EVERYMAN'S SCIENCE

Vol. XLIII No. 4 (Oct. – Nov.'08)

COVER PHOTOGRAPHS ***(From the Top)***

Past General Presidents of ISCA

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2. **Dr. K. S. Krishnan (1949)**
3. **Prof. P. C. Mahalanobis (1950)**
4. **Dr. H. J. Bhabha (1951)**
5. **Dr. J. N. Mukherjee (1952)**
6. **Dr. D. M. Bose (1953)**
7. **Dr. S. L. Hora (1954)**

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

Annual Subscription : **(6 issues)**

Institutional Rs. 200/- ; Individual Rs. 50/-

Price : Rs. 10/- per issue

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EDITORIAL

CHIK CHALLENGES

Chik, a synonym of Chikungunya, an almost unknown disease in India has now suddenly become a new threat to public health as it has spread like fire affecting 216 districts in 17 states of our country starting its recent (?) journey since 2006.

Chinkungunya is a local word used by a tribe in Tanzania in Africa, meaning 'to contort or bend'. This word has been used to describe the clinical manifestations of a virus epidemic that took place in 1952-53. The disease is wide spread in Africa. It is also present in Saudi Arabia, Borneo, Malaysia, the Philippines, Thailand, Cambodia, Vietnam, Myanmar, Sri Lanka and India. The disease results in crippling arthritis and noting similar symptoms it has been stated that this viral infection did probably occur in epidemic form in 1779 in Indonesia.

Chikungunya is an arthropod-borne alphavirus belonging to the family Togaviridae. The virus was isolated in Africa in 1952-53. In Africa the main vector mosquito is *Aedes aegypti*, but there is a forest cycle, that is maintained by *Ae. Africanus* and a few species of Mansonia mosquitoes, and baboons and monkeys may serve as reservoirs. In other parts or the world only the human cycle exists, where *Culex quinquefasciatus (C. fatigans)*, *C. tritaeniorhynhus* and *C. gelidus* act as vectors. The incubation period in mosquito is about 8–11 days. After the bite of an infective mosquito the disease may manifest in man within 2–4 days.

The disease is biphasic. After 1–4 days the fever subsides and there may be an afebrile period of 3 days. The fever then returns. A red rash appears on the trunk and extensor surfaces of the limbs. After another 3–6 days complete recovery occurs with remission of the fever. Usually no chronic sequelae are there, but a crippling arthralgia may remain for upto 4 months.

The Indian scenario of Chikungunya is mysterious as well as interesting. The virus was first isolated in India during the outbreak of Dengue haemorrhagic fever in Kolkata in 1963. The epidemic continued up to the early part of 1965. Although the virus was isolated in Kolkata in 1963, examination of sera collected in 1960 from Kolkata and elsewhere revealed antibodies to Chikungunya virus indicating that this virus of an antigenically related virus was active in this area many years before the outbreak of haemorrhagic feve. Subsequently the virus was detected in Chennai and Vellore in South India. In one case both Dengue and Chikungunya viruses were isolated.

A serosurvey conducted by Calcutta School of Tropical Medicine in 1995 in Kolkata and its suburb revealed the presence of Chikungunya antibodies only in 4.37% of the population and that too only in those people who were above the age of 50 years thereby indicating that the disease was quiescent for nearly three decades.

Most of these investigations were carried out in 1960s. As its biphasic phase the disease remained practically silent. Then there was a sudden, serious, spectacular severe outburst after a lull of many years. In 2006, total fever cases / suspected Chikungunya fever cases in India were 1390322, of which 15961 samples were sent to NIV / NICD and 2001 were confirmed cases of Chikungunya. The corresponding figures of 2007 were 59535, 7837 and 1826 respectively. No death of course was recorded.

In West Bengal the nature and extent of the disease were studied in a bit detail. Out of a total of 800 patients on whom serosurvey was conducted in 2007, 321 (40%) were reactive in 9 out of a total of 18 districts. The disease affected 4–70 years of

age, 66% of the patients were males. 4 suspected deaths were encountered, authenticity of which was not confirmed. In Chikungunya, usually there is no haemorrhagic or central nervous system complications. However, in Asia it has been associated with mild haemorrhagic feature, but no shock. It is to be noted that in Chikungunya though rare, death up to 0.4% was recorded, but in patients under 1 year of age it may be as high as 2.8% and similarly over the age of 50 years, the death rate may increase.

The symptoms of the disease were also studied meticulously. Fever, with occasional chill and rigor, arthralgia (joint pain), reddish skin rash, severe myalgia (muscle pain), enlargement of lymphnodes, nausea, photophobia, congestion of conjunctivae, etc. were observed. In one case gum bleeding was found.

Epidemiology of Chikungunya needs to be studied very effectively to solve several problems. Why and how this sort of countrywise resurgence occurred after a lull of about 43 years should be thoroughly investigated. It seems that Chikungunya overwhelmed Dengue. The most important study would be to incriminate the vector. Is the same vector transmitting both Dengue and Chikungunya or there are different vector/s that transmit Chikungunya ? Unless this is conclusively known, effective control strategies cannot be formulated, for which geospatial investigations are also needed to adopt integrated measures. As a preliminary probe, addresses of the victims are plotted on the map of Kolkata and certain sensitive areas have been identified suggesting micro-environmental manipulations.

Diagnostic facilities are extremly limited. MAC Elisa Kits are available having certain limitations. IgM would be reactive after at least 5 days of onset of the disease, by which time the disease itself may subside. Again available MAC Elisa kits require standardization as in a small survey these kits fail to detect the presence of antibodies where HAI test, still known as the goldtest, was found to the positive ; but this test is time consuming and cumbersome requiring paired samples. So diagnosis of Chikungunya is mainly symptomatic, yet then the blood should be examined for Malaria parasite and platelets, the diminishing count may indicate secondary Dengue, which then can be managed effectively. This differential diagnosis plays a pivotal role in areas where Malaria, Dengue and Chikungunya coexist. Concurrent infection is also possible which should also be kept in mind. Antigen detection kits should also be developed, where at the onset, the disease can be detected. Such type of kits are found to be available in the market so far as Dengue is concerned.

As there is no speific medicine, the treatment is obviously symptomatic. Death usually does not occur due to Chikungunya, but close observation is needed for the children and aged persons. Clinical manifestations of this so-called new disease which perhaps is going to exist should also require adequate attention.

Genetic studies of the virus should also be planned in the light of mutation. Chikungunya challenges the scientists in the concerned fields.

This challenge must be accepted.

Dr. Amiya Kumar Hati

We know what we are, but know not what we may become
—William Shakespeare

PRESIDENTIAL ADDRESS

SCIENCE AND OUR PROBLEMS

DR. J. N. MUKHERJEE*, D. Sc. F. N. I.

I deeply appreciate the honour my scientific colleagues have done me in electing me to preside over the thirty-ninth session of the Indian Science Congress, being held once again in the city of its birth, at the invitation of the University of Calcutta, my *Alma Mater*, which I had the privilege to serve as a teacher for 30 years.

For several years past, the Prime Minister has, inspite of the heaviest demand on his time, made it convenient for himself to encourage us by his distinguished presence. We all owe him the deepest debt of gratitude for his unfailing interest in the promotion of Science.

With the advancement of the Department of Scientific Research to the status of a Ministry, Science has secured a more definite place of recognition in the counsels of the state. In this and other developments, Dr. S. S. Bhatnagar has played a very vital role and his scientific colleagues feel proud of his achievement.

SCIENCE AND OUR PROBLEMS

The deliberations of the annual session of the Indian Science Congress constitute a measure of the progress of Science and technology in India and we may feel satisfaction at what has already been achieved. During the past few years, a programme of expansion of facilities for scientific research and training has been undertaken by several ministries of the Central Government supported in some instance by public benefaction. Some of the existing institutions are being further developed and a number of new institutions have been or are being established. Together they will make no inconsiderable contribution to the progress of Science and Technology.

A representative number of non-official scientific societies, all of which are engaged in activities essential for the promotion of Science, has been built up by the unfailing devotion of scientists of India. The recognition given to the National Institute of Sciences of India marks the beginning of a fuller cooperation between the scientific talent of the country and the State ; which is absolutely necessary for the ordered progress of science, technology, agriculture and industry.

Organized scientific research in India is still in its early stages of development. Our sum total contribution to the knowledge of science and technology is relatively small as yet and we have a long way to go if we are to fall in line with the countries in the forefront of scientific developments. Economic and social problems are many and the supreme need is increased industrial and agricultural production. The Government and industries have undertaken several large-scale programmes of development, and a five-year plan of further development is being worked out by the Government. In many fields we are very much dependent on foreign experts, whose help we welcome. Until however, the necessary scientific

* General President, Thirty-ninth Indian Science Congress, held at Calcutta during January, 1952.

and technological knowledge and experience are available within the country, the development of our resources is bound to be slow, unbalanced and costly.

Scientists may ask themselves the question whether they are participating to the fullest extent in planning, framing and implementing the programmes of development. There has been in recent years, frequent references to the standards of training in educational institutions. The universities are the backbone of scientific and technological training and university research still forms the "spear-head" of scientific progress. In the intellectual sphere, quality is more important than quantity. A low standard of training and level of research will constitute a great handicap to our progress.

We may consider to what extent use is being made of the existing scientific knowlwdge in industry and agriculture. Even in such an advanced country as the United Kingdom, it has been found desirable to establish an Advisory Council on Scientific Policy, directly under the Cabinet, in order to ensure that existing scientific and technological knowledge is fully utilized in practice.

The manner in which Science and technology can best be promoted and may contribute to the solution of our problems should find a place in the thought and deliberations of scientists of India.

Some people think Science to be magic and consequently have expectations from it which cannot be fulfilled. There is a much greater number perhaps who think that a scientist engaged in an investigation should produce results quickly and if he cannot do so, he is no good. There are others who have no patience with what they call "academic" scientists, and consider that the need of the hour is "practical" scientists ; but fail to recognize how much Science the latter must know to make themselves practically effective and the harm that will result if "academic" Science is sterilized. They perhaps fail to distinguish between the technologist and the technician both of whom are essential for industry.

More widespread and systematic dissemination of scientific information through Science writing, the press and the radio is sure to educate public opinion.

THE SCIENTIFIC WAY OF THINKING

In successive sessions of the Indian Science Congress, the Hon'ble Pandit Jawaharlal Nehru, in his stimulating addresses to us, has stressed that the scientific way of thinking, if properly cultivated, could substantially contribute to the cure of many of the ills which today affect us and the world at large. This is a subject of very wide implications and comes within the purview of the Committee of Science and Social Relations of the Indian Science Congress. There are some socio-political problems regarding which they may be able to make useful suggestions.

Superstition, ignorance and the domination of preconceived notions unsubstantiated or contradicted by facts stand in the way of rational and objective thinking and cloud reasoning. They may also obstruct the adoption of measures based on well-established scientific knowledge for the improvement of social and economic condition.

EDUCATION IN THE METHODS OF SCIENCE AND THE DISSEMINATION OF SCIENTIFIC INFORMATION

The study of natural objects in the immediate environment could be made an esential part of the earlier stages of the curriculum of studies in schools. Simple observations on, and accurate descriptions of common flora and fauna, physiographic features and climatic conditions, could form the contents of such studies. It should also be possible to illustrate

some typical and simple facts of Chemistry, Physics and Mechanics with the help of objects the students are familiar with. This will create in them a real interest in the environment which is desirable in itself.

Adult education affords great scope for the promotion of the scientific way of thinking. The lectures, illustrated with sketches, diagrams, experiments and films could deal with subjects, having a direct bearing on the daily life and environment of the men and women attending them.

The science teachers in schools will require supplementary training in suitably equipped centers. The provision of ancillary facilities is an offical responsibility. Many items will admit of production at a low cost since they will be required in large numbers, and the rest may be prepared or collected by teachers and students.

There is in existence a number of publications in different parts of the country which are devoted to the dissemination of scientific and technical information in a popular or semi-popular language. Books on scientific subjects written in non-technical language are also being published in increasing numbers. Official support—financial and otherwise—is, however, necessary and the sums involved need not be beyond the capacity of the State, as voluntary effort is forthcoming. The award of prizes, medals and certificates of merit based on such advice and the translation of the best publications in foreign languages with suitable adaptations by arrangement with the publishers, are economically feasible methods of stimulating sicence writing. I may mention the donation of one thousand pounds by Mr. Patnaik for the award, through the UNESCO, of a prize for science writing.

Articles dealing with the activities of scientists in universities and other research institutions seldom appear in the press. This is perhaps partly due to the paucity of suitable articles. It may also be due to the fact that newspapers have rarely scientifically trained men in their establishments or amongst their correspondents.

Science writing has a large field of useful activity, but a science writer to be successful must have a thorough basic training in the field to be covered by him, power of expression and simple literary style. He has to be well-read and a serious student and should have access to a good library. Much harm can be done by incompetent writers.

The translation and uniform use of technical terms and words, which are foreign to our languages, deserve immediate attention. We have also a great opportunity of developing their common use in all Indian Languages if we act quickly.

SCIENTIFIC SOCIETIES

Journals and other publications issued by societies serve the essential function of making the results of research known. Through these, the standards of research are also determined. Almost all societies do not publish papers without scrutiny by referees. The maintenance of a high standard will increase their circulation and make Indian contributions to Science more widely known. Only a very small number of scientific societies have been able to arrange for periodic scientific discussions and conferences, which play an essential part in the promotion of Science. Specialists meet very rarely to discuss problems of common interest. The scientist working in isolation suffers from many disadvantages and in these days of rapid scientific developments, he may develop an unbalanced view of his subject and even of his own work. He misses the stimulating effect of criticism and the benefit of information obtained in discussions. For the progress of many branches of Science, periodic excursions by groups of scientists are also essential. The extension of the concession

in railway fares which has been granted for attending the sessions of Indian Science Congress and the grant of leave on duty will materially help these activities.

From 1939 until recently, scientific journals were not getting sufficient supplies of paper and met with difficulties of printing. Conditions have improved but the increased cost of publication still constitutes to be a great difficulty. But for the grants made available by the Department of Scientific Research through the National Institute of Science, many of these publication would not have survived. The fees from the small number of members and the grants they are now receiving from official sources are insufficient, although voluntary service is being given ungrudgingly. The realization by the public and the industry of the good these societies are doing is overdue.

NATIONAL COMMITTEES

National committees for the major branches of Science exist in many countries. The constitutions of the International Unions of Science and their coordinating body, the International Council of Scientific Unions, as also of several other international scientific organizations provide for the establishment of such committees by "adhering countries". In a few cases, such committees have been formed in India, but they are yet to be established in most of the major branches of Science. The matter is under consideration by the government and it is hoped they will be established during the year.

These committees may be assigned another useful function. They could, in cooperation with the scientific bodies they represent, keep under review problems relating to the progress of Science.

INTERNATIONAL CONGRESSES AND CONFERENCES

In 1950 and 1951, a number of international scientific conferences have been held in India at the invitation of the Government. This is a very welcome development. They enable the largest number of our scientists to participate in such conferences. Invitations extended individually or in groups to eminent scientists, whose cooperation Indian scientists feel to be desirable, to stay in India for periods varying from 3 to 6 months and work in association with their Indian colleagues would also be of material help. As yet, very few Indian scientists have participated in internationally sponsored collaborative research. This is a subject which may be considered by the Indian Science Congress and the National Institute.

STANDARDS OF TRAINING AND RESEARCH

It is well-recognised that planning is as much necessary for the development of scientific research and training as in any other field. During the period of the last war, the Government of the United Kingdom appointed a number of committees, each of which dealt with specific aspects of this subject. This procedure has a great advantage, as it avoids diffuse and voluminous reports and discussions on generalities. The chairmen of the different committees have, however, to work together to evolve a consistent plan. The Sargent report and the reports of the Scientific Man Power Committee and of the University Commission require to be followed by more specific enquiries.

Whether a deterioration of educational standards has taken place requires serious consideration. There is nothing fundamentally wrong with our young men. They are now living in a more eventful atmosphere and they are gradually settling down to the changed conditions. Brilliant young men are surely coming out of the universities and the total number of capable men, both as teachers and research workers have increased. The range of subjects being studied or under investigation is also now greater than ever before. This question, therefore, needs a closer examination.

One of the definite changes that has taken place is the increase in the percentage of candidates who succeed in examinations. A low percentage of passes indicates a low standard of education as also that a higher standard of examination is necessary to screen out the undersirables. But this is wastage, pure and simple. However, an increase in the percentage of successful candidates will in itself have the effect of an apparent lowering of the standard of training. The proper remedy lies in admitting only those who are capable of attaining the standard laid down and to ensure that the instruction, and the laboratory, library and other facilities are adequate and that the same standard is followed in the examination. The gifted young man will always do well in spite of deficiencies in training but he may be handicapped by a meagre basic knowledge which he will have to make good later as best as he can with his own efforts. It is, however, the majority of average intellect who suffer.

It will not be possible to regulate admissions strictly unless an extensive re-orientation in education is effected. The pressure for higher education will increase with time rather than diminish. Diversification of education and its correlation with the needs of industry and agriculture offer a solution.

As a result of the increase in the number of teaching and research institutions, new posts have been created and many of them have to be filled by what is in effect a rapid promotion similar to what has happened in recent years in the administrative services. If is likely to be a passing phase, as with time most of the men already recruited will gain adequate experience, and more qualified men will be soon available.

A much smaller proportion of the more gifted young men is now joining the educational and research institution as opportunities for better types of employment have increased. A certain amount of leakage of scientifically trained men will always take place. Many science graduates are rendering very useful service to their country in eminent positions. There is nothing wrong in this. The remedy lies in turning out a sufficient number to allow for normal leakages and wastage. The most unfortunate leakages are those where a promising young man with a creditable record of research has to leave Science to take up another job only because he cannot get even a modest emolument.

CONDITIONS OF EMPLOYMENT AND RECRUITMENT

Conditions of employment should be attractive for the best brains, as leadership in Science must be maintained at a high level if we are to realize our goal. The uncertainties about their future career and the greatly increased cost of living are causing more worry to young men than ever before, and the considerations, for stable appointment and good living outweight others. The modest recommndations of the University Commission for the improvement in the emoluments of teachers have not yet been given effect to.

Introduction of insurance benefits and free medical service even on a modest scale, in addition to the provident fund contributions, will be helpful to make the teaching and research lines more attractive. The possibility of increasing the employers' contribution to the provident fund is also worth consideration. Men going in for teaching and research lines must have love for their work and should remember that they are getting opportunities to improve themselves and make contribution to knowledge. However, the thesis that learned men should forget their wordly needs, especially the demands of the health and education of their issues and their obligations to their families has no chance of general acceptance.

It is the general practice in universities that for every vacancy of a higher category, a person already

employed has to compete with others. The object is to secure the best qualified person and to ensure a continuous effort on the part of the men for improvement. Success at examinations early in one's career is not the criterion for leadership in research. It is the contribution to knowledge that a man has been able to make which determines his status in Science. The pressure for direct promotion in Government institutions is very great. This is not in the best interests of Science. A continuous scale covering all stages of seniority is also not desirable and is not operative in universities. Even important key positions are kept vacant in research and/or teaching institutions and officiating appointments are continued till a really good man is available. An incompetent man blocks the way of progress and is a bad example to others. Research or training institutions have to be kept alert and vigorous by keeping alive the desire in their personnel for self-improvement and outturn of good work. In most foreign universities and research institutes attempts are made to select the best men wherever they may come from, not only by inviting applications, but also by direct negotiations with qualified persons. Sometimes, even the assistants accompany their chief to a new institution. Also the provident funds or pensionary rights and insurance benefits are transferred to the new place of work. This not only gives an incentive for an improvement, but also great scope for the development of Science and the talent of the country. Such a procedure, if adopted, will also break down the barriers of local patriotism and enrich the country as a whole. Another way to help the promotion of Science and the maintenance of standards is to invite eminent men from other institutions to teach and work for a term or more.

COURSES OF TRAINING

Rapid developments in Science make periodic revisions of textbooks necessary. Courses of instruction, both theoretical and practical, as also aids to instructions require adjustments to the growth of knowledge. Boards of Studies carry out what may be called the annual repairs of the courses of studies, but a thorough overhaul is required at longer intervals.

The basic training that is essential has to be such that on its sure foundations, a student can develop his knowledge and experience in the line he proposes to take up later, and it has consequently to be re-adjusted as knowledge progresses. A student of a degree course in Chemistry must have a good knowledge of Advanced Mathematics. There is now virtually no boundary of separation between Theoretical Chemistry and Chemical Physics, as the contributions of chemists to Chemical Physics will show. Students of human or plant Physiology must have a good grasp of certain branches of Chemistry and Biochemistry. Mathematical Statistics and highly specialized chemical and physical techniques have become very important for some branches of the Biological Sciences. The same is true of Applied Sciences. The chemical engineer and the works chemist are fundamentally chemists. For students of the Applied Sciences, a smattering of basic training and just a little top dressing of the fundamental sciences will not carry them far. A few years ago a conference of entomologists expressed the opinion that an honours degree in Zoology should be the qualification for admission to courses in advanced Agricultural Entomology. The Loveday Committee in their report on the reorganization of agricultural education in the United Kingdom recommended that the "honours tripos part I" or its equivalent should be the minimum qualification for admission to a two years graduate course in Agriculture. The research engineer must have a high standard of knowledge of Mathematics and Physics.

We must be careful to see whether we are turning out applied scientists or technologists and not technicians minus the skill and the practical

experience of the latter. Technicians are required in large numbers and are of essential usefulness but the purposes they serve and their courses of training are different. A young man who gets a university degree has every right to think that he has got a basic grounding in the subject. No blame attaches to him if he cannot rise to his fullest stature because of insufficient or defective training at early stages. This is wastage of a serious nature.

The demand for men having specialized types of experience and knowledge is increasing as is natural. As men with requisite experience are not often available, persons have to be given appointments who have suitable qualifications in a basic or allied subject. Many of them will no doubt, make good in time. The remedy, however, lies in providing for supplementary courses of training in universities and encouraging research in a wider range of subjects. The introduction of a two years Ph. D. course in which regular instructions are provided for as happens in the United States seems to be very desirable. This will make possible an adaptation of the training to the needs of special subjects as also allow supplementary training to be given to make up for deficiencies in the proceding stages.

These are matters for the consideration of the Inter-university Board and the Council of Technical Education. A Council of Agricultural Education, the formation of which the speaker proposed as a member of the scientific Man Power Committee has recently been constituted. It is hoped it will also look after this question and arrange for regular courses of training in those subjects for which no provision exists at present. The standard of agricultural education and research is of vital importance for the success of our plans of increased agricultural production. All agricultural colleges should have an attached farm run strictly on commercial lines. The graduates will then have a background of practical agriculture, agricultural economics and the farmer's problems. They will be better able to win the confidence of farmers and take to farming as a profession, if they like to.

LABORATORY AND WORKSHOP FACILITIES

For a majority of institutions, the position regarding laboratory equipment, chemicals and apparatus and workshop and library facilities is serious. During the war, repairs and replacements were not possible. The cost of all articles have increased severalfold, while the grants have not. Besides, new techniques have developed which require the purchase of new instruments. Adequate grants are essential if desirable standards are to be achieved.

The manufacture of scientific instruments, apparatus and chemicals in India would materially reduce their cost. These industries will not only give employment to a large number of Science graduates but will also improve the general standard of research, as they would employ highly trained scientists in key positions to design new instruments for research. Moreover, it should be possible for universities and other research institutions to make many of their instruments, if they are provided with good workshop facilities and small-scale chemical plants. They have also an educational value. Cooperation between the different institutions each concentrating upon items which it can profitably deal with will be helpful.

LIBRARY FACILITIES AND INFORMATION SERVICE

It is not possible for a scientist to keep himself abreast of the latest developments if adequate library facilities are lacking. It is also not easy, if not impossible, for any man to keep in touch even with publications, which have a bearing on his own

line of research. To meet the needs of the research worker, library information service is essential. There are a number of Science libraries in India, which can serve as centers of information service. The library of the Indian Agricultural Research Institute is the best in the country in the Agricultural Sciences. In the same building the Indian Council of Agricultural Research has a library with a separate staff. It the two libraries are amalgamated, there will not only be a reduction of expenditure but the Indian Agricultural Research Institute library will also be reinforced. The institute has been recently equipped with a photostat and a plan for developing an information service was approved by the authorities several years ago. I am making a special reference to this library, as there are large number of young scientists working on agricultural problems who are scattered all over the country in places where library facilities are very meagre.

FUNDAMENTAL AND APPLIED RESEARCH

The line of demarcation between pure and applied research has not always been very clear except for more or less routine investigations. With the progress of Science, the distinction between them is becoming less sharp and purposeful. The nuclear fission of U 235 was definitely established by the epoch-making work of the famous chemist, professor Otto von Hahn. In this, his well-known earlier researches on radiochemistry and the origin of the actinium series must have been of great help. To apply this knowledge for the evolution of atomic weapons requires a large team of eminent mathematicians, physicists, chemists, engineers and technicians backed by the highest levels of industrial potential. During the war, the evolution of newer types of machines and instruments became of immediate urgency. The objectives were achieved by the cooperative work of a team of scientists, engineers and technicians. I believe that the same method of approach, if followed, will succeed in building up rapidly the knowledge and experience required for the solution of many technological problems concerning our industrial development.

The National Laboratories and the Indian Institute of Technology will, in course of time, render much needed help to the industry. Another happy development is the increasing interest that the large industries are taking in establishing research laboratories of their own. Research associations which have been found very useful in the United Kingdom for those industries who are not in a position to be more or less self-contained as regards research facilities will, it is expected, soon follow.

It appears very strange that in India scientists in universities and research institutions work in virtual isolation from industries. This is good for neither party and is perhaps responsible for the criticism that Indian Science is "academic". Indian scientists have made most brilliant contribution to Science and there is no justification to think that they cannot help the industry. Scientists in universities and research institutions and scientists in industries can certainly inform and reinforce one another and such association is of immediate necessity. This would be of the greatest help for the advancement of Science and technology as also of industry.

I shall now discuss some aspects of the problem of increasing the production from the land.

SCIENCE AND THE YIELD PER ACRE

The Possibilities of Increasing Agricultural Production

There are a few publications in which it has been claimed that the possible limits of crop yield are many times higher than the theoretically maximum yields now obtained anywhere. These are speculative. The history of European agriculture, however, shows how great have been the actual

achievment[1]. "From the fall of Rome to the French Revolution, grain yields in Europe remained at an average of 10 bushels or less an acre. By 1850, they had risen to 14 bushels in France, to 16 bushels in Germany and to over 20 bushels in England. By 1906, they had gone to 20 bushels in France, 30 bushels in Germany and to over 30 in England. Now in Denmark and Netherlands, the average figure is close to 45 bushels with much higher yields on particular farms and the end is not yet. New strains, more fertilizers, new production techniques and modern appliances are all playing their part. On land at present under cultivation it is entirely practicable to increase production on most items by an average of at least 20 per cent". During the last war, the U. S. A. increased food production by about one-third with very little increase in the acreage and the U. K. by more than 50 per cent, by increasing the acreage and the yield.

The possibilities on increasing agricultural production in India and methods of doing so have been discussed in a number of publications[2]. Dr. W. Burns[2a] estimated that if all known methods of improvement are put into effect then under present conditions, "there should be no difficulty in increasing the present average outturn (of paddy) by 50% ; 10% by variety and 40% by manuring". For wheat, he concluded that an even greater percentage of increase is possible. An increase of 50% can be had from irrigation alone. The conference of agricultural scientists[2c] held in April 1949 at the instance of the then minister of Food and Agriculture, H. E. Mr. Jairamdas Daulatram has discussed the subject in detail. There are, however, many difficulties to be faced.

SOME BASIC CONSIDERATIONS

Our agriculture is very much dependent upon the vagaries of the monsoon. About 80% of the cropped area is dependent upon rains, The land now under arable cultivation per capita is on an average about 0.6 acre.

The small size of holding and their sub-division into scattered still smaller units cause many problems. It is difficult and some times impossible to adopt many improved techniques. Compact blocks of farm land of sufficient size which will give a desirable standard of living will make easier the utilization of methods of improving production. But it is not easy to achieve this.

As in other fields of economics, there is a close relation in agriculture between the input of labour, skill, knowledge and money and the outturn. The production of food grains, however, is in the main, the occupation of the least literate and poorest section of the community. It is perhaps significant that the average yields of wheat and paddy have practically remained stationary[2e, 2b], if not decreased, in spite of improved varieties and increased facilities for irrigation, while that of tea, coffee and sugar-cane is increasing. Finance and the facilities which it commands perhaps make the difference. Credit facilities and supplies which the farmer needs for production but cannot get unless their procurement and distribution are organized on a large scale have to be made available to him.

Thus, while methods are known for increasing the production, difficult problems have to be faced for utilizing them. Consequently, various measures which have been, or are being adopted for increasing production may not show as quick results as we desire but they will undoubtedly gather momentum with time. The next few years may give cause for anxiety.

PLANS OF PRODUCTION AND STATISTICS

Various estimates have been made of requirments of food, fodder and raw materials for industry. The latest is that of the Planning Commission[3], which estimates that the extra quantity of foodgrains to be produced in 1956 will

be about 7 million tons on the basis of 13.67 oz per adult per day and about 16 million tons on the basis of 16 oz. The quantities of materials and the sums of money involved are so large, the difficulties of procurement and of internal and external transport so great, that large errors in estimates of production may have undesirable consequences. Estimates are necessary not only of "normal" production and of present and future requirements but also of the fluctuations, caused by the departure from the "normal" of each major factor determining the production. Every year one area or other will be subject to droughts and floods and we should be able to obtain fair estimates of the loss in production resulting from "natural calamities" and of the gain from a "favourable" season in order that the results achieved by the measures adopted and the deficit or carryover can be assessed.

The steps that are being taken for improving Agricultural Statistics are welcome, but it is very desirable that a system of enumeration through questionnaires is gradually developed. It will be unwise to rely absolutely on any one method such as the random sample method. Even the estimates of "normal" production are not easy to arrive at, as admittedly Statistics in the past have not been very accurate. The village records and cooperating farmers can supply useful information.

THE YIELD PER ACRE

There are three lines of increasing production from the land : the fullest possible use of all available land, an increase in the intensity of cropping and yield of each crop per acre. The intensity of cropping will be determined by the sequence of crops which will maintain the soil productivity at the highest level realizable in practice.

Our climatic conditions have the advantage[2] that two, and in some areas even three, crops can be produced in one year on the same land. Large areas are, however, under a single crop ; for example, in West Bengal, more than 80 per cent of the cropped land grows only one crop (late paddy).

The productivity of a soil[4] depends in a given climatic setting on the properties of the soil, on all factors of its management which contribute to fertility and on the protection of the crop from damage or loss caused by such factors as pests, diseases and lodging. Either for the short-term or long term programmes, methods of increasing the yield per acre are of the greatest importance.

Research on the problems of agricultural production forms part of the general structure of agricultural research and the progress of both are interrelated.

The establishment of the Indian Council of Agricultural Research, the commodity committees and the crop research institutes has given great impetus to agricultural research. Its present structure has been built up by the devoted services of Mr. T. Vijayaraghavacharia, the late Sir Bryce Burt and Mr. P. M. Kharegat, Valuable contributions have been made by agricultural scientists of India. However, considering the needs, their number is small and facilities are limited. Besides, the setup of the commodity committees as is understandable, has stressed more the applied aspects, relating to crops which are raw materials for large industries. The establishment of the Rice and Potato Research Institutes has enabled more attention to be given to these two crops. However the problems of the farmer and several basic branches of the Agricultural Sciences, such as soil survey, plant (and insect) physiology and ecology ; agricultural economics and agricultural engineering, have not received systematic attention worthy of their importance. This lack of balance deserves to be corrected.

THE CROPPING SYSTEM

The plant breeder in India has evolved many

improved varieties, many of which are now being extensively cultivated. There are some aspects, however, which merit more intensive and extensive investigation.

Varieties should be evolved to suit all significant differences of soil and climatic conditions, which are of improtance to the yield. This has been the aim and achievement of the breeders of hybrid corn in the U. S. A. and of rice in Japan. The average yield of hybrid corn is the highest in the U. S. A. and that of rice in Japan is 3,000 lbs per acre. Both countries also use manures and fertilizers in very large quantities. In Madras, work has been done to evolve varieties to rice on somewhat similar lines.

While breeding against disease resistance has been on the programme of work on some crops, it is not as extensive or intensive as is necessary. For example, until lately no systematic attempt was made to breed sugar-cane resistant to red rot, one of its worst diseases. Co203, an improved strain was wiped out after introductions into cultivation. In the U. S. A. breeding for resistance against mosaic is considered most important for cane.

Large crop yields carry with them the danger from lodging which causes considerable damage under our climatic conditions. Resistance to lodging deserves to be an item in the breeding programme. The height and strength of the stalk, and the root system as also soil conditions are important. The requirements of mechanised cultivation may also need attention.

The aim of agricultural research is to develop a system of permanent agriculture. The crop rotation occupies a high place in it, as the productivity of the soil depends on it. Grasses and legumes build up the structure of the soil and improve its fertility. Cereals deplete it. Suitable crop rotations balance the depletion. In ley farming the fertility created by grasses and legumes grown for a number of years is utilized in producing succeding grains crops. As there is very little of pasture land, crop rotations in which grasses and legumes have been included and ley farming are of essential importance. They would give in addition to grains much needed nutritive fooder for farm animals and increase largely the milk production.

Most countries have developed suitable crop rotation. It is well-known that the introduction of the Norfolk rotation resulted in a great increase in the average yield of wheat in the U. K. A recent experiment in Australia may be cited. The average yield of wheat grown continually for 17 seasons was 15.2 bushels. The best of five rotations tried included a fallow but gave 43.79 bushels of wheat in addition to 55.27 bushels of oats and 31.58 cwts of air-dried winter pasture in a 4-course rotation.

The plant breeder is faced with a continuous struggle and he requires plant material which could be utilized for his work. Collection of these have to be made even by special expeditions, if necessary, from wherever they can be had. Because of the wide variation in the soil and climatic conditions, India has a very rich flora, which include also medicinal plants and plants like pyrethrum which are sources of important insecticides. But the flora cannot be fully utilised unless its study is adequately organized. Some of our most important crops ; potatoes, many winter vegetables, tomatoes, tobacco and cinchona have been introduced from other countries by pioneers, all of whom were not scientists. The possibility of such direct introduction has not been exhausted. There is a great scope especially for the introduction from outside of grasses and legumes into crop rotations and ley farming, and for erosion control.

It is very necessary that a Bureau of Plant Introduction is established which will enable a coordinated approach and systematic attention to

the problems of plant introduction. A proposal for its consitution was formulated a few years ago and it is hoped that it will soon be established.

The present supply of seeds of improved varieties is not sufficient. Seeds should be of good quality. As in other countries, seed growing should be developed as an industry and managed by Seed Growers Association. It will then be easier to enforce the provisions of a Seed Act, which is necessary for the regulation of the production and sale of seeds. The losses in yields due to bad germination are considerable. The quantities of useless seeds that are wasted in the fields will alone run into several hundred thousand tons. Estimates of such losses will convey to people an idea of their magnitude.

SOIL SURVEYS

The farmer everywhere knows that there are many kinds of soils. Soil surveys enable us to determine their characteristics, kinds and distribution and to classify them. In the soil map, the boundaries of different kinds of soils are delineated. Soil surveys are very important for the planned utilization of land. They give valuable information on the possible uses of the land and their comparative advantages and disadvantages. The results of experiments carried out with one variety of soil have little significance for another.

We owe the origin of the scientific study of the soil as a natural body to Russians. Previously, two ideas dominated soil studies. One descending from the great German chemist, Liebig, which considers the soil to be merely a reservoir of plant nutrients, withdrawals from which by plants have to be made good. Maps are prepared showing the contents of the total and available plant nutrients in the surface soil. Such chemical estimation are even now made and are very useful but they provide no scientific basic for the classification of soils.

According to the other point of view, soils were classified on the assumption that each geological formation gives rise to a soil characteristic of it and "the map of the surface Geology could be translated with due interpretation in the soil map"[7]. It has however been found that different soils develop from the same geological formation and that climate, vegetation and relief have a dominating effect on soil formation.

The scientific classification of soils now centers round the characteristic of the soil profile, i.e., a vertical section of the soil in which "a sequence of genetically related horizons" is seen and they carry on them the impress of soil forming processes. Many of the alluvial soils of India have genetically related horizons, but alluvial soils which do not show them are also classified in soil surveys.

Soil survey has developed into a specialized subject[2]. The reports on the survey contain information dealing with not only the characteristics of the soil and its profile, but also the existing and potential use of the land, the yield being obtained by the farmer or by experimental stations under different systems of mangement, erosion and drainage conditions, and possibilities of reclamation or suitability for irrigation, where these are necessary. Soil maps and survey reports form the basis of the planned utilization of the land and they have also been found useful in road and building projects. During the last war, they were widely used by army engineers.

Before undertaking an irrigation project, a soil survey is carried out. The history of irrigation shows that many soils have been damaged or ruined due to the rise of the water table and salinity or alkalinity. In the U. S. A. soil survey[8], the individual mapping units are grouped under five classes defining the degrees of suitability for irrigation. Such classification is necessary from economic considerations and to assure the best use of water.

The main purpose, of soil surveys however, is to make an inventory of soil resources. The scope of a soil survey is determined by the purpose in view.

Unless common methods and nomenclatures are followed by soil surveyors, confusion will result. Sir John Russell, in his report to the Indian Council of Agricultural Research, stressed the need for appointing a committee of soil experts for this purpose. Such coordination is effected in all countries.

The importance of a systematic soil survey has been emphasized by soil scientists in India. Some comments of the Royal Commission on Agriculture might have been responsible for lack of attention to it. A number of soil surveys has, however, been carried out through the zeal and enthusiasm of individuals. The work of Indian soil scientists has been highly appreciated by eminent men who have visited India.

A detailed soil survey is costly and sould be undertaken only when it is essential to do so. For carrying out a systematic survey with limited resources, the most suitable approach seems to be, first to map out the basic soil and climatic regions[9]. Such maps can be prepared on the basis of available knowledge of soils, geology, relief, vegetation and climate. Within each, region, important "soil associations"[8b] may be determined by a reconnaissance soil survey and representative sample areas could be selected for classification and mapping by a detailed basic soil survey. Alternatively, strips may be selected at random as samples. This will give us much needed information which can be of immediate use. As the soil survey progresses, the information will improve both in detail and extent.

Because of the great progress made by the U. S. A., soil surveys in England, Australia and some other countries are now modeled on the U. S. A. pattern. It is necessary for us also to do so, at least in the beginning, as recommended by the Central Soil Science Committee.

The climatic maps also could be developed to give more information and detail for purposes of plant ecology and plant introduction.

It is necessary to make provision for the training of soil surveyors. A knowledge of the parent material from which the soil has developed and of the vegetation is required for soil classification. It is also necessary to know the surface geology of the area and to use geological maps. Geologists are consulted for further information. A soil surveyor should have a general knowledge in these subjects in addition to his basic training in soil science and general agronomy. Detailed field experience is the basis of his training. Field observations are supplemented by physical and chemical examinations in the laboratory.

THE USE OF MANURES AND FERTILISERS

Without the use of very large quantities of fertilizers, it will not be possible to maintain high yields and to achieve agricultural production in the quantities required. Europe, America and Japan have been using fertilizers for a long time for this purpose. In Japan, roughly half the plant food comes from bulky organic manures and half from fertilizers and most of the straw is used for preparing manures and composts. Her consumption of fertilizers per unit area of arable land is one of the highest. In Europe and America bulky organic manures still form a major source of plant food, and all practicable measures should be adopted to increase their supply in India. But fertilizers are neessary to supplement them. Farm yard manure and composts have their virtues but we cannot afford to make a fetish of them.

The following Table shows how the world production of fertilizers[10] is rapidly increasing.

For making recommendations to the farmer, it is necessary to mention the quantities and ratios of manures and fertilizers he should use and the increase in the yield he may expect in order that he can assess the economic advantage of the proposed treatment. A majority of experiments so far carried out are not suitable for giving such advice. Often sites and plots have been chosen without due regard to their suitability for experiments. It is not uncommon that the control plots[11] ("no manure") show higher yields than those treated with manures and fertilisers. The largest number of experiments are of very short duration, from one to three years. Data on soils of the experimental plots are generally lacking. Soil maps of experimental farms have not been prepared in most cases. Experiments with mixed fertilisers as also on different compounds of nitrogen and phosphate have been very rare. High yields and full benefits from improved seeds and irrigation cannot be obtained unless manures and fertilisers are used in adequate quantities based on experimental results.

Estimated Consumption of Fertilisers.1
(thousand tons plant food.)

Region	1936–38 Average			1946–47			1947–48			1948–49		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Europe	1,277	2,011	1,742	1,189	1,594	1,530	1,437	1,980	1,895	1,470	2,239	1,991
North & Central America	374	703	410	741	1,647	826	832	1,760	877	956	1,863	987
South America	31	22	10	46	73	14	47	77	17	53	71	23
Asia	463	297	116	325	130	66	475	176	23	489	237	189
Africa	86	74	11	50	88	23	69	96	26	91	111	31
Oceania	17	345	15	11	357	9	14	386	10	15	452	8
World total[2]	2,248	3,452	2,304	2,362	3,889	2,468	2,874	4,475	2,848	3,074	4,973	3,229

[1] Estimated by F. A. O., excludes ground phosphate rock.
[2] Excluding U. S. S. R.

Five tons of commercial ammonium sulphate and five of super-phosphate are roughly equivalent to one ton of N and one ton of P_2O_5 respectively. Thus, nitrogenous fertilizers equivalent to 15 million tons of ammonium sulphate and phosphatic fertilizers equivalent to 25 million tons of superphosphate are being used mostly in Europe, America and Japan.

The Sindri Factory has come into production and will meet our present needs to a substantial extent. But much larger quantities of fertilizers including phosphates (and perhaps potash) will be necessary. The rated capacity of production of superphosphates is only about 100,000 tons. The manufacture, procurement and distribution of fertilizers merit detailed consideration and planning. Estimates of the quantities of fertilizers we require have to be prepared in advance. The available results of manurial experiments indicate the general need of nitrogen and in many cases of phosphates but only very rough and imperfect estimates of the requirements can be made.

Sir John Russell, in his report to the Indian Council of Agricultural Research, stressed the desirability of carrying out trials in the plots of farmers, of results obtained in experimental stations. Dr. A. B. Stewart, in his report to the I. C. A. R., has given details of these and other essential experiments. A committee after examining his proposal made detailed recommendations for further experiments. The I. C. A. R. is financing : the experiments on farmer's plots. This is, however, only part of the problem. Properly designed and systematic experiments on manures, fertilisers and crop rotations are necessary on a large-scale on the major kinds of soils of each state.

Chemical analyses of soils and also of fertilisers and plant materials are carried out in enormous number for soil surveys, laboratory and field experiments and advisory service. Very few experimental stations have the requisite laboratory facilities. Colorimetric and spectrographic measurements are being used for many of the analyses as they are more rapid than chemical methods. It may be of interest to many that new spectral, analytical and chemical methods are being developed in experimental research stations and soil research institutes.

SOIL STRUCTURE

The importance of soil structure as a factor in soil fertility is becoming increasingly realised. For the growth of the plant, its roots must spread in order that the delicate structure of root hairs have access to plant nutrients. They thrive only if there is an adequate supply of water and air. In several countries having plantation sugar-cane, continuous high yields obtained by irrigation and heavy applications of manures and fertilisers have created problems. Chemical analyses show that common plant nutrients are not lacking but something has happened to the soil which is interfering with its productivity. It was thought that the cane itself is deteriorating, but this is not likely, as it is propagated vegetatively. Unfavourable conditions might have been produced for beneficial soil micro-organisms. The deterioration of the soil structure seems to play a direct part. Soil micro-organisms have an important influence on the soil structure. The soil organic matter, formation, decomposition and transformation of which are caused by micro-organisms is of great importance in relation to soil fertility and soil structure.

More experiments on soil structure and other physical properties of soils such as permeability, porosity, moisture retention capacity are desirable. Soil fertility depends on a large number of complex factors, all of which are not known. Physical properties of the soil are no less important than chemical properties. Methods are available for studying these properties but it is necessary to develop better methods, as is being done in several countries.

The clay fraction determines many physical and chemical properties of soils. The mineralogical composition determines the properties of clays. X-ray studies and differential thermal analysis of clays have now become a necessary line of work in soil laboratories. The electrochemical properties of clays are fundamentally important for an understanding of soil behaviour.

Road and building research stations and geological departments are also taking an active part in the study of clays. Vast deposits of clays occur. They have many industrial uses and are also potential sources of metals in short supply.

DEFICIENCY DISEASES AND PLANT NUTRITION

A discovery which was made early in this century and has rapidly established its scientific and

practical importance is that very small quantities of certain chemical elements are essential for the growth and health of plants. These are known as micro-nutrients or trace elements. Somewhat larger quantities than what is good are toxic to it. When these elements are not taken up by the plant symptoms of diseases appear. Spectrographic methods are specially suitable for the chemical analyses of soils and plant tissues required in investigations on these diseases. In addition to chemical analysis, diagnostic treatment by injections is taken recourse to. Deficiencies of manganese, zinc and copper are widespread in citrus trees[12]. In India. The diseases are cured by applications of the deficient element to the soil and by spraying the trees. Some of these trace elements are being incorporated in fertilizer mixtures. Vegetable and fruit trees respond sometimes in a spectacular fashion to such treatments. The production of fruits and vegetables in India is not well-organized. Vegetable and other horticultural crops have received comparatively less attention.

Physiological studies of plant nutrition are now highly developed. It is hoped that they will be pursued more extensively in India also.

POT EXPERIMENTS AND INDICATOR PLANTS

Field experiments form the real basis of advisory work but they are costly and time-consuming and it is not possible to have them on each and every kind of soil. Chemical analyses of soils and in some cases also of leaves of plants are used for advisory work and extend the range of application of results of field experiments. Pot experiments give valuable information under controlled conditions on the manner in which different factors influence plant growth. They have been also used for giving advice using less elaborate procedures. Use of indicator plants in pot experiments give information more quickly and this method has been used in the U. S. A. and Canada.

CONTROL OF PESTS AND DISEASES

Various estimates are given of the losses caused to crops by pests and diseases in India. While these are vague guesses, there is no doubt that the losses are great. For the use of control meaures we are very much dependent on the knowledge and experience of other countries, which we should no doubt utilize but conditions differ and methods useful elsewhere should be tested under field conditions and newer methods developed. The Science basic to the study of insecticidal action is insect physiology and of fungicides in the physiology of micro-organisms. These basic branches deserve attention.

There is a rich field for organic chemists in the synthesis of chemical substances which can be used for plant protection, or weed control or for promoting and controlling plant growth. The development of "systemic" insecticides which when taken up by plants would poison insects infecting them but are not toxic to the plant is an interesting example of the attractions of this field. In the formulation of preparations of insecticides and fungicides and in understanding their action, very interesting problems of Physical Chemistry arise. Also the study of strains for example, of the house-fly resistant to insecticides (D. D. T.), is of common interest to physiologists and biochemists. These are problems of interest to university departments of Chemistry and Biology.

D. D. T. and other insecticides have a great field of usefulness but being toxic to man and beast should not be used indiscriminately. The U. S. Department of Agriculture and also the U. S. health authorities have set no toxic limits of D. D. T. Its use in dairies is not at all advisable, nor of open vegetables such as cauliflower.

A large-scale organization is necessary to get the benefit of the measures of plant protection. Only a very small fraction of the crops which are capable of protection by known methods is being reached. Encouragement to private enterprise to undertake approved measures of control at a reasonable cost to farmers will be very helpful.

It is now possible to protect grains to be used as seed by chemicals. But being poisons they are not suitable for the protection of grains to be used as food.

Seed dressings which protect crop from diseases borne on the surface of seeds have a wide fields of application.

MEASUREMENT OF SOIL MOISTURE

A major portion of the land under cultivation will remain unirrigated. In arid and semi-arid areas, crop production depends on the conservation of soil moisture. Millets are an important crop in these areas. Their water requirement is low and they can better withstand the adversities of the climate. Data on soil water available for plant growth during the growing season form the scientific basis for deciding upon improved cropping systems. The "dry" farming stations in Sholapur and Hagari have worked out methods of soil and water conservation. In Sholapur, measurements have been made of the increase in the content of soil water resulting from conservation practices ; work has also been done on cropping systems and manurial treatments suitable for such conditions. Work on similar lines is desirable in other "dry" areas.

Measurements of the amount of water retained at different tensions have a wide field of use. Several methods are being used for this purpose. Apart from the tensiometers which measure tension directly, indirect methods involving the use of blocks of gypsum, nylon and fibre glass have been developed and are quite convenient. Extensive measurements of available water in the soil are now made in irrigation research and in controlling irrigation practices.

THE USE OF WATER

The irrigation system of India does great credit to our engineers. Out of the present total cultivated area of 251 million acres, 48 million acres are irrigated[3]. Many new irrigation projects are under way or are under contemplation. The Planning Commission have estimated that when both short-term and long-term plans are completed, the irrigated area will be doubled.

Water for irrigation is so precious to us that it should be utilized to the best advantage. The ideal is to make available to the plant just the quantity of water it can utilise for its vigorous growth and to minimize all losses from seepage, percolation, transpiration by weeds in channels and evaporation The losses due to seepage in the main canals, the distributaries and percolation in the fields of farmers are, however quite large. Buckley estimated[13] that "of each 100 cusecs entering a canal 15 cusecs are lost in canal, 7 cusecs are lost in distributaries and minors and 22 cusecs are lost in "guls". 56 cusecs are actually used in the fields and out of this 27 are wasted by cultivators one way or another but mainly in excessive irrigation". These losses have been considerably cut down in many countries by using concrete pipes and various types of linings and by adjusting irrigation and irrigation practices to the suitability of the soil and other conditions.

Irrigation Departments in the Uttar Pradesh and especially in the Punjab, have carried out experiments on the linings of canals[14]. In the Uttar Pradesh tube-well projects, two-fifths of the length of channels build by the expenses of the State are lined.

Methods have been developed for the protection of harbour breakwaters and stretches of river banks against water erosion. Concrete blocks set in bitumenised sand, sheet asphalts, graded and dense asphalt, asphalt groutings are being widely used[15].

The U. S. Bureau of Reclamation has developed a buried asphalt membrane and also a prefabricated type of it which is claimed to be economic and very suitable for irrigation canals and channels. Multi-layer linings are being used to prevent the loss of water in storage reservoirs. Intensive work on the development of suitable linings deserves to be taken up. Large-scale fabrication may lessen costs. As a result of the establishment of the oil refineries bitumen and asphalt are likely to be available at reasonable prices.

The present system of selling irrigation water according to a fixed rate per acre of a particular crop makes the farmer take as much water as he desires and this has led to wasteful practices. He believes that the more water he takes, the higher the yield he will get. Also, as the holdings are scattered, the water passes through field channels continually. The losses are, therefore, very great. If water is sold according to the quantity supplied to the farmer, as is done in most countries, he will be careful in using water. The meaurements of the water itself should not constitute any difficulty as there are suitable methods. It seems possible to introduce this system by assigning a zone to each crop in each parcel or block of land, fed by one delivery outlet, in which the farmer will have the same area under each crop as he now has. A fixed cropping plan based on the existing practices of the farmer and the results of experimental stations should also be introduced. Other alternatives to the above suggestion may be possible but the main thing is that a way must be found to eliminate avoidable losses.

With the water that is available the acreage under irrigation can be increased by an appreciable percentage, twenty per cent is a reasonable estimate, if avoidable losses are eliminated.

Comprehensive researches on "water or irrigation requirments" based on soil surveys, manurial treatments and crop rotations have been carried out in Padegaon. It is desirable that each State using water for irrigation carries out work of this type using modern methods and techniques which are now well developed. The problems have a regional setting.

A thorough examination of the losses of water in the different irrigation systems, the basis on which water requirements have been worked out and methods of reducing losses is most desirable. There are stretches of canals (and distributaries) where the losses are much higher than the average and they should be treated by suitable methods.

There is also room for a closer association between the irrigation and the agriculture department. The use of water and the irrigation practices to be followed are the responsibilities of the latter and the layout of distributaries and channels should be carried out on their advice based on soil surveys and other data. This is the normal practice in other countries and is essential for ensuring the best use of the water.

In considering whether an irrigation project is finanicially feasible or not, the approach so far has been to consider it as a business investment which must yield a minimum return after meeting operational charges, depreciation, cost of normal repairs and replacements. This does not give full consideration to the benefits from irrigation. If we produce an extra ton of grain, it not only brings a return to the farmer, but also gives occupation to him and many others and the crop residues add organic matter to the soil. The money spent on imports of

grains is a total loss of the country. The increase in national wealth requires some consideration. While it is perhaps fair to charge a betterment fee from the owner of the land, the state also should share part of the burden.

Tube-wells for irrigation are being sunk in different parts of the country. In 1938, the Indian Science Congress recommended that a hydrological survey should be carried out. This is very much necessary to ascertain the extent of underground water resources which may be available for irrigation and other purposes. Underground water is an important source of water of especial value during summer and winter. The geological survey may take up this work systematically.

SOIL CONSERVATION

Large quantities of soil and plant nutrients are lost by surface run-off. Conservation practices attempt to minimise these losses and also improve the fertility of the soil. In India, some useful work has been done following the methods developed in the U. S. A. The work done so far, however, touches only a fringe of the problem.

The conservation of our soil and water resources of the catchment areas in a major item of the work in the river valley projects. As Indian experience is yet limited, preliminary investigations and consultation, and exchange of information between different workers are desirable before any method is adopted on a large scale. It is not safe to disturb the soil and vegetation and the practices of the farmer without adequate study.

THE FARMER AND HIS PRACTICES

Timely and appropriate cultivation contributes materially to production. In each village, farmers can be broadly grouped into three classes. There is the farmer who has experience, and finance and other facilities at his command for carrying out cultural and other farm operations properly and in time and for using manures and fertilisers. The second group may have the experience but not facilities on the desired scale. The third may have insufficient facilities or lack in experience. The efficient farmer gets very high yields, as high as is obtained in experimental stations and not very infrequently much greater. The recent attempts to spot the efficient farmer have shown how good some of them are.

A report of U.S. Department of Agriculture says that the farmer knows many things which the scientist does not and the scientist knows many things which the farmer does not. The two must work together. This should also be true in India. The practices of the farmer rest on empirical experience; some may not stand the test of Science but some obviously must. It is desirable to study his practices and obtain scientific data before advising him to change them. The problems of the farmer and of his farm have received little integrated attention. The Indian farmer has the same outlook as the farmer in other countries. He wants to see before he believes. Without his enthusiastic cooperation, plans of production cannot succeed. Although the percentage of farmers with education may not be large, their total number will not be small. It will hardly be justifiable to treat them or even uneducated but efficient farmers in a patronizing manner. If the cooperation of the efficient farmer is obtained and his plots are made the centers of demonstration, rapid improvements will be effected. In the U. K., during the war, county executive committees, with which farmers were directly associated, were established. In the U. S. A., farmer communities serve very useful purposes. It is very desirable to organize village committees of Indian farmers.

There is perhaps sometimes a confusion between the functions of men engaged in research and in advisory work. Each should form a distinct organization as in other countries. Also, neither of

them are technicians ; the farmer is. It is desirable to keep these distinctions in mind.

For our immedidate programme, the existing knowledge has to be utilized. It descends from three sources : that of the efficient farmer, that of the experimental stations and that of other countries which we can justifiably use irrespective of differences in conditions. It is desirable to work out recommendations crop by crop and soil by soil for advisory work. Loose recommendations are of little value.

The object of this admittedly imperfect review of the methods of promotion of Science and its applications to the solution of the problems of our agricultural production is to create a wider interest in these subjects. A comparison of what is being done with what requires to be done in order to make full use of Science will enable us to decide upon the steps to be taken for the realization of our plans of production. If full use is made of Science, there is no reason to doubt that crop productions can be increased to the same level as has been achieved in Europe, Japan and America. We have the resources in brain, men and materials. Science shows the way but what use we make of it depends on us. With an objective approach to the study of problems, coordinated team work and the will to succeed we are bound to reach our goal—the improvement of the conditions of living in India. In this, the scientist has a great responsibility and the noble task of serving his fellow countrymen.

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DO YOU KNOW ?

Q1. What is Pandiculation ?

Q2. Where does a shrimp carry its heart–in which part of the body ?

Q3. Who amongst these can recognize in the mirror themselves ?

A. Cats, dogs and horses

B. Monkeys

C. Primates (Chimpanzee, Orangotang, Gorilla.

Q4. How much fish is consumed annually by mankind ?

BACILLUS THURINGIENSIS (B.t.) AND B.t.-TRANSGENIC PLANTS

Pranav Chettri, P. U. Krishnaraj and M. S. Kuruvinashetti*

One of modern agriculture's best defenses against plant-eating insects is *B.t.*, which either can be applied to the surfaces of crops to povide temporary protection or can be genetically engineered into the the crops to protect against insects throughout the lifespan of the plants. Judicious use of *B.t.* has allowed growers to avoid applying large quantities of costly and potentially toxic insecticides. However, the widespread success of *B.t.* has prompted concerns that insects might someday become resistant to this important treatment. This review is mainly focused on the biology, application and the safety issue related with *Bacillus thuringiensis.*

WHAT IS B.t. ?

B t. is the short name for *Bacillus thuringiensis*, a nature bacterium in the genus *Bacillus.* It is a rod shaped Gram-positive soil bacterium discovered in 1901 and is amongst the most thoroughly studied bacterial species of agricultural importance for over a century. This diverse genus also includes more than 20 other *Bacillus* species and hundreds of different subspecies. Members of the genus *Bacillus* are generally considered soil bacteria, and *B.t.* is common in terrestrial habitats including soil, living and dead insects, insect falces, granaries and on the surface of plants ; *B.t.* also occurs in nature predominantly as spores that can disseminate widely throughout the environment.

A unique feature of *B.t.* is that bacterium produces crystalline structured protein and these proteins have activity against some insect species. The organism was first isolated about 100 years ago in Japan from silkworm larvae and for over 40 years, it has been applied to crops in spray form as an insecticide, containing a mixture of spores and the associated protein crystals.

Rechel Carson promoted *B.t.* as a nature insecticide in her book, *Silent Spring,* published in 1962. By 1995, 182 *B.t.*-based products were registered by the United States Environmental Protection Agency (EPA). However, by 1999, the total of *B.t.* formulations constituted less than 2 percent of the total sales of all insecticides because *B.t.* lacked performance compared to many other available insecticides.

HOW DOES B.t. KILL INSECTS ?

B.t. produces a large number of proteins that are toxic to insects. It also produces (a) several enzymes, (b) some compounds that lyse erythrocytes and (c) some that are enterotoxic to verteberates. *B.t.* toxins are produced either within the bacterial cell (endotoxins), or on the cell surface (exotoxins). More than 200 toxin-encoding genes have been isolated from *B.t.* collections. Among the endotoxins, the insecticidal crystalline proteins (ICP), called the delta-endotoxins, are significant in *B.t.* technology. The crystalline proteins are described para-sporal, as they are co-produced and

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co-existed along with spores (the means of bacterial propagation), in the bacterial cells. When the bacterial cell lyses to release the spores, the crystalline proteins are also routinely released into the soil. *B.t.* is not a contact pesticide. Susceptible insect must ingest *B.t.* spores containing δ-endotoxins to be affected. The target site for δ-endotoxins is the insect midgut. The cells of the midgut become paralysed by δ-endotoxins and normal digestion is disrupted. Affected insect dies of starvation or septicaemia. The mechanism of action for the δ-endotoxins involves solubilization of crystalline protein in the alkaline midgut of the susceptible insects. After solublization insect enzyme cleaves the δ-endotoxins to form active toxin that binds the receptor on cell membrane of the midgut of insect's epithelium. Following receptor binding, the δ-endotoxin generates pores in the epithelial cell memberane that disrupts the cellular osmotic balance leading to cell rupture and death.

The name of the genes that encode the crystalline proteins are prefixed with Cry, as for example *Cry1Ab*, *Cry1Ac*, *Cry9c*, etc., and the proteins that are encoded by these genes are 'Cry' proteins. The non-crystalline endotoxins are prefixed with 'Cyt'. Most of the *B.t.* toxins are insect group specific. Cry1Ac and Cry2Ab control the cotton bollworms; *Cry1Ab* control corn borer, *Cry3Ab* controls Colarado potato beetle, *Cry3Bb* controls corn rootworm and *Cry IV* for mosquitoes.

B.t. AS A BIOPESTICIDE

B.t. produces a wide range of insecticidal toxins and it has been used in pest control since 1938. There are over 100 biopesticides exclusively based on *B.t.* and over 90 per cent of commercial biopesticides used even in organic farming contain *B.t.*, some products and Able™, Biobit®, Dipel®, Cutlass™, Thuricide® and Vectobac®.

WHAT ARE B.t. TRANSGENIC PLANTS ?

B.t. plants have genes from the *Bacillus thuringiensis* engineered into them so that the plants produce an ICP toxic to the pest species of concern. As the insect feeds on the plant, it ingests the ICP and suffers the same fate as if has it ingested leaf tissue sprayed with *B.t.* Examples are *B.t.* corn, *B.t.* cotton, *B.t.* potato and *B.t.* brinjal.

EFFICACY of B.t. :

The efficiacy of the *B.t.* strain results largely from the presence of four Cry proteins : Cry1Aa Cry1Ab, Cry1Ac and Cry2Aa. The *cry1Ab* and *cry1Ac* genes in the *Bacillus thuringiensis* HD1 strain are the prototypes for the genes currently expressed in corn and cotton. Deployment of Cry proteins in plants offers several opportunities to improve efficacy compared to microbial delivery systems. Unlike externally applied microbial *B.t.* products, the efficacy of plant produced Cry proteins is not affected by time and accuracy of application or wash-off by rain and inactivation by sunlight. *B.t.* protected plants produce sufficient quantities of Cry protein to ensure effective insect control. These attributes and the cost-savings opportunity have contributed to the rapid adoption of *B.t.*-protected plants by growers.

WILL INSECTS DEVELOP RESISTANCE TO B.t. PLANTS.

A recent survey found that there are only two insects, the diamondback moth and the cabbage looper that have developed resistance to *B.t.* under commercial situations. In a few places in the world, some populations of these insects have developed resistance to foliar sprays of *B.t.* which warrants that some insect species have the capacity to develop resistance to an ICP. However, after decades of large-scale plantings of *B.t.* crops, there have been no reported failures of *B.t.* crops in the field due to resistance. The important question is : why have we not seen resistance ?

Although there are no definite answers, there are some interesting speculations. One is that high and consistent levels of ICP production in the plant does not favour development of resistance compared to the variable and constantly changing dose when *B.t.* is sprayed on the plant. Also there may be fewer genes for resistance in insect populations

than was originally thought. And resistance in insects may be, what geneticists call a recessive characteristic, whereby resistance may take many more generations to develop.

Perhaps most importantly, *B.t.* plants are more strictly regulated than foliar sprays of *B.t.* The principal requirement for a resistance-management program for *B.t.* plants is the use of non *B.t.* "refuge" to allow *B.t.*-susceptible genes to be maintained in the general population of insects.

When growers deliberately plant non-*B.t.* crops nearby, it is a trade-off : growers sacrifice a fraction of their refuge crop to insects, in exchange for avoiding the remote possibility that all insects will become resistant to *B.t.* No other insecticides, including foliar sprays of *B.t.* are so strictly regulated.

BIOSAFETY CONCERN RELATED TO B.t.

Eighteen human volunteers ingested 1 gram of commercial *B.t.* pesticide daily for five days. Five of them also inhaled 100 mg of pesticides for five days. Researchers did not detect any adverse effect on the volunteers. Epidemiological studies were conducted to evaluate the health effects of *B.t.* on people who lived in areas aerially treated for two years with *B.t.* sub species *Krustaki.* Approximately 120,000 people lived in the sprayed area. Clincians isolated *B.t.* from 55 people seeking medical services during the period. Illness in 52 individuals was not related to *B.t.* however, it could not be ruled in or out as the source of ailments in remaining three people, Health survey of agricultural workers, who handled *B.t.* treated crops, revealed skin and antibody reaction to *B.t.* with the majority of reactions occurring in the workers at the highest *B.t.* exposure. In another study, eight men were exposed for seven months to *B.t.* during the commercial manufacture of the *B.t.* pesticide. None of them experienced adverse health effect. A farm worker who accidentally splashed *B.t.* in one eye, developed corneal ulcer after ten days. The ulcer was healed with treatment.

WHAT'S THE BOTTOM LINE ?

It has only been since the genes for production of *B.t.* ICPs were engineered into plants that *B.t.* really becames a major insecticide. However, with its widespread use there is increased risk of resistance being developed to *B.t.* plants. So far, we have not seen any resistance after decades of use, and this is remarkable since some insects have developed resistance to other insecticides in fewer than five years.

But resistance may come in future. However, if it does come, it is likely to be only a single type of ICP and other *B.t.* ICPs will still provide control. Nevertheless, considering that in the years prior to the development of resistance to a specific ICP, substantial environmental and human health benefits accumulated compared to the use of more toxic insecticides.

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CELLULAR RADIO NETWORKS : A PERSPECTIVE

Madhu Jain*, G.C. Sharma* and Sapna Chakrabarti**

Wireless technology is the fastest growing segment of telecommunications. The evolution of the wireless technique has resulted in a large number of changes in the paradigm of the way we communicate. Technological advances and rapid development of the handled wireless terminals allow cellular subscriber to wander anywhere in the country by remaining connected to the public switch telephone network (PSTN) *via* the mobile phones. The focus of this article is to provide a detailed discussion on the performance issues related to the cellular radio systems. It also overviews the different channel assignment schemes and their comparison on the basis of the performance and flexibility. Moreover, innovations and the future directions of the cellular mobile technology have also been discussed.

INTRODUCTION

When Marconi turned theory into practical reality he had already seen the commercial possibility for a system of telegraphy freed from the limitations of wires. Nowadays, it is purely a matter of convenience for everyone and one receives and makes calls easily at any time and from any place. Technological advances and rapid development of wireless terminals have facilitated the rapid growth of wireless communications,[2] and mobile computing. A cellular mobile system uses a large number of low powered wireless transmitters to create cells, which comprise the baisc geographical service area of wireless communication system as shown in Figure 1. Each mobile phone uses a separate temporary radio channel to talk to a cell site which in turn talks to many mobiles at once, using one channel per mobile. The channels use a pair of frequencies ; one is forward link for transmitting from cell site and other is reverse link, which receives the cells from the users.

Communication channels are the most important resources in mobile cellular network. Cellular technology has proved a strong backbone for dealing with the incresing demands of services such as tele-conferencing, telemedicine, video-on-demand, etc.. The main aim of this study is to examine the performance of the existing cellular network and the wireless local loop (WLL) network. The rest article is structured as follows. A brief overview on the cellular radio network is provided in the next section, which includes the cellular architecture and the events that occur when a call is made. Thereafter various channel assignment problems in a cellular environment are discussed. The concept of wireless local loop (WLL) is explained next and a new technology, namely CDMA, is briefly outlined. Finally, the future scope of the cellular technology used today is discussed.

CELLULAR RADIO NETWORK

The increase in demand and poor quality of the existing service have led mobile service providers to find ways to improve the grade of services and

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to support more users in the system. The design of such networks is based on the cellular architecture, which is birefly explained as follows.

THE CELLULAR ARCHITECTURE

In the modern cellular telephony, the rural and the urban regions are divided into areas according to specific provisioning guidelines. In any radio network, the number of simultaneous calls that occur is governed by available frequency spectrun. However, due to the growing demand, there is need for sufficient frequencies for mobile cellular coverage.

- ***Cells :*** In cellular networks each mobile station communicates with a base station (BS), which is connected to the wire line telephone networks. The region in which the mobiles are connected to a given station is called a cell represented as hexagons as shown in Fig. 1.

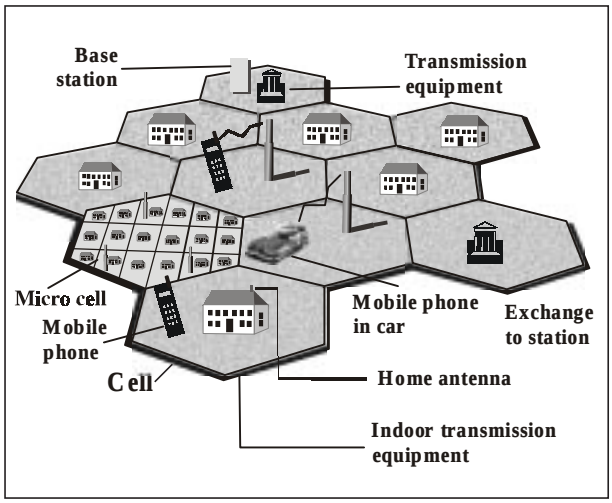

Fig. 1 : Basic geographical cell structure

- ***Cluster :*** To use a cellular radio, each cell uses a different set of frequency. A set of cells, which do not share the same frequency, is said to form the cluster, i.e. there is no channel reused within a cluster.
- ***Frequency Re-use :*** In a conventional radio system, the groups or areas are allocated a dedicated radio frequency. To reuse the radio channels in order to carry more than one conversation at a time, the concept of frequency re-use come into existence. Frequency re-use is achieved by assigning a subset of total number of channels available to each base station thereby increasing the cellular network capacity.
- ***Handovers :*** When a mobile user moves out of the coverage area, the BS detects it from the signal power and informs the mobile station controller (MSC) about the event. The MSC instruct all the BS to measure the mobile phones signal level and switch the call to the new cell which receives the strongest signal level so that there is no interruptions during the on going talk. The handover procedure is illustrated in Figure 2. If there is no channel available in the new cell, then the handoff call is blocked and this kind of blocking of the ongoing calls due to the mobility of the users is called handoff blocking.

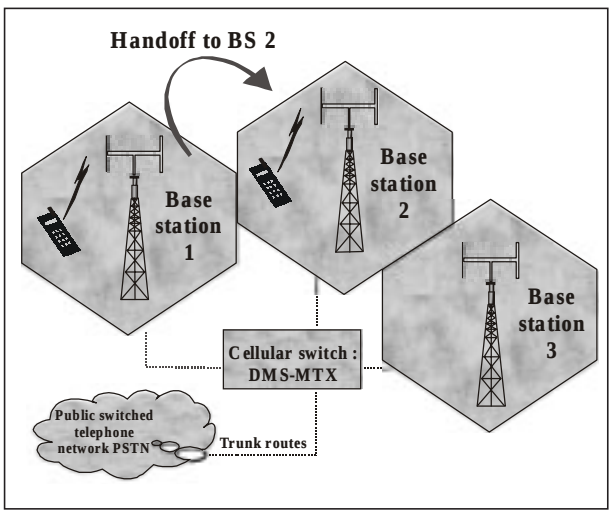

Fig. 2 : Handover of the calls from a base station to another

Cellular System Components : The telecommunication system is a wired network which allows the users to wander anywhere in the country

and remain in contact with PSTN via mobile phones.

A hierarchical structure of the network system has the following main entities (*see* Figure 3) :

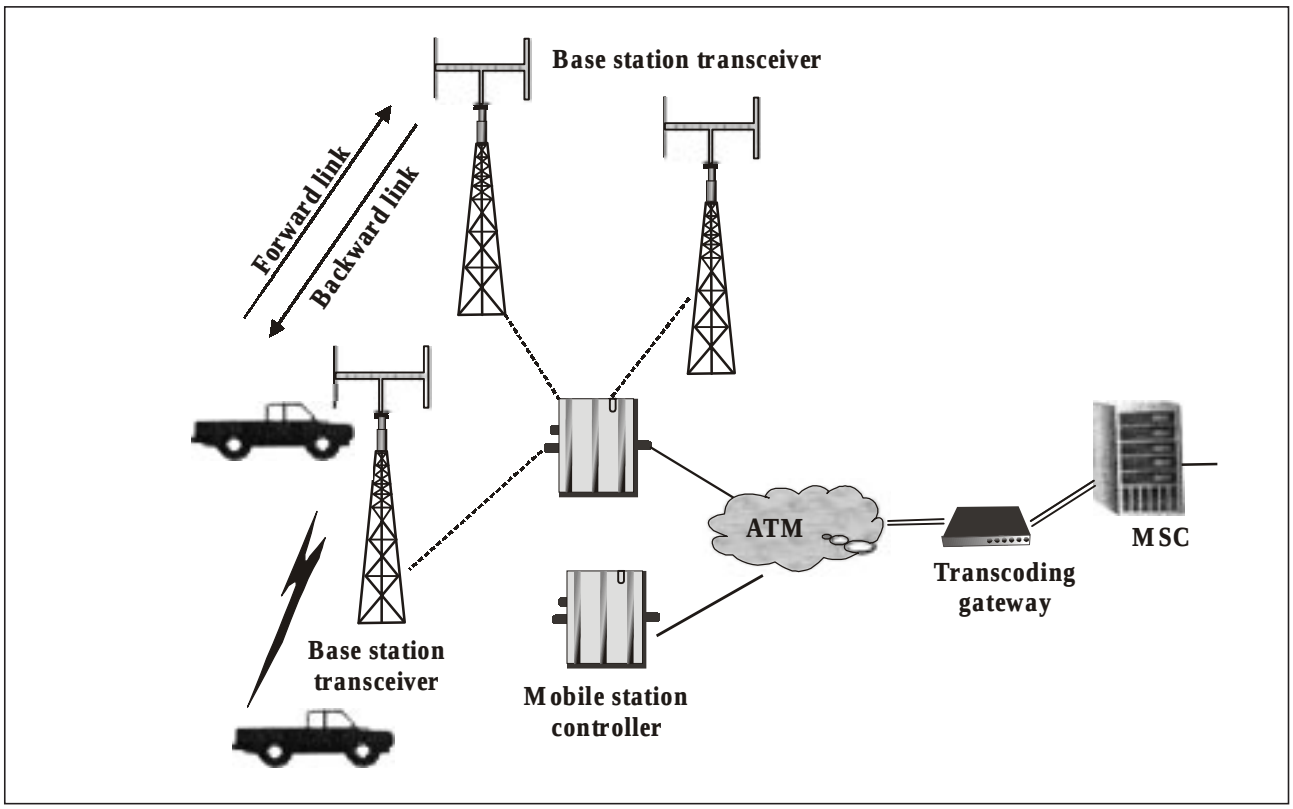

Fig. 3 : Cellular System

- ***Mobile station (MS) :*** This is basically the mobile phone, which is used to communicate over the cellular network. Portable and transportable telepohnes are handheld and can he used anywhere.
- ***Base station (BS) :*** The covered region of cellular network is divided into small geographical areas called cells (*see* Fig. 1). The BS serves a cell and communicates with all other mobiles.
- ***Mobile station controller (MSC) :*** The MSC controls a number of cells and arrange BS and channels for the mobiles. It stores the information about the subscriber within the cluster and is responsible for directing the cells to them and helps in switching of the calls whenever needed.
- ***National Carrier Exchange :*** This is the gateway to the national fixed public switched network (PSTN). It handles connections on behalf of the national communication systems, and is usually integrated with the MSC.

WORKING OF CELLULAR SYSTEM

When the mobile phone is switched on, then depending upon its location an appropriate BS is registered for it. The cell position is also stored at the suitable MSC. When the call is made, then the BS monitors the single level from that mobile phone and reports the controlling MSC about the event. The MSC makes decision concering the routing of the call and instructs all the nearby base

stations to mesures the mobile signals. The call is switched to the BS, which receives the stongest signal level. This is called handover and it occurs within 400 m range and is not so much noticeable for voice transmission. In this way the call continues as long as the user is connected, and the user is not interrupted or altered at all.

CHANNEL ASSIGNMENT SCHEMES

As the use of mobile communication grows, there is a need for more efficient channel allocation technology. The number of channels on a real world network are in scarce. Thus the tremendous growth of wireless user population requires an efficient use of this scarce radio spectrum. An overview of different channel assignment schemes[3] available for cellular environments is given below.

Fixed channel allocation (FCA) : In FCA, each cell is allocated a predetermined set of voice channels according to some reuse pattern. Unused channels can serve any call within a cell and if all channels are occupied in that particular cell, then the call is blocked and the user does not receive the service.

Dynamic channel allocation (DCA) : In this scheme, voice channels are allocated to different cells permanently. DCA provides flexibility and traffic adaptability, but under high load conditions, DCA strategies are quite less efficient than FCA.

Hybrid channel allocation (HCA) : To overcome the drawbacks of DCA and FCA, a hybrid schemes[4] of FCA and DCA is assigned which is named as hybrid channel allocation (HCA). In this scheme, the total number of channels is divided into fixed and dynamic sets.

Cut off priority scheme (CPS) or guard channel scheme : Whenever a call is handed off to the neighboring cell and the cell does not have enough channels to support the handoff, then the call is blocked. Therefore, to overcome the blocking of the ongoing calls and for the successful handling of the handoff calls, the system must reserve some channels exclusively for the handoff calls. This type of prioritization of the handoff calls is termed as cut off priority schme (CPS) or guard channel scheme.

THE FUTURE TECHNOLOGY

The mobile communication devices consist of handheld phones, car phones, notebook computers, palm-top computers, portable data collection devices, etc. The wireless technique extends the bounds of the existing telecommunication network system by connecting the telephone at home or office to a fixed telephone network without cables. This wireles connection is 'wireless local loop' (WLL), which is a completion of the subscriber loop to connect devices over a multiple access radio system to PSTN. The WLL technology[5] uses radio signals to substitute the copper wires.

WLL works on the principle of the fixed cellular technology, which includes a base station at a local exchange to a phone cell at the customers' end with a telephone receiver. Thus, WLL has proved to be an economical and practical solution for those connecting subscribers that are residing in an isolated region such as rural areas and the developing countries. There are various types of WLL technologies ; including digital such as TDMA, CDMA, GSM, and the analog access technologies such as advanced mobile phone system (AMPS), North America digital cellular (NADC), etc.. These new technologies significantly assure the improvement of the grade and efficiency of the cellular system thereby allowing a large number of users to be served simultaneously.

Advanced mobile phone system (AMPS) : Cellular radio systems, implemented for the first time in the advanced mobile phone system (AMPS), support more users by allowing reuse of frequencies. It is an analog access technology that has been extensively deployed in North America. The current cellular standard, namely IS-553, describing access methods to the network divide 50 MHz of specturm

into 832 frequency channels. AMPS are analogus system, and is a part of first generation cellular radio systems.

Time division multiple access (TDMA) : It is a digital access method that allocated the time slots to different users so that they can occupy one bandwidth. TDMA divides each frequency channel into time slots thereby increasing the system capacity.

Code division multiple access (CDMA) : CDMA is an interference-limited system, which has soft capacity limit ; provisioning 10-15 times the capacity of an analog system. CDMA employs a commercial adaptation of wide spectrum single side-band technology in which the users are isolated by the code. CDMA sends message over a wide frequency channels that is decoded at the receiving end. Thus, each mobile unit in a cell is assigned a different spreading sequence and allowing the users to share to same frequency improving the network capacity problem encountered in AMPS.

CONCLUDING REMARKS

Cellular networks are becoming high-speed data networks. The second generation cellular system, Global System for Mobile Communications (GSM)[6] uses a combination of both FDMA/TDMA. Though TDMA and CDMA have a higher capacity, improved voice quality and increased security, but these technologies do not have the ubiquitous access that advanced mobile phone systems (AMPS) have. Therefore, to take advantage of today's cellular services, the providers must migrate for better services by overlaying the existing networks with TDMA and AMPS architecture.

The development of mobile data applications depends upon the development of new communication protocols. Current cellular radio system are in their second and half generation. The third generation of cellular systems (3G systems) will allow different systems to interoperate in order to attain global roaming across different cellular radio networks. The International Telecommunication Union (ITU) has been doing research on 3G system since the mid 1980s. Their version of a 3G system is called international mobile telecommunications - 2000 (IMT-2000). 3G systems use common global frequencies for all cellular networks according to some efficient spectrum utilization schemes. They provide worldwide roaming with high data transmission rates for both circuit and packet switched data. Researchers are going on 4G and 5G technologies, which will change the attitude of the modern society as far as wireless communication is concerned. It now takes into consideration the fact that data services have changed the landscape of mobile communications. Current GSM networks not only provide voice services, but data services at 9.6 kbps. Now, meaning of PCS not only encompasses the delivery of voice services to people regardless of location , but also that of data, images, multimedia, etc. service regardless of location, network, or terminal used.

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PROSPECTS FOR UTILIZATION OF MUNICIPAL SOLID WASTE (MSW) IN INDIA

Manju Rawat Ranjan*, and Sanjay Sharma**

Generation of municipal solid waste in India is increasing day by day. The average per capita generation of waste was about 500 g/day in 2007 and it will increase to 925 g/day by 2047. The most important step to be used for management of this waste would be minimising its generation but this is not really possible. Then to manage waste sustainably, the waste to wealth route remains a viable solution although in India it is not common practice. Maximum recycling, composting with organic municipal solid waste and waste to energy generation should be utilised for MSW management. This aproach of sustainable waste management can solve the problem of land required for waste disposal and resulting pollution problems of air, ground, surface water, soil etc.

INTRODUCTION

India with the second largest population in the world (16.7 per cent of the world population.) accounts for a meager 2.4 per cent of the world surface area. With the changing life style and consumer economy waste generation is increasing rapidly in India and the annual municipal waste generation. (MSW) is 48 million tons/year (5 million tons/year is hazardous waste) already. This will increase to approximately 300 million tons annually by 2047 (Table 1).

Table 1 : Increase in Municipal Solid Waste in India[1].

YEARS	1947	1997	2047 (Proj.)
URBAN POPULATION (millions)	56.9	247	—
DAILY PER CAPITA WASTE GENERATION (GRAMS)	295	490	925
TOTAL WASTE GENERATED (Million tones)	6	48	300
AREA UNDER LAND FILLS (Thousand of ha)	0.12	20.2	140
ANNUAL METHANE EMISSIONS (million Tones)	0.87	7.1	39

Municipal solid waste (MSW) generation is around 500 g/day/person.This is estimated to further increase to 925 g/capita/day by 2047[1]. The MSW contains largely food/organic waste, papers, plastics, textiles, rubber, leather, wood, glasses, batteries,

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ferrous and nonferrous metals containing components etc. Indian MSW has 40-60% of compostable material or organic material with high moisture contents (Tables 2 and 3). The rising income levels and in turn greater purchasing power of individuals especially in big cities have given rise to consumer preferences that make goods obsolete quickly and this has led to a sharp rise in generation of wastes. Wastes pose a severe challenge for Municipal Authorities for its sound disposal and the problem has been agitating the minds of policy makers, regulators and concerned citizenry. One recent example of tragic impact of improper management of municipal solid waste was seen as epidemic in Surat, Gujarat in 1994. Land scarcity in the cities has made waste disposal more difficult. The use of landfill is no longer cosidered to be a satisfactory environmental solution due to many health hazards linked with it. Therefore, new methods have to be found to produce wealth from the waste[2]. Obviously, the impact on environment can be reduced by reducing waste

Table 2 : Physical Characteristics of MSW in Indian Cities.

Population Range (in million)	No. of cities surveyed	Paper	Rubber, Leather and synthetics	Glass	Metals	Total Compostable metals	Inert
0.1 to 0.5	12	2.91	0.78	0.56	0.33	44.57	43.59
0.5 to 1.0	15	2.95	0.73	0.35	0.32	40.04	48.38
1.0 to 2.0	9	4.71	0.71	0.46	0.49	38.95	44.73
2.0 to 5.0	3	3.18	0.48	0.48	0.59	56.67	49.07
> 5	4	6.43	0.28	0.94	0.80	30.84	53.90

All value in % and are calculated on dry weight basis.

(Source : Manual on MSW management for GOI, Ministry Urban Development Ministry, 2000)

Table 3 : Chemical Characteristics of MSW in India Cities.

Population Range (in million)	No. of cities surveyed	Moisture %	Organic Matter	N as (TN)	P as P_2O_5	K as K_2O	C/N ratio	Calorific Value in K cal/Kg
0.1 to 0.5	12	25.18	37.09	0.71	0.63	0.82	30.94	1009/89
0.5 to 1.0	15	19.52	25.14	0.66	0.56	0.69	21.13	900.61
1.0 to 2.0	9	26.98	26.89	0.64	0.82	0.72	23.68	980.05
2.0 to 5.0	3	21.03	25.06	0.56	0.69	0.78	22.45	907.45
> 5	4	38.72	39.07	0.56	0.52	0.52	30.11	800.70

All Values except moisture are on dry weight basis,

(Source : Manual of MSW Management for GOI, Urban Development Ministry, 2000)

generation itself and failing this, waste should be either recycled or reused. When these options are unsuitable, waste must be incinerated for energy recovery. The last resort should be used in landfills because it requires space and run the risk of leakage.

ADVERSE IMPACTS BY UNPLANNED DUMPING OF MSW

Some adverse impacts are ground water contamination through leachate generation, surface water contamination by run-off from waste dumps, fire menace, bird meance, bad odours from dumping sites, epidemic through stray animals, global warming due to release of greenhouse gases (methane and CO_2), acidification of surrounding soils, stratospheric ozone deletion, photo-oxidant formation, etc. These can be eliminated if MSW is put to some use[3]. It should be noted that much of MSW may be rich in nutrients.

Thus, there is need to bring technological interventions for achieveing waste reduction and its utilisation. Waste should be taken as resource/ wealth lying at a wrong place. Thus, in view that it has immense potential for resource recovery, it is required that MSW is looked from cradle to grave, properly collected, stored, transported segregated and made ready for final disposal. Only those wastes should be sent for dumping which cannot be reused or recycled. The organic waste can be used as compost. The approach in waste management should be such that maximum possible waste generated could be used in one way or other.

Proper MSW management requires sensitizing the community about the importance of environmentally sound waste management practices, as well as concerted efforts and adoption of a scientific approach by the concerned authorities. The biggest challenge is to ensure that different kinds of wastes are kept segregated from the very beginning when individuals or families discard them.

WASTE TO WEALTH POTENTIAL

Reduction in waste generation should be the first priority in MSW management hierarchy and then comes its maximum recycling possibilities. The 3R principle Reduce, Reuse and Recycle should be used to minimize waste generation. Now there is a fourth R which implies Rebuy. Thus, encouraging to rebuy the products made from the recycling of MSW, recycling industries can be promoted. There is no process in the world which has zero or no waste generation.

Some of the steps that can be taken for waste to generate 'wealth' from MSW are as follows :

Composting from Municipal Solid Waste : Composting of MSW is recognized as a cost-effective method for waste management that results in an end product that can be used as a soil conditioner with beneficial effects on soil productivity.

The MSW in India has 40-60% (or sometime more) of compostable material with high moisture contents. The high moisture contents and low calorific value makes it unsuitable for incineration. Biomethanation and composting are perhaps better alternatives for treatment of wastes.

Waste to Energy Generation Option : In the waste management hierarchy, waste to energy (WTE) has been considered as a mode for the recovery of resources that must be considered before ultimate disposal of the final inert materials.

It is true that incineration plants are expensive. Because of this reason burning technologies are considered as inappropriate method of waste management by environmentalists. Several incineration plants that were installed in Delhi and

Lucknow have failed to deliver rated energy outputs and have since been closed. However, there have been success stories elsewhere and the Govt of India provides subsidy for installation of incineraters which not only generate power but reduce the bulk of wastes to a small volume of ash[5].

Anaerobic digestion or biometha-nation : Methane is produced by unaerobic decomposition of landfill solid waste and it contributes towards global warming. Methane is 21 times more potent green house gas (GHG) than CO_2. Calorific value of landfill gases is app. 4500 Kcal/m^3. Biomethanation technique of using methane gas for combustion or electricity generation could also provide compost for soil conditioning. This technique can be effectively used in a developing country like India. The methane value estimated for wastes generated in six selected metropolitant cities in India is 2 million tons/annum[6] to several times more. It is expected to increase to 39 million tons/annum by 2047 (Table 1).

Refuse derived fuel (RDF)/Pelletisation : This proven and tested technology has been widely implemented in Europe for disposal of MSW and this RDF is suitable for Indian cities. The pellets are a good coal substitute. The NOX and SO_2 emissions are less than what are emitted from coal burning and the calorific value of these pellets are 2500–3000 Kcal/Kg. A 6.6 MW electricity generation plant from incinerated pellets is satisfactorily running at Mahbobnagar, Hyderabad.

Incineration : Calorific value of MSW in India ranges from 600–1100 kcal/m^3 and 100 tons of raw solid waste can potentially produce 1–1.5 megawatt power. In Malaysia, where 80% of MSW contains food, papers and plastics with 55% of moisture contents incineration plants operate successfully. By incinerating 1500 tons of MSW/day with an average of calorific value of 2200 kcal/kg one can produce 640kW/day[7]. In Delhi, Muncipal Corporation of Delhi (MCD) has planned to produce 16-20 MW of electricity by first converting MSW to RDF and then incinerating it to produce electricity[8].

Pyrolysis/Gasification : This is a process of destructive distillation. In this process, MSW is heated to 900–1000ºC so that pyroligenous liquid/water gas can be used in internal combustion engine to produce electricity. This is a bit expensive technique but can be used in more effective manner in small scale production of electricity.

EARNING OF CARBON EMISSION REDUCTION (CER'S)

One can earn carbon credits under CDM (Clean Development mechanism) of Kyoto Protocol n or m by preventing generation of methane and carbon dioxide gases as landfill gas recovery and utilization by composting/biodigestion, efficient collection and recycling, closing and capping of the existing dumping grounds.

The possibility of availing carbon credit in these projects not only ensures that the best of technology will be used for sound disposal but projects will also be financially remunerative.

CONCLUSION

With population growth and changing preferences of people, more and more waste comes for disposal. Land scarcity has further aggravated the problem of environmental friendly disposal. The way left for sound waste management is utilization in one form or other. Some of the utilization techniques are recycling, compost formation, biomethanation, WTE, bio-fuels etc. Composting and biomethanation are considered as most suitable.

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DO YOU KNOW ?

Q5. How many times can a bee sting ?

Q6. When does a pig look at the sky ?

Q7. If you sneeze too hard can you damage your body ?

Q8. Name the animal that cannot jump ?

FIBRE REINFORCED POLYMER (FRP)–AN INNOVATION FOR RENOVATION

P. N. Raghunath*, K. Suguna*, and V. Nagardjane*

Fibre Reinforced Polymer (FRP) composites consist of reinforcing fibres embedded in a polymer matrix. The matrix may be polyester, vinylester or epoxy. The fibres, generally made of carbon, glass or aramid, can be used in a variety of forms such as random chopped strands, woven rovings and continuous rovings. A variety of hybrids can also be prepared and used to suit different situations.

Most applications of FRP composites were earlier confined either to aerospace applications, automotive industries or marine enterprises. Construction uses were generally non-structural. Renewal of civil engineering infrastructure has received considerable attention over the past few years throughout the world and the civil engineers have been exploring ways and means of strengthening and upgrading existing civil engineering infrastructure to cater for changes in use and general deterioration. The search for innovative solutions triggered the development of FRP composites for this purpose. Beneficial attributes of FRP composites include high strength-to-weight ratio, resistance to corrosion, reduction in labour costs, elimination of the need for scaffolding, large deformation capacity, minimum changes in geometrical dimensions and minimum interuption to existing services and availability of FRP in different sizes, geometry and dimensions.

COMPOSITE MATERIALS

Selection of materials for different strengthening systems must ensure that the fibres and resins are designed to work together. This implies that a resin system for one strengthening system may not work properly for another strengthening system. Further, a resin system for fibres may not provide good bond to concrete. Hence it is necessary that only those systems whose applicability has been qualitatively ascertained shall be used for strengthening purposes.

The primary materials for an FRP strengthening material system include *adhesives, resin matrices and reinforcement fibres*.

The purpose of an *adhesive* is to produce a continuous bond between the concrete surface and the composite material to ensure that full composite action is developed by the transfer of shear stress across the thickness of the adhesive layer. The best option is to use a two-part cold curing *epoxy* adhesive as it possesses several advantages over other polymers as adhesive agents in civil engineering. A comparison of typical properties for epoxy adhesive, concrete and steel is given in Table 1.

The function of resin matrix is to protect the fibres against abrasion or environmental corrosion, to bind the fibres together and to distribute the

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load. The matrix has a strong influence on several mechanical properties of the composite. Physical and chemical characteristics of the matrix influence the choice of the fabrication process. Hence a proper selection of the matrix has to be made for the composite system. Epoxy resins, polyester and vinylester are the most common polymeric matrix materials used with high performance reinforcing fibres.

Fibres are effective reinforcement materials. They are available in continuous as well as in discontinuous form. The continuous fibres can be unidirectional or bi-directional. The fibres should be significantly stiffer than the matrix and should also be of higher strength. Fibres used for strengthening exhibit a linear elastic behaviour up to failure and do not have a pronounced yield plateau as well. The commonly used reinforcement fibres include glass, aramid and carbon. Glass fibres can be of E-glass, AR-glass, C-glass or S-glass. Carbon fibres can be of high strength carbon, ultra high strength carbon, high modulus carbon or ultra high modulus carbon, Aramid fibres can be of low modulus aramid or high modulus aramid. A major distinction of aramid fibres is that they are highly tenacious in the non-composite form and do not behave in a brittle manner as both glass and carbon fibres do. Typical properties of some fibres in use are given in Table 2. Typical mechanical properties of some fibre composites are presented in Table 3.

Table 1 : Typical Properties of Epoxy Adhesives, Concrete and Steel

Property	Cold-curing epoxy Adhesive	Concrete	Mild Steel
Density (kg/m^3)	1100-1700	2350	7800
Elasticity Modulus (GPa)	0.5-20	20-50	205
Shear Modulus (GPa)	0.2-8	8-21	80
Poisson's Ratio	0.3-0.4	0.2	0.3
Tensile Strength (MPa)	9-30	1-4	200-600
Compressive Strength (MPa)	55-110	25-150	200-600
Shear Strength (MPa)	10-30	2-5	200-600
Tensile Strain at Break (%)	0.5-5	0.015	25
Approximate Fracture Energy(J/m^2)	200-1000	100	10^5-10^6
Water Absorption : 7-days-25ºC (%)	0.1-3	5	0
Co-efficient of Thermal Expansion (10^{o6}/C)	25-100	11-13	10-15
Glass Transition Temperature (ºC)	45-80		

Table 2 : Typical Properties of Reinforcing Fibres

Material	Specific Gravity	Elastic Modulus (GPa)	Tensile Strength (GPa)	Ultimate Tensile Strain (%)
Glass				
E	2.56	70	1.9–3.0	3.0–4.5
S	2.49	85–90	3.5–4.8	4.5–5.5
Aramid				
Kevlar 29	1.44	70–80	3.5–4.1	4.3–5.0
Kevlar 49	1.45	115–130	3.5–4.0	2.5–3.5
Carbon				
High Strength	1.76	215–235	3.5–4.8	1.4–2.0
Ultra high strength	1.75	215–235	3.5–6.0	1.5–2.3
High modulus	1.87	350–500	2.5–3.1	0.5–0.9
Ultra high modulus	1.89	500–700	2.1–2.4	0.2–0.4

Table 3 : Typical Properties of FRP Composites

Material	Fibre Content (%)	Density (kN/m^3)	Elastic Modulus (GPa)	Tensile Strength (GPa)
Glass / Polyester GFRP Laminate	50–80	16–20	20–55	0.4–1.8
Aramid/Epoxy AFRP Laminate	60–70	10.5–12.5	40–125	1.0–1.8
Carbon / Epoxy CFRP Laminate	65–75	16–19	120–250	1.2–2.3

FRP Systems

Different systems of externally bonded FRP reinforcement exist. The two commonly used systems include wet lay-up system and prefab system. In the former dry unidirectional fibre sheet, dry multidirectional fabric, resin pre-impregnated uncured unidirectional fabric sheet, resin pre-impregnated uncured multidirectional fabric/sheet, dry fibre tows or pre-impregnated fibre tows are utilized. The fabric can be either directly applied into the resin that has been applied on the concrete surface or can be impregnated with resin and then applied wet on the concrete surface. In the latter system, pre-manufactured cured laminates, shells, jackets or angles are installed through the use of adhesives.

TECHNIQUES FOR FRP STRENGTHENING

The basic technique, which is most widely applied, involves the manual application of either wet lay-up or prefabricated systems by means of cold cured adhesive bonding. The external FRP reinforcement is bonded to the carefully prepared concrete surface with the fibres parallel to the direction of principal tensile stresses.

Prestressed FRP reinforcement proves to be beneficial on many accounts. With adequate anchorage it increases the ultimate moment of resistance by avoiding failure modes associated with peeling-off at cracks and at the ends of the laminates. When strengthening a member using pre-stressed FRP laminate, it is necessary to ensure that the tensile failure of the laminate should not precede either yielding of internal steel or compressive failure of concrete to ensure adequate ductility.

FLEXURAL STRENGTHENING OF BEAMS

Flexural strengthening using FRP composites is generally by bonding an FRP plate to the beam soffit (Fig. 1). The FRP plate may be a pultruded plate or may be constructed on site by a wet lay-up

Fig. 1 Application of FRP Laminate to the Beam Soffit

process. The surface must be adequately prepared to remove weak surface layer of concrete, expose the coarse aggregate to improve bond with FRP and provide an even surface. FRP plate can be bonded to the beam soffit with pre-stressing. Since FRP's have high tensile strength, pre-stressing leads to more efficient use of their tensile strength. In practical applications mechanical end anchorage should be considered. RC beams with unanchored and un-stressed FRP plates have been widely investigated and used in practice.

SHEAR STRENGTHENING OF BEAMS

Flexural failure is generally preferred to shear failure as the strength - governing failure mode as the former is ductile allowing stress distribution and provides ample warning. When an RC beam is shear deficient or when its shear capacity is less than the flexural capacity after flexural strengthening, shear strengthening must be considered. Various schemes have been evolved to increase the shear capacity of RC beams. These include bonding FRP to the sides of the beam, bonding FRP U-jackets and wrapping FRP around the whole section of the beam. The fibres may be oriented in such directions as to control shear cracks best.

Under reversed cyclic loading and earthquake attacks, use of fibres in two directions can be beneficial for shear resistance. The combination of different bonding configurations, fibre orientations and fibre distributions can result in many different types of strengthening schemes. Fig. 2 shows most common shear strengthening schemes, orientations which may be useful for the selection of a suitable strengthening scheme. When both flexural and shear strengthening are required, FRP for shear strengthening should be applied first which reduces the risk of premature de-bonding failure of the soffit plate from the beam. The effective location of FRP strip is shown in Fig.3.

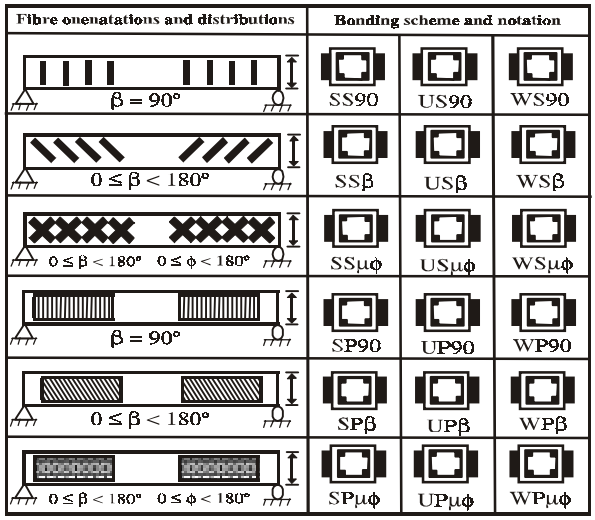

Fig. 2 : FRP Shear Strengthening Schemes

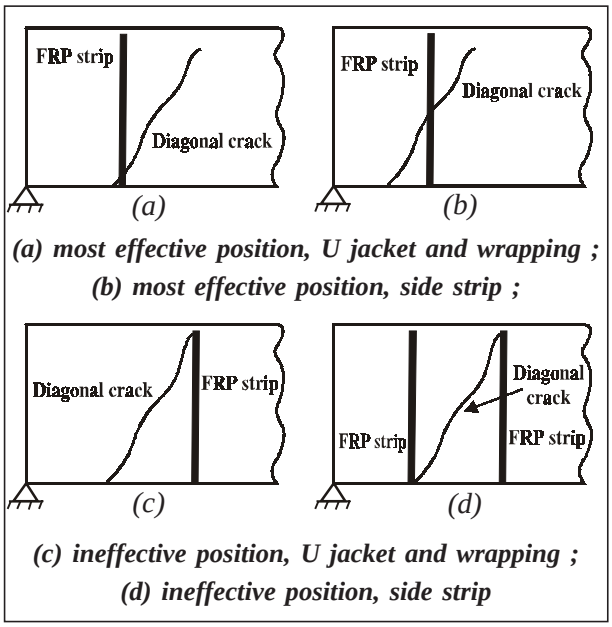

Fig. 3 : Effect of Location on the Effectiveness of an FRP Strip

FLEXURAL STRENGTHENING OF SLABS

Strengthening of one-way slabs is carried out by bonding FRP strips/sheets to the soffit along the longitudinal direction. For two-way slabs, strengthening is done by bonding FRP strips in both directions as shown in Fig. 4a. For slabs cantilevering from a wall or a large beam, a simple

option is to bend the FRP strips/sheets on the wall surface as shown in Figs. 4b and 4c. For achieving sound anchorage, FRP strips shall be inserted into holes pre-drilled in the wall as shown in Figs. 4d. The holes shall be filled with epoxy mortar. For continuous cantilever slabs, the anchorage of FRP strips/ sheets may be achieved by extending the FRP reinforcement to the inside slab for a sufficient distance.

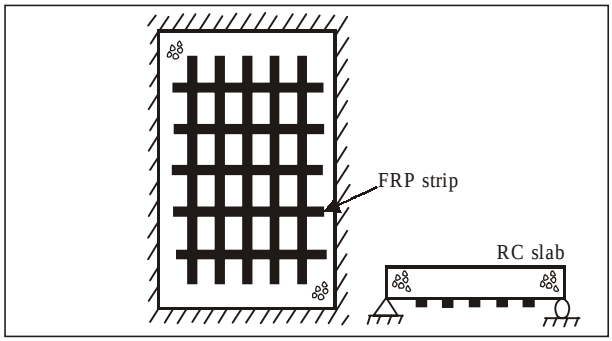

Fig. 4 (a) Two-way Slab Bonded with FRP Strips

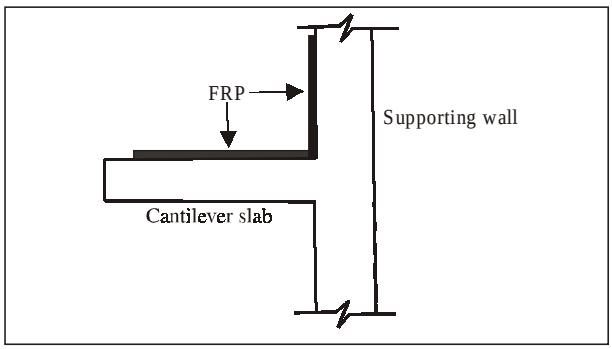

Fig. 4 (b) Fixed End Anchorage for Cantilever Slabs

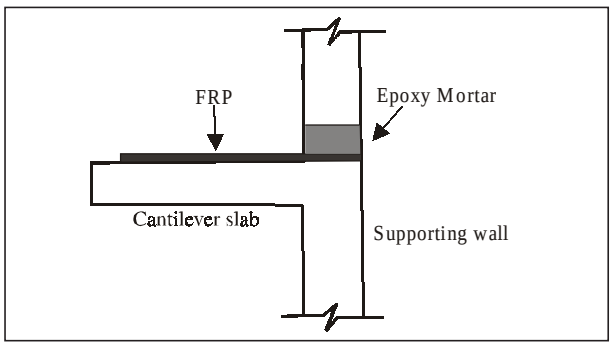

Fig. 4 (c) Fixed End Anchorage for Wall Supported Cantilever Slabs : Inserting FRP Strips in the Wall

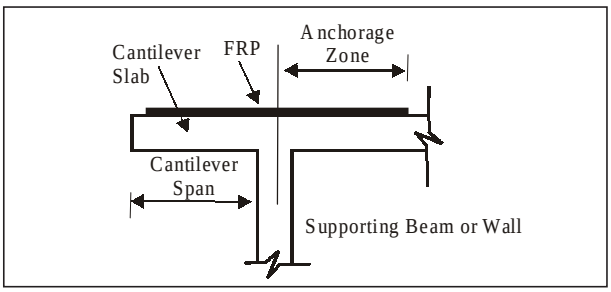

Fig. 4 (d) Fixed End Anchorage for Continuous Cantilever Slab

CONCLUSIONS

Fibre Reinforced Polymer (FRP) is a highly effective material for strengthening structural members like beams and slabs. Flexural members strengthened with FRP have higher load carrying capacity and better seismic performance. They can be used for rehabilitating ageing structural members to improve their performance and new structural members to provide additional strength.

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SOMETHING TO THINK ABOUT

HOW TO MAKE THINGS INVISIBLE ?

Hem Shanker Ray

Invisibility has fascinated mankind from time immemorial and, thus, in mythologies of all cultures there have been characters who aquired powers to become invisible at times. The fantasy has continued through literature of all ages. Even today it finds place in many stories and movies. Harry potter also has a cloak which makes him invisible when the cloak covers him. Of course, the cloak also becomes invisible. The traditional method, however, requires drinking a magic potion often prepared by a crazy wizard who does not have better things to do !

There is a difference between disappearance and invisibility. A magician can suddenly become invisible on stage leaving behind his magic wand that continues dancing. Here the magician is not visible because he has managed to escape altogether. In many movies, parts or whole of a person can be made to suddenly look invisible by using various cinematographic tricks. Sometimes, only the uncovered parts disappear leaving the clothes and the hat to do the dancing. This article is not about such tricks. We discuss, from scientific angle, the possibility of a body becoming invisible even though it continues to exist. If the body is still there, then it cannot pass through walls and closed doors, but can sneak in and out unseen. If a fellow roams about unseen, imagine what interesting things he can see and hear—in bed rooms, board rooms, terrorists dens or politicians' chambers. Yet, since the body exists, he has to be careful about not colliding with things and drop vases on the floor, let alone actually have body contact with others. The angry invisible man in the movies often enjoys throwing things at or kicking and punching his hapless enemies who, in frustration, can only throw punches at random and try his luck !

There is a serious flaw in this concept. Even if the body responds to the magic potion of invisibility, the clothes may not. One, therefore, has to be nude to start with and hope that the potion works. Then even if the body disappears, the eyes never can because to see one needs retinal images. If the eyes disappear then one has to go blind too and then all fun is lost. There are fishes with transparent bodies that allow light to pass through. Some internal organs and the eyes, however, remain visible. Because of transparency clear glass is often nearly invisible, specially when immersed in water. It can be made totally invisible if the refractive index of the liquid is such that it matches that of glass.

A common way to make things invisible is to blend it with the surroundings. Then, eventhough something is there, it goes undetected by the viewer. This is 'camouflage' that achieves a disguise by deceit. The green grass hopper amidst grass attempts this for protection from those who find it tasty. Many insects are far ahead in this game as they have evolved shapes and colouns to become practically indistinguishable from leaves and twigs. Camouflage helps in both defence and attack. The stone fish, that rests itself on sea floor amidst rocks, looks in shape and coloring exactly like the surrounding rocks. It is detected only for an instant

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when it stirs to swallow a passing prey. Then it goes back to its meditative state when every rock begins to look like stone fish. Squids and octopusses are masters of disguise as they cannot only change colours to blend with the surroundings but their shapes also. Camouflage is common amongst reptiles too, but bigger animals do not need this as much. The tiger's stripes do, however, help it approach its prey unseen among tall grasses.

Soldiers wear uniforms with green and brown patches and cover helmets with leaves to avoid easy detection in jungles and bushes. Tanks and even war planes are painted appropriately to blend against the surroundings so as to be less visible during combats.

Let us look at the subject from a more scientific angle. In many fairs a common trick that draws crowds comprises display of a living and talking human head on a table top with nothing underneath—no part of the body is seen. The effect is hightened when the head is that of a small girl talking sweetly. The head is seen on a platter on the table placed in a cubicle covered with black cloth with a low partition distancing the onlookers. As many may be aware the effect is achieved by covering the body underneath by two mirrors at an angle of 90º or so. There is a hole in the table top for the head to come through. The mirrors reflect the black cloth around to create the illusion of emptiness underneath. One thinks that one is seeing through to look at the black curtain behind.

Mirrors can be used to cleverly make soldiers and tanks apparently disappear into the surroundings. This can be done by making the soldiers wear body suits of mirrors and similarly covering tanks and other armoured vehicles. The mirrors reflect the surroundings, say sandy terrain or green fields and thus provide disguise. It is also possible in theory to cover a tank with white screens and project from inside instant videos of the landscape to provide similar disguise. Military establishments in some countries have carried out many studies with these ideas but, for obvious reasons, they remain confidential.

The ideal solution for invisibility requires the viewer to see through, that is receive light from behind an object. This can be achieved if light does not follow a straight line but rather comes from behind skimming the surface and contours. It appears that scientists have come close to achieving this. The solution for invisibility then will not come from any magic potion but having a covering layer like Harry Potter's cloak that make light from behind slide alone the body and emerge in the front.

An international team has engineered a material to achieve this (the times of India, Bangalore edition, Monday Aug. 11, 2008). The basic concept requires the surface coating to control visible light's direction of traval to bend it around the object to render anything from people to large tanks and ships invisible. The object would be hidden by light rays so bent as rock beads the river to flow around it. The viewer will not see the object but things behind it.

Substances that can do this are known as *meta materials* that can only be made by nanoscale engineering. Apparently, good results have already been achieved with electromagnetic radiation of longer wave lengths. To achieve the same result with visible light would need a big jump forward. Yet scientists believe this would be possible in the near future and, therefore, defence establishments are sponsoring research in this area. Obviously, the invisibility suit will not be available in shopping malls at least for some years and when they become available, they would be perhaps expensive. And those who will be able to afford will be precisely those who want to be visible at all times. This is similar to the dilemma of book lovers—those who love books often cannot afford them and those who can afford do not read books !

KNOW THY INSTITUTIONS

RAMAN RESEARCH INSTITUTE, BANGALORE

The Raman Research Institute was founded by Nobel laureate **Sir C. V. Raman** in 1948 with funds from private sources. The main activity of the institute was basic research in selected areas of physics which were of particular interest to Porf. Raman. The institute owes its origin to the support of government of Mysore in gifting to the Indian Academy of Sciences a plot of land in Bangalore in December 1934. In the year 1956, Prof. Raman made an irrevocable gift to the Indian Academy of Sciences, of various movable and immovable properties for the use and the benefit of the Raman Research Institute.

After Prof. Raman's death in November, 1970, The Indian Academy of Sciences created in July 1971 a public charitable educational trust by the name Raman Research Institute Trust (RRI Trust). The Academy transferred to the trust the lands, buildings, deposits, securities, bank deposits, moneys, laboratories, instruments and other movable and immovable properties held by it for the purpose of RRI. One of the main objectives of the RRI Trust is principally to maintain, conduct and sustain the Raman Research Institute.

Administered by a Governing Council the institute was reorganized in 1972 and started receiving funds from the Department of Science and Technology, Government of India.

MAIN AREAS OF RESEARCH

Currently, the main areas of research are Astronomy and Astrophysics, Soft Condensed Matter, Theoretical Physics and Light and Matter Physics.

Astronomy and Astrophysics

Astronomy research began in RRI in the 1970s with an emphasis on radio astronomy. Some of the main areas of research at the time was pulsar astronomy, supernova remnants, and surveys at low frequencies.

At present, RRI astronomers are involved in various research activities, including surveys, transients, compact objects, the Milky Way, extragalactic astronomy and cosmology. The research encompasses both theoretical and observational studies, as well as instrumentation.

Soft Condensed Matter

Liquid Crystals has been an active area of research at the Raman Research Institute for over three decades. The research programme covers a broad spectrum of activities ranging from the synthesis of new liquid crystalline materials to display electronics. Discoveries of the columnar phase formed by disc-like molecules and pressure induced mesomorphism are two of the early significant contributions made by the liquid crystal group. Recently, two new liquid crystalline phases, namely the undulating twist grain boundary C* phase and the biaxial smectic A phase have been discovered in our laboratory. Addressing techniques for driving passive matrix liquid crystal displays developed here are now widely used. The group is also interested in the magnetic properties of liquid crystals. In recent years, the group had been working on electrochemical aspects of surfaces and interfaces and on other soft materials like surfactants, polymers, and on the physics of biological systems.

The ongoing research activities are in the following areas :

Liquid Crystals :

(1) Experiments (2) Theory (3) Displays (4) Chemical Synthesis (5) Surface Science (6) Surfactant Systems (7) Physics of Biological Systems

Theoretical Physics

The Theoretical Physics Group conducts research in general relativity, gravitational waves, quantum gravity, soft condensed matter, non-equilibrium statistical mechanics, biological physics, optics, quantum mechanics and the geometric phase.

Light and Matter Physics

(1) Atoms in External E & B Fields (2) Ultra–Cold Molecules (3) Non–Linear Optics (4) Intense Field Interactions (5) Light Scattering (6) Laser Cooler (7) Quantum Optics (8) Bose Einstein Condensation

ELECTRONIC INSTRUMENTATION

In several laboratories for developing several electronic instruments, development work is done both in analog and digital instruments primarily to support basic research in astronomy and physics. There are three different laboratories :

- **Radio Astronomy Laboratory**

This lab caters to the needs of research in Astronomy and Astrophysics. The lab is equipped with state-of-the art analog and digital test equipments. Developmental activities include design and construction of Feeds and Receivers for various radio telescopes operated by the institute. Digital Signal Processing is a major activity of the laboratory.

- **Liquid Crystal Display Laboratory**

This laboratory is attached to the research group on physics of liquid crystals. Devices are developed and built for various addressing techniques of LC displays.

- **Instrumentation Cell**

This unit, which is housed within the Radio Astronomy Lab, undertakes development of electronic instruments for various experimental setups in the liquid crystal laboratories and optics laboratory.

ENGINEERING WORKSHOP FACILITY

This facility mainly caters to the requirement of mechanical components required by the Radio Astronomy Lab, Optics Lab etc. The workshop has fairly advanced machinery and a team of skilled personnel who can undertake fabrication of various sophisticated mechanical hardware components.

Some of the major jobs handled by the workshop team are given below :

- Construction of the 10.4-m millimetre-wave radio telescope antenna using honeycomb panels following the design of R. B. Leighton, Caltech, USA.
- Fabrication and installation of nearly 1100 helical antennas and other hardware components for the Mauritius Radio Telescope.
- Fabrication of waveguides and receiver boxes for the 21 cm receiver for the 30 antennas of GMRT.
- Fabrication of high precision mixer blocks, Tripler Blocks, waveguides etc. for millimetre-wave receivers.
- Precision mounts and positioners for the Optics Lab.
- Fabrication of Components for Ultra Light flying machi

LIBRARY

The library started by Prof. C. V. Raman, with his varied interests in different branches of science and deep interest in reading, has many invaluable books. From 1972 onwards, library's collection developed in the new areas of research activities, viz. astronomy and astrophysics, theoretical physics, optics and liquid crystals. There are books on computer science, electronics, scientific biographies, general science, nature and fine arts. It has also a collection of non-book materials like scientific slides, CDROMS and sky surveys (both on paper and CDROMS), audio and video tapes. The Library participates in inter library networking activities. The library has full text access to several ONLINE JOURNALS.

Library offers circulation, reprographic and inter library borrowing services. Journals received at Indian Institute of Astrophysics and the National Aerospace Laboratory are displayed at this library on a regular basis. In addition, few journals are accessible under FORSA consortia. Using LIBSYS software, the library catalogue has been computerized and is now available online to the readers both within and outside the Institute.

COMPUTER DIVISION

The computer division of RRI caters to the various computing needs of the different research and development groups in the institute. The computing systems are located in the designated computer rooms in several buildings across the campus. A campus-wide local area network (RRI LAN) hooks up these systems.

The computing facilities include multiple platforms like Digital/Compaq, SUN and Intel based Linux servers and workstations. Users directory are provided on NFS Server and the machines on the campus network use NIS Services for easy sharing resources. Application specific software packages along with development tools are available on these platforms. Multi-CPU systems along with tools are also available on Digital/Compaq and SUN platforms. Back-up tape media support is available for 8mm, 4mm, DDS and VXA.

Please contact for further information :

Director, Raman Research Institute, C. V. Raman Avenue, Sadashivanagar. Bangalore-560 080, India Ph. 2361 0122 to 2361 0129 (8 lines) **Fax :** +91-80-2361 0492

LIFE SKETCHES OF OFFICE BEARERS AND SECTIONAL PRESIDENTS INDIAN SCIENCE CONGRESS ASSOCIATION, 2008-2009

DR. T. RAMASAMI

General President,

Dr. T. Ramasami, currently Secretary to the Government of India, Department of Science and Technology, holds a Master's degree in Leather Technology from the University of Madras, India and PhD in Chemistry from the University of Leeds, UK. He has also worked on energy research in Ames Laboratory lowa, USA and on electron transport phenomena in the Wayne State University, USA prior to returning to India for undertaking his scientific career. He joined the Central Leather Research Institute, Chennai as a scientist in 1984 and served as its Director for more than 10 years till May 2006. He is known among the scientific establishments in the country for his leadership to the Central Leather Research Institute. The institution earned a global leadership status during his tenure as its Director as evidenced by the 30% global share of publications, >7% share of global patents, positions in fashion forecasting and the level of public-private partnership built in leather research.

Dr. Ramasami is currently engaged in the development of policies and programs for attraction of talents for study and careers with science, rejuvenation of research in universities, stepping up of international S & T cooperation, development of public-private partnerships in R & D sector and accountability of public funded research, development and demonstration. The Department of Science and Technology is aggressively engaged in the development of new models and mechanisms for enhancing the role of public funded institutions in innovations and research and development.

Dr. Ramasami has a large number of publications in highly peer-valued journals and a significant number of patents, which are under commercial exploitation. His research experience spans several fields and areas in both basic and applied sciences. He has made some important contributions in the fields of inorganic chemistry as well as chemical and leather related technologies. His contributions to the understanding of the chemistry and applications of chromium as well as leather science and environment related technologies have earned him several professional recognitions in both India and abroad. These include Shanti Swarup Bhatnagar Prize for chemical sciences in 1993, election to all major science academies as a fellow as well the Third World Academy of Sciences and the National civilian award Padma Sri in 2001.

PROF. A. BANERJI

General Secretary (Head Quarters)

Prof. Avijit Banerji was born on 26th May 1946 at Calcutta. He did his schooling at Calcutta Boys' School, appearing at the Cambridge Overseas School Certificate Examination 1960, standing sixth in the order of merit in West Bengal. He studied at Presidency College, Calcutta, obtaining a first class in B.Sc. (Honours) in Chemistry (1964), and then at the Science College, Calcutta University, standing first in M.Sc. in Chemistry (1966). He obtained his Ph.D. (1970) in Chemistry working with Professor (Mrs.) Asima Chatterjee, FNA, on the basis of his thesis submitted on "Nitrogen Hetorocycles". He received the Nagarjuna Prize for best piece of research work carried out in Chemistry at Calcutta University for the year 1968, and subsequently the prestigious Prem Chand Roychand Studentship and Mouat medal of the University. He has received the Basudev Banerjee Award (1985) and P.K. Bose Memorial Award (1999) of the Indian Chemical Society. In December 1999, he delivered the Professor Mukarram Hussain Khondakar Memorial Lecture at Dhaka University, which is a premier award in Science in Bangladesh.

Dr. Avijit Banerji started teaching at the Chemistry Department, Calcutta University as an Honorary Lecturer in 1971. He joined the Department as Lecturer in July 1972, becoming Reader in 1979 and Professor from January 1986. He was the Head of Department of Chemistry (1996-1998), Chairman Undergraduate Board of Studies in Chemistry, Co-ordinator of the Department's COSIST Programme and Member of the Senate of the Calcutta University. He has been actively associated with the Special Assistance Programme, later upgraded to Centre of Advanced Studies on Natural Products founded by Professor (Mrs.) Asima Chatterjee at the Chemistry Department for over 30 years. At present Professor Banerji is the Programme Coordinator of this Centre where activities have been extended and renamed as the Centre of Advanced Studies on Natural Products including Organic Synthesis.

Professor Banerji has worked at several places in India and abroad for periods ranging from about a month to nearly two years. He worked with Professor A.R.Katritzky, FRS (University of East Anglia, U.K., (1974-1976) on a Nuffield Institute sponsored Fellowship. He was a UNESCO fellow at the Pennsylvania State University, USA (1982) with Professor R.A. Olofson, Work at both centres involved research on frontier areas at the Chemistry of Nitrogen Heterocycles. He has also worked for short periods at the CDRI, Lucknow ; and IISc, Bangalore. He has visited several research organizations and attended conferences in USA, UK, Switzerland, Germany, Thailand, South Korea, Bangladesh, China, Malayasia and Singapore.

Professor Banerji's research contributions can be divided into a number of categories—

(1) Natural Products Chemistry in all its aspects (isolation, structure-elucidation, transformation

reactions of mechanistic and sterochemical importance, synthesis, biological activity) in the fields of (a) idole alkaloids (his initial interest), (b) Piper constituents and related compounds and also (c) Constitutents of other genera-terrestrial and marine. The latter two categories include work on peptide alkaloids, alkamides, lignans, triterpenoids, phenanthene derivatives, kawapyrones, coumarino sesquitespenoids, coumarino lignoids, plant extractives as antibiabetic agents.

(2) 1, 3-Dipolar Cycloaddition reactions of Nitrones have been extensively investigated regarding mechanistic, stereochemical and synthetic aspects. Theoretical Calculation on these 1.3 DC reactions are being.

(3) Single-Electron Transfer reactions and synthetic applications.

(4) Work on Heterocyclic Chemistry included investigations on azetinones, chromanones, indoles, multi-centre cyclisation reactions of amidiners.

(5) Metal reagents in Organic Reactions.

(6) Green Chemistry.

(7) Nano Catalysis.

(8) NMR investigations of several classes of Natural Products and synthetic compounds; use of NMR spectroscopy as a probe to determine electronic and steric effects and mechanistic.

Twenty students have obtained their Ph.D. degrees in Chemistry with Professor Avijit Banerji, and a number are working with hin for their Ph.D. degree at present. Three students have received M.Phil. in Environmental Studies at Calcutta University with him.

About 125 research papers and several reviews have been published so far, and about 170 abstracts have appeared in proceedings of National and International Conferences. He has delivered several invited and Award lectures in India and abroad.

Professor Banerji is a Life Member of the Indian Science Congress Association since the 1960s. He was elected Council member (1994-1995) and then Executive Committee member (three consecutive terms, 1995-1998) of the ISCA. He was the Sectional President of Chemistry, at the 84th Session of the Indian Science Congress at Delhi in January 1997. He served as Treasurer from 2003-2005, relinquishing this office on being elected General Secretary (Headquarters) from 2005.

Professor Banerji has also been very active in the Indian Chemical Society : Honorary Secretary (two consecutive terms—1990-1993) and Vice-President (1996-1997 ; 2000-2001). He served as a Council member (1981-1987, 1994-1995), Treasurer (2002-2003), He revived the Society's international links, and was its representative in the Federation of Asian Chemical Societies, and was Project Coordinator of National Products of FACS from (1991-1995). He was a founder-member of the Board of the Asian Network on Research in Anti-Diabetic Plants (ANRAP). He is a Life member of the Indian Science News Association and the Indian Council of Chemists, serving on its Council, and as Joint Secretary.

Professor Banerji was elected a Fellow of the West Bengal Academy of Science and Technology, Chemical Sciences in 1990. He is a member of the Council of the West Bengal Department of Science and Technology (WBDST), and Chairman of the Advisory Committee of Chemical Sciences. He has helped to design courses at IGNOU and Vidyasagar University in addition to the University of Calcutta.

DR. A. K. SAXENA

General Secretary (Outstation)

Dr. Ashok K. Saxena obtained his Master degree in Zoology in First Division from Meerut University in 1967. He did his Ph.D degree from the Kanpur University, Kanpur in 1973. Dr. Saxena has more than 40 years teaching experience in Post Graduate and Degree classes. He first joined as a Lecturer in the Dept. of Zoology of D.A.V. College, Kanpur in 1967, and became Reader in 1986 and since 2005 is the Principal of that College. He has 38 years of research experiences and under his research guidance 23 students have been awarded Ph.D degrees. He has contributed more than 55 papers in a number of National and International Journals. Dr. Saxena is also a Convener of the Board of Studies in Zoology of CSJM University, Kanpur.

Dr. Saxena has been associated with a number of Professional Societies including General Secretary of Indian Society of Life Sciences. He has been associated with Indian Science Congress Association for the last 35 years and first Elected Member of Sectional Committee of the section of Zoology, Entomology and Fisheries of the Association then elected Recorder of the section of Zoology, Entomology and Fisheries for the year 1993-94 and 1994-95, Later he was elected a Council Member in 2004-05 & 2005-06 and then an elected member of Executive Committee in 2006-07. He is also Life Member of different Academies/Societies like Zoological Society of India, B.H.U., Indian National Academy of Sciences, Allahabad, Society of Bio Sciences, Muzaffar Nagar etc.

Dr. Saxena has more than 21 publications in the form of Books, Symposia, Proceedings. He is Convener of the Editorial Board of 'Trends in Life Science'—an International Journal ; Member of Editorial Board 'Life Science Advances' an International Journal and Referee of ICAR Krishi Bhavan, New Delhi.

Dr. Saxena has received several honours/awards in recognition of his meritorious research works. Some of which are : (i) International Award of Recognition 5000 Personalities of the World for Outstanding Services to the Research and Teaching Profession by American Biographical Institute, (ii) Zoological Society of India Gold Medal for the contribution to Life Sciences. (iii) Research Fellow of American Biographical Institute (iv) One of the Member of the Research Board of Advisors, American Biographical Institute. Dr. Saxena was elected as General Secretary (Outstation) of ISCA from 2007 for three years. Recently Dr. Saxena was invited by the American Association of Advancement of Sciences at their 80th Annual Meeting held in Feb 2008 at Boise State University Boston.

PROF. COL. DR. R. SEN
Treasurer

Prof. Col. Dr. Ranajit Sen was born in Kolkata on 31st January, 1952. He graduated in Medical Science in 1974 from Calcutta University, obtained Diploma in Oral Surgery from Leiden, Netherlands in 1983, Post Graduate Training in Oral Surgery in London in 1984, Fellowship in Dental Surgery of the Royal College of Surgeons in Edinburgh in 1985, Doctor of Philosophy in 1987. He was awarded Bachelor of Law of Calcutta University in 1986. He was trained in Acupuncture, Cryogenics, Electron Microscopy, Statistics and AIDS. He has been practicing Head & Neck Surgery, and Oncology. Being closely, long associated with the Central Forensic Science Laboratory, Govt. of India, he is an expert in Lie Detection, Narco Analysis, Brain Mapping. He teaches Forensic Science in the University of Calcutta as well as the Criminal Detection Training School, Govt. of India. He was Professor and Head, Oral and Maxillofacial Surgery in Calcutta Medical College Hospital. He also taught in Chittaranjan Cancer Hospital, Katihar Medical College, National Institute of Homeopathy, Armed Forces Medical College, Metropolitan Homeopathic Medical College in India, and University College Hospital, Eastman Dental Institute, Italian Hospital, Saint Margarette Hospital and Whipp's Cross Hospital in England. He also served as Principal-cum-Medical Director of Uttaranchal Dental and Medical Research Institute, Dehradoon.

He was credited with the Commonwealth award and several National awards.

He published till date 13 Medical Books and one Law Book through publishers of International repute. The Law Book "Physically Handicaps—Laws & Rehabilitation" was awarded Anath Nath Deb Gold Medal of Calcutta University in 1985. He published 369 popular Medical articles in Your Health (IMA Magazine), The Statesman, The Ananda Bazar Patrika, The Swastha Dipika etc. His efficient research work could enable publication of 47 original research papers, mostly in International Journals, and presentation in 16 International and several National Congresses.

He served as a member of the Editorial Board of the Journal of Indian Medical Association. He is a member of the European Association of Oral and Maxillofacial Surgeons, International Association of Oral Pathologists, etc. He is a Council Member of the Indian Academy of Forensic Sciences.

He is devoted to social work through his three organizations namely Health Ultimate Research Organization, 3 R's Academy, Silent Lady, and one trust, Getwell. He is also a member of the Red Cross Society, Rotary International and Lions Club. Needy people are rehabilitated through his organizations both socially and medically.

Being a Student Member in 1966 followed by Life Member in 1974 of the Indian Science Congress Association, he has been intimately devoted to this association for its noble scientific cause. He was not only the Executive & Council Members of this association, he was the Recorder and the President of the Medical Sciences including Physiology also. Presently, he is the Treasurer of the Indian Science Congress Association.

DR. H. PATHAK
President,
Section of Agriculture and Forestry Sciences

Dr. Himanshu Pathak, Co-Facilitator, Rice-Wheat Consortium, International Rice Research Institute (IRRI)-India office, New Delhi was born on February 2, 1965 in village Kanara in Purulia district of West Bengal. He joined Banaras Hindu University for obtaining B. Sc. (Ag.) and moved to Indian Agricultural Research Institute (IARI), New Delhi to obtain M. Sc. and Ph. D. degrees in Soil Science and Agricultural Chemistry and then joined Agricultural Research Service (ARS) of Indian Council of Agricultural Research (ICAR) as a Scientist. Before joining IRRI, he was working as a Senior Scientist in the Division of Environmental Sciences at IARI, New Delhi. He worked as a visting scientist in the University of Essex. United Kingdom ; International Rice Research Institute, Philippines ; CSIRO Land and Water, Griffith, Australia and Institute of Meteorology and Climate Research, Garmisch-Partenkirchen, Germany.

Dr. Pathak evaluated and promoted resource-conserving technologies (RCTs) such as zero/ minimum tillage, laser-aided land leveling drill/ drum seeding, leaf colour chart and integrated crop management to increase resource use effciency and farmers' income in rice-wheat system. Farmers in the Indo-Gangetic Plains are adopting the RCTs in large scale. Dr. Pathak has contributed significantly in quantification of greenhouse gas (GHG) emission from agricultural soils, evaluation of the effects of management practices and biotic and abiotic factors on GHG emission and development of inventories of methane and nitrous oxide emission from Indian agriculture. His research has helped in rationalizing the estimates of GHG emmission from Indian agriculture and formulation of management recommendations and policy guidelines for mitigation of GHG emission. He has developed simulation models such of InfoSoil, InfoCrop, TechnoGAS and InfoRCT for predicting the impacts of management and climate on crop yield and optimizing resource use for increasing farmers' income and minimizing environmental pollution.

He has published about 75 scientific papers in international journals, 2 books, 30 book chapters, 3 technical reports, 12 review articles and 40 conference proceeding. Dr. Pathak is a Faculty Member of the Post Graduate School, IARI, New Delhi since 1995 and teaches Soil Science and Environmental Science to M. Sc. and Ph. D. He has visited many foreign countries.

Dr. Pathak is a Fellow of the National Academy of Agricultural Sciences (FNAAS) and recipient of the Alexander von Humboldt Fellowship of Germany, Dr. B. C. Deb Memorial Award of the Indian Science Congress Association (ISCA), Best paper award of ISCA, Golden Jubilee Commemoration Young Scientist Award of the Indian Society of Soil Science, BOYSCAST Fellowship of Department of Science and Technology, Govt. of India, and Young Scientist Award of ISCA.

DR. D. KUMAR
President,
Section of Animal, Veterinary and Fishery Sciences

Born on 19th August 1948, Dr. Dilip Kumar passed B. Sc. Hons from L. S. College, Muzaffarpur, M. Sc. and Ph. D. degrees from the University of Bihar, Muzaffarpur and joined as a Lecturer at the University of Bihar, Muzaffarpur and L.N. Mithila University, Darbhanga. Later, he joined the Central Inland Fisheries Research Institute, Barrackpore as an ARS Scientist. He established the Aquatic Animal Health Management Unit at CIFA, Bhubaneswar, and developed it into a premier centre of advanced research in ichthyopathology. He underwent advanced training in Fish Virology and Fish Cell Culture at Zagreb University, Croatia. In 1990, he joined FAO as a Fishery Extension Expert and rose to the rank of Chief Technical Advisor/Team Leader for several FAO/UNDP projects.

His notable contributions to the art and science of aquaculture include the development of models of integrated fish farming, and of composite fish culture ; development of a cell line from silver carp tumour cells ; and pioneering studies on diseases of Indian major carps. In the field of marine fisheries, he has the distinction of developing the highly acclaimed "Fisheries Co-management" model under FAO/UNDP project in Bangladesh that ensures community participation in the management of coastal fisheries resources. His contribution of distinction is the development of low cost aquaculture technology in Bangladesh, Sri Lanka and Vietnam. He conceptualized and field-tested the "Trickle Down System of Aquaculture Extension," which is now widely practiced in Bangladesh and several other Asian countries. The project through which these achievements were made under his leadership was adjudged as the best delivered FAO project in the world leading to the prestigious Edward Souma Award of FAO for the year 1997. He also developed highly acclaimed aquaculture technology for upland communities in Vietnam.

Dr. Dillip Kumar is the Founder Secretary of the 'Association of Aquaculturists' at Bhubaneswar. He played a lead role in the formation of 'Network of Aquafarmers Associations in the Asia-Pacific region' and also significantly contributed in the develpment of 'Asia Regional Aquatic Animal Health Certification and Quarantine System'. Currently, he is the President of Indian Fisheries Society, Mumbai.

Dr. Dilip Kumar has published a large number of research papers in peer reviewed journals of National/International repute, author of three internationally acclaimed books, recipient of several honours and Award including–Edward Souma Award of FAO (1997), Eminent Indian Zoologist Gold Medal (2007) by Zoological Society of India, Prof. E. P. Odum Gold Medal (2007), Indian Society of Environmental Education and Research Gold Medal and most prestigious Sir Dorabji Tata Gold Medal (2008) by Zoological Society of India. He is also on the Editorial Committees of several peer-reviewed journals and recipient of fellowship (F. Z. S. I) F.A.S.F.T. and many others by different academic bodies of India.

Dr. Dilip Kumar is currently the Director/Vice Chancellor of the Central Institute of Fisheries Education, Mumbai.

PROF. DR. A. B. DAS CHAUDHURI
President,
Section of Anthropological and Behavioural Sciences (including Archaeology and Psychology & Educational Sciences)

Prof. Asit Baran Das Chaudhuri was born on 31st December, 1943 in Assam. He did B. Sc. (Honours) and M. Sc. in Anthropology and was awarded the Ph. D. (Science) degree in Anthropology by University of Calcutta in 1973. He was offered Fellowship by the Alexander von Humboldt Stiftung (1979-1980), West Germany. He joined the Anthropologisches Institute (now named as Institute for Human Biologiae, Universitat Hamburg) to do researches on the advanced method of quantitative genetics in man. Moreover, Dr. Das Chaudhuri worked on human cytogenetics with Prof. Dr. G. Flatz, Director, Human Cytogenetik Labor, Medizinische Hochschule, Hannover. Dr. Das Chaudhuri furthered his Ph.D. research investigation on family and population materials to work out the mode of inheritance of hair micro-morphological variables and ascertain their utility on family and population materials. On the basis of the results of this work, the University of Calcutta awarded him the D. Sc. degree in Anthropology in 1982 and he became university professor in 1998. He has published more than 50 papers in international journals of repute. He has participated in international seminars and symposiums in a number of countries. A number of students were awarded Ph. D. degrees in Anthropology under his supervision.

Prof. Das Chaudhuri's major research contributions are as follows : (a) Twin, family and population models were simultaneously utilized for the first time in the discipline of biological anthropology for comprehensive understanding of the genetic basis of quantitative and qualitative variations of micromorphological variables of human scalp hair. (b) Modified Martin's method of hair micro-technique by preparing guaranteed high quality section of human scalp hair. (c) Throughout the past two decades, contributions were made in understanding fundamental researches on twin studies relating to inheritance/genetics of twinning and biology of twinning and efficient system of zygosity diagnosis of twins. A set of twins diagnosed with a battery of genetic markers was utilized for understanding genetic and environmental components of variability of a number of biochemical traits in man. (d) Efficient sequential search procedure for twin diagnosis utilizing gene frequency of genetics markers in a population has been developed. (e) In the late 1970s, Dr. Das Chaudhuri extracted four factors of dermatoglyphic variables by using the multivariate methods of factor analysis which showed that each finger is a disecrete part of digital complex comprising ten fingers and not a separate unit acted on independently by genes involved. (f) Contributed in understanding the determinants of anthropometric and metabolic risk factors and their relationship with coronary heart disease (CHD). Researches on anthropometry and sex hormones were also initiated in India. (g) Introduced the use of Atomic Absorption Spectrophotometry (AAS) for determination of occupational and environmental pollution of lead (Pb) from human scalp hair in the discipline of Physical Anthropology in India.

Dr. Das Chaudhuri has intiated the six-months Certificate course in Forensic Anthropology under

CUIIPP at the Department of Anthropology, University of Calcutta and has acted as its co-ordinator since 2004. He is also Fellow, West Bengal Academy of Science and Technology.

PROF. G. PANDEY
President,
Section of Chemical Sciences

Prof. Ganesh Pandey was born on 5th July 1954 at ancient holy city Varanasi, India and studied Chemistry at Banaras Hindu University, Varanasi. After completing his Ph. D. in 1979, he proceeded to Purdue University, U.S.A. for his postdoctoral studies in the group of Prof. Harry A. Morrison where he studied the photobiology of urocanic acid, the skin pigment. On returning to India in mid 1983, he first joined Panjab University, Chandigarh as "Pool Officer" and then moved to Indian Institute of Chemical Technology, Hyderabad as a Scientist and continued there till July 1991. He moved again to National Chemical Laboratory, Pune in 1991 and continuing as a Director Grade Research Scientist till today.

Prof. Pandey has made significant research contribution in developing conceptually new reactions based on the understanding of the chemical dynamics of photoinduced electron transfer (PET) generated radical ions. His scientific research spanning for approximately 25 years is devoted in elucidating the ramifications of PET reactions for generating fundamentally new chemistry. His research interest continues in the area of the total synthesis of natural products, development of newer synthetic methodologies and radical-ion chemistry.

Prof. Pandey is recipient of some of the most prestigious prizes in India such as Shanti Swarup Bhatnagar Prize (1999), B. M. Birla Science Prize (1991), CSIR Young Scientist award (988) and Vigyan Ratna Samman, Govt. of U.P. (2002). Recently, he has also been awarded with J. C. Bose Fellowship (2007). He is also the Fellow of all the three Science Academies of India.

Prof. Pandey has been a visiting Professor at Arizona State University, U.S.A. (July-December 1994) and Nagoya Institute of Technology, Japan (September-December 1999). He has also been occupying ICOS-10 visiting Chair Professorship at Hyderabad University. He has extensively travelled and lectured in USA, Germany, France, South Korea and Russia. He has also assumed the role of Regional Editor for TETRAHEDRON recently. He has also delivered many prestigious endowment lectures.

PROF. H. B. SRIVASTAVA
President,
Section of Earth System Sciences

Prof. Hari Bahadur Srivastava was born at Gonda District of Uttar Pradesh on third July 1956. He obtained his B.Sc., M.Sc. (Geology) and Ph.D. degree in Geology from Banaras Hindu University. Prof. Srivastava joined the Faculty of Department of Geology, BHU as Lecturer in November, 1981. Since then he is actively engaged

in teaching and research. Prof. Srivastava was nominated to visit France in 1988 as "Exchange Scientist" under Scientific Exchange Programme between CSIR and CNRS. Presently he is working as Professor in the Department of Geology, Banaras Hindu University, Varanasi.

Soon after joining as Reader he was awarded National Fellowship by Ministry of Human Resource Development Govt. of India to carryout Post Doctoral Research at University of Minnesota, Minneapolis from 1991 to 1993. At University of Minnesota he worked with Prof. Peter Huddleston and learnt modern techniques of analysis of folds and shear zones in high grade complexly deformed metamorphic rocks. In 1994 he was awarded European Economic Community Post-Doctoral Fellowship (Mari Curie Award) to work with Prof. Peter Cobbold in the laboratory of Tectonophysique, at University of Rennes, France, where he learnt the techniques of Physical modeling in the laboratory and their simulation with naturally deformed structures.

Based on his research contributions Ministry of Mines, Govt. of India, has awarded him "National Mineral Award" Prof. Srivastava is closely associated with Indian Science Congress Association (ISCA) for the last one decade and has served ISCA as Recorder Earth System Sciences in 92nd (held at Ahmedabad in Jan. 2005) and 93rd (held at Hyderabad-in Jan.2006) Session of Indian Science Congress.

The research interests of Prof. Srivastava include Structural Geology/Strain studies, Tectonics of the Himalaya, analogue modeling (simulation of naturally deformed structures in the laboratory) and active faulting. He has contributed to over 35 research papers in national and international journals on various aspect of Geology, structure, strain and tectonics of Himalaya. He has participated in several national and International seminars and Symposia. Prof. Srivastava has also been the Principal Investigator in several research projects sponsored by Government Funding Agencies. Prof. Srivastava is currently engaged in analogue modeling related with collision of Indian plate with Asia plates with the help of different modeling materials.

Prof. Srivastava is the life member/member of different academic and professional bodies of India and abroad.

SRI. N. B. BASU
President,
Section of Engineering Sciences

Born on 14th. Day of July, 1956, Sri Nilangshu Bhusan Basu graduated in Civil Engineering from Bengal Engineering College in the year 1977 with distinction. He completed Master's degree in Structural Engineering from Jadavpur University in the year 1983 with distinction and successfully undergone training in River Basin Management at Thames Water Authority, U. K. in the year 1989 with Commonwealth Scholarship. He is serving as Chairman of Architectural Engg. Divison of Institute of Engineers, West Bengal Chapter. He is also adorning the honoured post of the Vice President at The Institute of Public Health Engineers. Presently, he is working at The Kolkata Municipal Corporation in the capacity of the Principal Chief Engineer (civil). Under the supervision of his Engineering skills a good number of infrastructure projects for the city of Kolkata have been completed successfully. 40 MGD water treatment plant at Palta, 100 MGD

pressure station for clear water at palta, 100 MGD intake jetty with intake station at palta, Networking for water mains, Booster pumping stations at Parkcircus, Bagmari, Ranikuthi, Kalighat Drainage pumping station at Southern Avenue, Automated computerized car parking system at Roudan street (over ground) at Lindsay street (underground) etc. are only a few among the large number of successful projects that he has so far undertaken. All the JNNURM projects of KMC have also formulated and would be executed in his leadership. Of them three schemes that have been duly sanctioned which are worth Rs. 600 crores.

PROF. M. G. TIWARI
President,
Section of Environmental Sciences

Prof. M. G. Tiwari, born on 13th August, 1948 at Village-Rerma, Daltonganj, Dist–Palamau of Jharkhand did his B. Sc. (Hons.), M. Sc. and Ph. D. from Ranchi University, Ranchi. He is working as Head, P. G. Department of Botany at Deoghar College, Deoghar, a constituent unit of S. K. M. University, Dumka (Jharkhand).

He has teaching and research experience of 32 yrs. His field of specialization is "Phycology and Environmental Sciences". He has published more than 35 research papers. He has attended more than 42 Symposia and Seminars and presented many papers. He is a receipient of Best Poster Presentation Award by Indian Science Congress Association in the Section of Plant Sciences at 86th Session held at Anna University, Chennai in the year 1999. He has been also honoured by Zila Sanskritik Parishad, Deoghar (Jharkhand) on 26th January, 2001.

He is a fellow of Indian Botanical Society (FBS), International Society for conservation of National Resources (FNRS) and Mendelian Society of India (FMA).

He has been elected as a Member of Executive Committee, Indian Science Congress Association in the sessions 2001-02, 2002-03 & 2003-04. He has also served as a member of Council, Indian Science Congress Association in the session 2000-01, 2004-05 & 2005-06. He was also elected as a executive council member of Indian Botanical Society from 1999 to 2002. He was 1st Recorder of Environmental Sciences, Indian Science Congress Association in the session 2002-03 & 2003-04. He is a life member of different scientific organisations and has chaired in different Seminars and Symposia.

PROF. S. K. BANDYOPADHYAY
President,
Section of Information and Communication Science and Technology (including Computer Sciences)

Prof. (Dr.) Samir Kumar Bandyopadhyay was born on 24th October 1954 and did his B. E. in

Electronics & Tele-Communication in the year 1975 from B. E. College, Shibpur (now it is Bengal Engineering & Science University). He also did his M. Tech. and Ph. D. (Computer Science & Engineering) from the University of Calcutta. The title of his Ph. D. thesis is "Diagnosis of Cardiac Diseases using Syntactic Pattern Recognition Approach". He received Fellowship Award from Computer Society of India in the year 2005. He has been working on different areas of computer Science & Engineering, such as Biomedical, Graph Theory, Signature Verification, Image Processing, etc. over a period of 20 years. Presently, Dr. Bandyopadhyay has been performing his duties as Professor of Computer Science & Engineering, University of Calcutta, and he was the Registrar of the University of Calcutta when the University celebrated its 150th year. He has 25 years of teaching and research experience in the field of Computer Science & Engineering.

Prof. Samir Kumar Bandyopadhyay is an elected Council Member of the Computer Engineering Division of the Institution of Engineers (I). He is also Counsulted Editor of Computer Engineering Journal of the Institution of Engineers (I). Prof. Bandyopahyay visited as leader of a delegation from India to deliver invited talk on "Sethu Samudram Projects. He has been working as Visiting Professor of many Foreign Universities of high repute. Dr. Bandyopadhyay is Fellow of IETE and Member of IEEE. He published eight computer related books and published over 100 research papers in the International Journals and Conferences and also published over 75 research papers in Indian Journal. Dr. Bandyopadhyay served many administrative posts such as Inspector of Colleges in University of Calcutta, Registrar of the West Bengal University of Technology. Also he worked as acting Vice-Chancellor of the West Bengal University of Technology. Dr. Bandyopadhyay has visited many foreign countries.

PROF. K. SOMAIAH
President,
Section of Materials Science

Prof. Karnati Somaiah was born in 1946 and got his education from Osmania University. Hyderabad. He obtained his Ph.D in 1980 working on X-ray intensifying screen materials. He has been actively engaged in the research on Phosphor Materials concentrating on luminescence of them for the last thirty years. He is expertised on synthesis and characterization of Lamp, Television, X-ray, Dosimetric and Display phosphors. Thus he worked as a scientist for ENEA, Rome, Italy and visiting scientist for Du-Pont Co, USA. Subsequently he also worked as a visiting professor for Kanazawa University, Japan. He got the Research Fellow award from ICTP Trieste, Italy to persue the research on Laser Host materials at University of Rome, Italy. Prof. Somaiah worked as a full time consultant/ Advisor for Aisin Cosmos R&D Co Ltd, Japan, Hyderabad branch whose R&D is on Dye Sensitized Solar Cells and Organic Light Emitting DEVICE materials

He has about 100 publications to his credit having published in various national and international journals . He supervised Five Ph.D Thesis in Osmania University and coguided a M.Tech at Kanazawa University, Japan. Prof. Somaiah is an active founder member of Luminescence Society of India and involved in

organising annual conferences on Luminescence during the last twenty years. He is member of several scientific organizations and societies. He attended more than 50 national and international conferences/seminars and delivered invited talks on different kinds of luminescence materials. He is a fellow awardee of Andhra Pradesh Akademy of Sciences and Luminescence Society of India.

Prof. Karnati Somaiah taught solid state physics/Materials science to post graduate and doctoral level students for 30 years at Osmania University. He is a co author of two physics Text Books prescribed for B.Sc students of Andhra Pradesh Open University and also edited a book on "Luminescence and its Applications"

He held several administrative positions in Osmania University besides his teaching and research activity. The Government of Andhra Pradesh felicitated him by awarding "Meritorious Teacher" award.

PROF. B. K. DASS
President,
Section of Mathematical Sciences (including Statistics)

Prof. B. K. Dass, Professor of Mathematics, University of Delhi, born in 1951, received his Ph.D. degree in 1975 from University of Delhi, and D.Sc. degree in 1983 from Marathwada University. For the last 33 years Prof. Dass is actively engaged in teaching and research at University of Delhi. His specializations / interests include Combinatorial/Algebraic Coding Theory, Information Theory, Cryptography, Discrete Mathematics, Applied Algebra, Optimization, Fixed Point Theory in Analysis, in which he has published more than 85 research papers in national and international journals of repute. Several papers out of these are an outcome of collaborative research carried out with foreign researchers . He has also edited/ co-edited five books.

Prof. Dass has delivered more than 150 lectures outside India. He is adjunct professor at University of Pescara at Chieti in Italy. He has supervised 12 Ph.D. candidates and 14 M.Phil, dissertations so far . He is on the editorial board of more than a dozen international journals published from outside India.

Prof. Dass is on the committees of several Govt. agencies like DST, UGC. He is also the Chairman of the National Committee of India Mathematics Year 2009 (IMY 2009). He has been instrumental in the establishment of Centre for Mathematical Sciences at Pala (Kerala), Centre for Mathematical Sciences at Banasthali Vidyapeeth (Rajasthan), Centre for Mathematical Biology at Indian Institute of Science (Bangalore), Centre for Interdisciplinary Mathematical Sciences at Banaras Hindu University (Varanasi), and for the upgradation of Gallery on mathematical genius Shrinivas Ramanujan at Tamil Nadu Science and Technology Centre at Chennai. Prof. Dass has represented the cause of promoting higher education and research in Discrete Mathematics in the country and motivated a noticeable pool of talent amongst the younger generation to pursue a research career.

Prof. Dass is on the Advisory Board/ Chairman to many organisations , member of Board of Studies , Research Committees and Governing Council of several universities and institutions of national and international repute. Prof. Dass is member/life member of various academic,

research and educational organisations/ societies. He is recepient of 'Distinguished Service Award' by Vijnana Parishad of India for outstanding contribution to promote applications of Mathematics in India, 'Distinguished Service Award' by the Indian Society of Information Theory and Applications for outstanding services in promoting Information and Coding Theory, 'Lifetime Achievement Award' by the Society for Reliability Engineering, Quality and Operations Management for exceptional, dedicated and pioneering research contributions to Discerte Mathematics. Prof. Dass is also fellow of the Academy of General Education (Karnataka).

PROF. A. M. CHANDRA
President,
Section of Medical Sciences
(including Physiology)

Prof. Ananga Mohan Chandra was born at Bandgobindapore a village in the district of Midnapore (now east Midnapore), West Bengal on 21st February, 1951. He obtained B. Sc (Honours) in Physiology M. Sc degree in Physiology and Ph. D. degree in 1981 from Calcutta University.

Prof. Chandra started his teaching career at the Physiology Department of Raja Pearymohan college, Uttarpara, Hoogly in 1979. He joined the Department of Physiology, Calcutta University as Lecturer in June, 1989 and became Professor in 2000. He was acting Chairman in both PG and UG Board of Studies in Physiology and member of P. G. and U. G. board of studies of Vidyasagar University, Burdwan University, and Kalyani University. He also acted as Resource Person, Academic Staff College, University of Calcutta. Prof. Chandra also was invited at University Sains Malaysia, Kelantan, Malaysia as Visiting Professor.

The Research activities and field of interest of Prof. Chandra is Body Composition & Fluid Balances, Work Physiology & Ergonomics, Sports & Exercise Physiology, Mine Environments and Health Profile of Miners & Lung Function Tests and Improvement of Sports and Athletic Performances. Working in these fields a few students have obtained their Ph. D degree in physiology under the guidance of Prof. Chandra and a number of students are working with him for their Ph. D degree at present. About 40 research papers and several reviews have been published so far, and about 70 abstracts have appeared in the proceeding of the National and International Conferences. He was also invited to deliver lecture in several places. Prof. Chandra also organized several International Conferences.

As joint secretaries he conducted 3rd congress of Federation of Indian Physiological Societies (FIPS), 2000 held at Science City, Kolkata. He was Awarded Prof. S. R. Maitra Memorial Award-2006.

He jointly conducted Collaborative Research with IDC, IIT Bombay, 1992-1994 on National Ergonomic Database-a MHRD Project. An Ergonomical approach for the evaluation of work environment, respiratory functions & safety devices of mine works was also jointly conducted with Central mining research institute (CMRI), Dhanbad. He has been acting as Editor of Ind. J Physiol. & Allied Sciences since 1998 till date. Prof. Chandra is life member of several scientific organizations.

PROF. K. V. R. CHARY
President,
Section of New Biology (including Biochemistry, Biophysics & Molecular Biology and Biotechnology

Prof. K. V. R. Chary is an outstanding structural biologist with seminal contributions towards understanding relationships between the structure and function of several biomolecules. His experimental tool is NMR. He has developed NMR techniques to obtain better quality NMR data and detailed structural information at atomic detail on several biomolecules. His studies on nucleic acids are of fundamental value to understand the biological activity of nucleic acid structures at a molecular level. He has developed novel methodologies in protein engineering and in isotope labeling of proteins. The 3D structural elucidation of several biologically important proteins by Prof. Chary is outstanding. He has developed a novel methodology to automatically assign the complex 3D triple resonance spectra of proteins. He developed NMR techniques, which speed up the acquisition of NMR data by several orders of magnitude and render information about several NMR parameters.

Prof. Chary has been regularly invited to deliver talks at national and international conferences. He is a member of Editorial board of three international journals. He is a member of several international bodies. To name a few, he is an executive committee member, International Conferences on Magnetic Resonance in Biological Systems (ICMRBS) and an International Advisory Board member of ICMRBS-2006, 2008 and 2010, a member of the "NMR Task Force and Advisory Committee", International Union for Pure and Applied Biophysics (IUPAB). He is an Executive Council member and Secretary of Indian Biophysical Society.

PROF. S. P. OJHA
President,
Section of Physical Sciences

Born on 11 Nov 1943 at Varanasi, Prof Ojha did his M. Sc (Physics) in 1966 and Ph. D in 1972. He has served Banaras Hindu University on the faculty position for more than 36 years. He was head of the department of Applied Physics, IT Banaras Hindu University and Vice Chancellor of CCS University, Meerut.

Prof Ojha is Fellow of Institute of Physics (London) and Chartered Physicist (London), Vice President and Founder Fellow of International Academy of Physical Sciences, Fellow of Optical Society of India, Full Member of Sigma XI (USA), Regular Member of SPIE (USA) and reviewer of several international journals of repute. He has chaired several international conferences. He received Lifetime Achievement award by the "International Association of Education for World Peace" Alabama, USA

He has supervised 24 Ph. D. Scholars and published above 200 papers in journals of international repute. Prof. Ojha's research interests have been in the field of Nano-Photonics, optoelec-

tronic, Fiber optics, Atomic Physics, and Material Science.

DR. S. M. PAUL KHURANA
President,
Section of Plant Sciences

Dr. Khurana is a doctorate from University of Gorakhpur from where he did his M. Sc. also. He did two years' (1970-72) post-doctoral work on Advanced Plant Virology at Kyushu University, Fukuoka (Japan). He also worked at University of Minnesota. St. Paul (USA) on Immunodiagnostics (bio-technology). He established a school of plant virology at CPRI, Shimla. The various positions he has held include : (1) Director, CPRI, Shimla (2002-2004) (2) Project Coordinator (Potato), AICRP (Potato), Shimla (1994-2004) (3) Principal Scientist & Head Plant Pathology, CPRI, Shimla (1988-1993)

He has been actively engaged with Universities & Research Organizations either as Academic Councillor or member for Advisory/Executive Committees for HPU, Shimla, UHF, Solan, Mahatma Gandhi Gramodaya University, Chitrakoot, CCS University, Meerut, SAIF-PU, Chandigarh, NRCM, SILB, Solan, HPKVV, Palampur. He is a Member of Research/Scientific panels/task force of DST, DBT, ICAR, etc. Currently he is Member of Executive Council Committees of Red Cross ; Hindi Granth Academy (M. P.), Advisor, NBAIM, Mau and Chair. Res. Advisory Committee, Central Tuber Crops Res. Institute, Trivendrum.

Dr. Khurana has also held prestigious positions in various professional associations such as : (1) Indian Potato Association : President for three terms, Editor-in-Chief and also Secretary. (2) Aphidological Society : Vice President and Editor. (3) Indian Virol. Society : Editor-in-Chief. (4) Indian Phytopath. Society : President, Editor.

Dr. Khurana was awarded CPRI Golden Jubilee Outstanding Achievements Award (2000). Best Scientist of the Year (2002) Award, Dr. S. Ramanujam Memorial Award for Outstanding research & Leadership in Potato R & D in India and The All India Potato Improvement Project (Potato) run by Dr. Khurana for 10 yrs. as P. C. has been adjudged as the Outstanding Project in 2005, for Ch. Devi Lal Award of ICAR, UNO : Dr. S. Radhakrishanan International Award (2006) for Excellence in Higher Education amongst almost two dozen & odd others.

Dr. Khurana is a Fellow of National Academy of Agricultural Sciences, New Delhi ; National Academy of Biological Sciences, Chennai (India) and Distinguished Fellow of the Indian Potato Association. He was the first Indian to deliver the keynote address at the Seventh Olympiad of the Mind at Paris (May 2005). He has delivered various memorial/invited lectures in various Universities/Institutions both in India and abroad and even the IAS Acad.

Dr. Khurana has published over 130 original research papers and has also authored more than 75 reviews/book chapters. His research career is spangled with achievements like standardization and use of enzyme linked immuno sorbent assay (ELISA) & immuno sorbent electron microscopy (ISEM) for detection of potato viruses, development of simple techniques for screening of resistance to potato viruses, apart from pioneering work in detection of plant diseases ; associated with selection/release of eight potato varieties including the first ever two processing varieties in India. He has guided ten Ph. D. students and authored/edited eight books. Dr. Khora joined R. D. University, Jabalpur as Vice-Chancellor in Nov. 2004.

Conferences / Meetings / Symposia / Seminars

International Conference on Emerging Research and Advances in Mechanical Engineering, ERA-2009 March 19-21, 2009 organised by Department of Mechanical Engineering, Velamal Engineering College, Tamilnadu, India

The objective of the conference is to bring researchers, academicians, professional engineers and industry leaders from all over the world on a common platform to exchange cutting edge ideas relating to recent developments and advancement in the evergreen field of Mechanical Engineering

The Conference topics include, but not limited to the following broad areas

A. Thermal Engineering

B. Design Engineering

C. Manufacturing Engineering

D. Materials & Processing

E. Industrial Engineering & Management

Contact : V. Jaya Kumar/P. Tamilselvan, Organizing Secretary, Department of Mechanical Engineering, Ambattur–Rad Hills Road, Chennai–600066, Fax : 91-44-26591771, E-mail : era2k9@gmail.com

13th International Association for Sport Information World Congress 11-13 March, 2009–Canberra, Australia

Theme : Building and Sustaining Sport Information Communities–through connectivity, collaboration and sharing

The world of sport information spans many international and provincial jurisdictions and languages. The globalisation of information communications technology (ICT) is providing new collaboration opportunities across both developed and developing nations, and is transforming our relationships to data, information, and the way we share knowledge with others. The challenge for sport information communities today is how to best exploit this new era of ICT connectivity and its social networking environments. The Congress will cover a range of contemporary sport information topics and issues, and will provide attendees with a rare opportunity to participate in forums and to network with other sport infomation professionals, technology facilitators, and enthusiast alike across the globe.

The 13th World Congress has been organised around five sub themes :

1. **Online Collaboration Solutions for Sport Information Communities :** A global sport information community becomes a reality through the creation and successful implementation of an online environment. Current web based technologies and the proliferation of electronic resources provide information professionals with the potential to engage their clients and key stakeholders in new and

exciting ways. Here we will discuss social networking tools such as wikis and blogs, and consider other solutions to remotely access and share information and knowledge.

2. **Electronic Sport Information Resource Sharing :** The globalisation of information communications technology (ICT) is transforming our relationships to data, information, and the way we share knowledge with others. Within this theme we will examine the issue of copyright in the digital world, the impact of open source publishing, access to multi-lingual resources, and the creation of collaborative partnerships and consortia in order to efficiently manage sport information resource acquisition and access.

3. **Digital Asset Management Repositories :** The establishment of digital asset management systems gives rise to new questions regarding the application and ongoing development of these repositories. In order to provide solutions to technical problems, we must understand issues relating to the digitisation process, compression algorithms (codecs), and storage and bandwidth constraints. As information managers we need to consider metadata and archiving standards, data mining applications, and the development of user friendly interfaces and system navigation tools.

4. **Sport Performance Analysis Applications and Technology Solutions :** Many high performance sports centres and institutes are making innovative use of longitudinal data within sophisticated digital asset management systems in order to seek a competitive advantage over their opponents. We will investigate and discuss this innovative approach to informatics and performance analysis, and the implications for sport information managers and technology facilitators.

5. **Knowledge Delivery, Online Libraries and Archives :** The globalisation of sport information infers the active inclusion of knowledge delivery and access systems from disciplines outsider the sport information realm. Here we will present case studies from a variety of sport and non-sport entities with an aim to enlighten, challenge, and motivate the listener.

Contact : 13th IASI World Congress, National Sport Information Centre, Australian Sports Commission, PO Box 176, Belconnen ACT 2616, Fax : (02) 6214 1681, email : NSIC@ausport.gov.au

S & T ACROSS THE WORLD

BIO-FUEL FROM ALGAE

A team of scientists at the Fisheries College and Research Institute (FCRI) at Tuticorin has successfully extracted bio-fuel from marine micro algae. The extraction of bio-fuel by standardizing the research procedure was a major breakthrough and the FCRI planned to develop an industrial model for mass production of the bio-fuel from marine micro algae. The marine micro algae, isolated from seawater, was first cultivated under autotrophic and heterotrophic culture systems, using transestrification method, a process of conversion of an organic "acidester" into another "ester" of the same acid. The method involved catalyzed chemical reaction on micro algal oil.

In autotrophic system, the algae were grown in a standardised culture medium. The mass culture was achieved by transferring algal broth culture to larger tanks. Under heterotrophic conditions, mass culture algae was performed in a bioreactor of 3.1 litre capacity under controlled state to achieve high lipid accumulation. Micro algal cells harvested from culture solution were pulverized and bio-lipid oil was extracted with suitable solvents. A standard reaction mixture consisting of oil and methanol concentrate was then heated for a specific period and transferred to a tailor-made funnel where the bio-fuel was separated.

(PTI Science Service, Jun 1–15, 2008)

URANIUM EXPLORATION

In order that country's nuclear programme is not dependent, government is investing heavily in uranium exploration. Around Rs 700 Crore is being invested to explore states of Rajasthan Andhra Pradesh, Karnatka, Meghalaya and other regions.

Currently, the country has four uranium mines, all of which are located in Jharkhand. However, nuclear power plants in the country have been reportedly functioning at half the capcity due to lack of uranium, a radioactive metallic chemical element used as a fuel in nuclear reactors. Uranium plays a crucial role in India's three-stage nuclear programme, which in the future, is expected to be dependent on the radioactive element thorium that is found in large quantity in the country. Uranium Corporation of India Ltd (UCIL) has proposed the setting up of mining and milling plants in two districts in Andhra Pradesh. Further investments are also expected to be made in uranium processing in Jharkhand.

(PTI Science Service, Jun 1–15, 2008)

MALARIA'S STICKY GENES

Australian scientists have identified a potential new way of combating the global scourge of malaria, by pinpointing eight genes that help the disease-causing parasite remodel our red blood cells. The disease is spread by mosquitoes that inject into victims the microscopic parasites that infect healthy red blood cells. The parasites cause radical changes in the structure of the blood cells, hijacking them to produce scores of offsprings that go on to infect other cells. Blood cells infected by the malaria parasite lose their normal rigid shape and develop knobs on their surface, causing them to stick to blood vessel walls and stop circulating smoothly. "This stops the cells from being cleared by the spleen, which is a protective mechanism for the parasite. It's absolutely essential for the parasite to survive in human bodies. Infected cells can also cause blood vessels to clog, a factor in some of the more serious effects of malaria, such as cerebral malaria, where the disease affects the brain. It is also possible that researchers could use their new understanding to develop weakened forms of the parasite to use in a vaccine against the disease.

(ABC News, Aug 22, 2008)

SEMICONDUCTOR LAYERS

It is reported that Epitaxy facility of the PTB (Physikalisch-Technische Bundesanstalt) produces semiconductor layers of highest quality. Semiconductors are the basic material for computer and home electronics. In electrical quantum metrology, semiconductor devices are used in two areas. First, electrical resistance values are reproduced by the quantum-Hall effect with uncertainties below one part in a billion. Second, high mobile electron devices are used to fabricate single-electron pumps allowing controlled transport of electrons passing the device one by one. The mobility of these electrons increases with decreasing impurities collisions and it is therefore a measure for the quality of the semiconductor structure. PTB's new facility has an extremely powerful pumping system to produce ultra-low pressure in the growth chember. Moreover, special cooling panels, adsorb residual impurities before they can be incorporated the semiconductor crystal.

(EurekAlert, Aug 29, 2008)

TILLAGE FOR FOOD PRODUCTION

Dr. John Sij, Agri Life Research agronomist at Vernon, has been studying nitrogen response and forage production in relation to tillage practices. Tillage practices have important bearing on environmental conditions, such as frequent droughts, high winds and temperatures, highly erodible soils, low yields, low production inputs, low returns and intense rainfalls. Conventional tillage can sometimes be excessive and cause moisture loss as well as lower organic matter, he said. Severe wind and water erosion can also occur under conventional tillage, resulting in dust storms and low visibility. It is also expensive and time consuming.

Alternative to this, as reported by scientists, seems to be no-till or reduced tillage though work on this is still in progress for confirmatory results. Overall, however, it is believed by researchers that benefits of conservation on tillge include reduced fuel and labour costs, improved rainfall capture and improved infiltration.

(EurekAlert, Sep 4, 2008)

ANSWERS TO "DO YOU KNOW ?"

1. The stretching of body while yawning.
2. In the head.
3. The Primates *ie* C while A and B keep going behind the mirror.
4. Approximately 100 billion tons.
5. Only once. Because after stinging when it extricates itself, it loses a part of its body and soon dies. No chance of a second sting.
6. It cannot do so due to the absence of the neck.
7. Yes ; One can fracture a rib, the eyes can pop out, if not closed during sneezing. One can even rapture blood vessels in the head or neck if sneezing too hard.
8. Elephant.

भारतीय विज्ञान कांग्रेस संस्था
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iscacal_2004@yahoo.com

Terms of Membership and Privileges of Members :

Membership of the Association is open to persons with *Graduate or equivalent academic qualification* and interested in the advancement of science in India.

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

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

2. **Sessional Member :** Sessional members are those who join the Association for the Session only. A Sessional Member has to pay a subscription of Rs. 250/- (for foreign U.S. $60) only.

3. **Student Member :** A person studying at the under-graduate level may be enrolled as a Student Member provided his/her application be duly certified by the Principal/Head of the Department. A Student Member shall have the right to submit papers for presentation at the Session of the Congress of which he/she is a member, provided such papers be communicated through a Member, or an Honorary Member of the Association. He/she shall not have the right to vote or to hold any office. A Student Member shall not be eligible to participate in the Business meetings of the Sections and the General Body. Subscription Rs. 100/-

4. **Life Member :** A Member may compound all future annual subscriptions by paying a single sum of Rs. 2000/- (for foreign U.S. $ 500) only. Any person who has been continuously a member for 10 years or more, shall be allowed a reduction in the compounding fee of Rs. 50/- for every year of such membership, provided that the compounding fee shall not be less than Rs. 1,200/- (for foreign U.S. $ 12.50 and U.S $ 300 respectively). A Life Member shall have all the privileges of a member during his/her lifetime.

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

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

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

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

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

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

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

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

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

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APPLICATION FORM FOR MEMBERSHIP

To
The General Secretary
The Indian Science Congress Association
14, Dr. Biresh Guha Street,
Kolkata-700 017

Stamp Size Photograph

Dear Sir,

I like to be enrolled as a Member / Life Member / Donor / Sessional Member / Student Member / of The Indian Science Congress Association.

I am sending herewith an amount of Rs. ..... in payment of my subscription by Bank Draft / Money Order / Cash for Membership / Life Membership Subscription / from the year 1st April 200 ..... to 31st March 200 .....

I am interested in the following section (Please tick any one).

SECTIONS

1. Agriculture and Forestry Sciences
2. Animal, Veterinary and Fishery Sciences
3. Anthropological and Behavioural Sciences (including Archaeology and Psychology & Educational Sciences)
4. Chemical Sciences
5. Earth System Sciences
6. Engineering Sciences
7. Environmental Sciences
8. Information and Communication Science & Technology (including Computer Sciences)
9. Materials Science.
10. Mathematical Sciences (including Statistics)
11. Medical Sciences (including Physiology)
12. New Biology (including Bio-Chemistry, Biophysics & Molecular Biology and Biotechnology)
13. Physical Sciences
14. Plant Sciences

(Please type or fillup in Block Letters)

Name (in block letters) : _____ _____ _____
SURNAME FIRST NAME MIDDLE NAME

Academic Qualifications :
(Evidence to be submitted)

Designation :

Address for Communication :
(including State, City/Town and Pin code)

Phone No. & e-mail

Permanent Address :

Yours faithfully

Date : Signature

- *As per resolution of Executive Committee in its meeting held on October 10, 2004 application for membership of ISCA in 'Care of' of some other person is generally discouraged. However, if in the application form "care of" address is given then there should be also signature of the person in whose name "care of" is given.*
- *Admission fee of Rs. 50/- is needed only for becoming a new annual member and not for sessional member / life member / Institutional member / student member / donor.*