental pediatrician, orthopedic surgeon, occupational therapist, clinical psychologist, speech pathologist, speech therapist, and social worker is required, preferably under one roof. Ideally all children with CP must have evaluation of their motor, sensory and cognitive functions. In addition other problems like feeding and nutrition, mobility etc. must also be given due importance.

The main aim of assessment is to evaluate physical & functional abilities of the child within various performance areas and establish the current functioning level, assessing specific physical & structural limitations that may interfere with the attainment of certain goals, and functionality of skills. The management plan includes goal setting & implementation of individually tailored treatment & therapy program.

AIMS OF TREATMENT

The comprehensive goals of treatment [4, 5, 6, 10] includes: normalizing tone, preventing & treating tightness, contractures & deformities, improving balance & coordination**,** increase physical & functional abilities, correcting & improving posture & gait and achieving developmental milestones, thereby improving the quality of life.

CURRENT TREATMENT TECHNIQUES & METHODS

The following treatment techniques, procedures and therapies options are available for management of Cerebral Palsy.

Drugs, include muscle relaxants for spastic muscles like oral medications (such as Baclofen, Diazepam etc.), intrathecal medications (such as Baclofen, Morphine etc.) and anti-seizure drugs, if epilepsy is involved.

Occupational therapy, incorporates the use of specialized scientific techniques [4, 5, 9] such as Neuro Facilitation of Developmental Reactions (NFDR), Bobath, Rood, Proprioceptive Neuromuscular Facilitation & Sensory Integrative Therapy to improve movement control & coordination, correct posture, balance & enhance functional and motor abilities (such as developmental milestones, activities of daily living etc.). These techniques include specific therapeutic procedures like positioning, therapeutic exercises & activities, active & dynamic stretching, neurofacilitation, posture & balance training, recommendations for ergonomic modifications, adapted work settings, and adapted living arrangements.

Biofeedback provides the information about the internal physiological events in the form of audiovisual feedback signals and helps the children with Cerebral Palsy to gain increased voluntary control over movements.

Neuromuscular blocks, and Local anesthetics : such as phenol blocks, Botulinum toxin.

Orthopaedic Surgery[7] **(**Rehabilitative & Corrective), which can be helpful in dealing with certain specific problems, such as those involving static contracture & deformity, affecting posture and gait.

Orthotic devices[4] such as mobility aids (like walkers, wheelchairs) and Seating devices (like C.P. chair).

Splints, Casts and Calipers : specially designed shoes, ankle-foot orthoses and calipers may be required to provide stability to the joints in a child who is learning to stand and walk. Splints and Casts should not be used for prolonged periods of time as they may lead to disuse atrophy of the muscles.

Speech and language therapy : which can help children overcome some speech and hearing impairments, and also learn to use the great variety of mechanical and electronic devices and improve communication abilities.

Physiotherapy : includes Passive ROM & stretching exercises to prevent contractures and deformity[9].

Child and family counseling : which can offer family / parent education, emotional support and relief of stress.

Behaviour Management : some children with CP may have problematic aggression and at times hyperactivity and destructive behaviour. Behaviour modification techniques and parental counseling are helpful.

Table 1. Showing treatment option for management of Cerebral Palsy

Pharmacological	Nonpharmacological	Surgical
Oral Medication (Baclofen, Diazepam) Introthecal Medication (Baclofen) Antiepileptic drugs Neuromuscular blocks Local anesthetics	Occupational Therapy [Neuro Facilitation of Developmental reactions (NFDR), Bobath, Rood] Biofeedback Orthotic devices such as splints Mobility aids, seating devices Speech therapy Physiotherapy Child & family Counseling Behaviour Management	Orthopaedic Surgery (Rehabilitative & Corrective)

REFERENCES

1. M. Bax, M.Goldstein, P. Rosenbaum, A. Leviton, N. Paneth, B. Dan, B. Jacobsson, & D. Damiano, *Developmental Medicine and Child Neurology*, **47**, 571-6, 2005.
2. Hammodi F AL-Jumaily, *European Journal of Scientific Research*, **94**, 406-414, 2013
3. C. Sankar, N. Mundkur, *Indian J. Pediatr.*, **72**, 865-868, 2005.
4. NR. Finnie, Handling the Young Cerebral Palsied Child at Home. 2nd edn. New York, USA. Haynes U Dutton Sunrise Inc. 1974
5. JM Gracies, *Phys. Med. Rehabil. Clin. N. Am.*, **12**, 747-768, 2001.
6. E. Helander, P. Mendis, G. Nelson, A Manual on Community Based Rehabilitation for Developing Countries. Geneva W.H.O. Publications 1983
7. JP. Lin, *J. Neurol. Neurosurg. Psychiatry*, **74**, 123-129, 2003.
8. Ruth A. Hansen and Ben Atchison, Conditions in Occupational Therapy : effect on occupational performance." ed. Baltimore : Lippincott Williams & Williams, 8-21, 2000.

9. D. J. Russell, P. L. Rosenbaum & L. M. Avery, Gross motor function measure (GMFM 66& GMFM 88) users manual, *Clinics in Developmental Medicine* No. **159**, MacKeith Press. Distributed by Cambridge University Press 2002.
10. A. H. Tilton, *Semin. Pediatr. Neurol.*, **11**, 58-65, 2004.

PHYTASE-IMPORTANT ENZYME FOR ANIMAL, HUMAN NUTRITION AND ENVIRONMENT

Iti Gontia-Mishra, Khushboo Bardiya-Bhurat* and Sharad Tiwari

Phytases are enzymes that catalyze the breakdown of phytate into inorganic phosphorus and *myo*-inositol phosphate derivatives. Plant seeds that have high phytate content are used as animal feed. Phytases have been intensively studied in recent years and gained immense attention because of their application in reducing phytate content in animal feed and food for human consumption and indirectly lowering environmental pollution caused by undigested phytate. Microbial phytases have various biotechnological applications in diversified ventures such as animal feed additives, aquaculture, food industry, probiotics, biofertilizers, pharmaceuticals, development of transgenic plants and animals.

INTRODUCTION

Myo-inositol hexakisphosphate (phytase) is a ubiquitous constituent of cereals and grains, which serves as a major source of phosphorus for the animals and exists predominantly in its salt form (phytic acid). Phytic acid (phytate) is the principal storage form of phosphorus and inositol. It represents ~60-90% of the total phosphorus content in cereals, legumes, and oilseeds, ~50% in nuts and ~24% in cocoa and chocolate.[1] In spite of being a rich source of phosphorus, the bound phosphorus in phytate is poorly utilized by monogastric animals such as pigs, poultry and fish because these animals have very low levels of phytate-degrading enzymes *i.e.* phytase (myo-inositol hexakisphosphate phosphohydrolase) in their digestive tracts which requires addition to the forage of sources with $Ca_3(PO_4)_2$. Besides this phytate is also considered as anti nutritional compound because it forms complexes with several divalent cations of major nutritional significance, such as Ca^{2+}, Mg^{2+}, Zn^{2+}, Cu^{2+}, Fe^{2+} and Mn^{2+} and with proteins under both acidic and alkaline pH conditions which affect the protein structure, resulting in decrease in the enzymatic activity, protein solubility and proteolytic digestibility.[2, 3] The undigested phytate excreted by the animals is degraded by microorganisms in the soil and the released phosphorus at high concentrations gets into the rivers where it causes eutrophication. The importance of phytic acid as a source of phosphorus, its ability to cause undesirable ecological effects and antinutritive properties has stimulated research into ways for its dephosphorylation. Hence, from last few decades, phytases have attracted substantial interest of scientists and entrepreneurs in the areas of nutrition, environmental protection and biotechnology.

PHYSIOLOGICAL ROLES OF PHYTASES

It is clear and evident that phytases are widespread in nature ranging from microorganisms to plants and animals as well as the role of these enzymes in each organism varies depending on its physiological requirements.

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MICROORGANISMS

In microorganisms, phytase expression is most frequently induced and the enzymes are usually secreted in response to phosphate starvation and in some cases for pathogenesis. The expression of phytases results in release of inorganic phosphate from surrounding and/or internal Ins P_6 stores.

PLANTS

In plants, phytase is expressed during seed germination for phytate degradation to provide the growing seedling with orthophosphate, lower inositol Polyphosphate Phosphatase (IPPs), free myo-inositol and previously bound cations, such as K^+, Mg^{2+}, Zn^{2+}, and Ca^{2+} thus providing nutrition for plant growth.

ANIMALS

In animals phytases are mainly involved in maintenance of the cell's metabolic reservoirs of Ins P_6 and other IPPs. The Multiple Inositol Polyphosphate Phosphatase (MIPP) play vital role in regulation of cellular activities of Ins P_6 and Ins (1, 3, 4, 5, 6) P_5.

APPLICATIONS OF PHYTASES

Phytases are enzymes which have multifaceted applications ranging from human to animal, plant and environmental benefits as represented in Fig. 1. A few of the applications of phytases in various fields are listed here.

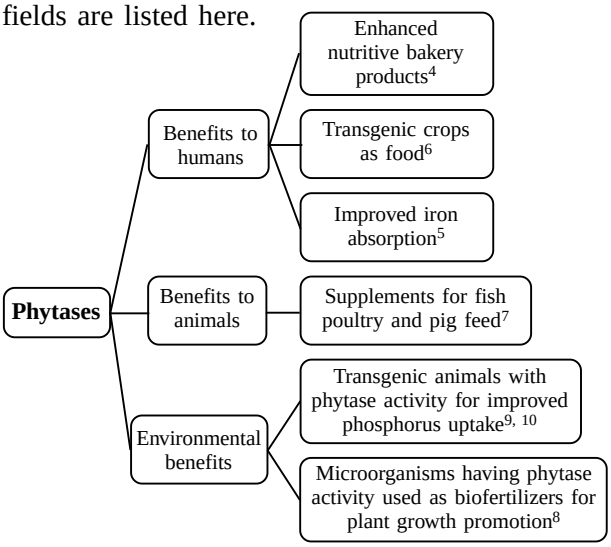

Fig 1. Multifacted applications of phytases

NUTRITIONAL BENEFITS TO HUMANS

● Enhanced nutritive bakery products

Preference for consumptions of whole grain bread is increasing due to its nutritional benefits like high fiber contents. Whole grain flour contains the high concentration of iron and phytate that originates from the bran.[4] Addition of phytase significantly reduced the phytate content in dough as well as shortened the fermentation time. Besides this, it also improved the bread shape, volume and softness of the crumb. Phytases also increase the bioavailability of essential minerals like Ca, Mg, Zn, Fe, etc. by acting upon phytate which have a tendency to form complexes with these metal ions.

● Improved iron absorption

Iron deficiency is widespread micronutrient deficiency world-wide. A major cause is the poor absorption of iron from cereal and legume-based diets high in phytic acid. The most-widely recognized strategies for reducing micronutrient malnutrition are supplementation with pharmaceutical preparations and food fortification. These strategies are not very well implicated for reduction of iron-deficiency. An alternative more sustainable approach would be the enrichment of food staples by increasing iron bioavailability, by development of phytase over-expressing transgenic plant. Using this approach *phy* gene from *Aspergillus fumigatus* was introduced into the rice endosperm for better bioavailability of iron.[5]

● Transgenic crop as food and feed

The approach to produce transgenic crops having high phytase expression is becoming a prerequisite to improve the bioavailability of phosphorus in food/feed along with direct supplementation of microbial phytase to animal feed. Transgenic crops expressing phytase were used as animal feed and showed comparable results to feed supplemented with microbial phytase in terms of phosphorus (P) utilization. As a cost-effective option, transgenic plants have been evaluated as bioreactors for the

production of recombinant phytases to meet the industrial demand. Moreover, transgenic plants over-expressing phytase gene from microorganisms targeted for root specific secretion can improve P nutrition in crop plants under P-limiting conditions.[6]

NUTRITIONAL BENEFITS TO ANIMALS

Supplementing the animal feeds with phytase is considered to be one way to check the phosphate utilization for better animal nutrition. A large number of microbial phytases are marketed and extensively used as animal feed supplements as mentioned in Table 1.

Table 1. List of commercially available microbial Phytases.

Company	Phytase source	Production strain	Trademark
AB Enzymes	*Aspergillus awamori*	*Trichoderma reesei*	Finase
Alko Biotechnology	*A. oryzae*	*A. oryzae*	SP, TP and SF
Alltech	*A. niger*	*A. niger*	Allzyme phytase
BASF	*A. niger*	*A. niger*	Natuphos
Biozyme	*A. oryzae*	*A. oryzae*	AMAFERM
DSM	*P. lycii*	*A. oryzae*	Bio-Feed phytase
Fermic	*A. Oryzae*	*A. oryzae*	Phyzyme
Finnfeeds International	*A. awamori*	*T. reesei*	Avizyme
Roal	*A. awamori*	*T. reesei*	Finase
Novozyme	*Peniophora lycii*	*A. oryzae*	Ronozyme®, Roxazyme®
Diversa/ Syngenta	*Escherichia coli*	*Escherichia coli*	Quantum™,
Diversa/ Danisco A/S	*Schizosaccharomyces pombe*	*Schizosaccharomyces pombe*	Phyzyme™,

● Phytase as supplement in fish feed

Fishmeal, which is usually used as fish feed is very expensive and needs a substitute. The replacement of fishmeal with plant or grain by-products is an effective low cost option for fish feed but it is associated with problems such as presence of anti-nutritional factors, like phytic acid. Supplementation of phytase in plant based feed will solve the above said problem without affecting growth, feed efficiency or bone phosphorus deposition. In addition it will aid in reduction of phosphorus discharge into the aquatic environment, thereby causing less pollution[7].

● Phytase in poultry and pig feed

The addition of phytase to high phytate containing diets improves the absorption and utilization of phosphorus. Microbial phytase addition to diets improves the bioavailability of Mg^{2+}, Zn^{2+}, Cu^{2+} and Fe^{2+} in pigs and poultry. The phytase supplementation in the diets significantly improved the digestibility of minerals, total phosphorus, phytate phosphorus and gross energy.[7]

ENVIRONMENTAL ASPECT

● Biofertilizers for plant growth promotion

Although plants have developed numerous mechanisms to increase the availability of soil phosphorus, utilization of phytate phosphorus from the soil is very limited due to low phytase activity present within rhizosphere. Thus, phytase producing microorganisms are the ideal candidates as biofertilizers for improvement of P utilization by plants. Phytase and phosphatases producing fungi were used as seed inoculants, to help attain higher P nutrition of plants in the soils containing high phytate phosphorus.[8] Alternatively, extracellular phytase producing microorganisms can be incorporated in traditionally used phytate rich manures such as poultry and fish manure. This will, in turn, help to increase the availability of phosphorus and other essential minerals in manure.

● Transgenic animals with improved phosphorus uptake

The problem of manure-based environmental pollution is wide spread and is a matter of utmost concern. To overcome this problem phytase expressing transgenic animals were developed such as transgenic mice and transgenic pig.[9] These transgenic pigs producing salivary phytase required less inorganic phosphate supplementation for normal

growth and excreted up to 75% less fecal phosphorus than non-transgenic pigs. These studies suggested that the introduction of salivary phytase transgenes into monogastric farm animals offers a promising biological approach to lessen the requirement for dietary phosphate supplements and reduce phosphorus pollution.[10]

CONCLUDING REMARKS

The importance of phytases as potential tool has been recognized in various fields. It is imperative to comprehend that all the nutritional and environmental applications cannot be fulfilled by any single known phytase. Thus, continuous efforts must be made to isolate new phytases with desirable traits. Alternatively, engineering of phytases is also required to optimize their catalytic and stability attributes to make a better phytase available for various applications. Phytases producing microorganisms, individually or in combination can serve as probitiotics in various food formulations for improving phosphate utilization. Supplementation of phytase significantly reduced the phytate content of various food products and provides health benefits for alleviation of mineral deficiency. Transgenic crops expressing phytases not only rules out the problem of mineral malnutrition, phosphate uptake in animals and humans, but also alleviates the environmental pollution due to phytate phosphorus. The transgenic plants expressing microbial phytase genes could also be used to improve soil fertility and availability of minerals to plants. Search of new phytases as well as engineering of known phytases for desirable characteristics should go hand in hand for proficient solutions to the biotechnological implication of phytases in mineral nutrition, and environmental protection.

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REFERENCES

1. D.E.C.S. Rao, K.V. Rao, T.P. Reddy and V. D. Reddy, *Crit. Rev. Biotechnol*. **29**, 182-198, 2009.
2. B. F. Harland and D. Oberleas, Phytic acid complex in feed ingredients. In: Phytase in Animal Nutrition and Waste Management 1999 (ed. M.B. Coelho and E.T. Kornegay), pp. 69-76, BASF, Mexico.
3. A. K. Kies, L. H. De Jonge, P. A. Kemme and A. W. Jongbloed, *J. Agric. Food Chem*. **54**, 1753-1758, 2006.
4. M. Haros, C. M. Rosell, C. Benedito, *Eur. Food Res. Technol*. **213**, 317-322, 2001.
5. S. M. Yoon, S. Y. Kim, K. F. Li, B. H. Yoon, S. Choe, M. M. C. Kuo, *Appl. Microbiol. Biotechnol*. **91**, 553-563, 2011.
6. I. Gontia, K. Tantwai, L. P. S. Rajput and S. Tiwari, *Food Technol. Biotechnol*. **50**, 3-10, 2012.
7. Z. J. Cheng and R. W. Hardy, *Aquacult. Nutr*. **8**, 271-277, 2002.
8. R. S. Yadav and J. C. Tarafdar, *Soil Biol. Biochem*. **35**, 745-751, 2003.
9. S. P. Golovan, M. A. Hayes, J. P. Phillips and CW Forsberg, *Nat. Biotechnol*. **19**, 429-433, 2001.
10. S. P. Golovan, R. G. Meidinger, A. Ajakaiye, M. Cottrill, M. Z. Wiederkehr, D. J. Barney, C. Plante, J. W. Pollard, M. Z. Fan, M. A. Hayes, J. Laursen, J. P. Hjorth, R. R. Hacker, J. P. Phillips and C. W. Forsberg, *Nat. Biotechnol*. **19**, 741-745, 2001.

KNOW THY INSTITUTIONS

CENTRAL INSTITUTE OF FRESHWATER AQUACULTURE, BHUBANESWAR

The Central Institute of Freshwater Aquaculture (CIFA) is a premier research Institute on freshwater aquaculture in the country under the aegeis of the Indian Council of Agricultural Research (ICAR), New Delhi. The present Institute has had its beginnings in the Pond Culture Division of Central Inland Fisheries Research Institute (CIFRI) established at Cuttack, Orissa in 1949 with a view of face challenges in the field of fish culture in ponds, tanks and other small aquatic body. Subsequently, CIFRI, in a major effort to give emphasis to freshwater aquaculture research, initiated steps to establish the Freshwater Aquaculture Research and Training Centre (FARTC) over 147 ha campus at Kausalyaganga, Bhubaneswar, Orissa. The Centre gradually developed into its full capacity and became an independent Institute during 1987 as Central Institute of Freshwater Aquaculture (CIFA). The Institute is also the Lead Centre on 'Carp Farming in India' under Network of Aquaculture Centres in Asia-Pacific (NACA) operative under Food and Agriculture Organisation of United Nation (FAO).

VISION

Making Indian freshwater aquculture globally competative through eco-friendly and economically viable fish production system for livelihood and nutritional security.

MISSION

Excellence in research for developing sustainable and diversified freshwater aquaculture practicies for enhanced productivity, quality, water use efficiency and farm income.

MANDATE

- To conduct basic, strategic and applied research in freshwater aquaculture.
- To enhance production efficiencies through incorporation of biotechnological tools.
- To undertake study on diversifcation of aquaculture practices with reference to species and systems.
- To provide training and consultancy services.

DIVISIONS

- Aquaculture Production and Environment Division.
- Fish Nutrition & Physiology Division.
- Fish Genetics and Biotechnology Division.
- Fish Health Management Division.
- Social Science Section.

AQUACULTURE PRODUCTION AND ENVIRONMENT DIVISION

RESEARCH ACHIEVEMENTS

Breeding of finfishes and shellfishes

- Induced carp breeding through use of synthetic hormones.
- Induced breeding and seed production of magur and singhi.
- Development of FRP hatchery system for magur.
- Breeding and seed rearing of *Wallago attu*, *Pangasius pangasius*, *Ompak pabda*, *Horabagras brachysoma* and *Mystus vittatus.*
- Breeding and seed rearing of Murrels and Koi.
- Breeding and mass scale seed production of different indigenous ornamental species.
- Design and modification of carp hatcheries.
- A portable model FRP hatchery for carps has been developed facilitating small-scale seed production at farmers' site.
- Prolonged and multiple carp breeding of carps: as many as four times in a year, from April-September, with 2-3 fold increase in spawn production from a single female.
- Advanved and delayed gonadal maturation through environmental and hormonal manipulation Cryopreservation of carp milt.
- Development of low-cost mini cryofreezer.
- Demonstration of cryomilt utilization at different states of India (Tamil Nadu, Haryana, Andhra Pradesh and Utter Pradesh).
- Technology for production of high quality captive broodstock of giant freshwater prawn, *Macrobrachium rosenbergii*.
- Development of mass scale larval rearing technique for freshwater prawn.
- Development of safe and simple procedure for the separation of embryonic stages of *M. rosenbergii* for cryopreservation studies.
- Breeding and larval rearing of freshwater mussel, *Lamellidens marginalis* with identification of appropriate host of glochidial attachment.

Culture of finfishes

- Development of packages of practices on carp seed rearing in nursery and rearing ponds.
- Low input technologies using biogas slurry or aquatic weed.
- Aquatic weed based system with grass as main components (40-50%) demonstrated 3-5 t/ha/yr production of without additional feed and fertilizer.
- Development of multiple cropping for grow-out production of carps.
- Diversification of carp culture with minor carps and barbs.

- Intensive carp culture with production levels of 10-15 tonnes/ha/yr in static pond with higher use of 20,000–25,000 fingerlings/ha densities, balanced supplementary feed, aeration and bio-fertilization with Azolla @ 40 t/ha/yr.
- Polyculture of freshwater prawn with carps: demonstrated 200-300 kg or prawn production along with 2-3 tonnes of carps/ha/yr.
- Sewage-fed carp polyculture with demonstration of 3-5 t/ha/yr production without any additional feed and fertilizer inputs.
- Integrated farming systems with sewage water involving agriculture, fish culture and horticulture.
- Seed production and supply of minor carps/ barbs of different states.
- Standardization of technology of cage culture with 80-130 tonnes/ha/yr production demonstrated.
- Standardization of techniques for pen culture using Indian major carps.
- Development of flow-through culture of carps with 60-65 t/ha/yr production demonstrated at high stocking densities under monoculture with continuous water flow through.

Culture of shellfishes

- Standardization of grow-out culture of freshwater prawn with 1-1.5 t/ha/crop production in six months with supplementary feed and aeration.
- Production of cultured pearls from freshwater mussel: shell sttached half-round and designed pearls, non-nucleated oval to round pearls.
- Development of nucleus through indigenous material for pearl production.
- Cell culture of epithelial cell of freshwater mussel.

Aquaculture engineering

- Design of hatcheries for carps and catfishes.
- Design of farm ponds.
- Development of closed-loop recirculatory system and flow-through system for industrial aquaculture.
- Development of Mechnical pond applicator.
- Development of Mechanized fish harvesting system.

Aquatic environment

- Comparative efficiency study of organic manures and inorganic fertilizers.
- Fertilization measures and schedules for different categories of ponds.
- Standardization of doses of major micro and macronutrients for enhancing the productivity in culture systems.
- Technology of waste water treatment through aquaculture using duck weed and fish.
- Control of aquatic vegetation through mechanical, chemical and biological methods.
- Optimization of productivity based on both autotrophic and heterotrophic food chains.
- Quantification of biological nitrogen fixation in freshwater fishponds.
- Biofertilization with Azolla in fishponds.
- Evaluation of biofilters and studies on bacterial flora of crops, catfish and prawn hatchery systems.
- Demonstrated trophic significance of microbial communities in carp culture.

FISH NUTRITION & PHYSIOLOGY DIVISION

Research Highlights

- Feeds standards for carps, catfish and prawn with Bureau of Indian Standards.

- CIFACA, growout carps feed.
- Starter-M and Starter Pangas, catfish larval feeds.
- CIFABROOD, brood Indian major carps feed.
- Pangas grower feeds 'Pangas Grow-I and 'Pangas Grow-II.
- On-farm demonstration of carp production towards doubling the national average with 'GRAM-CA-Feed'.
- National Feed Testing and Referral Laboratory for feed quality assurance and certification.
- A State of Art Feed Mill for feed technology demonstration.
- Climatology Laboratory for climate change study in Fish Physiology.
- Fish digestibility laboratory for nutrient digestibility study.
- Off season gonadal maturation and seed production techniques in carps.
- Cataloguing of region based feed resources in India.

FISH GENETICS AND BIOTECHNOLOGY DIVISION

Research Highlights

- CIFA IR1, Jayanti improved Rohu through selection.
- Production of Triploid grass carp .
- Diploid Meiotic & Mitotic Gynogenesis and Polyploidy (Triploidy/Tetra Ploidy).
- Evaluation of interspecific, intergenetic & intraspecific (Diallele) hybrids of major carps.

Fish Health Management Division

Important activities

- Monitoring national fish disease outbreaks and serological screening of diseases.
- Development of vaccine using molecular techniques.
- Molecular characterization of important bacteria, viruses, parasites and fungi.
- Application of probiotics in aquaculture.
- Immunity and immunomodulation in fish.
- Maternal immunity in craps and their role in seed survival.
- Standardization of cell culture of Carps.
- Repository of pathogenic bacteria and immuno diagnostic reagents.
- Isolation and characterization of bacteria associated with nutrient cycles and bioremediation.
- Biodiversity and identification of microorganisms important to aquaculture.
- Nanotechnology in aquaculture.

Achievements

- Development of Diagnostic kits : ELISA kits, Spot agglutination kits Nested and multiplex RT-PCR kits.
- Development of Chemical formulation-CIFAX, CIFACURE and herbal formulation (AQUAHERBICARE) to control diseases.
- Immunoboost-C of to enhance disease resistance.
- *Aeromonas hydrophila* resistant improved rohu *(In collaboration with Genetics and Biotechnology Div.)*

SOCIAL SCIENCE SECTION

The Social Science Section of the Institute was established in 2006 with a view to popularize research results for the overall development of the freshwater aquaculture sector, to provide a forum for feed back to the Institute, to maintain liaison with the fish farmers, fisheries departments and

fishery industry as a whole, to organize short term refresher courses, to conduct research investigations for studying the extent of adoption of the new and improved technologies developed by the Institute and to conduct economical and statistical investigations on various aspects of freshwater aquaculture.

The section also takes care of transfer of technology programmes, organizing educational programmes for farmers and farm women by conducting exhibitions, demonstrations, interactive meetings, trainings and campaigns. Presently there are 4 scientists working in the division of which 2 are in Fisheries Extension, 1 in Statistics and 1 in Fisheries Economics. There are 6 in-house research projects presently being handled by the division in addition to 2 funded projects. The division also serves the fish farmers through the Agricultural Technology Information Centre (ATIC) by supply of technological inputs, products and services through the single-window delivery system. ATIC receives over 4000 information seekers per year. Awareness programmes on freshwater aquaculture technologies and video shows are being organized at ATIC for large number of beneficiaries. The section also assists in preparing the audio, video CDs, publications and press coverage on important activities of the Institute.

RESEARCH PROJECTS

(i) Institute Funded

- Agricultural Technology Information Centre.
- Aquaculture in changing climate - a study based on the perception of freshwater aquaculturists (2008-13).
- Community based management for sustainable aquaculture in rural areas (2009-13).
- Digitalization of Research Project and Publication Records related to Freshwater Aquaculture (2010-2012).
- Development of a Database and Information System for Institute's Publications (2012-14).
- Mainstreaming gender concerns in freshwater aquaculture development-An action research (2012-14).

(ii) Externally Funded

- Bio-Technology Information System (BTIS) (DBT).
- Transfer of technology of composite carp culture through demonstration among SC/ST women in Boudh and Purulia. (DST) (2009-12).

Other activities in which Scientists are involved,

- As Nodal officer - PIMS.
- As Nodal officer - PERMISNET.
- As Nodal officer - National Knowledge Network (NKN).
- As nodal officer - Strengthening Statistical Computing for NARS.
- Creating infrastructure for 100 seat Online ARS Examination centre under NAIP project "Developing, Commissioning, Operating and Managing an Online Examination System for NET/ARS-PRELIM Examination For ASRB, ICAR"
- Officer in Charge, Extension
- Officer in Charge, Press and Media
- Secretary, Management Committee for Implementation of ISO-9001

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Conferences / Meetings / Symposia / Seminars

7th International Conference of IMBIC on Mathematical Sciences for Advancement of Science and Technology (MSAST 2013), Dec 21-23, 2013, Kolkata.

Theme :
- Mathematics
- Cryptology and Information Security
- Probability, Statistics and their Applications
- Bioinformatics
- Mathematics and Launch Vehicle Technology

Contact : Dr. Avishek Adhikari, Secretary, IMBIC, AH 317, Salt Lake City, Sector II, Kolkata - 700 091, West Bengal. E-mail : msast.paper@gmail.com

International Conference on Operations Research for Data Analytics & Decision Analysis, October 21 - 23, 2013, Srinagar, Jammu & Kashmir.

Theme :
- Global and Local Optimization
- Planning and Scheduling
- Optimal Resource Management
- Portfolio Optimization
- Combinatorial Optimization
- Inventory Management
- Mathematical Programming
- Supply Chain Management
- Multi-criteria Decision Making
- Fuzzy and Stochastic Programming
- Discrete Optimization
- Goal Programming
- Transporation and Routing
- Statistical Decision Making
- Statistical Computing/forecasing
- Queuing Models

Contact : Prof. Aquil Ahmad, General Chair, ICORDADA13, Head, Department of Statistics University of Kashmir, Hazratbal, Srinagar, Jammu & Kashmir-190006, Fax No. + 91194-2421357, Mobile No. 094199-72572, E-mail : icordadal3@gmail.com

XXVth (Silver Jubilee) Annual National Conference of Physiological Society of India, (PHYSICON 2013), 9th- 11th, December, 2013, Nalgonda, Andhra Pradesh.

Theme : Today's Physiology is Tomorrow's Medicine

Contact : Dr. B. R. Doddamani, Organizing Secretary, Department of Physiology, Kamineni Institute of Medical Sciences, Sreepuram, Narketpally-508 254, Nalgonda (Dist), Andhra Pradesh, Mobile no : 09342351898,08978630670, Email : drdoddamani@yahoo.com

International Conference on Recent Advances in Statistics and Their Applications, (ICRASTAT - 2013), 26th - 28th December, 2013, Aurangabad, Maharashtra.

Topics : Statistical Inference, Stochastic Processes, Computational Statistics, Clinical Trials and Bio Statistics, Data Mining, Reliability, Survival analysis, Industrial Statistics, Actuarial Science, Financial Statistics, Probability Theory, Decision Theory, Design of Experiments, Distribution Theory, Econometrics, Multivariate Analysis, Neural Networks, Operations Research, Simulation Methods, Statistical Genetics, Statistical Quality Control, Survey Sampling, Time Series Analysis, Agricultural Statistics.

Contact : Dr. V. H. Bajaj, Professor & Head, Co-ordinator UGC-SAP DRS-I, General Chair - ICRASTAT2013 Department of Statistics, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (M.S.) - 431 004 Mob : 094227 04381, 094045 03615, E-mail : vhbajaj@gmail.com, Web : www.bamu.ac.in/incrastat2013

S & T ACROSS THE WORLD

OLDEST NEARLY COMPLETE PRIMATE FOSSIL REPORTED

Scientists they have found the oldest known nearly complets skeleton of a primate—an animal ancestral to people, apes and monkeys.

The fossil of the tiny-dweller dates back an estimated 55 million years, to the so-called Eocene Epoch, and was found in Hubei Province in central China. This adds to growing evidence that primates originated in Asia, scientists said.

"This is the oldest primate skeleton of this quality and completness ever discovered and one of the most primitive primate fossils ever documented," said Northern Illinois University anthropologist Dan Gebo, a member of the research team. "The origin of primates sets the first milestone for all primate lineages, including that of humanity.

"Although scientists have found primate teeth, jaws, occasionally skulls or a few limb bones from this time period, none of this evidence is as complete as this," Gebo added. "With completeness comes more information and better evidence for the adaptive and evolutionary themes concerning prmiate evolution. It takes guessing out of the game."

Primates comprise two subgroups, or suborders, called prosimians (lemurs, lorises, and tarsiers) and anthropoids (monkey, apes, and people).

The research team, led by Xijun Ni of the Institute of Vertebrate Paleontology and Paleoanthropology at the Chinese Academy of Sciences in Beijing, describes the fossil in the June 6 edition of the Journal *Nature*.

Ni said that while doing fieldwork years ago in Hubei Province, he first came across the fossil, which had been found by a local farmer and was later donated to his institute. The fossil was encased within a rock and discovered after the rock was spilt open, yielding fossils and impressions of the primate of each side of the two halves.

It was discovered in a quarry that had once been a lake and is known for producing ancient fish and bird fossils from the Eocene. The quarry is near Jingzhou, south of the Yungtze River, and abotu 270 km southwest of Wuhan, the provincial capital.

"This region would have been a large series of lakes, surrounded by lush tropical forests dueing the early Eocene," Ni said. "This new primate was very small and would have weighed less than an ounce. It has slender limbs and a long tail, would have been an excellent arboreal [tree] leaper, active during the daytime, and mainly fed on insects."

The fossil has been named *Archicebus achilles*. *Archicebus* roughly means "first long-tailed monkey," and achilles is an allusion to its interesting heel anatomy and to the mythological Greek warrior, for whom the Achilles tendon is named.

"*Archicebus* marks the first time we have a reasonably complete picture of a primate close to the divergence between tarsiers and anthropoids," which include people, Ni said. "It represents a big step forward in our efforts to chart the course of the earliest phases of primate and human evolution."

Archicebus has an unusual blend of features never seen in this combination before, making it hard for the scientists to interpret, they added. This study of the fossil included a detailed 3D reconstruction, aided by high-tech scanning of the sample.

Archicebus differs radically from any other primate, living or fossil, known," said co-author Christopher Beard of the Carnegie Museum of Natural History in Pittsburgh. "It looks like an odd hybrid with the feel of a small monkey, the arms, legs and teeth of a very primitive primate, and a primitive skull bearing surprisingly small eyes. It will force us to rewrite how the anthropoid lineage evolved."

The most unusual aspect of *Archicebus* is its feet, Gebo added.

"We see typical robust graspring big toes, long toes and nailed digits of primitve arboreal primates, but we also have rather monkey-looking heel bones and monkey-like long metatarsals, often viewed as advanced features that you would not normally find in a primitive earlhy Eocene fossil primate".

"We have interpreted this new combination of features as evidence that this fossil is quite primitive and its unique anatomical combination is a link between the tarsier and monkey-ape branches of dry-nosed primates," he said. "This new view suggests that the advanced foot features of anthropoids... are in fact primitive for the entire lineage of dry-nosed primates."

Gebo said primitive primate fossils have been discovered on several continents, including North America, but he believes *Archicebus* and other ancient fossils point to Asia as the continent where primates of originated.

"In the past, many scientists believed that Africa was the continent of origin for all primates, but it appears over the last decade that Asia is the more likely continent of origin, and this new skeleton supports that view," Gebo said.

Courtesy of Northern Illinois University and World Science

NEW PRINCIPLE MAY HELP EXPLAIN WHY NATURE IS QUANTUM

Like children, scientists are always asking "why?" One question they've yet to answer is why nature picked quantum physics, in all its weird glory, as a sensible way to behave.

Researches Corsin Pfister and Stephanie Wehner at the Centre of Quantum Technologies at the National University of Singapore tackle this question in a paper published May 14 in the journal *Nature Communications*.

Things that follow quantum rules, such as atoms, electrons or the photons that make up light, are full of surprises. They can exist in more than one place at once, for instance, or exist in a shared state where the properties of two particles interact in what Einstein called "spooky action at a distance," no matter the distance between them. Because experiments have confirmed such things, researchers are confident the theory is right. But it would still be easier to swallow if they could show quantum physics sprang from underlying principles that seem sensible.

One way to approach the problem is to imagine all the theories one could possibly come up with to describe nature, and then work out what principles help to single out quantum physics.

A good start is to assume information can't travel faster then light, as established by Einstein's theory of relativity, but this isn't enough to define quantum physics as the only way nature might behave, Pfister and Wehner say.

They think they have come across a useful new principle, which is very good at ruling out other theories," said Pfister. In short, the principle is that if a measurement yields no information, then the system being measured has not been disturbed. Quantum physicists accept that gaining information from quantum systems causes disturbance. Pfister and Wehner suggest that in a sensible world the reverse should be true too. If you learn nothing from measuring a system, then you can't have disturbed it.

Consider the famous Schrodinger's cat paradox, they say, a thought experiment in which a cat in a box simultaneously exists in two states (this is known as a "quantum superposition.") According to quantum theory it is possible that the cat is both dead and alive—until, that is, the cat's state of health is "measured" by opening the box. When the box is opened, allowing the health of the cat to be

measured, the superposition "collapses" and the cat ends up definitively dead or alive. The measurement has disturbed the cat.

This is a property of quantum systems in general. Perform a measurement for which you can't know the outcome in advance, and the system changes to match the outcome you get. What happens if you look a second time? The researchers assume the system is not evolving in time or affected by any outside influence, which means the quantum state stays collapsed. You would then expect the second measurement to yield the same result as the first. After all, "If you look into the box and find a dead cat, you don't expect to look again later and find the cat has been resurrected," said Stephanie. "You could say we've formalized the principle of accepting the facts."

Pfister and Wehner argue that this principle rules out various theories of nature. They note particularly that a class of theories they call "discrete" are incompatible with the principle. These theories hold that quantum particles can take up only a finite number of states, rather than choose from an infinite, continuous range of possibilities. The possibility of such a discrete"state space" has been linked to quantum gravitational theories proposing similar discreteness in spacetime, where the fabric of the universe is made up to tiny brick-like elements rather than being a smooth, continuous sheet.

As is often then case in research, Pfister and Wehner reached this point having get out to solve an entirely different problem.

Pfister was trying to find a general way to describe the effects of measurements on states, a problem that he found impossible to solve. In an attempt to make progress, he wrote down features a "sensible" answer should have. The property of information gain versus disturbance was on the list.

He then noticed that if he imposed the property as a principle, some theories would fail. Pfister and Wehner are keen to point out it's still not the whole answer to the big "why" : theories other than quantum physics, including classical physics, are compatible with the principle. But as researchers compile lists of principles that each rule out some theories to reach a set that singles out quantum physics, they say, the principle of information gain versus disturbance seems like a good one to include.

Courtesy of National University of Singapore and World Science staff