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EDITORIAL

Village, community, caste and joint family are three cornerstones of Indian Social system. However, social scientists are still ambiguous in their views *vis-a-vis* the role these institutions play in modernization of the country. On the whole, it will not be an understatement if we surmise that by and large they are not at all favourably disposed to these institutions. In fact, an oft-repeated explanation was that backwardness of the country, the socio-economic inertia that thwarts her moving ahead, were all rooted in the traditional values held high by these institutions. The traditional values, no doubt, contribute to keep the society integrated. They also provide a base for the unique feature of the Indian Socio-political system, that is, its stability and resilience. Yet, at the same time, they weigh heavily against inducing any change in the system or a sub-system. Again, on the other hand, the very concepts of progress or development are embedded in the idea of change in the system or subsystem at least to some extent. Hence, to initiate any move in this direction becomes a matter of stupendous effort in developmental planning which has kept policy makers worried since the days of independence.

A catchy panacea usually put forward from different quarters was to organize a sort of 'Big Push' by mobilizing economic resources in the country. Obviously such a programme has got to be formulated and administered centrally such as, through Five Year or Annual Plans for the country. A successful implementation of these 'Plan' activities was expected to induce trickle-down effects in socio-cultural dimensions of quality of life in the Society. It cannot be denied that noteworthy economic progress has taken place in the country, whether measured in terms of GDP, or per capita income or consumer expenditure and so on.

The above, are, no doubt, quite encouraging examples of achievements of Planning in our country. But in other spheres of life rather depressing features are also coming up. Rural-urban dichotomy is fading fast, but parochial priorities are not giving place to national considerations. Bestowal of equal rights irrespective of cast or creed is happily received in the country, but outbursts of casteism and communal tensions still continue to poison social environment. It is claimed that average family income has increased with the increase in number of bread earners, often the male 'Head' and his wife are earners in an urban middle class family, but marital relationship has also become quite fragile as one gets an impression from various qualitative evidences. There are indications as well that the strength of moral bonds of duty and obligations within a family has eroded perceptibly. The case of a widowed mother who had to seek for judicial intervention against her son to stay 'peacefully' in her late husband's house, is an alarming example. The point as we want to raise is not at all to show that economic planning has been a socially futile exercise. On the contrary, the pointer is towards the other side of the coin. It certainly works to serve to

fulfill a basic need of the country such as making the country self-dependent or ameliorating the wretched condition of material well-being of a vast section of the people. But the discordant strokes which pain us cannot be resolved by economic upliftment as such, since they do not spontaneously follow from the latter. Hence the impact upon the pattern of social relations and value orientation requires to be anticipated simultaneously with fixing priorities for economic planning. The concerned processes occur partly independently by themselves, partly as overlapping with the domain of economic programmes. Consequently, these are to be treated not lineally, but as entities in a process of complex interaction at various levels.

If we agree with the above, it will pay to look round the 'structure of decision making' so to say that is, how the long term plans for national development are formulated. We only submit a few of the many issues for discussion in future in order to illustrate our point of view without going into details. In fact, these would require thorough review of various aspects of the process.

One of the major limitations of the structure of preparing long term plans is its lopsidedness in the sense that expertise from major non-economic streams of social science which are directly relevant in this regard are not involved in the process from the initial stage. They are rather at the receiving end of the process. Their partcipation seems to be called for only when a severe societal problem thumps at the door even though there is no dearth of prior experiences, both qualitative and quantitative, whose appropriate meta analysis could provide sufficient data to forewarn about future risks and constraints. A multi-disciplinary effort would certainly help the national planners to foresee more specifically the unanticipated negative side of social impact of central plans.

In a way, it tangentially leads to the necessity of building up an over-all on-going monitoring system embedded in the planning mechanism itself in order to look into the process while plan projects are in the pipeline. To conclude the present write up we like to draw attention to the following in this context. The seventh Five year Plan period was 1985-90, that is, just prior to initiation of the period of economic liberalization and globalisation. It will not be unreasonable to hold its Plan outlays for different programmes as the latest typical data regarding the then prevalent pattern of allocation of financial resources. We consider a common but quite, perhaps highly important for many regions of the country, urgently required item of allocation, namely, Major and Medium as well as Minor irrigation Programmes. A simple analysis of seventh Five Year Plan outlays bring out high correlation of irrigation outlays with the size of a state, whether by number of villages in each state or gross cultivable area which can be covered by irrigation.

The values of correlation of 'Major and Medium' irrigational outlays with the two measures of 'size' are 0.69 and 0.79 respectively while that of Minor irrigation are 0.91 and 0.83 respectively (all the four values being highly significant at 1% level). But if correlations of the proposed outlays are examined in terms of

utilization of irrigation benefits as percent gross potential upto the end of the sixth Five Year Plan period (1984-85) the values drop sharply almost to zero (ie. 0.02 and 0.09 for 'Major and Medium' and 'Minor outlays). Furthermore, it may be also noted in this context that Sixth Five Year Plan utilization shows low correlation (insignificant at even 10% level) with both the measures of 'size' (ie 0.12 and 0.21 in case of 'Major and Medium' outlays and 0.12 and 0.18 for 'Minor' outlays). Brute strength of 'size' suppressed the priority of efficiency.

Dr. S. Bandyopadhyay

'Knowledge comes but wisdom lingers'

–Lord Tennyson

PRESIDENTIAL ADDRESS

THE SCIENCE OF DISEASE

COL S. R. CHRISTOPHERS,* C.I.E., O.B.E., K.H.P., K.R.S. ; I.M.S. F.A.S.B

Your Excellency, Ladies and Gentlemen,

Before coming to the subject proper of my discourse today I have the pleasant duty to perform of welcoming all of you here to the 17th Meeting of the Indian Science Congress. Unlike some Scientific Congresses that have been held in India the Indian Science Congress is in inception and scope one intended primarily for India's own scientific workers. It is therfore worthy of our fullest support and of our efforts to make it as great a success as possible. I need hardly point out the high position India has taken in many scientific subjects. In Physics, Chemistry, Zoology, Botany, Geology, Agricultural Science, Meteorology, Medical Research, and other branches of Science Indian workers have added considerably to the sum total of the accomplishments of Science and I feel very deeply the honour of addressing this audience in which a number of those who have taken part in this work are present.

I found myself at first in some little difficulty to decide upon a subject that would be appropriate. It seemed most natural to speak on some medical research subject with which I was specially conversant. But this was perhaps too restricted a view to take for such a gathering as the present in which all Sciences are represented and I sought for some general question that might interest you. Yet when I began to venture into realms that were not my own I felt a certain trepidation since specialization now makes it very difficult for an ordinary person to speak without danger of tripping in any subject but his own. Eventually I decided not to roam too far, untrammelled by that strictly professional knowledge which many of you here possess in your own subject and, still within the safe bounds of my own general territory, to give you a brief sketch of the nature of the field covered by Medical Research, or as I prefer to it here the Science of Disease. Coming as Medical Research does into close relationship with many Sciences each of you may possibly be interested in at least some part of my remarks. I was the more supported in my choice when I remembered that there is a general interest taken in matters of health and disease and that, perhaps if I failed to interest you as experts in your own particular Science, I might still possibly approach you on a subject of general public importance and interest.

At the bottom of all questions of health, of curative or preventive Medicine, or of Medical

* General President, Seventeenth Indian Science Congress, held during 31st January to 5th February, 1930 at Allahabad.

Art lies the necessity of knowledge of the causes of disease. The Science of Disease is therefore the very root of Medical Research. We cannot know what is required to maintain health until we know what may cause departure from this and we cannot usually cure or prevent without knowing how diseases are caused. It is because just this knowledge, so simple when attained, so overlain in incredible secrecy until so attained, is so difficult and precious to come by, that medicine has had such an uphill fight. It has been both Medicine's trial and honour that the subject it has had to deal with is not simple and straightforward but bound up with what even in this present day, are among the most advanced developments of Science. Its Chemistry as we now realise is mainly Colloidal Chemistry since living matter consists of colliods, its Biology lies in the subtlest regions of Parasitology and the hosts reaction to invasion, its physics deals with the electric charge of proteins and such like things.

Just as Astronomy is the Science of the stars, Biology the Science of living things and Seismology the Science of earthquakes, and so on, there is clearly a Science of Disease, though curiously enough it seems to have no name. Nor is this Science unimportant or merely altogether the application of other Sciences. It has its own field, its own techniques, and its own extensions into high matters which cannot strictly be put under Chemistry or Biology any more than can Astronomy be usefully considered as merely Physics.

I propose then briefly to indicate the role of this Science, including its practical importance to mankind, to give a very brief history of its growth and development, to describe some of the features of its modern progress that have especially so far seemed to lead to advance and, lastly, I shall go on to some lines of development in which medical research has advanced into fields which are peculiarly its own and in which, though its methods, are, as they must be, those of the Sciences–Physics, Chemistry, Biology and the like, it would appear to have trodden new or unexpected ground.

THE ROLE OF MEDICAL RESEARCH

The enormous practical utility in human life of a knowledge of the cause of disease is undoubted. It is often said of progress in an individual career, "What serves it if a man gains the world and loses his own soul". A somewhat parallel case could be made regarding the enormous advances that have been made in human progress depending upon Mechanical and other Sciences. Without the means to control disease humanity lies helpless and open to attack . The conquering hero dies of cancer, the powerful emperor is sick of a fever. Disease is the most remorseless, the most cruel, the most continuous in its action of any of the great physical ills that threaten and control mankind. Of the three great terrors Sword, Famine and Pestilence, Pestilence, if we mean by this, disease, has easily first place. War, at least now, in any given country is temporary, Famine is episodic, but Disease is ever present.

This may sound an exaggeration, but probably few but medical men fully realise the terribleness and cruelty of disease. Insanity, ulcers, pain, blindness, deformations–it is all

misery. It is often the fashion with those who do not see much of real disease, as for example that curious body–the Christian Scientists, to speak of disease as though it were merely something a little irregular, a lapse in mental health. But though this may be the view of the fortunately healthy it is not the picture seen by those whose business brings them into close contact with real disease. It would be a terrible thing if the boon of anaesthetics, the reliefs of surgical and medical treatment had never been developed as they are now. Further to disregard the individual and think of disease as affecting communities it is easy to picture what forces of disorder and death might at any time make their appearance, populations ravaged by plague and ignorant of its cause, civilizations destroyed by malaria and knowing not whence it came, men marching athwart the prevailing wind to escape cholera which they carried with them as used to be done. All such thoughts show what a *necessary* Science is the one we are discussing. But for many, many centuries the necessity was seen, but this did not help knowledge.

THE HISTORY OF MEDICINE

The history of our Science, if in these early days one could call it a Science at all, takes us back a long way. Reference to medical subjects occur in the Vedas at a date estimated to be as early as 1500 B. C. Singer draws attention to an early Egyptian medical papyrus of about 1700 B. C. There are also Mesopotamian and Minoan origins. It is usual to commence the story of Medicine with Hippocrates. Hippocrates was a Greek physician born in the Island of Kos off the shore of Asia Minor. But the source from which knowledge of Hippocratic teaching is derived is the so-called Hippocratic Collection–about 100 books by different authors belonging to different schools and periods dating from about the 6th to the 4th centuries B. C.

The Hippocratic school taught that the body possesses four humours–the blood, phlegm, yellow bile, and black bile, a right proportion of which constitutes health and an improper or irregular distribution, disease. About the real causes of disease one is safe to say nothing was known. It should not surprise us that the Hippocratic school or indeed any ancient system, did not penetrate far the real portals of the causation of disease. For 2000 years afterwards no further progress in knowledge was made and indeed there was for a long time retrogression. So much so that when with the revival of learning in Europe the authentic text of the old Greek practitioners of the Hippocratic school was made available these ancient writings had a very great effect in revivifying the study and practice of Medicine. The humoral theory of the Hippocratic school had as much to be said for it and as little to be said against it in the 16th century A. D. as in the time of Hippocrates.

A great name in the history of Medicine was Galen (130-200 A.D.). Galen developed the idea of Pneuma (spirit) penetrating all parts of the body and mingling with the "humours" in different proportions. He held the theory of "temperaments". The normal condition or temperament of the body depended upon a proper mixture or proportion of the four elements–hot, cold, wet, and dry. At this time it was believed that combinations of these elements produced the visible universe, i.e., hot and wet made air, hot and dry fire, dry and cold earth,

and so on. In drugs were to be recognised the same elemental qualities, hot, cold, moist, and dry, etc., and so came indications for their use. Galen's explanations and system passed down through the ages as accepted facts. Throughout the middle ages beliefs about physiology and hence disease were always based on Galen. A thousand years later men hesitated before they contradicted even some detail of Galen's dicta. The views of this authority were not the truth but he had a logical mind and he unfortunately explained things so well that everyone was satisfied. One wonders how much we may sometimes be doing the same thing at the present time.

Arabian Medicine i.e., the Medicine which arose in the chief seats of the Moslem power in the Mahommedan Empire was a return in a sense to the old Hippocratian medicine for the writings of importance are chiefly based on translations of Greek books into Arabic carried out under the Abbasid Caliphs at Baghdad. The Caliphs were enthusiastically attached to ancient learning, especially the Greek. They collected manuscripts and had these translated by the most competent scholars they could attract to their court. Actual advance made was chiefly in the form of Pharmacy and therapeutic uses of drugs. Islamic Medicine was the Medicine of Europe in the middle ages and remained so till replaced by other systems based again on the old Hippocratian and Galenian systems.

Science which had its beginnings in the 17th century was sometime before it effectively asisted Medicine. Looking first for the somewhat simple types of explanation to which it had grown accustomed, it rather tended to create more fallacies of the old type than real progress. Even when Anatomy and Physiology, Mechanics, Chemistry, and the like had progressed some distance they had little real help to offer the difficult, intricate, and complicated issues which, had they known it were necessary to be dealt within the Science of disease. Even in the 18th century strange "systems" prevailed. The Brunonian system explained the proceses of life and disease as due to the property of "excitability" in virtue of which the "exciting powers" called forth the vital phenomena of "sense, motion, mental function, and passion". All exciting powers are stimulant. So diseases were recognised as sthenic or asthenic, the latter requiring stimulant treatment, the former sedative. Another system which arose in this time was that of Hahnemann, generally known as Homeopathy, a name one is still familiar with.

It is with relief that one turns from all the endless machinations of the introverted human mind in these early times to the beginning of real progress based on scientific method. It would take too long to follow step by step what now happened in decades where previously one has been dealing with centuries, if not millenia. I must merely indicate a few or some of the major advances made when Science at last entered the field.

Up to this we should remember that until the end of the 18th century no one knew that there was such a material thing as Oxygen. No one up to the middle of the 19th century knew really anything of the microbic origin of disease, though as often happens a sort of theoretical deduction had been put forward in advance of actual

knowledge. A Veronese physician, Frascatoro, held a theory which must at least be considered correct so far as it went viz., a rational theory of infection in which he hypothecated minute bodies with the power of self multiplication.

In 1615, Harvey discovered the circulation of the blood. About 1650 a way was found of constructing and mounting simple lenses of high power. In 1661, Malpighi by the aid of such lenses discovered the capillaries. In 1761, Auenbrugger introduced the stethoscope and Laennec (1781-1826) developed the application of so-called physical signs in medicine. In 1796, Henner showed the protection given by cowpox against smallpox and opened up the subject of Immunity. Schwann (1839) and others showed the cellular nature of animal tissues and laid the first foundation of Histology, Cytology, and much else. Pasteur (1822-1829) laid the foundations of Bacteriology and Lister (1861) of aseptic surgery. Anaesthesia came into surgery in 1846 with the use of ether by Morton and (1847) chloroform by Simpson. In 1876, Koch demonstrated the microbic causation of many diseases and began the study of disease causing organisms as things which could be seen, described, and grown.

Taking 1518, the date of the death of Leonardo di Vinci, who was the first to question the views of Galen as the very beginning of the new order of things, we have by 1880 or in about 250 years progressed from the stagnation of two millenia and the unchallenged supremacy of Hippocratean medicine of 300 B. C. practically into present day conditions, wherein theory and execution Medicine has become one of the greatest though still almost, if not quite, the most complicated and difficult of all Sciences.

FEATURES OF MODERN PROGRESS

So far the underlying note had almost always been "cure". Early Medicine was concerned primarily and almost single-mindedly with cure. With many even at the present day the idea of cure as the role of Medicine predominates. It is only relatively recently that the importance of prevention in the individual and in humanity in the mass come forward.

Another feature of modern and especially of preventive Medicine that is called to mind by the discussion of the predominance of the immediate utilitarian idea of cure is what is very aptly put by Singer in his short history of Medicine as the recognition of the "fallacy of the frontal attack". Many would have us picture as the highest ideal that of the worker who sets out to obtain a cure for some terrible disease. This would no doubt be a very worthy and high motive, but it is doubtful if to the world at large it is likely to be as effective as the perhaps more selfish but in the end more productive following of Science for its own sake. Medicine, still an art, advances only on a basis of Science. Its votaries and certainly its scientific staff would be wise to bear in mind one of the peculiarities of Science, viz, that from apparently the most seemingly and almost apparently trivial discoveries have come the greatest benefits. Koch would never have seen the tubercle bacillus, nor indeed any of us, if men from the love of Science for its own sake had not engaged themselves in those, what must have seemed in those times trivial, studies that resulted in the creation of the modern microscope, without which it is I think legitimate to say that no Science of disease could ever have originated.

Hence in the modern development of medical research the field must be wide, curiosity, that trait in human character which is the most powerful opener of secrets and apparently the key to the dominion of man over nature, must point the way. This agian raises issues which I do not propose to enter into here, which are nevertheless very important in the question of Medical Research Administration.

The time which I can expect you to give me is limited and I must pass somewhat more rapidly if I am to cover the ground intended.

As Col. Mackie has said in his excellent resume of Medical Research in India[1], in Medicine men at first depended on the unaided senses and such clinical and epidemiological observations as could be made without any very special outside help. With the microscope and delicate chemical and other tests there evolved the pathologist, bacteriologists, protozoologist, biochemist, parasitologist, entomologist, and so on. This specialization is becoming increasingly inevitable and its degree more pronounced owing to the vast field which even a single one of these Sciences embraces.

The evolution of medical research has followed these lines in all parts of the world but nowhere so remarkably as in the tropics where disease like vegetation flourishes in some sort of relation to temperature. The geatest outstanding feature in Tropical Medicine is perhaps the enormous advance in Parasitology and the transmission of parasitlogical disease. All this advance has been for the most part very recent, in what may almost be called the Recent or Holocene Period, of our subject speaking geologically, which may be said to start from the electrifying discovery by Ross that that age-long mystery, the method of entry into the human body of the parasite of malaria, was after all only a special case of Heteroxeny, by a parasite belonging to the Class Sporozoa.

So enormous has been the development in Tropical Medicine in the 30 years that have elapsed since that epoch-making discovery that it is quite impracticable for me to sketch even in outline what has been achieved in any detail. I shall do better to consider in broad outline what has been the general effect of this advance on our special Science, the Science of disease.

To those actually concerned with the prevention of disease nothing becomes clearer than that any effective action against a disease is almost absolutely dependent on the knowledge of the means of causation. A good example is Plague. Formerly plague was viewed in the light of a directly infectious disease. Thus sanitary cordons and such like measures were those first enforced. When the idea of microbic infection had gained ground indiscriminate disinfection was added. How many thousands of gallons of disinfectant, often quite unsuitable to destroy *insect* life, must not have been thrown broadcast killing only harmless saprophytes while real infection lurked in the living rats and fleas in safe retreat. To a demon it must have appeared like some grim game of blindman's buff, men seeking to destroy by blind indiscriminate ineffective action what, if they could have seen, they could have picked out selectively for elimination. A human case of bubonic plague

[1] Souvenir, The Indian Empire, 7th F. E. A. T. M. Congress, 1927.

we now know is comparatively harmless, the real danger lies in the epizootic conditions that infect the area and hence evacuation rather than cordons and disinfectants to destroy fleas rather than microbes, usually a different kind of chemical altogether, are the proper things to use and further and more fundamentally, we know there should not be such habitations as are suitable to infestation by rats or places that grain are kept that are not rat-proof and so on. The same exactly has been the case with malaria. People believed they were inhaling miasm, all nature as it were exhaling a poison, when in reality the source was concrete–a little fragile mosquito that individually could be crushed with ease and against which any individual with reasonable care can completely protect himself. We do not fear malaria now when we are in the primeval swamp but when we come to our camp amongst other humans who have the disease.

Further it is not enough to know only the broad fact of how a disease is transmitted. We must know every detail in such transmission. We must know intimately the life-histories of mosquitoes, fleas, lice and other insects, the resistance of organisms to desiccation, to chemical substances, and so on. We must know not only that some disease is due to faulty diet, for not all diseases are transmitted, but we must know with exactness the chemical and other characters that are lacking.

We now know pretty effectively the causation and details of transmission of plague, malaria, filariasis, typhs, relapsing fever, beri-beri, leprosy, enteric, hook-worm anaemia, schistosomiasis, and numerous other diseases.

RELATION OF MEDICAL RESEARCH TO OTHER SCIENCES

All this has not come about without a great deal of drawing upon sources outside medical research proper, if we think of this as purely medical work, nor has it all been done by medical men though these have done a major share. Many workers in medical research are chemists, many not only use biological methods but are to all intents and purposes biologists. Specialization may in present times be considered unfortunate, but it is only fair to say that only in this way can worker in one line get what he wants when he has to rely upon the services of another. It is often the fashion to make disparaging remarks about the dry as dust systematist, the man who counts the very hairs on an insects tail, yet scarcely a move can be made without his tremendous knowledge of detail in his own sphere, more and more the technique and methods of Entomology. Helminthology, Protozoology, Bacteriology, Colloidal and Physical Chemistry, and other Sciences are found necessary.

Medical research dealing as it does with departure from the normal conditions of the body has obviously a relation to Physiology. Largely through the effects seen in disease has come our knowledge of the functions of the ductless glands and the part played in the physiology of the body by the secretions of these glands or hormones. Again in nutrition it is largely studies directed against disease which have made us familiar with the effect of the vitamins and of radiation in the maintenance of the normal functions of nutrition.

With Biology medical research is very closely associated. The fact that many diseases are due to parasites has led to very close study by medical research workers of groups of organisms that otherwise might not have received such minute attention. The Science of Bacteriology which deals with a whole range of organisms, which we now know to play a tremendous role in nature, arose largely in the beginning from a study of the causes of disease and this Science, in one sense a branch of Biology, is still very largely dealt with by Medical Science. The same with the protozoa, especially the great parasitic groups sporozoa and flagellata. The life-histories of some of these, puzzles that have taken endles work to unravel would scarcely have been revealed to us had their activities not brought them into the field of medical research and so focussed upon them a specially intense effort. Even with higher parasites, e.g., the worms, Science would have been poorer without the results of the patient and difficult studies which have revealed to what degree of complexity parasitism may proceed. The development of filaria in the mosquito, of dracunculus in the water-flea, of schistosoma in the snail are examples. In Entomology certain groups, like the mosquitoes, have almost been a preserve in the hands of medical workers or those who work at them knowing the great medical interest taken in this group.

The modern investigation of drugs and especially the search for effective therapeutic compounds of mercury, arsenic, and antimony has added considerably to the stimulation of chemists in these subjects. Even more has the close association of the processes of health and disease with Colloidal Chemistry brough medical research activities into the higher realms of chemical research. A vast literature on immunology, really a study of complicated protein reactions, comes strictly perhaps almost under Physical Chemistry, though the techniques and chief results have been carried out in connection with the study of disease.

Nor is Physics immune from the encroachments of the nameless Science we are discussing. Questions of the electric charge borne by colloidal particles, adsorption and surface tension phenomena, and much else has been increasingly familiar in medical research laboratories in recent years.

SOME SPECIAL DEVELOPMENTS

But the contributions to Science of medical research, though they must naturally in a sense fall within the limits of Physics, Chemistry or Biology, are not always merely applications of these Sciences or subordinate additions to their findings. With a mention of some recent examples of such a kind space now demands that I should bring my remarks to a close.

First, I will take the very interesting subject of Bacteriophage and the biological issues raised by this. From about 1917 a series of communications by D' Herelle clearly set forth the discovery of an entirely new phenomenon, in which the essential feature was the apparent eating up, or more strictly the solution, of the bodies of various kinds of bacteria under the influence of an invisible "enemy". D' Herelle was working at the bacteriology of the contents of the alimentary canal of locusts, seeking in fact for a virulent organism capable of being

used in the destruction of these insects. When making plates in the usual way for the isolation of organisms it frequently happened that clear spaces were evident in the opaque growth of the bacteria under investigation. These spots, it was eventually clear, were the result of the activity of some invisible agency, which dissolved the bodies of the bacteria. Under the microscope when the process was in action one could see a vacuole appear in the substance of a bacterium which increased in size, and if others were present coalesced with these, until suddenly the minute bacterial body underwent complete dissolution. Transferring material from a clear spot to an unaffected area on the plate caused the phenomenon to repeat itself.

Not only was the principle causing this solution of bacterial substance invisible, but it was found to be capable of passing readily through the pores of a Pasteur Chamberland filter, a fact that showed that it was far more minute than the organisms with which it was associated. Further this principle was capable of indefinite self-propagation. If to a tube of culture a little of this principle was added the bacteria which cause the nutrient fluid medium to be turbid were dissolved with the result that the medium then became quite clear. If a tiny drop, or fraction of a drop, from such a cleared tube were added to a fresh culture this also was cleared and such a process could be repeated for as many transplantations as one wished, the enormous dilution involved after a time making it quite clear that the principle, whatever it was, was reproducing itself actively in every tube. Evidently the principle had one very important character which we are accustomed to think of as proper to Life, viz, it was capable of indefinite self-propagation so long as there was "food" for it to work upon.

Though invisible it was possible to show that this principle was particulate and indeed it is now quite well-known that it is of the nature of a protein colloidal particle. The phenomenon is called by D'Herelle bacteriophagy and the particulate cause "bacteriophage".

Now is this principle alive ? Hitherto biologists have dealt with life as tantamount to properties exhibited by the "cell". Always it is protoplasm, usually with a nucleus, which is supposed to be alive. In the bacteriophage we have something clearly very near a living thing which is clearly not a cell, nor is protoplasm. I am not here tonight to say whether the bacteriophage particle represents life or not, but you will agree with me that here medical research has brought into the workshop of Science something that can be easily investigated and which must be of supreme interest to the biologist.

D'Herelle believes that natural cure in disease results when the bacteriophage in nature overcomes the infecting organism. All the immunological processes medical research has dealt within such vast but confusing thoroughness he admits only as accessory phenomena, mere necessities of colloidal phases. What the practical importance of bacteriophage may be none can yet say. Even if it should have no direct bearing on the prevention of disease, which is unlikely, it is a new line of investigation into most fundmental regions of Colloidal Chemistry and Biology and who can say at this early stage where it may lead.

But the bacteriophage does not stand alone. It has close relationships with the so called

Filterable Viruses. When the microbic origin of many disease had been demonstrated it was natural to believe that all infectious diseases must be due to some form of organism even if one had failed to demonstrate this. And a certain number of disease have eventually fallen under the microbic category though they for a time resisted the search for a causative microbe. But many have resisted every attempt and some of these are amongst the most deadly of diseases known, e.g., small-pox, rabies or hydrophobia, and yellow fever. In many such cases, it is now recognised that infection will pass through the Pasteur Chamberland filter and so it is probable that the causative organism, if it is an organism, has not been seen because it is too small for visibility. Further infection is not thought to be the result of an organism in the accepted sense, i.e., minute cells as the bacteria and protozoa all are, but to be probably of the nature of protein colloidal particles and for this reason they are known, as "Viruses". Indeed, the bacteriophage seems to be only a special form of an entirely new type of living thing, i.e., if we are prepared to define life as ordinarily understood, and certainly small-pox, for exmaple, if it is not due to a living thing is remarkably similar in its natural history to other diseases that are.

Yet if these viruses are living things they are something almost if not quite as far below the bacteria in size as these are below living things visible to the naked eye. And on account of their size they are subject to influences which do not affect the relatively large bacteria or protozoa. Bacteriophage, for example, when first added to a bacterial culture disappears entirely from the fluid medium to appear only later when the bacteria are breaking down. In other words, it appear to be subject to adsorption which not even the smallest bacterium is.

There still remain diseases as outstanding puzzles as ever any disease has been, I need mention only cancer, and medical research, nameless as a Science though it is, may yet strike many things in its own proper sphere which are of great importance in the general advance of Science.

TRANSGENIC PLANTS : AN EMERGING APPROACH FOR PEST MANAGEMENT

Abhijit Das*

Insect pests are the major cause of loss to the world's commercially important crops. They account for 20-30% loss of crops. Current strategies to reduce crop losses due to pests rely primarily on chemical pesticides. Alternatively, transgenic crops with intrinsic pest resistance proteins like d endotoxin, lectins, protease inhibitors, cholesterol oxidase, a amylase inhibitors and vegetative insecticidal proteins (VIPs) offer a promising alternative and need to be developed.

INTRODUCTION

While the world has been changing during the last few years both politically and economically in unexpected and remarkable way, food security remains an unfulfilled dream of billions of people. With the world population crossing six billion mark, the demand for food grains is increasing at an alarming rate. Increasing population, on the other hand, has led to decrease in cropping area. In order to meet the global food demand we have to increase the productivity. Insects have always been a major cause of yield–loss in agriculture. They account for 20-30% of crop-loss. Several approaches e.g. physical, chemical and biological have been used with varying degree of success to reduce such losses. To increase the net productivity by preventing such losses in an ecofriendly manner is the need of the hour. Natural resistance that provides resonable protection against insect pests is available in some crops. It means that crop or variety has a specific gene which confers the plant resistane through production of certain protein (genes are the unit of inheritance). Through breeding the resistance can be transferred to different varieties of the same crop. But such type of transfer of resistance from one species to another is not possible through breeding programme. With the advancement of technologies in the recent past, it is now possible to identify and isolate a particular gene of one organism, and then to introduce it into another. Such techniques are referred to as genetic engineering. Such gene transfer can be done across the species boundaries. The organism which receives the gene is called transgenic. So it is now possible to introduce the insect resistance gene of one species into a desired plant which never had such type of resistance gene in its gene pool. Once introduced the new trait will be inherited generation after generation and can also be transferred to other varieties of that crop by hybridization.

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This new technology is seen as an additional tool for the control of insect pests and could offer certain advantages over conventional use of insecticides, such as more effective targetting on specific insects, greater resilience to weather condition, no question of seasonal application, operator exposure and most importantly ecofriendly system.

Transgenic insect resistant plants can be developed through following steps :

- Submission and approval of bio-safety protocols for transgenic crop development from the appropriate government and other environmental agencies along with its disposal.
- Identification of insect resistance gene.
- Isolation of the desired gene.
- Construction of recombinant DNA with a suitable vector and the desired gene or preparation of a construct.
- Transfer of the vector construct to the callus or protoplast of the desired plant.
- Regeneration of transformants.
- Study regarding expression of insect resistant character in transgenic plant.
- Examination of the stability of the transgene.
- Biosafety protocol confirmation and proper disposal of products.
- Large scale field trial at multiple locations for several generations.
- Proper notification to the biosafety agencies about the transgenic product along with failures, if any.

Genes for insecticidal proteins like δ endotoxin, protease inhibitors, α amylase inhibitors, lectins, cholesterol oxidase, isopentenyl transferase and vegetative insecticidal proteins have been identified and transgenic plants with these genes have been developed (Table-1). Several other proteins with insecticidal property are being identified and characterised, and will provide valuable options for insect management using transgenic crops.

Table–1

SOME TRANSGENIC PLANTS DEVELOPED WITH INSECT RESISTANCE GENES

Gene product	Target insect	Transformed plants
Transgenic plants with crystal protein genes of B. thuringiensis		
Cry IAb	Lepidoptera	Apple, cotton, maize, rice, potato, tomato, tobacco, white clover
Cry IH	Lepidoptera	Maize
Cry 3A	Coleoptera	Tobacco, potato, egg plant
Cry 9C	Lepidoptera	Maize

Gene product	Target insect	Transformed plants
Transgenic plants with protease inhibitor gene.		
C-II (Soybean serine protease inhibitor)	Coleoptera Lepidoptera	Potato, tobacco, poplar, oilseed rape
Cp TI (Cowpea trypsin inhibitor)	Coleoptera, Lepidoptera	Apple, lettuce, potato, rice, sunflower, sweet, potato, tobacco, tomato.
OC-I (Rice-cysteine protease inhibitor)	Coleoptera Homoptera	Poplar, tobacco, oilseed rape
Pot PI-II (Potato protease inhibitor II)	Lepidoptera Orthoptera	Birch, tobacco, lettuce, rice
Transgenic plant with lectin gene		
Snowdrop lectin (GNA)	Homoptera Lepidoptera	Tobacco, potato, rice, oilseed, rape, sweet potato, sugarcane, sunflower, tomato
Pea lectin (plec)	Homoptera Lepidoptera	Potato, tobacco
Wheat germ agglutinin (WGA)	Lepidoptera Coleoptera	Maize
Rice lectin	Lepidoptera Coleoptera	Maize
Transgenic plants with α amylase inhibitors		
α amylase inhibitor of common bean (αAI-Pv)	Coleoptera	Pea, tobacco
α amylase inhibitor from cereals (WMAI-1)	Lepidoptera	Tobacco

d ENDOTOXIN

Bacillus thuringiensis, a gram-positive soil borne facultative bacterium, was first identified by Ishiwata in 1901 in silk worm larvae. In 1909, Berliner gave a detailed information about the bacterium. In adverse climatic condition, it undergoes sporulation along with the formation of a bipyramidal crystal protein which is toxic

to insects and known as Cry protein, Bt toxin or δ endotoxin[1]. The spores can survive for many years but the protein (δ endotoxin) remains functional for a few days to a few months depending on the environmental condition. Different subspecies of the bacterium produce different crystal proteins and they are very specific in their action. *B. t kurstaki* acts on lepidopterans, *B. t. israelensis* on dipterans and *B. t. tenebrionis* on coleopterans. The insectcidal crystal protein (ICP) is coded by a gene in plasmid (a self replicating extra-chromosomal DNA). The gene first gives a proprotein of 130 kDa. Proteolytic enzyme at high pH in insect midgut breaks down the proprotein to active toxin of 65-75 kDa. This protein results in pore formation of columnar cells of midgut by osmotic lysis and subsequently leads to paralysis and death of the larvae. It is not clear whether one crystal can puncture the cell membrane or an aggregate is needed for it. There are different types of Cry proteins, i.e. CryI. CryII, CryIII, etc. which have their own specific receptor in the columnar cells of the midgut.

The Bt is being used as insecticidal spray since 1957 under different trade names like Thuricide, Agree, Dipel, Javelin, Condor, Foil and Biobit. But high cost of production and low stability in the field due to UV and sunlight have resulted in its limited use. With the advancement in the field of genetic engineering, the δ endotoxin gene of *B. thuringiensis* became an attractive candidate to be among the first genes transferred into plants. In 1987, transgenic tobacco and tomato plants with δ endotoxin gene were developed[2] and transgenic potato plant in 1992.

Initially insect resistant transgenic plants were developed using *cryIA(b)* gene with constitutive promoters. As the transformation was done using *Agrobacterium tumefaciens*, the experiments were limited to dicots only. Although transgenic tobacco plants with crylA(b) gene became resistant to tobacco hornworm (*Manduca sexta*) and budworm (*Heliothis virescens*), use of full length native gene resulted in poor expression of ICP in transgenic plants. To overcome this problem of low expression of native δ endotoxin genes, synthetic genes were constructed. Different strategies are employed to design such synthetic genes.

- Elimination of potential intron (non-coding DNA sequence in a gene) splicing sites.
- Elimination of polyadenylation sites.
- Elimination of mRNA instability signals.
- Optimization of translation by altering codon usage.

Native cry genes are having 37% G + C. In modified cry gene the G + C content has been increased to simulate that of plants. Partially and fully modified genes show a 10 to 100 fold increased expression when compared with wild type gene[3]. Transgenic cotton with modified crylA(C) gene have been found resistant to cotton bolloworm (*Helicoverpa zea*), leaf perforator (*Bacculatrix thurberiella*), pink bolloworm (*Pectinophora gossypiella*) and beet armyworm (*Spodoptera exigua*). Monsanto, an American company, has developed cotton bollworm and pink bolloworm resistant transgenic cotton varieties called 'Bollgard' and 'Ingard'. Transgenic potato plants with *cryIIIA*

gene show resistance to colorado potato beetle (*Leptinotarsa decemlineata*).

With the development of other methods of gene transfer like microinjection, gene gun and electroporation it has become easier to transform monocots. Transgenic maize with *cryIA(b)* gene resistant to European corn borer (*Ostrinia numilalis*) is the first transgenic monocot. Commercially available transgenic maize varieties of USA are yieldgard, maisgard and naturegard. Transgenic rice with modified *cryIA(b)* gene is resistant to striped stem borer (*Chilo suppresalis*), yellow stem borer (*Scirpophaga incertulas*) and leaf folder (*Cnaphalocrosis medinalis*).

PROTEASE INHIBITOR

Many plants have natural defense mechanisms against insects based on the production of certain protease inhibitor(s). These protease inhibitors generally act on the enzymes which are responsible for the protein catabolism in insect midgut. Protease in insects include serine, cysteine, aspartic and metallo protease that catalyse the release of amino acids from dietary protein and so provide the nutrients crucial for normal growth and development. In contrast to δ endotoxin, these proteins (inhibitors) have antimetabolic activity against a wide range of insects. Lepidopterans have serine proteases and coleopterans have cysteine proteases. Serine protease inhibitors are of 1000 Da and can simultaneously inhibit two molecules of the substrate, may be of same type or of two different types. That's why they are termed as double headed or Bowman birk type[4].

Transgenic tobacco plants with cowpea trypsin inhibitor (*CpTI*) genes are resistant to larvae of tobacco budworm (*Heliothis virescens*). Transgenic tobacco with tomato or potato protease inhibitor II are resistant to tobacco hornoworm (*Manduca sexta*). It inhibits trypsin and chymotrypsin activity. Although most of the works carried out todate have used serine protease inhibitors, transgenic tobacco plants with cysteine protease inhibitor like oryzacystatin I are resistant to coleopteran insects. However, the major disadvantage of protease inhibitors is that it needs very high level of the inhibitor for insect mortality.

Transgenic plants with serine protease inhibitor genes from mamals and toabcco hornworm (*Manduca sexta*) are resistant to a number of lepidoptera and homoptera. Based on in *vitro* study of inhibition of proteolysis in midgut extracts of a range of lepidopteran larvae, bovine pancreatic trypsin inhibitor (BPTI), α antitrypsin and spleen inhibitor (SI) have been identified as promising insect resistance proteins and transferred into a wide range of plants. *M. sexta* protease inhibitor gene expressed in cottons and in tobacco have been found to reduce reproduction in *Bemisia tabaci*[4].

a AMYLASE INHIBITOR

Insecticidal activity associated with the common bean seed is due to an inhibitor of α amylase (a digestive enzyme) activity. Studies have shown that α amylase inhibitors present in seeds are active against insects and mammals but not against plant and bacterial α amylase and are thus highly specific. α amylase inhibitor is known to be larvae of two seed feeding beetles, the cowpea weevil (*Callosobruchus maculatus*) and the azukibean weevil (*C. sinensis*). Transgenic pea plants with α

amylase inhibitor gene have been found to produce 1.2% of α amylase inhibitor protein in seeds and confer resistance to both cowpea weevil and azukibean weevil[5].

LECTINS

Lectins are carbohydrate binding proteins available in plenty in plants, animals and bacteria. Lectins found in plants, particularly in seeds, are involved in defense against the attack of bacteria, fungi, insect and other animals. Lectin binds to midgut epithelial cells of insects and leads to disruption of critical cellular functions. Insecticidal activity of lectins i.e. LC_{50} is in milligram per gram diet, whereas that of δ endotoxin is nanogram per gram diet. That's why the lectins must be expressed at a higher level in the transgenic plant. Transgenic maize with lectin genes like wheat germ agglutinin or jacalin or rice lectin gene is found to be resistant to European corn borer and southern corn rootworm. Transgenic tobacco, sweet potato and mustard with lectin gene are also resistant to various insects[4].

CHOLESTEROL OXIDASE

Screening of filtrates from microbial fermentation often reveals presence of certain proteins which attacks some insects. The protein present in two streptomyces culture filtrates which show acute toxicity to boll weevil larvae has turned out to be a cholesterol oxidase (CO). Cholesterol is required for integrity and normal function of virtually all-cellular membranes, therefore any interference in its availability leads to toxicity. Histological studies on boll weevil larvae fed on diet containing CO show cellular attenuation accompanied by local cytolysis of midgut epithelial cells. CO catalyses the oxidation of cholesterol already incorporated into the memberane to produce ketosteroids and hydrogen peroxide. Midgut epithelium is the primary target for CO and thus it interferes with the process of digestion and absorption[6]. Although newly emerged adult boll weevils exposed to CO do not exhibit acute toxicity, they display severe costatic effects (i.e. reduction in fecundity and oviposition) due to poor development of ovaries in adult females. LC_{50} of first and second instar larvae of boll weevil is comparable to that of δ endotoxin. Enzymatic activity of CO has been detected in protoplast of transgenic tobacco with native CO gene[7].

ISOPENTENYL TRANSFERASE

The gene for isopentenyl transferase (ipt), a key enzyme in the cytokinin biosynthesis, was isolated from *Agrobacterium tumefaciens*. Expression of *ipt* in transgenic tobacco and tomato plants by a wound inducible promoter has resulted in a decrease in leaf consumption by tobacco hornworm (*M.sexta*) and reduced survival of the peach potato aphid[4] (*Myzus persicate*).

OTHER INSECTICIDAL PROTEIN FROM PLANTS

Tryptophan decarboxylase (TDC) from periwinkle expressed in tobacco is known to reduce the reproduction of whitefly (*Bemisia tabaci*) by upto 97%. TDC converts tryptophan to indole alkaloid tryptamine. Tryptamine and tryptamine derived alkaloids in plants may act as antioviposition and antifeedant agents or as inhibitors of larval and pupal development[4].

VEGETATIVE INSECTICIDAL PROTEINS (VIPs) FROM BACILLUS SP.

In search of novel insecticidal proteins, it is discovered that culture supernatant fluid collected during vegetative (i.e. log phase) growth of Bacillus sp. is a rich source of insecticidal substances. Supernatant fluid of *Bacillus cereus* isolates possesses acute bioactivity against Northern and Western corn rootworm. Here insecticidal properties are associated with a binary system, whose two proteins are termed vipl and vip2. Similarly, supernatant fluid of certain *B. thuringiensis* cultures has potent insecticidal properties against black cutworm and fall armyworm. Potency-wise it has been shown that VIPs are comparable to δ endotoxin. The cloning and characterization of the gene encoding this activity has yielded a novel insecticidal protein *vip*3A which is active against lepidopteran insects particularly black cutworm, fall armyworm and beet armyworm. This protein results in complete lysis of gut epithelial cells, particularly columnar cells[7]. Transgenic maize with *vip3A* gene is found to be resistant to underground pets like western and northern corn rootworm[7,8].

RESISTANCE MANAGEMENT

Insects have demonstrated a high capacity to develop resistance to wide array of chemical insecticides. Resistance against microbial spray of δ endotoxin has already been observed. There has been some concern that use of δ endotoxin genes for insect control in transgenic plants may lead to rapid development of resistance[9,10]. Such concern is however based largely on computer models.

To minimize the development of resistance to transgenic monitoring of pest population should be combined with a variety of strategies :

1. ***High dose strategy***-The strategy to produce transgenic plants synthesizing very high level of insecticidal proteins has been found to be highly effective in preventing or delaying development of resistant variety of insects. This strategy may help eliminate heterozygotes (i.e. carrying only one resistant allele). Although there is a chance of decline in titre level of the protein in successive generations or with ageing, there is no report of decline of titre level below the important desired level in Bt-cotton and maize in the trials before commercial release[11]. Again it is apprehended that high dose of toxin in transgenic plant product may be harmful for human health. But Bt gene have been found to be species specific and are thus harmless to other non target insects, vertebrates including users and the environment.

2. ***Refuge strategy***–It is adopted to provide a source of susceptible insects for mating with the resistant ones, of any. This will prevent the fixation of resistance gene. Refuges can naturally occur when a certain percentage of an agricultural acreage is planted with non-transgenic plants. Refuges may also be established by using mixture of transgenic and nontransgenic seeds, or by growing border rows of susceptible variety, or by growing susceptible variety a little away from the crop field for highly mobile insect species[12]. However, the point of concern regarding this strategy is the size of the refuge. In India, for Bt cotton cultivation, experts have suggested a separate refuge of 30% of the land cultivated.

3. ***Multigene strategy***–Transgenic plants producing additional insecticidal proteins with either different modes of action, different targets or both can solve the problem. Recent discovery of a number of new insecticidal strains of B. thuringiensis and new insecticidal proteins from such strains may provide more active components to be used for the purpose. New insecticidal components from sources other than B. thuringiensis may also be helpful for this. Several options should be available that include introduction of multiple genes with unique mode of action into the same plant, or alternatively, independent plants each with a unique insecticidal protein could be used in rotation.

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DO YOU KNOW?

Q1. What is ISI standard No. 1?

Q2. Do identical twins have identical DNA sequences?

RELATIONAL APPROACH AND ITS SIGNIFICANCE IN CONVENTIONAL SOCIOLOGY

Arun Kumar Chatterjee *

In present day sociological parlance 'Relational Approach' in Sociology seems to have gained a new lease of life. The relational approach promises to be different from the conventional approach with respect to both concept and methodology. But, the research strategies following the relational approach do not fully match with its promises. Relational approach provides a good philosophical perspective conducive to social network analysis.

INTRODUCTION

Since the period of western classical sociology of Georg Simmel and J. L. Moreno's sociometry and other socio-anthropological engagements, relational approach has ramified with different versions. Of late, sociologists, who love identifying themselves as relational sociologists, have further added to this process. Thus it has got a long historical past. It is certainly interesting to go through the complex historical evolution of relational sociology. The thrust of the present paper, however, is not to delve into the historical process that it has gone through but to briefly discuss its difference with conventional sociology and to acquaint the reader with various features of relational approach in sociology.

For this purpose, let us take the two major formulations : (a) ***Methodological Individualism***, (i.e., in short, the supposition that individual persons or collectivities do have inner force for self-action) and (b) ***Anti-categorical Imperative*** (i.e., in short, the assertion that no a priorily fixed human category does reflect the inter-actional social reality)-for the purpose of discussions in contrast with conventional approach. In recent articles Mustafa Emirbayer[1,2] has dealt at length in this regard. The first formulation, i.e., methodological individualism, goes to challenge the essential feature of conventional sociological (variable) analysis which takes the units of observation as 'discrete' phenomena and claim that relational sociology is free from this limitation. The second one, i.e., anti-categorical imperative goes to assert that a priori categorization which is another essential feature of conventional sociological analysis, distorts the structure of inter-personal interactions and claim that the method of relational sociology does not believe in any a priori categorization of actors in a society without observing the actual pattern of their interactions.

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METHODOLOGICAL INDIVIDUALISM

It means that "The 'mind' as 'actor', still in use in present day psychologies and sociologies, is the old self-acting 'soul' with its immortality stripped off'[3]. Here, individual is thought to possess the quality of *self-action*. Individual (it may be individual person or collectivity) as an entity is conceived of having an inner force or substance to take action independent of others. This self-actional substantialist view of individual provides the base of some well-known conventional approaches in social sciences. Rational choice/game theory, normative action, structuralsim as reified substance, or 'Inter-action'–are some such which have been based on this self-actional substantial approach[1].

RELATIONAL OR TRANSACTIONAL APPROACH

It claims to be free from 'methodological individualism'. "What is distinct about transactional approach is that it sees relations between units as pre-eminently dynamic in nature, as unfolding, ongoing processes rather than as static ties among inert substances"[1]. Here, the units involved in a *transaction* derive their meaning, significance, and identity from the changing functional roles they play within that transaction. This is very much opposed to the idea of 'interaction' where interacting units do not depend on the interaction for their identity or meaning (very much like Billiard balls). In 'relational approach' the event of transaction and the transacting actors are seen together and reject the notion of discrete pre-given units such as the individuals or societies as the ultimate starting point of sociological analysis. Unlike substantivist approach, relational approach is very much dependent on *spatio-temporality*. According to this approach "no one would be able succesfully to speak of the hunter and the hunted as isolated with respect to hunting"[3]. It is absurd to set up hunting as an event in isolation from the spatio-temporal connection of all the components. "While a social identity or categorical approach presumes internally stable concepts, such that under normal conditions entities within that category will act predictably, the (relational or transactional) approach embeds the actor within relationships and stories that shift over time and space and thus precludes categorical stability in action"[4]. The methodological departure of relational approach can be called as '***anticategorical imperative***'. This imperative rejects all attempts to explain human behaviour or social process solely in terms of the categorical attributes of actors, whether individual or collective. Given this anticategorical imperative, relational analysis emphatically rejects all varieties of culturalism (norms, values, inner-force) and methodological individualism.

However, this transactional viewpoint is rarely practiced with precision in social science parlance. This is some sort of ideal typical approach which is rarely followed without varying extent of departure by any tradition of research in sociology. Once Karl Marx conceded with this approach when he says that "society does not consist of individuals, but expresses the sum of interrelations, the relations within which individuals stand"[5]. In Capital, Volume 1, he further observes that "capital is not a thing, but a social relation between persons which is mediated through things"[6]. However,

Marx has shifted from the position on other occasions.

Marx exhibits substantialist position most notably in his reification of class interest, in his presumption that actors within the same class category will act in similar ways (to the extent they are 'class for itself') even when differentially situated within relational settings. Georg Simmel, the classical socilogist is most deeply committed to relational theorizing. He notes both abstract and concrete dimensions of social reality. He says that "society is the supra-singular structure which is nonetheless not abstract. Through this concept, historical life is spared the alternatives of having to run either in mere individuals or abstract generalities. Society is the generality that has, simultaneously, concrete vitality"[7]. The tendency of substantialism is very common in Talcott Persons' theory of social action. Yet, he comes very close to the transactional approach in connection with his later "interchange model" and theory of 'generalized media'[8]. It is worth mentioning also that "At no point ..... Parsons claimed that theories which actually existed in history were not identical to the different logical positions he outlined. That is, he tried to combine different theoretical positions. Most of them are in fact opaque versions or combination of several of these logical alternatives"[9].

SOME THEORETICAL IMPLICATIONS

The theoretical implication of the relational approach is far reaching :

(a) As regards some key sociological concepts this relational approach gives a new connotation. Take for example the concept of 'equality'. Typically, *equality or inequality* is defined essentially as a matter of individual variations in possession of 'human capital' or other goods. Relational approach, in contrast, views that it is the "bonds, not essences, (which) provide the bases of durable inequality"[10]. Members of a categorically bounded network, for example (recently arrived immigrants), acquire control over a valuable resource (e.g., information about employment opportunities), hoard their access to it (e.g., by sharing it only with others in their personal networks), and develop practices that perpetuate their restried access (e.g., by staying in touch with their places of origin through frequent correspondence and visit home). Hard, durable differences in advantages and disadvatges are thus created. Unfolding transactions, and not the pre-constituted attributes, are thus what most effectively explain equality and inequality. Here, a new dimension of inequality is taken into account. This is people's differential capability of getting access to resources by 'connections' with or without addition to individuals' possession of human capital.

(b) Transactional approach allows the re-conceptualization of 'micro' and 'macro' level of enquiry. At the most macroscopic level, society is often interpreted as an autonomous, internally organized, self-sustaining system. Nation state, for example, is having a territorial boundary with certain economic, political, or military activities. But that boundary is not always unproblematic. Boundaries of nation states do overlap unevenly with populations, production and consumption patterns, cultural identities collective emotional commitments and so on. "Societies have never been sufficiently

institutionalized to prevent interstitial emergence. Human being do not create unitary societies but a diversity of intersecting networks of social interaction"[11]. Some of these networks are relatively stable ; but are subject to constant alignment and relaignment forming new networks, extending old ones and sometimes forming rival configurations. According to this view 'society' is constituted by multiple overlapping and interecting networks of individuals or collectivities. That is why it is sometimes suggested that the term 'society' should be replaced by 'relational settings'[12]. Thus micro and macro can be taken care of into single frame.

SOME DIFFICULTIES

(a) Boundary specification of the transactional sphere is a great problem. Social network (which has closest affinity with relational approach) researchers for example, continually grapple with the question of where to draw lines across relational webs as such possessing no clear cut natural boundaries.

(b) Social actors' *reflexive engagement* with the problems confronting them in everday lives remains significantly under-theorized in the network processes.

(c) It is really a challenge for relational approach to take care the issue of *causality*. Since it emphasizes on fluidity, temporality, continuous construction and reconsruction of relational milieu, causal analysis is under-emphasized. Entities such as 'forces', 'factors', 'structures' containing substantivistic self-actional feature are nullified in relational approach.

(d) Another challenging area is how relational enquiry takes into account the normative issues. It takes a critical stand in this respect. Transactional thinking, in a word, deconstructs a taken-for-granted moral universe. Values, according to this approach, are by-products of actors' engagement with one another in ambiguous and challenging circumstances, which emerge when individuals experience a problematic situation of multiple normative commitments. But it does not adequately address the question of how individuals motivate themselves in the initial period of taking action or giving preference to competing choices. How that can be free from value judgment ?

DISCUSSION

Social network analysis, for example, finds close affinity with the relational approach by setting individual persons in relational perspective[13]. But social network studies do not follow any particular strategy in this regard. Any meticulous scrutiny of the studies on social network will prove[1] it. For example, instead of countering the 'non-substantivist', 'non-category' based methodology, it (social network analysis) often takes the network features as new kind of 'variable' as if it has some 'inner-force' (which is primarily nullified in relational approach) to cause something. But, certainly, this is not a case of a *priori* categorization.

To make it viable for empirical studies some sort of pragmatic methodological consideration has to be evolved. Any discussion on the issue of methodological innovation in this regard deserves separate space. However, the challenges it throws in sociological methodology defying methodological individualism of conventional

sociology and prescribing anti-categorical imperative in methodology provides food for thought. The perception of fluidity, spatio-temporality, non-holistic of social reality seem to come close to the perception of 'de-constructionists' also, which provokes for another theoretical discourse. Lastly, the basic thrust of the network approach (*relational approach*) that investigates the '*constraining*' and '*enabling*' dimensions of relationships provides scope for some theoretical insight as well as innovative exercise in methodology afresh.

EPILOGUE

1. **Rational choice theory** : It takes for granted that "the elementary forms of social life is the individual human action. To explain social institutions and social change is to show how they arise as the result of the action and interaction of individuals" (Elster, J. 1989. Nuts and Bolts for the Social Sciences. Cambridge : Cambridge University Press. P-13). Here pre-given entities are seen to generate self-action. Even as actors engage in game playing with other actors, their underlying interest, identities, and other characteristics remain unchanged.

Norm following action : Another popular approach takes norm following individuals, or more specifically, the vital inner forces driving them, as its basic unit of anaysis. It depicts individuals as self-propelling, self-subsistent entities that pursue internalized norms given in advance. In contrast to 'rational choice' theory and economics, the 'norm following action' takes non-rational action as the special province of its mode of analysis.

Structuralism as reified substance : The holistic social theories and 'structuralism' also posit not individuals but self-subsistent 'societeties', 'Structures' or 'social systems' as the exclusive source of action. Not the individual person, but groups, nations, cultures, and other reified substances do all the acting in social life and account for its dynamism.

Inter-action approach : This approach is often confused with the 'relational' approach. While interacting "Entities remain fixed and unchanging throughout interaction, each independent of the existence of the others, much like billiard balls or the particles in Newtonian mechanics. This idea of interaction finds home today in a viewpoint that dominates much of contemporary sociology, from survey research to historical-comparative anaysis. This can be called 'variable centered' approach.

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DO YOU KNOW?

Q3. Why does the human brain carry innumerable fold?

Q4. Do twins have identical finger prints?

PREPAREDNESS FOR MITIGATION OF NATURAL DISASTERS

Achintya *

Natural disasters can be classified into two groups, namely Recurrent Disasters such as floods, droughts, landslides, etc. and Non-recurrent Disasters such as earthquakes, cyclones, etc. It is quite widely recognized that in many third world countries, disaster mitigaion programmes implemented by government agencies, with or without the participation of NGOs or community based organizations, suffer from a series of defects and distortions. The present article discusses these issues. It also deals with how the society should prepare for monitoring and mitigation of natural disasters.

INTRODUCTION

Since the creation of this universe, no place on our planet has been free from disasters due to natural events such as floods landslides, cyclones, volcanic eruptions, earthquakes, tsunamis, etc. In recent years, increasing number of natural disasters has inflicted widespread death, destruction and devastation in different parts of the world. The nature and extent of preparedness for disasters involve a complete spectrum of events from avalanches to floods, earthquakes, landslides and so on. Mitigating the effects of natural disasters requires an integrated and scientific approach calling for collective and coordinated efforts of all agencies–international, governmental and voluntary.

Preparedness for the mitigation of disasters includes development, adoption and implementation of multipronged approaches comprising various disciplines such as estimation and evaluation of risk and technological assessment with respect to design and construction, financing, education and above all, people's participation.

Natural disasters are classified into recurrent disasters such as floods, droughts, etc. and non-recurrent disasters such as earthquakes, volcanic eruptions, etc. However, the nature and requirements of disaster preparedness are almost similar in both types of disasters.

DISASTERS AND DAMAGES

Disasters may also be classified into direct, indirect and intangible ones. Direct disasters include damage to residence, human lives, stores, industries, etc. Losses due to direct disasters are apparent ones, which can be asssessed by the cost of repair or replacement of all physical damages caused by the disasters. Indirect disasters include the damage to business, service and economic activity. This becomes sometimes so complex as to make even a rough estimate

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difficult and it is often expressed as proportion, i.e. 0.5 to 1.0 times or more of direct disaster. Intangible disasters are not subject to direct money-evaluation. They include effects upon health, social and economic security.

There are, however, valid and cogent reasons for believing that recent disasters are of greater magnitude than those which occurred in the past, precisely on account of rapid industrialization, urbanization, increased land-use and on top of all, growing population world over. Disasters of recurrent and non-recurrent nature are liable to continue to occur for all time to come and man cannot prevent them. All he can do is to take steps for safety and thus minimise appalling losses of life and property, making use of available advanced technologies at his disposal.

RECURRENT DISASTERS

Flood is the most frequent, recurrent natural disaster that has been damaging and destroying human life and property since the time immemorial. In India, the Himalayan rivers account for nearly 70% of the flood damages. Many of the Indian states such as Assam, Bihar, West Bengal, U. P., etc. face the floods almost every year as a routine affair during the monsoon period when the rivers are in spate. These floods create havoc for the inhabitants of the adjoining areas.

Let us go to the saga of regular flood disaster of North Bihar in India which basically serves as the catchment's area of high flood discharge of the rivers originating from the mountainous terrains of Nepal. These rivers, such as Bagmati, Gandak, Lakhandei, Adhwara groups, Mahananda, Kosi and others, are scripting a grievous saga of omnipotent turbulence along the flood plains of Bihar. The devastation due to disastrous flood in north Bihar in 2004 was more than that caused by the earthquake of terrifying 1934. During every monsoon, while these rivers are restlessly biting into the embankments ; the villagers too are tirelessly working. The arrival of the fatal flood results in exodus. Rickety cots, rattling pans and pots, and even home-made stuffs are plied on bullock carts, tractors-trailers too are pressed into service. Thatched huts are carted away to makeshift camps. Most of the farmers have to lose their farms and many houses are drowned. Millions of people have to suffer for want of shelter, food and sanitation, least to talk of their cattle and other belongings most of which meet their watery graves.

But, the rivers–the Gandak, the Bagmati, the Mahananda, etc. (of Bihar) are thirsty to swallow more. The villagers know that this inevitable episode is only a matter of time against which they are racing to retrieve as to what they can. They build homes, not merely houses. What they are getting dismantled are only houses ; home is now under the open sky for men, women, and children and even for dumb cattle. Government and administration have a tough time to care for millions of villagers engaged in their hopeless fight against the nightmare of floods.

NON-RECURRENT DISASTERS

Earthquakes, landslides, cyclones, etc. are the non-recurrent disasters in the Indian context. The degree of sensing and warming in such disasters varies from case to case, the general

constraint being less time margin incapacitating all the tackling machineries. As is evident from the Andhra Cyclone of May, 1990 in which more than a thousand people lost their lives despite four days' advance warning and prompt Govt. action. This goes without saying that the level of awareness and promptness in all concerned is still to be raised.

In the case of the earthquake, no precise warning system has so far been developed. The earthquake being the fastest acting destroyer of man-made structures brings down inadequately designed built structures immediately. Indian lore is full of references to earthquakes. In this decade, i.e. from 1991 to 2001, India has experienced several devastating earthquakes. The most recent earthquake of Bhuj and Ahmedabad in Gujarat on January 26, 2001 was so massive and furious that it defies all imagination.

In India, the northern region of the Himalayas and its foot-hills fall under the most active seismic zone. The Assam earthquake of June 12, 1897 was probably one of the biggest earthquakes in Indian history. The great alluvial trough of the Ganga is a tectonic one. The Bihar earthquakes of 1833, 1934 and 1988 had their origin in this trough. The loss of lives due to earthquakes in India over the last 200 years is more than a million. Simultaneous loss of property is even manyfold.

During the post-earthquake or post-cyclone investigations, one often observes that the damage varies from total destruction to only minor effects and including varying degrees such as partially or fully damaged or blown-out walls, broken windows, uprooted roofs, downed transmission poles, etc. The performance of man-made structures during earthquake or cyclone has been observed to be very poor in potential disaster areas. The reason behind the inefficient performance and incapability of the structures is primarily due to lack of continuity, bracing, symmetry and redundancy of the structural and poor quality of construction. In most of the cases, substandard construction practice, inferior foundation and inadequate detailing have been the root cause of the structural damages. Seismic behaviour of masonry construction in general has been very unsatisfactory. Most catastrophic failures of unreinforced masonry buildings have been observed with obvious defects such as lack of proper joins, asymmetric layout of resisting elements and scarcity of walls in one direction.

In case of cyclones, some waterfront structures experience damage from storm surge and waves ; and strong gusty winds enhance the structural loads, leading to the successive failure of the structure. A typical failure is triggered by the failure of one or more of the system components. For example, since storm winds create lifting forces on the roof, poor connection or anchorage of the roof system to the walls can lead to the lifting of the roof. When wood-frame structures loose their roofs, the walls are left with no support at the top and usually collapse because of the surronding wind pressures. In some coastal communities, where the house are on masonry columns without any reinforcement, failure is often initiated at the foundation level due to uplift caused by storm surge. The losses to life and limb, economy and exchequer, social structure and morale are quite enormous and

devastating in such non-recurrent disasters. The recent Orissa cyclose of 1999 caused devastation in all fronts and loss of over 10,000 lives.

AWARENSS AND CONSCIOUSNESS OF DISASTERS

A single disastrous event can destroy crops and buildings, roads and railways, water supply and power supply–even reduce a whole town or many villages into barren land. Once a disaster strikes, the aftermath is faced with variety of problems, mainly human and civic, Right from arranging food, drinking water, clothes, etc. to fighting insanitation, diseases, etc. the task of the tackling-authorities becomes formidable. All this results from the congestion of large number of people in limited space called rehabilitation centres or camps and that too with inadequate civic facilities. This poses additional problems for the attending physicians and workers. Pitiably, most countries, particularly the developing and under-developed ones, face the devastation first by the natual disasters and then start relief measures after the calamities. (Why not predict or monitor natural disasters, develop emergency preparedness and take measures to control their effects ?

We had to, in the past, put up with all such adversities and then we activated relief measures. But we can, at present, predict, control, monitor and manage most disasters through science and technology. The disaster consciousness should be a common concern for both the authorities as well as for the suffering people. For this purpose, proper education must be imparted both before and after the disaster. By inculcating a sense of cleanliness among the affected people and by administering proper medicines and drugs, post-disaster epidemics and diseases can well be contained to a satisfactory limit.

The level of education scenario of our society is dull and dreary. Hence the work of consciousness and awareness development among masses is very difficult, if not impossible. Some attempts may be carried out on the following lines. Suppose in the case of earthquakes or cyclones or regular floods, the regions are identified and it is possible to determine the type of seismic zone or cyclonic zone or the likelihood of recurrence of high flood discharge. These informations are available in the Codes of Practice developed by the Bureau of Indian Standards and also available with the various government departments related with these activities. Yet, these informations cannot be comprehended and understood by a person with shallow knowledge. Hence, it is recommended that the presentation of these informations should be made simple to such an extent that even a common person may follow it.

An extensive awareness programme consisting of cartoon films, slogans and posters containing scenes from actual earthquake disasters or flood disasters should be disseminated to the people through television channels, radio, cinema and newspapers. Demonstrations may be held in villages as well as the skilled persons may be invited to the institution for crash demonstration-cum-training programme. Even the course of the curriculum must provide the lessons about personal safety in the event of the occurrence of the natural disaster. The objective of this is to generate awareness and consciousness among the masses such that the

persons of each and every stratum could observe and feel the nightmare of natural disasters whatsoever and its mitigation as well.

DISASTER PREPAREDNESS IN A SOCIAL VACUUM

In many developing and underdeveloped countries, a social vacuum has emerged between the theory and practice of natural disaster mitigation which inhibits action. The disaster mitigation measures adopted and executed by the government, without the participation of NGOs or community based organizations suffer from a series of maladies in many third world countries. These include the following :

I. Failure to Initiate and Encourage Participation of People

Many mitigation programmes are based on specialized technologies and professional skills. Therefore, these are carried out without the participation of the inhabitants of the disaster affected areas and their organizations in planning and execution. The local people are not involved for providing labour under organized self-help schemes. Hence, several programmes turn out to be uneconomic as they do not include the locally available resources for mitigation such as the local inhabitants themselves, their local skills, know how and organizations.

II. Failure to Identify Vulnerability

Many disaster mitigation measures are unidirectional and unisectorial, related to a specific type of disaster for a defined span and particular period of time. As a matter of fact, they cannot address vulnerability which is a complex phenomenon of people's actions and their socio-economic and physical condition. The data are available on community psychology, people's social and economic condition, and their behavioural response to disasters. Yet, much mitigation becomes null and void to take into account the complex range of constraints and normally it goes on to implement people's own decisions.

III. Susceptibility to Manipulation

The most serious criticism of the government sponsored mitigation is that due to concentration of power amongst a centralised management, it is susceptible to politial manipulation by powerful groups. Mitigation becomes merely an instrument for maintaining the status-quo or for actually making the poor people more vulnerable. Many programmes limit demands of people of low income group and their organizations either by outright repression or by cooption. For many political parties and the government, disaster mitigation is implemented more by political and economic self-interest than by humanitarian motives. Whenever a disaster strikes, this is the common feature of the news-columns of newspaper, TV channels and radio that the government and the opposition are engaged in making hue and cry and throwing blames on each other concerning the implementation of the mitigation measures.

It is, however, difficult to persuade the government to change its development policies. At the same time. NGOs and community based organization working in the field have little influence over the structural causes of disaster ; therefore, it is necessary to bring about a policy change in which a qualitatively different and more protagonist role of community based

organizations should be allowed. Further it is believed that NGOs can contribute in bringing the policy change as follows :

(A) As mediators, assisting in negotiations with government and international agencies.

(B) As organizers, reinforcing the network and coalitions and the exchange of informations.

(C) As advisors, supporting community based organizations that own mitigation programmes.

(D) As communicators, allowing the transfer of appropriate methodologies and technologies.

It is recommended that the mitigation role models should be developed by the NGOs which can be achieved by consensus at the following three levels :

(i) With people and their organizations.

(ii) With NGOs and other institutions providing technical support, training and similar activities.

(iii) With local, regional and central government agencies which are able to execute mitigation with technical, legislative and financial support.

It is, therefore, suggested that a model for NGOs intervention should be developed so that it may fill the vacuum between mitigation theory and practice which evidently exists and which may be applicable in many developing and underdeveloped economies.

CONCLUSION

Disasters cannot always be prevented but their effects can cerainly be mitigated. Natural disasters may be of two types such as recurrent ones and non-recurrent ones. For some disasters such as earthquakes, floods, etc., the prone areas can be earmarked and suitable mitigation provisions be made accordingly. Such areas need investigation, planning, provisions and manning of special facilities for timely mitigation of such disasters, their nature, degree of severity and exact location. Actions can be identified in case of a disaster by government, local and voluntary agencies and the inhabitants of the affected areas.

Experience of the mitigation of natural disasters has proved that a great deal of destruction takes place due to inappropriate planning and decision-making. If the structures are built adequately to withstand the fatal forces created by the disasters, the damages could be minimized.

Further, it has been proposed that NGOs can act as communicators between people and government and that real mitigation requires the complimentary participation of state, market and community sectors. A model for NGO intervention has been suggested so as to fill the vacuum between theory and practice of mitigation which evidently exists and which may be applicable in many developing and underdeveloped countries.

SATELLITE REMOTE SENSING : AN OVERVIEW

V. M. Rokade and P. Kundal *

Remote sensing is science and art of obtaining information about an object through analysis of data acquired by a device located at a distance. Observations are made on the reflected/scattered of self emitted electromagnetic energy (EMR) from the earth in different wavelength bands. Remote sensing has the capability to provide timely, synoptic and repetitive coverage over large areas across various spatial scales. It is, therefore, a powerful tool for monitoring and assessment of natural resources. This technology has wide applications in agriculture, forestry, geology, hydrology, oceanography, urban development, soil mapping, disaster mangement and land use/ land cover mapping. Under Indian Remote Sensing satellite Programme, so far ten satellites have been launched by ISRO. These remote sensing satellites are equipped with sensors to provide data in different combinations of spatial, spectral and temporal resolution. In this article, an attempt has been made to provide an overview of the developments that have taken place in satellite remote sensing technology in India.

INTRODUCTION

One of the most exciting developments of modern times has been the advent of satellites–for studying the surface and atmosphere of the earth, for converting homes into class rooms, for weather forecasting and disaster warning, for communications, for TV and Radio transmission and for investigating space. Space instruments and remote sensing tools provide us new eyes to study this planet and they extend the scope of vision. Remote sensing derives information about an object from measurements made from a distance. It is a multidisciplinary activity, which deals with the inventory, monitoring and assessment of natural resources through analysis of data obtained by observations from a remote sensing platform. The observations which are synoptic, provide repetitive coverage of large areas and quantitative data. The system consists of a sensor (PAN, LISS I, LISS II, LISS III, WiFS, etc.) to collect electromagnetic radiation and a platform (satellite, aircraft, rocket, balloon, etc.) on which the sensor can be mounted. The information received by the sensors is reformatted and processed on the ground to produce photographs, CD's or computer compatible magnetic tapes (CCTs). The basic source for this technology is elctromagnetic radiation (EMR) and this energy is either received from a natural source like sun or from artificial sources like RADAR (Radio Detection and Ranging) and/or SONAR (Sound

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Navigation and Ranging). This energy reaches the earth surface and gets reflected, transmitted or absorbed by varions objects, before being collected by the sensors mounted on satellites. Remote sensing of the earth has tranditionally used reflected energy in the visible spectrum and emitted energy in the thermal infrared and microwave regions to gather radiation that can be analysed numerically or used to generate pictorial representation i.e. a satellite image. Gathering of different range of wavelengths is the essence of what is termed as "*Multispectral Remote Sensing*". Images made from varying intensity signals show variations in gray tones in black and white images and as colours, in terms of hue, saturation and intensity. In general, there are three types of the satellite data products, namely, black and white image or Panchromatic satellite data, Normal colour and False Colour Composite (FCC).

INTERPRETATION OF SATELLITE DATA

Interpretation comprises detection, identification, description and assessment of significance of an object and pattern imaged. The satellite data do not provide complete information for applications without the use of ground truth. Thus, interpretation of satellite data needs to be followed by field visits. The remotely sensed data can be interpreted either digitally or visually, or by a combination of both. Digital analysis is done with the help of computers but, even after the digital analysis, the output is also visually analysed. In the case of visual interpretation, a few guidelines help us identify the features. (Elements of interpretation) The basic elements are shape, size, pattern, tone, texture, shadows, location, association and resolution.

Shape : It refers to the general form, configuration or outline of individual objects. The shape of some objects is so distinctive that their images may be identified solely from this e.g. roads, airports, rivers etc.

Size : The size of an object is one of the most useful clues to its identity, e.g. settlements, agricultural fields, reservoirs etc. This depends on the scale and resolution of the satellite image. Smaller features will be easily identified in large scale image.

Pattern : It is related to the spatial arrangement of objects into distinctive recurring forms. This can be explained through the pattern of a road and railway line. Eventhough both looks linear, major roads are generally associates with steep curves and many intersections with minor roads.

Tone : Tone refers to the relative brightness in colour of objects on satellite images. Different objects reflect/emit different amounts of energy in different wavelengths of the electromagnetic spectrum. In almost all cases, there is difference in tone or colour between objects or between an object and its background. For example, various shades of red colour in False Colour Composite (FCC) indicate the various types of vegetation. The blue colour indicates water bodies, the density of the colour being proportionate to the depth of the water body. Objects with high reflectance values are white in colour, e.g. snow, cloud, sand, salt affected areas, etc. Human settlements are bluish gray in colour.

Texture : Texture is the frequency of change and arrangement of tones. This is a micro image

characteristic. The visual impression of smoothness or roughness of an area can often be a valuable clue in image interpretation. Still water bodies are typically fine textured, grass medium and bushes rough. There are always exceptions as resolution of the satellite data plays a role. The grass may appear to be smooth, bushes medium and forest rough on low-resolution data of the same area.

Site : This refers to arrangement of objects with respect to one another, or with respect to terrain features. Aspect, topography, geology, soil, vegetation and cultural features on the landscape are distinctive factors that the interpreter should be aware of when examining a site. The relative importance of each of these factors will, of course, vary with local conditions, but all are important. Just as some vegetation grows in swamps, others grow on sandy ridges or on the sunny side vs. the shaded sides of hills. Crop types may prefer certain conditions (e.g. orchards on hillsides). Man-made features may also be found on rivers (e.g. bridge, dam etc.) or on hilltops (e.g. observatory or radar facility).

Shadow : It indicates the outline of an object, for example ; Church steeples and smokestacks can cast shadows that can faciliate their identification. Tree indentification can be aided by an examination of the shadows thrown.

Association : Some objects are so commonly associated with one another that identification of one tends to indicate or confirm the existence of another. For example, a shadow is associated with clouds, sand dunes are associated with deserts, mangroves with the coastal regions, etc.

Resolution : It depends upon the imaging device i.e. sensors and includes of spectral and spatial resolutions. The spectral resolution helps in identifying the feature in specific spectral bands. High spatial resolutions images are useful in indentifying small objects.

APPLICATION OF REMOTE SENSING

Remote sensing is useful in evolution of natural resources potential and projections for the future economic scenario, assessment of land and oceanic rescources that are physically useable and economically relevant and identification of management strategies that offer sustained production and other benefits. Analysis of constraints related to resource development-physical, economic or social and indentification of appropriate corrective and conservative measures are also possible by remote sensing. This advanced technology has been extensively applied in several fields and areas of the study, some of which are outlined below :

(a) Geological Mapping

This involves identification of rock types, landforms, structures and lineaments. Mapping in the inaccessible terrain like the Himalayas has been possible by using remotely sensed data. Large aerial coverage given by the remotely sensed data help in indentifying various regional structures and lineaments. The use of remote sensing data to map large area and then to demarcate the target area for detailed field study is of enormous help for exploration geologists.

(b) Agriculture and Forestry

India is an agriculture intensive country, and in this scenario, a technology like remote sensing can provide timely and reliable information on

agriculture which is a prerequisite for optimal land use planning and formulating policies on food security. Mapping of vegetation species from remote sensing media is widely followed because many sensing devices operate in the green, red and near infrared regions of the electromagnetic spectrum. Crop area estimation, crop yield estimation, crop yield prediction, chlorophyll absorption studies, forestry monitoring etc. are some of the applications in practice. Repetitive coverage of an area helps in monitoring deforestation/afforestation.

(c) Land Use / Land Cover Mapping

A knowledge of land use and land cover is important for many planning and management activities concerned with the surface of the earth and satelite image is a powerful medium for mapping what's at the earth's surface. One can identify and categorize the various natural and man-developed features in terms of "land cover", and "land use", which refers specifically to how the land is used for human activities.

(d) Soil Mapping

Mapping and monitoring of soil resources is one of the major pre-requisites for estimating land capability and irrigability by assessing salt-affected soils, eroded lands, shifting cultivation, etc. For careful land use planning, waterlogged areas have to be delineated in order to take up preventive and reclamative measures. These days soil mapping using satellite remote sensing is commonly followed practice.

(e) Water Resources Applications

Water resources studies include both surface and subsurface water potential tapping. Remote sensing data are used in identification of the natural drainage system, sources of the major river, etc. for effective planning of reservoirs and for fruitful watershed development and mangement. Drinking water, which is one of the basic human needs, is still a precious commodity in many parts of India. Satellite data are being used for preparing hydrogeomorphological maps towards indentifying sites for sustainable drinking water sources.

(f) Disaster Mangement

The primary role of the remote sensing data for natural disaster managment is two fold, disaster forewarning and monitoring. The use of the data in flood management, volcanic eruptions, forest fire mangement, oil spill etc. is widely acclaimed. These days, remote sensing data have found its application in seismic monitoring also. The other branch of application of the data includes studies in oceanography, which includes sea temperature and depth measurment, ocean coast monitoring, etc.

INDIAN REMOTE SENSING PROGRAMME

The remote sensing program was initiated in India in 1970 when aerial survey was conducted to produce Infrared Imagery to study the coconut wilt disease in Kerala plantation. Since then remote sensing technology and the applications have developed tremendously.

Following the successful demonstration flights of Bhaskara 1 and Bhaskara 2 launched in 1979 and 1981 respectively, India began development of an indigenous IRS (Indian Remote Sensing Satellite) program to support the national economy in several areas of application. The launch of first operational Remote Sensing Satellite, IRS-IA on 17, March 1988 was an

important feather in the cap of ISRO (Indian Space Research Organization). IRS-1A was carried two sensors namely LISS-I and LISS-II (Linear Imaging Self-Scanning System). On March 17, 1995, IRS-1A was retired from routine service after collecting about 300,000 images. The IRS-1B was launched on August 29, 1991, It is a follow-up satellite of the IRS-1A, and its instruments are practically identical to those of the IRS-1A. The IRS-1E was launched on 20th September 1993 by the first Indian PSLV (Polar Satellite Launch Vehicle) rocket, but it ended in a failure when the payload plunged in the ocean. The IRS-1E and the IRS-P series are considered to be experimental satellites. On October 15, 1994, IRS-P2 was launched from Sriharikota aboard the PSLV. This satellite provides Panchromatic data (useful for urban planning and mapping), multi-spectral data (for natural resource planning) and the WiFS (for large-area vegetation monitoring). IRS-1C and IRS-1D, which are identical, were launched on December 24, 1995 and September 28, 1997, respectively. They carry three cameras namely, Panchromatic Camera (PAN), Linear Imaging Self Scanner (LISS-III) and Wide Field Sensor (WiFS). Unfortunately, IRS-1D was almost lost when it entered a wrong orbit due to malfunction of PSLV. The IRS-P3 satellite was launched from Sriharikota using PSLV on March 21, 1996. It has an X-ray astronomy and two remote sensing payloads, namely WiFS and MOS. On May 26, 1999, IRSO launched OCEANSAT-1 (IRS-P4), which is the first Indian satellite dedicated fully for the study of oceans. It carries the Ocean Colour Monitor (OCM) and the Multi-frequency Scanning Microwave Radiometer (MSMR). TES (Technology Experiment Satellite) was launched on board PSLV in October 2001 to demonstrate and validate technologies that could be used in the future satellites of ISRO. The heaviest earth-observation spacecraft, RESOURCESAT-1 (IRS-P6) was launched on October 17, 2003. It is the most advanced satellite built by ISRO, bringing continuity to the current IRS 1C and 1D programmes. Data derived from RESOURCESAT-1 can be used for advanced applications in vegetation dynamics, crop yield estimates, disaster mangement support etc.

India is presently pressing ahead with an impressive national programme aimed at developing more and more Earth observation satellites to meet ever-increasing demands which have been created with the use of this technology. The Earth observation system, as an important space infrastructure, has now become an essential tool for the government for achieving the goal of application of technology for national development.

CONCLUSION

In a country like India, which has diverse spreads in terms of geography and population, it is essential to put satellite data to effective use and ensure that the advantages percolate to the grass-root levels for overall development. Remote sensing technology by virtue of many advantages has become a very useful tool in the hands of scientists, planners and administrators in obtaining accurate informations on various aspects. Various national level operational projects viz. Drought Monitoring, Disaster

Management, Urban Studies, Soil Mapping and Land Degradation Studies, Geological Surveys, Mineral Targeting, Drinking Water Potential Zone Mapping, Watershed Development Planning and several others, are conducted by National Remote Sensing (NRSA) with concerned government organizations have been giving good results in reaching space technology for the benefit of common man. Due to improvement in space borne remote sensing satellites in terms of spatial, spectral, temporal and radiometric resolutions there will be further enhance and extend the benefits of space technology. Like other developed countries India has a well-integrated and self-supporting space programme, which is providing and will continue to provide important services to society in future.

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DO YOU KNOW?

Q5. Where does sound travel faster–in air or water?

Q6. Will a lake freeze if the air temperature falls to – 1°C?

IS IONISING RADIATION BOON OR CURSE TO HUMAN HEALTH ?

Arun Chougule *

Discovery of X-rays in 1895 by Prof. W. C. Roentgen has revolutionised the medical diagnosis procedures. Though most of the crucial medical decisions are dependent on X-ray diagnosis and early diagnosis of some diseases depends completely upon X-ray examination, yet it cannot be ignored that the diagnostic radiological procedures contribute maximum population dose as compared to other man made radiation sources. There is growing concern to radiation doses received by the patients during various radiological procedures. The dose received by the patient varies from machine to machine, technique used and safety precautions followed. X-ray is many a times being overused as a ritual diagnostic procedure. The patient receives radiation dose in excess due to bad practice and bad equipment. Hence every X-ray machine should be subjected to periodic quality assurance (QA) test and radiation protection survey.

INTRODUCTION

Ever since human is born on this earth, he is bombarded by ionising radiation. Everybody on this earth, irrespective of his place of stay and occupation, is getting some dose of ionising radiation which exists all around us. This is called natural background radiation (terrestrial and extra-terrestrial). The natural background radiation varies from place to place. It is maximum, 260 mSv/year, at Chavara coast of Kerala and average for whole India is about 2 mSv/year. We have no control over the natual background radiation exposure. In addition to natural background radiation, human is exposed to manmade radiation. **Amongst the manmade ionising radiation, X-ray diagnostic procedures contribute the highest per capita radiation dose to the population over and above the natural background radiation.**[1]

On 8th Nov. 1895, Prof. Roentgen discovered X-rays which has revolutionised the medical imaging. It is overwhelming to know that within one year, in 1987, 49 books and over 1000 article were published on use of X-rays in Medicine. Since the discovery, X-rays are being widely used as the most important and reliable scientific tool for effecting proper diagnosis of ailment and for assessing the efficacy of the treatment given to the patient. Use of X-rays for radiography and fluoroscopy started in 1896, whereas radioisotope use for nuclear medicine procedures started in 1950. X-ray CT was put to clinical use in 1972 and X-ray digital imaging was introduced in 1977. WHO reports that more

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than one third of all crucial medical decisions are dependent on radiological procedure and early diagnosis of some diseases depends only on X-ray examination. However, the fact that the diagnostic radiological procedures contribute maximum population dose, as compared to other man made radiation source, cannot be ignored and more so when, on one hand, X-ray diagnostic facilities are being made available to larger section of the society (the frequency of radiological procedures per person per year has increased more than twice in last two decades) and on the other hand, public awareness is growing of the potential hazards of the radiation at rapid rate. Many a times the X-ray diagnostic procedure is being over used as ritual/routine diagnostic procedure. Clinician should first ask himself/herself before ordering the radiological investigation as to what he/she is going to do if the radiological diagnosis turns positive or negative. If the answers for both these are the same, then there is no need of that radiological investigation.

Ionising radiation has played an important role in medicine ever since the discovery of X-rays and radiocativity at the end of the nineteenth century. The benefits it has brought are innumerable, but there is also a risk of harm from the radiation exposure. Though the radiation is beneficial to mankind, it has many harmful effects on human. The fact that ionising radiation produces biological damage has been known for many years. The first case of human injury was reported in literature just a few months following the discovery of X-rays and the first case of radiation induced cancer was reported in 1902. During the early years, indiscriminate use of X-rays has caused visible damage to several physician and X-ray enthusiasts. In 1921, Dr. Ironside Bruce, a pioneering radiologist in London hospital died of cancer at the young age of 36 years. By 1922 more than 100 radiologists had been reported to have died due to radiation induced cancer. In spite of all these reports, the enthusiasm for use of X-rays was so overwhelming that radiation protection awareness was gradually forthcoming. The radiation dose limits to radiation workers have been reduced drastically from 1100 mSv/year to 20 mSv/ year during 1934 and 1992. Therefore, all possible measures, to reduce or limit radiation does received by patient and staff during various radiological procedure, are essential.

Now we will try to understand how the radiation causes damage to human body. The absorption of x-rays (ionising radiation) in human body may lead to cause many kinds of physical, chemical and biological products or lesions. The physical events such as excitation and ionisation are very short lived and last for less then 10^{-15} sec. The chemical process which takes place within 10^{-6} sec. after irradiation produces free radicals such as OH, RH, and H_2O_2. These radicals/chemical lesions diffuse through and/or react with other bio molecules in the human cell such as DNA molecules, thereby creating DNA radicals i.e. creating bio molecular lesions in the organic material within the cell. DNA radicals are also produced by direct action of radiation. In the direct action the atoms of the target, i.e. DNA, itself may be damaged. While in the indirect action the atoms of target, i.e.

DNA, may be damaged via interation of OH radicals. The bio molecular lesions are relatively longer lived and can last for minutes, hours, days, months or even sometims for years. The entire process is extremely complex. The radiobiological effects in biological system are of two types (1) Somatic effect occurring in the exposed individual and (2) Genetic effects which occur in the next or subsequent generations (progeny).

RADIATION DOSE UNITS

The unit of radiation absorbed dose is Gray (Gy). If 1 Joule of energy is absorbed in 1 gm of tissue the absorbed radiation dose is 1 Gy. The commonly used sub unit of Gy is the milligray (mGy) which is one thousandth of the gray and 1 mGy = 0.1 rad. Similarly 1 μ Gy = 0.001 mGy. For radiation protection, the dose equivalent unit of Sievert (Sv) is used and 1 Sv = 1 Gy $\times$ Q $\times$ N. Where Q is the quality factor which is different for different kind of radiation (for X and γ rays it is 1, for alpha particles it is 20) and N is normalization factor which takes into account the radio sensitivity of tissue into account. For simplicity for X and γ rays 1 Gy = 1 Sv.

HOW MUCH RADIATION DOSE IS SAFE FOR HUMAN ?

There is no threshold of radiation dose for the initiation of some deleterious biological changes. Even a small dose may increase the risk of cancer and small absorbed dose in gonads may induce mutation or chromosomal changes potentially capable of inducing hereditary disorders in the offsprings. These types of effects are known as stochastic, that is the probability of occurrence of the effect depends on the absorbed dose, whereas the severity of the effect is independent of the dose. **The current knowledge of radiation biology indicates that even the low doses of ionising radiation have ability to enhance the cancer risk to three times than what was estimated earlier. Similarly the recent studies also indicate that low level of ionising radiation have the potential to effect the IQ of the unborn, if it was exposed in womb.** A fetus exposed between 8 and 15 weeks of the conception may have various degrees of physical and mental impairment depending on the dose and shift of 30 IQ units per Gy dose is a possibility. Therfore, it is assumed in radiation protection planning that every increment of dose in an individual may carry some risk, even though the risk for a particular X-ray examination is small. It is therefore essential to quantify the radiation dose to the patient from diagnotic X-ray and CT procedure to predict the possibility of harmful effects. The CT scanner has become a popular tool and this modality is being over used in both the sexes and in all age group. The CT images are uniquely informative but delivers very high radiation dose. It has been observed that the unnecessary high dose in the diagnostic radiological procedures is due to :

1. Radiological investigations which are often requested without adequate evaluation of the patient and alternative techniques.

2. High repetition rate due to wrong techniques, improper procedure, incomplete patient preparation etc.

3. Poorly trained or casual attitude of the trained staff.

4. Inappropriate or poorly functional equipment.

5. Incorrect radiological technique.

6. High work load.

In an attempt to quantify the radiation doses received during different radiological procedures, the author[2,3,4,5,6] has carried out extensive measurements in various private and govt. hospitals of Rajasthan and the radiation doses received by the patient in common radiological procedures is given in Table-1. Similarly the organ doses in common examination by CT is given in Table-2 so as to get an idea about the radiation doses received by various organs during various CT procedures. To emphasize the magnitude of radiation doses delivered by some common CT procedures I have attempted the comparison of radiation doses received

TABLE–1

RADIATION DOSES RECEIVED BY PATIENT SKIN SURFACE DURING COMMON RADIOLOGICAL PROCEDURES

SR. NO.	RADIOLOGICAL PROCEDURE	SKIN SURFACE DOSE mGy
1	AP chest	0.3 ± 0.1
2	Pa pns	7.4 ± 1.4
3	Skull Radiograph	6.4 ± 1.3
4	Cervical Spine AP	5.1 ± 0.9
5	Kub	6.2 ± 1.1
6	Hysterosalpingog-raphy (HSG)	9.2 ± 2.1
7	Bronchography	45.1 ± 6.2
8	Cystourethrogram	146.0 ± 12.0
9	Myelography	519.0± 186.0
10	Barium Meal	115.6 ± 25.2
11	Barium Swallow	150.0 ± 12.0
12	Barium Enema	164.0 ± 40.0

TABLE–2

RADIATION DOSES TO IMPORTANT SENSITIVE ORGANS DURING VARIOUS CT PROCEDURES

EXAMINATION	ORGAN	DOSE RECEIVED mGy
Skull	Brain	24.3 – 32.2
	Bone Marrow	3.1 – 4.1
	Thyroid	0.91– 1.4
Thorax	Breast	23.5 – 27.1
	Lungs	20.0 – 25.5
	Bone Marrow	4.3 – 5.8
	Thyroid	2.3 – 3.1
Abdomen	Upper Large Intestine	20.0 – 26.7
	Lower Large Intestine	10.1 – 13.5
	Uterus	14.7 – 20.1
	Bone Marrow	6.9 – 9.7
Pelvis	Uterus	16.1 – 21.9
	Upper Large Intestine	7.5 – 10.3
	Lower Large Intestine	14.6 – 19.8
	Bone Marrow	5.6 – 7.9

during these procedures with that of chest radiography and the comparison is tabulated in Table-3. Though CT scan images are uniquely informative, it is evident that they deliver a high dose of ionising radiation because high kVp and mAs pencil X-ray beams are used for

TABLE–3

COMPARISON OF THE DOSES RECEIVED DURING VARIOUS RADIOLOGICAL PROCEDURES AND ISOTOPE SCANS WITH THAT OF CHEST X-RAY DOSE

INVESTIGATION	EFFECTIVE DOSE mGy	EQUIVALENT TO NUMBER OF CHEST X-RAYS
AP Chest X-ray	0.02	1
Cervical Spine	0.1	5
Dorsal Sine	1.0	50
Lumber Spine	2.4	120
ABDOMEN	1.5	75
Pelvis	1.0	50
Intervenous Urogram	4.6	230
Barium Study-Stomach	5.0	250
Barium Study Esophagus	2.0	100
Barium Study-Smal Bowel	6.0	300
Barium Study-Large Bowel	9.0	450
Isotope Bone Scan	3.6	180
Thyroid Scan	1.0	50
Lung Perfusion	1.0	50
Dmsa Scan	0.4	20
Dtpa Renogram	1.6	80
Hepatobiliary Scan	2.3	115
Liver Scan`	0.7	35
Gastric Emptying	0.3	15
201 TI Myocardial per Study	18.0	900
CT Scan Brain	2.0	100
CT Scan Chest	8.0	400
CT Scan Abdomen	8.0	400
CT Scan Pelvis	7.0	350

creating the images. From Table-3, **it is evident that relative effective dose received by patient undergoing CT brain is equivalent to that of 100 chest X-rays. Similarly in CT chest, abdomen and pelvis it equals 400, 400 and 350 chest X-radiographs respectively.** Radiation dose received by the patient during the CT for abdomen is 15 times that of pelvic radiograph or equivalent to 3 barium meal examinations or equivalent to 2 isotope bone scans. The radiation burden further increases in CT guided interventions like CT pulmonary angiography, high-resolution CT chest, oral contract CT bowel and oncological studies. Though CT constitutes only < 2% of total radiological investigations, it represents more than 25% of population dose where as chest radiography accounts for more than 30% of the radiological examinations but contribute only 2% of collective radiation dose. Moreover 8-10% of CT procedures are for children under 15 years of age. There is a considerable room for reduction of CT related doses. Some of the measures which can be undertaken with little efforts, are :

1. Educating referring clinicians so that injudicious request, made by them go down.

2. Encouraging the referring clinicians for other alternative investigations such as MRI and USG. In many instances even isotope studies result in comparatively less dose of radiation without compromising on diagnostic end results. For example, isotope liver scan gives effective dose equivalent to that of 35 chest X-rays and effective dose equivalent during lung perfusion study is equivalent to that of 50 chest X-rays.

3. Using technologically superior equipment such as multi slice spiral CT with faster scan speed.

4. Optimization of CT settings and reduction of tube current and kVp. This is very important for pediatric patients and very thin patients.

5. Often CT scans are done before, during and after injection of IV contrast material. When medically appropriate, multiple exposures may be reduced by eliminating pre contrast scanning.

6. If the pitch (in helical scanning) is increased, the amount of radiation needed to cover the anatomical area of interest decreases without loss of diagnostic information.

7. Proper maintenance of equipment and judicious use of equipment by well trained staff so that the repetition rate is reduced.

8. Bladder emptying before pelvic CT in order to facilitate movement of uterus, ovaries and bladder into the bony pelvis, which result in reduction of absorbed dose to these organs.

9. Avoiding unnecessary medical X-ray exposure is particularly important when the patient is a child as they are at relatively greater risk than adults are. Children have more rapidly dividing cells than adults do and they have longer life expectancy also. When CT scan is performed on a child or small adult with the same technique factors that are used for a typically sized adult, the small patient receives significantly larger doses than the adult does.

10. Advice to delay conception to men by 2-cell renewal times (about 130 days) and to women for at least 3 cycles in case exposure occurs to gonads.

11. Continuous education and training programme for radiologists, nuclear medicine physician and technologists.

HOW MUCH HARMFUL THE RADIATION DOSE IS ?

To understand the severity of radiobiological effect, it is prudent to know the nominal risks, meaning the probability of occurrence. Therefore radiation induced serious hereditary effects and fatal cancers in individual exposed to dose of 1 mGy is as given in Table-4. Similarly, the effective doses and life time risks of cancer from some common radiological procedures is given in Table-5.

TABLE–4

RADIATION INDUCED SERIOUS HEREDITARY EFFECTS AND FATAL CANCERS IN INDIVIDUAL EXPOSED TO DOSE OF 1 mGy

EFFECT	NOMINAL RISK PER mGy
Hereditary Effects	1 in 250,00
Leukamia	1 in 500,000
Female Breast Cancer	1 in 200,000
Lung Cancer	1 in 500,000
Thyroid Cancer	1 in 2,000,000
Other Cancers	1 in 200,000

IRRADIATION IN UTERO

The patient usually identifies, "her doctor", the referring physician, as the one providing care and whose counsel is the most important to her. The referring physician should not only investigate the possibility of pregnancy but also understand and relate to the patient to the degree to which a diagnostic radiological procedure might compromise the pregnancy.

Diagnostic radiological procedures in pregnant women should be performed only when there is sufficient reason to believe the benefit to her or her child or to both exceeds the known or reasonably suspected risks. When female is not pregnant, the protection philosophy is the same as men. However, when it comes to patient who receives large radiation doses from any radiological procedure involving direct exposure of lower abdomen, the chance of undetected pregnancy being always present, radiation exposure to gonads of woman of reproductive capacity has always been a matter of concern.

Two possible effects of radiation on the developing embryo or fetus need consideration namely development abnormalities and cancers which may be expressed during chidhood or in adult life. The risks for maldevelopment as a result of irradiation in utero begin at about the 3rd week after conception and continue through the 25th week. After irradiation during the 3rd

TABLE–5

EFFECTIVE RADIATION DOSE AND LIFETIME RISKS OF CANCER FROM SOME COMMON RADIOLOGICAL PROCEDURES

SR. NO	RADIOLOGICAL PROCEDURE	MEAN EFFECTIVE DOSE (mGy)	FATAL CANCER RISK
1	Chest AP	0.02	1 in 1 million
2	Skull PA	0.03	1 in 700,000
3	Cervical Spine	0.08	1 in 250,000
4	Abdomen or Pelvis AP	0.7	1 in 30,000
5	Lumber Spine AP & LAT.	1.0	1 in 20,000
6	Head CT Scan	2.0	1 in 10,000
8	Barium Meal	3.0	1 in 7000
9	Barium Enema	7.0	1 in 3000
10	Chest CT Scan	8.0	1 in 2500
11	Abdomen CT Scan	10.0	1 in 2000
12	Pelvic CT Scan	10.0	1 in 2000
13	Tc Isotope Kidney Scan	0.7	1 in 20,000
14	Tc Lune Perfusion Study	1.0	1 in 20,000
15	TI Myocardial Perfusion	18.0	1 in 1000
16	Tc Bone Scan	3.0	1 in 7000

through 8th week, radiation detriment may be expressed as malformation of specific organs. After irradiation during 8th through 25th week, radiation detriment may be expressed in the form of defective development of the forebrain, resulting in severe mental retardation. The risk is higher in the 8th through 15th week than in the 16th through 25th week. Recent data are also compatible with an absorbed dose threshold below which severe mental retardation may not be induced. An increased risk of subsequent cancer in childhood has been correlated within utero irradiation throughout pregnancy

and the nominal risk for irradiation utero for absorbed dose of 1 mGy in the embryo or fetus is given in Table-6.

2. Any women considered for diagnostic or therapeutic irradiation that might affect the uterus should be asked if she is or might be pregnant

TABLE–6

IN UTERO IRRADIATION THROUGHOUT PREGNANCY AND THE NOMINAL RISK FOR IRRADIATION UTERO FOR ABSORBED DOSE OF 1 mGy IN THE EMPRYO OR FETUS

TIME AFTER CONCEPTION	NOMINAL RISK PER mGy
First two weeks	Minimal
3 rd – 8 th week	Potential for malformation of organs
8 th – 15 th week	Severe mental retardation 1 in 2,500
16 th – 25 weeks	Severe mental retardation 1 in 10,000
Throughout pregnancy	Childhood cancer 1 in 50,000

In mid 60's great concern was aroused which resulted in propagation of 10 day rule which stated that in all women of child bearing age, the clinician requesting examination should never overlook the possibility of early pregnancy and should whenever possible, confine the radiological examination of lower abdomen and pelvis to 10 days interval following the onset of menstruation. This is because pregnancy would almost certainly not have occurred in 10 days immediately following the onset of menstruation.

Looking to the radiation risk to fetus following guidelines must be followed before undertaking the radiological procedure of women of reproductive age :

1. It is essential for referring physician, radiologist and nuclear medicine physician to treat any woman with an overdue menstrual period as pregnant unless additional information indicates otherwise.

and she should be regarded as pregnant unless the answer is a definite 'NO'.

3. When patient is regarded as pregnant special care should be taken to ascertain whether the procedure is necessary. Exposure of tens of a mSv to the fetus which could double the natural risk of childhood cancer should be avoided in early pregnancy unless there is an overriding clinical need. As the risk of irradiating the fetus may be much less than that of failing to make a correct diagnosis, the procedure should be done if a need is indicated but with particular care to minimise radiation dose to fetus.

As the medical radiation exposure is responsible for highest per capita dose to general population, one should strictly follow the essential requirements of safe X-ray

diagnostic procedures before undertaking any radiological procedure[7].

1. X-ray room should have dimensions of about 6 m x 4 m or should have 24 sq m. floor area.

2. The room should have all four-side walls of 9-inch thick (23 cm) brick or equivalent.

3. All windows/ventilators to be located at 2.5 m above the floor level.

4. As far as possible there should be only one entry/door to the x-ray room.

5. Chest stand must be located such that x-ray beam points towards a non occupied area.

6. Control panel should be at one corner of the room, preferably near door and should be provided with movable protective lead barrier of 1.5 mm lead equivalent thickness and lead glass of same thickness.

7. The lead rubber aprons of at least 0.25 mm lead equivalent thickness must compulsory be used by radiologist, technician and others involved in fluoroscopic work.

8. In case of fluoroscopy, the lead rubber flaps having lead equivalent of not less than 0.5 mm and dimensions of not less than 45 cm x 45 cm should be used to give additional protection to gonads. In case of vertical fluroroscopy, these flaps should be hung from the bottom of the screen such that the flap overlaps the fluroscopic chair. In case of horizontal fluoroscopy thin lead rubber flaps should be hung from table top.

9. The X-room should be provided with suitable warning signal in local language and a red light. The red light should be switched on whenever the X-ray exposure is given.

10. Under no circumstances should the X-ray beam be directed towards doors, windows or the control panel.

11. No person other than those specifically concerned with any particular X-ray examination should stay in the room when the X-ray exposure is on.

12. The field size used for any examination should always be limited to the minimum so that it only covers the part/area under examination.

13. No member of the staff must hold the cassette or the patient while X-ray is on. If need be, the patient attendant or relative must be asked to hold the patient or cassette while X-ray beam is on and person rendering such help should be provided with lead apron.

14. All the staff working with radiation must wear the personel monitoring film/TLD badge.

In the end, I would like to say that no radiation dose is safe. However radiation is boon to mankind if used with caution. Hence, if the radiological procedure is helpful in diagnosis of the disease and helps in management of patient, it should be done.

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DO YOU KNOW ?

Q7. What is the colour of the black box kept in every commercial airlines?

Q8. A champion sprinter of international standards can cover 100 metres in about 10 seconds. Assuming that he is about 2 metres tall, he thus covers per second 5 times his body length. How does the common housefly compare in speed?

SHORT COMMUNICATION

WHAT CAUSES THE SCUM ON TEA ?
(STORM OVER THE SCUM ON TEA)

D. Balasubramanian*

Controversies and debates often rage among scientists on matters of great importance, such as whether all mankind arose from one primordial "Eve" who existed in Africa 200 000 years ago, or whether there exist genes in our body that determine our longevity or life-span. Debates of this kind can get boisterous and even personal, particularly when proponents of rival theories come face to face. This is seen from time to time in some sessions of scientific conferences and the chairman of the session has to use all his charm, tact and wit to cool tempers. Editors of scientific journals also face such situations ; it has now become standard practice in several journals for a scientist who wishes to publish his findings to request the editor not to send the manuscript for refereeing to such people who he fears will give a negative opinion because of rivalry and bias. These are situations and occasions when we are reminded that scientists are not any larger people than musicians, art critics or lawyers.

This point is also brought forth on other occasions which are less sombre and more light hearted. The movie portrayal of a scientist as a serious, gaunt, unsmiling and intense fellow with a beard and a lab coat is a caricature. Humour among scientists is not any less frequent than others, though it does take on a scientific colour and flavour. The physicist George Gammow once collaborated with a Professor Alfven and wrote up a joint paper. Struck by the phonetics of the two names, he could not resist calling up their friend Hans Bethe and asking him for permission to include his name as well in the paper. Reason ? The paper would then have been written by Alfven, Bethe and Gammow–the alpha, beta and gamma of physicists ! Another puckish scientist has been running a spoof scientific journal for over two decades now, called the *Journal of Irreproducible Results.* Among his latest spoofs has been the practice of awarding what he calls the "Ignoble Prize" as a counter to the prestigious Nobels. He chooses real (and imaginary) scientific projects and theories and awards them the Ignobles–based on how ludicrous they can be. One such Ignoble was awarded this year to the scientists who set out to find whether Coca-Cola speeds up the motility of sperm cells or dulls them. (I leave it to the reader to discover or guess the answer!). And then there is the scientist wit who had the three laws of thermodynamics described accurately, if wryly. The first law is "You cannot win", the second : "You cannot even break even" and the third : "It's all frozen to zero".

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In this genre of the seriously lighthearted (or vice versa) comes the latest controversy or storm in a tea cup. The earthshaking question to be addressed is : what causes the scum on tea ? Drs Michael Spiro and Deogratius Jaganyi of the Chemistry department of the Imperial College of Science, Technology and Medicine, London, pioneered this research about a year ago and reported their findings in the 12 August 1993 issue of the august science journal *Nature*, and with that started the proverbial storm in the teacup.

Spiro and Jaganyi noted that when tea is brewed in hot water, an unsightly scum develops on the surface of the cup and in the teapot. Many of us have seen it in our own teacups and pots but it was left to these two chemists to try and figure out the actual chemical nature of the scum. Using all the high-tech arsenal that they had at their command, such as scanning electron microscopy, matrix-assisted laser desorption, ionization, mass spectrometry (with the almost R K Narayanesque acronym of MALDI) and chemical microanalysis, they concluded that the scum is a base of calcium carbonate on which the polyphenolic constituents of tea are deposited after they are oxidized in air. Scum formation, they concluded, is formally similar to the fermentation process by which the tea manufacturers convert their green tea leaves into black tea–the curing part of the cure, twist and curi (CTC) process.

Reaction was not long in coming. Dr P P Jones demurred with regard to the organic components of the scum and pointed his finger at the tannins rather than the polyphenolics. Tannins are a bit of unwelcome nuisance, as anyone who overbrews strong Indian tea finds out to his distaste. The Chinese tea has less tannins and more phenolics and flavonoids, whose glory has been sung by many scientists in the recent past for their antioxidant properties and their role in reducing cholesterol levels in the blood. This raises the interesting point, not so far addressed by Spiro, Jaganyi, Jones or anyone else, namely the relative scum contents of Darjeeling, Assam, Sri Lankan, Chinese and other teas.

Dr Ralph Lewin, of the Scripps Institution of Oceanography in California, rebutted the Imperial College claim and dismissed calcium carbonate off the scene. Instead, he thought that it is the high melting lipids or the oily coat on the tea leaves which are melted off by the hot water and float as floes (note the oceanographic imagery) on the surface. As the tea is drunk, the wexy layers stick to the sides of the cup. They stain with tea phenolics which go brown on oxidation. When milk is added to the tea, the fat and proteins present there thicken the scum layer. "One can liquefy, saponify and solubilize them with very hot water and detergent ; I do this every day", says Lewin.

The issue has been joined and the controversy is on : is there calcium carbonate or not ? What about the tannins ? Chemical analysis by the Imperial College group showed calcium carbonate, so why is Lewin not able to see it ? The puzzle became teasing enough and scientifically challenging for other scientists to enter the fray. At this point two Brazilians, Dr Jacinta Enzweiler of the Institute of Geosciences and Dr Marcelo G de Oliveira, of the Institute of Chemistry of the Universidale Estadual de

Campinas at Sao Paulo, took a crack at the problem of where that solid film of calcium carbonate comes from.

The clue is in the water used to brew the tea. If the water used is hard, it contains dissolved calmum bicarbonate which would decompose upon heating to release carbon dioxide as gas and calcium carbonate. The latter, being insoluble in water, would precipitate as a white solid. This is of cousce the basis of the scales that line the walls of steam boilers, heating pipes and kitchen kettles. Thus, the primary cause of formation of the scum-film that floats on the tea is the hard water used. The Imperial College scientists used the London mains water which is hard while Dr Lewin must have used soft water to brew his tea.

In a reinforcement of this conclusion, the Brazilians brewed tea using distilled water, which contains no salts of any kind. No scum layer was formed. When tap water from Milton keynes of Southampton in England was used, scum formed while water from the Sao Paulo mains being soft did not produce it. Indeed, Spiro and Jaganyi had pointed out the role of calcium bicarbonate earlier. They showed that distilled water produced no scum, nor did water containing calcium chloride. The latter does not break up on heating to produce a precipitate as calcium bicarbonate does. Also, if calcium ions are removed from hard water using the complexing agent called EDTA, no scum fomed.

Two other minor puzzles are also solved neatly by this calcium carbonate theory. One is the observation that no scum formed with lemon tea. The answer is two-fold. One is that lemon acidifies the tea through its citric acid. The acid will dissolve and decompose the calcium carbonate in the scum layer ; also the citrate present in the lemon juice complexes the calcium and dissolves it, just as EDTA does. The other minor puzzle was the unexpected result that when more tea bags were used to brew the same amount of water, the less was the scum formed ! They suggest the main reason behind this to be the greater degree of acidification more tea, arising from the higher concentration of polyphenolics in the brew. These act in a manner similar to the citric acid of lemon.

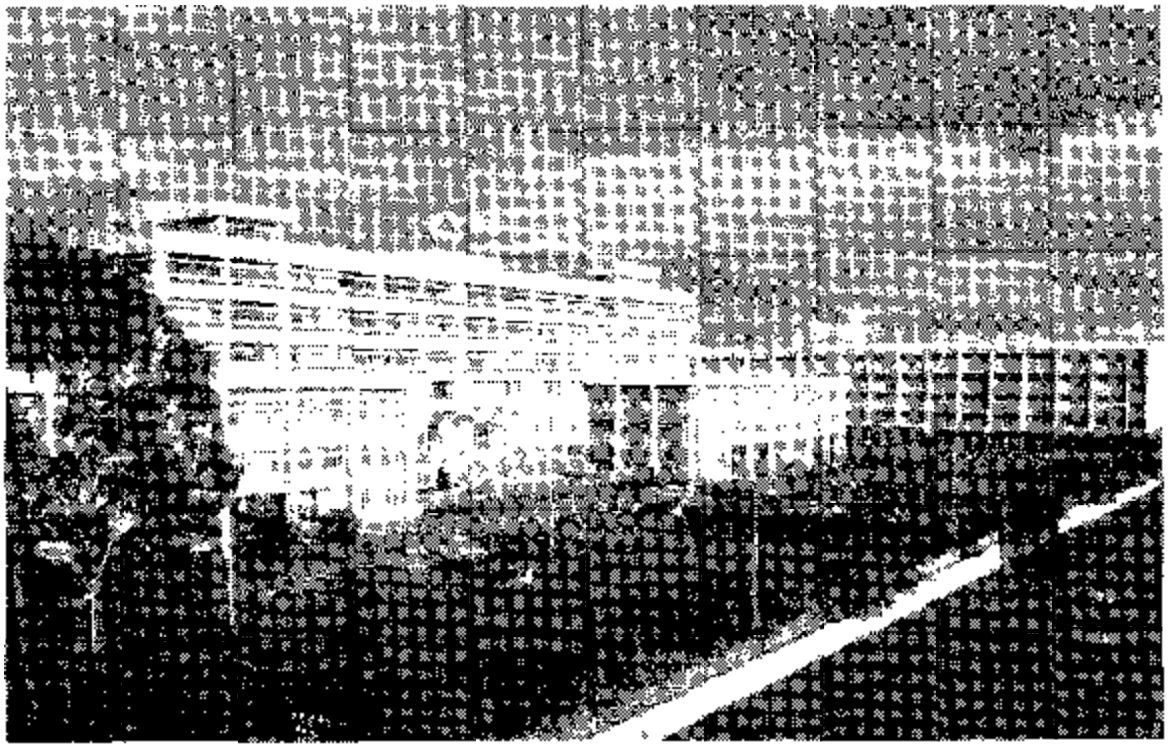
Oxygen too plays a role in the formation of the scum. When tea was brewed in the laboratory in a nitrogen atmosphere rather then in air, there was less scum. Conversely, when an oxygen atmosphere was used there was more scum. Thus, an oxidation process is implicated, so that not all of the scum can be either mostly calcium carbonate (as the Brazilians would have it), or the waxy lipids and the tannins (which Lewin and Jones emphasized). These do not use up oxygen the way the phenolics do. Spire and Jaganyi went back to the laboratory, provoked by the various rival theories, and measured the chemical contents of the scum. It contained about 3–7% calcium and 24–40% carbon material. The amount expected for a film of calcium carbonate coated with a layer of organics would be 40% Ca and about 12% carbon. Thus, the scum material appears to be made up largely of insoluble tea polyphenolics together with some calcium carbonate. It is the former that form the major component, as the elemental analysis would demand. Why not waxy lipids ? That is also answered when one

uses that terrible concoction called instant tea. In making instant tea, the manufacturer removes the waxy lipids in order to make it soluble in water. But even instant tea seems to produce some scum, so the culprit must be some other organic materials. Why not tannins ? Since they do not vary with the oxygen content, as the scum material does.

Spiro and Jaganyi reported something else that was at once rigorous and clinching. They decided to monitor the amount of scum formed at various temperatures. The higher the brewing temperature, the more the scum. From such an experiment, one can derive what is referred to as the "activation energy" of the process, which gives an indication of the amount of energy that needs to be pumped into the system in order that the reaction occurs. Physical processes such as diffusion of molecules in a liquid do not demand much energy, whereas chemical reactions such as oxidation would need activation. The experimental value of 34 kilojoules per mole that they determined for scum formation argues for a chemical reaction, and not just wax melting and rising to the top.

Apart from the "fun" part, the tea scum experiments provide much skillful experimentation and analysis. They also typify a class of experiments which we may call as kitchen chemisty, that can be done readily by any school student. They do not demand much in terms of facilities, laboratory equipment or cost, are intellectually stimulating and also didactic. Our own laboratory is attempting to compile about a hundred such kitchen science experiments involving the hen's egg, so that anyone with minimum laboratory facilities can do them and discover how much fun science can be. After all, as the NCERT school textbook says, "Science is Doing" and "Science is Fun".

KNOW THY INSTITUTIONS



RESEARCH & DEVELOPMENT CENTRE FOR IRON & STEEL (RDCIS), RANCHI

RDCIS, the Corporate R & D and the answershop of SAIL is one of the best equipped industrial research organisation in the field of ferrous metallurgy in India. It's main Centre is located in Ranchi. Organisational features of RDCIS are :

- 6 Centres in SAIL Plants
- 3–tier organisational structure-Areas, Divisions and Groups.
- 6 Areas : 13 Divisions : 34 Groups & 11 Supporting Departments.
- 776 Employees (38% Scientists and Engineers)
- Rs. 103 Crore state-of-the-art facilities : 5 pilot facilities : 15 laboratories
- Annual Budget : ~ 60 Crore.

It is the first organisation in the Steel Industry to receive the ISO : 9001, 1994 certificate. It has implemented Total Quality Assurance System in all its activities.

Policy

The quality policy of RDCIS is : *RDCIS shall provide customers with prompt, innovative and*

cost-effective R & D solution ; develop and commercialise improved processes and products; contiually enhance the capability of its human resources and emerge as a centre of excellence.

Objectives

The quality objectives are :

- Provide thrust on R & D programmes of large technological impact and high returns through innovative solutions.
- Ensure fast response and speedy realisation of benefits for customer satisfaction.
- Develop and facilitate commercialisation of improved technoligical processes and value added products.
- Achieve continuous growth in revenue generation by expanding consultancy and technology marketing efforts.
- Enlarge expertise and intellectual-capital through urturing of competence and interaction with reputed academic and research institutes.

Working

RDCIS has introduced several systems and procedures to achieve the quality objective, which are :

- Selection, Microplanning, Monitoring & Evaluation of Project and its post transfer utilisation.
- Certification of the annual monetary benefit produced by R & D innovation on its utilisation by SAIL plants/units.
- Determination of Customer Satisfaction on implementation of R & D projects in SAIL plants/units.
- Quarterly review of quality parameters of R & D projects at Centre.
- Quarterly review of on-going projects by Head of Works of the SAIL plants.
- Technology Awareness Programmes for Internal & External Customers.
- Technology Marketing of the Know-how developed by RDCIS and consultancy services to customers outside SAIL family.
- Externally funded research work.
- Intellectual Property Management and Publication of Research Outputs.

Projects & Programmes

RDCIS pursues five different types of projects. They are :

- Plant Performance Improvement (PPI) ;
- Investigation & Consultancy Assignment (ICA) ;
- Basic & Scientific Research (BSR) ;
- Equipment & Instrument Development ; and
- Major Technology Development.

The first two category of projects are pursued jointly by RDCIS and SAIL plants/units in their shops/units. Other three types of projects are pursued at RDCIS. The projects are micro-planned and the objective, approach, resources, plan are documented in Project Microplan Document (PMD) before their approval. Annual performance plan (APP) and Book of milestones (BOM) are prepared and approved. APP is approved by Chairman. BOM serves as the base document for monthly and quarterly review of

the progress by heads of Area, Division & Group. Project Coordination Division facilitates and review of progress of projects by head of Centre each month and head of works each quarter.

On completion of the plant, a report is prepared. In case of plant based projects, the report is approved by the plant authorities and at the time of approval of the report, the concerned head of the shop also gives his feedback on the following aspects of the project completion :

- Adherence to time schedule ;
- Objective fulfilmet ;
- Ease of Utilisation ; and
- Techno-economic impact.

Economic impact of the innovation is calculated after its sustained utilsation by the concerned shop. It is certified by the head of works, after authentication by the concerned shop and the finance department of the concerned plant. The system is in use for more than a decade.

Performance at a Glance

RDCIS measures its performance using procedures and paramenters which are acknowledged to be unique in the world : Return of the benefit to cost (841% in 2003-04) and Customer Satisfaction Index (3.70 in a scale of 4 in 2003-04). One of the major strength of the quality system of RDCIS is the quantification of inputs and outputs. In the beginning of the year RDCIS plans its projects in consultation with the SAIL plants/units and prepare the annual plan. The performance is evaluated at the end of the year against the plant and reported to the SAIL Board.

During last ten years, Centre has accomplished the following :

- 473 patents and copyrights ;
- 1485 publications / presentations ;
- External earning worth Rs. 77.8 million ;
- 131 technology awareness programmes
- Helped generated monetary benefit of Rs. 16996 million by use of R & D inovations.

Human Resource

Availability of professionals in diverse engineering and scientific disciplines gives RDCIS the rare strength and ability to execute multidisciplinary and complex projects. Table 1 gives qualificationwise breakup of executives.

Table 1 : Qualification-wise break-up of Executives

	Ph.D	P G	Graduate	Others	Total
Engineering	48	83	147	9	287
Pure Science	10	11	32	–	53
Others	1	19	61	10	91

Facilities

The research laboratories of RDCIS comprise 55 diagnostic equipment and 12 major facilities covering a wide spectrum of research tools required for advanced R & D work in the field of iron and steel making. The facilities are supported by an Information & Documentation Centre (IDC) for providing latest information for its ongoing and future research activities. IDC is equipped with extensive information back-up, integrated computerised library

management system, metadex-on-line search and a modern library for prompt dissemination of information. Appropriate Automation Promotion Centre (AAPC), set up at RDCIS under the aegis of the then Department of Electronics (now Department of Information Technology), Government of India devises and implements computer based process control strategies. A new PLC laboratory has been added in AAPC during 2003-04.

Performance

The Certified Annual Benefit (CAB) in 2003-04 was Rs. 231.32 crore, of which Rs. 98.01 crore was incremental CAB as certified by the Heads of Works and Rs. 133.31 crore was recurring CAB generated due to sustained utilisation in 2003-04 of R&D innovations certified during earlier two years.

The 'Incremental CAB' is the annual monetary benefit produced by plants by use of all the R&D innovations for the period of first 12 months after the starting date of utilisation. The 'Recurring CAB' is the annual monetary benefit produced by R&D innovations in use, after 12 months and up to 36 months, from the starting date of its utilisation.

The earnings from marketing of in-house developed innovations and provision of technical services to external customers were Rs. 176.34 lakh during the year. In addition, sponsored research worth Rs. 1006.34 lakh was undertaken under the aegies of SDF.

Scientists and engineers of RDCIS published 44 papers in journals of repute and made 151 presentations in various national and international conferences & programmes during 2003-04.

26 patents and 31 copyringts were filed during 2003-04. The patents filed include 5 on behalf of SAIL plants (2 from Bokaro Steel Plant and 1 from Bhilai Steel Plant, 1 from Durgapur Steel Plant and 1 from Rourkela Steel Plant). In addition, 7 Indian and 3 foreign patents were sealed. A list of patents and copyrights is given in output details.

Scientists and engineers from RDCIS received 8 diferent national awards and distinctions in 2003-04, including Metallurgist of the Year, G.S. Tendulkar Prize, Jharkhand Engineering Execellence Award, Visveswaraya Gold Medal.

RDCIS pursues several other important activities which, though not quantifiable (like CAB), make significant contributions to the knowledgebase of the centre. Notable among these are activities towards Technology Dissemination and Operating Committee Meetings. Besides these RDCIS renders valuable technical services to SAIL plants and units from time to time and pursues several generic activities, such as testing of coals and contributions towards energy and technology management.

For details contact : G. I. S. Chauhan, Research & Development centre for Iron & Steel, Ranchi.

e-mail : chauhan_gis@sail-rdcis.com.

BOOK REVIEWS

JOURNEY IN SEARCH OF TRUTH–*Dr. J. Sarkar and S. Bhattacharya,* Published by Sri Makhanlal Das, Srirampur, Hooghly, 148P. Price 100.00.

The pompous title of the book gives the first impression that it may be a book relating to philosophical or spiritual matters or an autobiography of some Gandhian. The smaller prints under the title leave things more open ended.

It is only when one sees the list of contents that one understands that the authors have assumed all articles, scientific or otherwise, to imply a journey in search of truth. Actually, a better title would have been Random Thoughts on Random Subjects. The articles collected some analysis on a variety of topics arranged at random.

There are twenty articles in all, ten each by Sarkar and Bhattacharya. The writing of Sarkar deals with amongst other things ancient India–architecture, industries and status of women, folklore in Science, Science in Kalidas' writings and also Benoytosh Bhattacharya and Asiatic Society and Yogadya legend in Radha Bengal. This is a baffling collection and the reader better not look for logic and connectivity in the collection.

There are nevertheless many passages that show erudition. Numerous quotations from Sanskrit and ancient Bengali can appeal to some readers. Unfortunately, the readability suffers due to listing of unnecessary, superfluous and repetitive references (and in one case, there are four pages of references for a four-page article!)

The ground covered by Bhattacharya is eqaully formidable : education in present day India, decline of ancient India's Science, abortion, insects, human sex, animal population and even twins in nature. Some of the articles present interesting information. Many opinions, expressed here and there, however can be challenged. In Bhattacharya's selection of articles also there is no common theme or logic, except of course, search for truth !

The weakness of the book, the lack of a theme, may be its strength too. If somebody does pick up this book, there may be something interesting some where. The Reviewer, however wishes that the book was more reader friendly. This could have been so if the title was appropriate, the arrangement of articles different and a lot of superfluous matter removed.

Prof. H. S. Ray
Central Glass and Ceramic
Research Institute
Kolkata

A TEXT BOOK OF BIOTECHNOLOGY–*R. C. Dubey,* Published by S. Chand & Co2mpany Ltd. Ram Nagar, New Delhi–110055, Price. 125·00

Recently, biotechnology has been introduced in the syllabus of most of the universities, at the graduate and/or postgraduate level (s), either as a separate paper or a part of it. Realising the problems of the students, the author has compiled this book to provide the students, current information on different areas of biotechnology. He has taken help from a number of standard books, journals, research and review papers.

The language of the text is simple and lucid, the subject matter is fully illustrated wherever possible. Some of the figures have been drawn by the author himself. Sources of figures and table that are modified and presented in the text, are duly acknowledged in their text. At the end of each chapter, some relevant problems are given which would help the students to grasp the matter.

The book is divided into several parts. Part I or the introductory part gives us an overall view of what is biotechnology, its global impact, its applications in health care, agriculture, environment, etc. The author has also drawn a vivid picture of the different areas of biotechnology in which researches are going on specially in India. Topics such as ban of genetically modified food, biodiversity of India and its conservation genebank, etc have also been touched in the introductory chapters. This is an appreciable effort on the part of the author.

Keeping in mind that the undergraduate and post graduate students should possess a strong foundation knowledge of basic biology, the author has included topics like chemical nature of DNA, its chemical composition, definitions of nucleotides nucleosides, Watson and Crick's model of DNA, structures of RNA, etc. in this section. Topics like the lac operon, artifical synthesis of genes, amplification of DNA, application of PCR technology, tools and techniques of genetic engineering will quench the thirst of those who want to know more.

The third part deals with animal biotechnology. Topics like requirements for animal cell, tissue and organ culture, disaggregation of tissue by physical and enzymatic methods, whole embryo culture, valuable products from cell as well as insect cultures, manipulation of reproduction in animals, embryonic stem cells, in vitro fertilisation and embryo transfer in the humans, application of molecular genetics for the improvement of livestocks, diagnosis, elimination and breeding strategies of genetic diseases, etc are included in this section.

The fourth part deals with plant biotechnology. The students will develop a good concept of the biotechnological principles and applications like what is totipotency, requirements of cell and tissue culture, benefits from cell culture, *in vitro* androgenesis, mentor pollen technology, selectable markers and their use in transformed plants (cat gene, nptll gene, lux gene, lac Z gene) after going through this section. The basics of cryobiology, biological nitrogen fixation, biofertilisers, biological control of plant pathogens, pests and weeds have not been neglected and occupies an important position in this portion.

The next part deals with microbial technology and features biotechnological importance in microorganisms, primary metabolites, secondary metabolites, enzyme technology, single cell protein and mycoprotein. As a diverse set of topics are included in this section, the students of microbiology will find this section exceptionally useful.

The biotechnology and environment part of the book is highly descriptive. Biomass, biomass energy, environmental biotechnology (this part includes bioremediation, in situ bioremediation,

intrinsic bioremediation, engineered bioremediation, exsitu bioremediation , solid phase and slurry phase systems, microbial leaching and so on)-will be well understood after hovering through the chapters of this section.

The last part of the book deals with rules and regulations of biotechnology. This part includes chapters like biosafety, hazards of environmental engineering, intellectual property rights and their protection, patenting of biological materials, significance of patents in India. This section will create a consciousness of the different biodiversity wealth of India so that in the near future India can get the credit of holding a large number of patents owing to its rich biodiversal and ecological heritage.

A list of references at the end suggests that whatever information that has been furnished is highly authentic.

Dr. Minakshi De
Dept of Microbiology
Surendranath College, Kolkata

Conferences / Meetings / Symposia

Date	Topic	Contact
15-25 June 2005	Course on Heterogeneous **Catalosis and Kinetics,** Varanasi	**Dr A S K Sinha** Department of Chemical Engineering and Technology, Banaras Hindu University Varanasi 221005 (Email : asksinha@sify.com)
21-26 August 2005	**4th International Congress of Ethnobotany (ICEB-2005)** Istanbul, Turkey	**Z Füsun ERTUG** Congress Secretary ICEB Yeditepe University 2005 IFSSH Congress Centre 26 Agustos Yerlesimi Kayisdagi Caddesi 34755 Kayisdagi / Istanbul Turkey (E-mail : fertug@iceb2005.com)
28-30 September 2005	International Symposium on **Applied Geochemistry in the Evaluation and Management of Onshore and Offshore Geo-resources,** Hyderabad	**Prof K Surya Prakash Rao** Indian Society of Applied Geochemists (ISAG) P B No 706 Osmania University 1-2-7/1 ROJA Kakatiyanagar Habsiguda, Hyderabad 500 007 (Email : ksprao@satyam.net.in)
16-20 October 2005	International Conference on **The Indusry in India : Naturals and Aroma Chemicals– Production & Markets** Cochin	**IFEAT Secretariat** GAFTA House 6 Chapel Place Rivington Street London EC2A 3SH, UK

Date	Topic	Contact
12-17 October 2005	Third Annual International Medicinal Mushroom Conference, Port Townsend	Fungi Perfecti, LLC PO Box 7634 Olympia, WA 98507 (Email : mycomedia@aol.com)
28-30 November 2005	XVI International Symposium on Status of Bauxite, Alumina & Aluminium Industry and Future Prospects, Nagpur	Dr. A.K. Nandi, 206, Gulmohar Apartments, Tilak Nagar, Nagpur-440 010 INDIA. (Email : aknandi@sifv.com)
27-29 January 2006	National Seminar on Herbs and Spices in Health and Diseases, Kolkata	Dr. Minakshi De Organising Secretary–NSHSHD Rammakrishna Vivekananda Mission Institute of Advanced Studies, 3 B T Road, P O Kamarhati, Kolkata 700 058 (Email : amitkde@satyam.net.in)

ANSWERS TO 'DO YOU KNOW?'

A1. Dimensions of the Indian Flag.

A2. Yes.

A3. Extra folds increase the surface area which helps to dissipate massive amounts of heat produced by thinking.

A4. No.

A5. In water, four and half times faster.

A6. Not necessarily. To freeze water one needs to take out 80 cal. of heat from each gram of water. This takes time and happens normally at a much lower temperature.

A7. Orange for better visibility.

A8. It moves or rather flies, about 250 times its body length per second.

S & T ACROSS THE WORLD

INNOVATION DISCOVERY IN CONSTRUCTION

The Innovation Discovery Programme is a collaboration between BRE with its extensive technical expertise and knowledge of the constructions sector, and Inventa Partners, a company with wide experience of guiding companies through the process of unlocking their own innovations, and exploting the latest ideas from elsewhere. The new initiative will help construction insustry companies gain greater commercial success from both their innovative ideas and practices, and the latest research and development in the construction and other sectors.

It is assessed to be a unique approach to enable companies to unlock innovation efficiently and effectively. BRE and Inventa will look across the existing reasearch base (within the construction industry and outside) to see if there is anything that can be applied to solve clients' problems. BRE sees this as a natural extension to the services they offer to their clients in construction activities.

(BRE Release, Jan 3, 2005)

THINKING CARPET

German carpet makers teamed up with leading chip makers to develop what they claim is the world's first 'Thinking Carpet'. It is claimed that it checks the temperature to control the heating, detects footprints to switch on lights and calls the police if it senses someone walking on it when the house is supposed to be empty. These new floor coverings are equipped with sensors, linked to control computer to discharge the said functions. Carpets are likely to be available in shops by year end.

(The Times of India, Jan 13, 2005)

TEMSIROLIMUS-AN INVESTIGATIONAL DRUG

Temsirolimus is a very significant contribution to the Wyeth pipeline, a largest research-driven pharmaceutical and health care products company. Temsirolimus is an investigational drug, which specially inhibits in mTOR (mammalian target of rapamycin) Kinase, an enzyme required to control a cell's life cycle, preventing cell division into new cells. Phase III trials are underway using temsirolimus, an m TOR inhibitor, for several cancers including renal cell carcinoma and advanced metastatic breast cancer. The trials are investigating whether temsirolimushas the potential to provide improved survival rates for advanced cases of these cancers.

Recently, the US Food and Drug Administration (FDA) granted "fast track" designation for temsirolimus in the first-line treament of poor-prognosis patients with advanced renal carcinoma. In addition, based on the mTOR mechanism of action, temsirolimus is in clinical trials to investigate its therapeutic utility in other diseases such as mantle all lymphoma, rheumatoid arthritis and multiple sclerosis.

(Biosalce. com, Dec 11, 2004)

WIRCLESS ACCESS IN SUBWAYS

Boston plans underground wireless access at four of the city's busiest subway stations. Massachusetts Bay Transportation Authority has entered into a 15 year contract with In Site Wireless of Alezandria to this effect. Thus system is expected to be beneficial with regard to safety and security. Installation of wircless service in subways will enhance security by allowing passengers to call for help without having to rely on police call boxes in the stations. Further people will have increased ability to report safety issues to the proper authority. Four stations are within a half mile radius and the service will eventually expand to other stations.

In site thinks all the major voice and data providers will sign contracts to use its system of underground antennas and fiber-optic cables to reach their subscribers.

(abs, News, Feb 11, 2005)

ROVER TO MARS

The Mars Scientific Laboratory (MSL), the next Rover to the planet Mars, will be ready for launch by National Aeronautic and Space Administration (NASA) in 2009. It is reported the MSL would be the third Rover to carry out several experiments in Mars. The first and the second Rovers are said to have completed a year each on January 4 and 24 respectively. Both the missions are doing very well by showing clouds on the planet and spectacular sand dunes. Both the Rovers have driven long distances exceeding expectations. Scientists are now studying the heat shield of the Rovers which would help them to improve the landing technology on Mars. This study is important as the most dangerous part of going to Mars is not the journey but entry into the Martian atmosphere and therefore the temperature and resistance factors will be studied on detail. Since the heat shield covering the Rover fell off after the Rover entered the Martian atmosphere, scientists endeavour to improve upon it. NASA is also planning to launch Mars Resource Orbiter Mission in August 2005.

(PTI Science Service, Jan 16-31, 2005)

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India

Current Science
Down to Earth
Food & Nutrition World
Indian Journal of Experimental Biology
Indian Journal of Biochemistry and Biophysics
Indian Journal of Marine Sciences
Pramana
PTI Science Service
Science Reporter

Foreign

Ambio
American Scientist
Endeavour
Interdisciplinary Science Reviews
International Studies in the Philosophy of Science
Journal of Environmental Planning and Management
Nature
Natural History
New Scientists
Policy Studies
Science
Science & Society
Social Choice and Welfare
Technology Analysis & Strategic Management
Tropical Science

In addition to those subscribed above, the following journals/newsletters are also received by the Library in exchange of the Association's journal "Everyman's Science" :

Chemecology
CSIR News
DRDO News
Environmental Awareness
Environmental Health Perspectives
Gana Darpan
Gyan Bigyan
IASSI Quarterly
INSA News
Indian Journal of Physics
JIMA
Natural History (Bombay)
Science & Culture
Spices India
University News
WMO Bulletin
WISTA

The Library is open to all category of members of the Association as well as school, college and university teachers on all weekdays (except Saturday, Sunday and holidays) from 10.00 a.m. to 5.30 p.m.

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

ANNOUNCEMENT FOR AWARDS : 2005-2006

1. Prof. Hira Lal Chakravarty Award : Applications in prescribed forms are invited from Indian Scientists, below 40 years of age as on December 31, 2004 with Ph. D. degree from any University or Institution in India, having significant contributions in any branch of Plant Sciences. The award is given on original independent published work carried out in India three years prior to the award. The award carries a cash amount of Rs. 4,000/- and a Certificate. Awardee will be requied to deliver a lecture on the topic of his/her specialization during annual session of the Indian Science Congress in the Section of Plant Sciences. Last date of submitting application is **July 15, 2005.**

2. Pran Vohra Award : Applications in prescribed forms are invited from Indian Scientist, below 35 years of age as on December 31, 2004 with Ph. D. degree from any University of Institution in India, having significant contributions in any branch of Agriculture and Forestry Sciences. The award is given on original independent published work carried out in India within three years prior to the award. The award carries a cash amount of Rs. 10,000/- and a Certificate. Awardee will be required to deliver a lecture on the topic of his/her specialization in the section of Agriculture and Forestry Sciences during the Indian Science Congress session. Last date of submitting application is **July 15, 2005.**

For proforma of application forms and necessary information, please write to the General Secretary (Hqrs.) The Indian Science Congress Association, 14, Dr. Biresh Guha Street, Kolkata–700 017.

E-mail : isca.assoc@gems.vsnl.net.in/iscacal@vsnl.net.

Fax No. : 91-33-2240-2551.

The form can also be downloaded from http : //w.w.w.sciencecongress. org.

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/- (for foreign * U.S. $ 50) only, along with an admission fee of Rs. 50/- (for foreign U.S. $20) only. The annual subscription of a Member shall become due to on the 1st April of each year. Any one who fails to pay the subscription *on or before the 15st 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 of the Session of any one section of their interest and also the bimonthly journal of the Association "Everyman's Science".

2. **Sessional Member** : Sessional Members are those who join the Association for the Session only. They may contribute papers for presentation at the Science Congress and receive, free of cost, reprint of the Proceedings of the session of any one section of their interest. A Sessional Member has to pay subscription of Rs. 250/- (for foreign U.S. $ 60) only.

3. **Student Member** : A person studying at the undergraduate/postgraduate level may be enrolled as a Student Member, provided his/her application is duly certified by the Principal/Head of the Institution/Department. He/She may contribute papers for presentation at the Science Congress, provided such papers are communicated through members of the Association. The subscription for Student Membership is Rs. 100/- (for foreign U.S. $ 50) only.

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.

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 Annual Science Congress Session as also a copy each of the Association's journal "Everyman's Science".

6. **Donor** : Any person paying a lump sum of Rs. 10,000/- (for foreign U.S. $ 5,000) 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 sum of Rs. 50,000/- (for foreign U.S.$25,000) only, can become an *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 Session and also the Association's journal "Everyman's Science".

(i) 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 a University or a City Corporation.

(ii) 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.

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

भारतीय विज्ञान कांग्रेस संस्था

14, डा० बिरेश गुह स्ट्रीट, कोलकाता 700017, भारत

THE INDIAN SCIENCE CONGRESS ASSOCIATION

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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

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/Cheque/Money Order/Cash for/from the year 1st April 200..... to 31st March 200..... I would like to have reprint of proceedings of the following Sections (Please tick any one)

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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 Biochemistry, Biophysics & Molecular Biology and Biotechnology)
13. Physical Sciences
14. Plant Sciences

Yours faithfully,

Date : (Signature)

Name (in block letters) :

Academic Qualifications :

Designation :

Address for Communication :
(including State, City/Town and Pin code)
Phone no. & e-mail

Note : (1) All Money Orders, Bank Drafts, Cheques, etc. should be drawn in favour of *Treasurer, The Indian Science Congress Association*. A Bank Charge of Rs. 70/- is to be added to the subscription amount, if paid by an outstation cheque.